Zoomland

Studies in Digital History and Hermeneutics

Edited by
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Volume 7

Zoomland

Exploring Scale in Digital History and Humanities

Edited by
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DE GRUYTER
OLDENBOURG

ISBN 978-3-11-131752-6
e-ISBN (PDF) 978-3-11-131777-9
e-ISBN (EPUB) 978-3-11-131791-5
ISSN 2629-4540
DOI https://doi.org/10.1515/9783111317779

Library of Congress Control Number: 2023944121

Bibliographic information published by the Deutsche Nationalbibliothek
The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available on the internet at http://dnb.dnb.de.

Cover image: Zoomland Map, University of Luxembourg / Luxembourg Centre for Contemporary and Digital History (C²DH)
Typesetting: Integra Software Services Pvt. Ltd.
Printing and binding: CPI books GmbH, Leck

www.degruyter.com

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Introduction

Abstract: This chapter outlines the conceptual framework of the book and the variety of viewpoints related to the use of the notion of scale and zooming in digital history and humanities. The contributions included in the volume encompass different degrees of theoretical assumptions, practical insights and middle-ground reflections, symbolically expressed through the three conceptual levels: *bird's-eye view*, *overhead view* and *ground view*. While no general theory of scale is defined, the reader is offered the ingredients needed to build such theoretical constructs based on his or her own exploratory and symbolic journey through Zoomland. This variable-scale representation is combined with four categories of enquiry or thematic realms that make up the territory of Zoomland: *History*, *Media*, *Hermeneutics* and *Digital landscapes*.

Keywords: scale, zooming, digital history, digital humanities, multiple perspectives

Welcome to Zoomland!

Imagine you could travel to Zoomland – both physically and virtually. This is what this book – in both its printed and online open access version – is offering. To explore its multi-layered landscape, you can delve into this opening chapter for a more con-

Acknowledgement: The authors would like to thank Sarah Cooper, from the Language Centre of the University of Luxembourg, for English proofreading.

Note: This book is the result of a *thinkering grant* awarded in 2019 by the C^{2}DH to the first editor. The initial project included a call for papers, launched in October 2021, and a cross-reviewing workshop, which was held at the C^{2}DH and online in June 2022 so that the authors could come together to collectively discuss the selected proposals. During the discussion, it was also decided which of the three conceptual or symbolic levels or views should be assigned to each chapter, to foster multi-scale explorations of Zoomland. The criteria used for this purpose involved aspects such as the degree and coverage of theoretical considerations or the particular focus on a specific project or topic, and the in-between possibilities for middle-ground enquiries. The contributions included in the volume represent the outcome of the peer-review and selection process that followed the workshop. The symbolic book-land(scape) representation of Zoomland was initially devised by Florentina Armaselu as a 2D visualisation using symbols and colours for the three perspectives and four thematic areas to make up a landscape. The three symbols, suggesting a certain object size or position relative to the ground, were assigned to the chapters according to the workshop discussion; the representation eventually served as a starting point for the game.

https://doi.org/10.1515/9783111317779-001

ventional introduction to the topic or, if you are looking for a thrilling adventure, embark on an experimental online game[1] set on the uncharted island of ZOOMLAND.

Figure 1: ZOOMLAND game: *physical map.*

Figure 2: ZOOMLAND game: *symbolic map*; bird's-eye view, overhead view, ground view; and *thematic* colour code: **History**, **Media**, **Hermeneutics**, **Digital landscapes**.

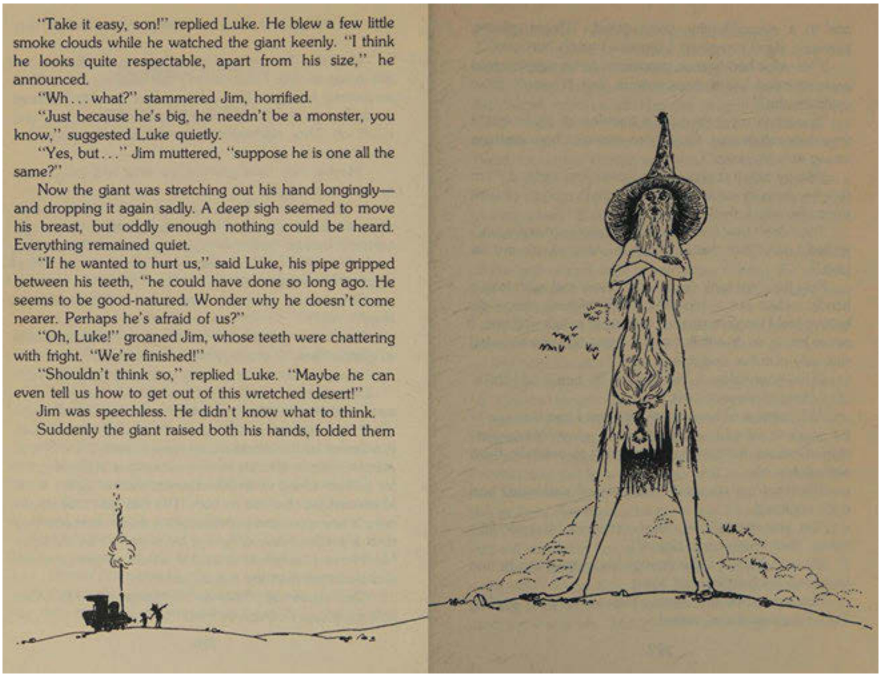
1 Zoomland, accessed on July 25, 2023, https://www.c2dh.uni.lu/zoomland.

Designed by **Kirill Mitsurov** and **Daniele Guido**, the online game, inspired by the book-land(scape) metaphor, invites the player/reader to embark on the small island of ZOOMLAND and explore the unknown territory (Figure 1) by looking for signs and symbols that represent different heuristic perspectives and thematic entry points from which the content of the book can be discovered and explored. In order to do so, the player/reader has to collect the chapter cards assigned to the various objects scattered across the island. These objects, according to their size or position relative to the ground, can stand for three conceptual standpoints – bird's-eye view, overhead view and ground view –, one of which is attributed to each chapter. Through this quest, the player is building a symbolic map of the island (Figure 2) that offers another way of looking at the configuration and nature of the assembled pieces and another means of accessing the actual manuscript of Zoomland.

A voyage into Zoomland feels like an encounter with the fairy-tale figure of Tur Tur, the imaginary giant in Michael Ende's famous children book "Jim Button and Luke the Engine Driver" (*Jim Knopf und Lukas der Lokomotivführer* in the German original) from 1960. Jim Button is a little black boy living on the tiny island of Morrowland. When Jim grows bigger, there is simply no longer enough space for everybody. Someone must go, decides King Alfred the Quarter-to-Twelfth. But should that someone really be Emma, the locomotive of Jim's best friend Luke? Jim cannot allow that. Together with the engine driver and Emma the locomotive, he leaves the island and sets off on a great adventure: transparent trees, stripy mountains and dragons cross their path.[2] In a desperate episode on the journey, in which Jim and Luke traverse a desert at the end of the world, they see a giant apparition on the horizon. Although Jim is frightened, they finally decide to wave to the figure and tell it to come closer. And to their great surprise, the long-bearded figure gets smaller with every step closer he takes. When the friendly old man finally stands in front of them, he has shrunk to the size of a normal person and presented himself as Tur Tur the imaginary giant. "Good day", he says. "I really don't know how I can thank you enough for not running away from me. For years I have been longing to meet someone who got such courage as you, but no one has ever allowed me to come near them. I only look so terribly big from a long way off" (Ende 1963: 123–124).

After the initial shock has worn off, Jim and Luke ask Tur Tur to explain the nature of his existence as a make-believe giant.

2 Michael Ende, accessed on July 29, 2023, https://michaelende.de/en/book/jim-button-and-luke-engine-driver.


"Take it easy, son!" replied Luke. He blew a few little smoke clouds while he watched the giant keenly. "I think he looks quite respectable, apart from his size," he announced.

"Wh . . . what?" stammered Jim, horrified.

"Just because he's big, he needn't be a monster, you know," suggested Luke quietly.

"Yes, but . . ." Jim muttered, "suppose he is one all the same?"

Now the giant was stretching out his hand longingly—and dropping it again sadly. A deep sigh seemed to move his breast, but oddly enough nothing could be heard. Everything remained quiet.

"If he wanted to hurt us," said Luke, his pipe gripped between his teeth, "he could have done so long ago. He seems to be good-natured. Wonder why he doesn't come nearer. Perhaps he's afraid of us?"

"Oh, Luke!" groaned Jim, whose teeth were chattering with fright. "We're finished!"

"Shouldn't think so," replied Luke. "Maybe he can even tell us how to get out of this wretched desert!"

Jim was speechless. He didn't know what to think.

Suddenly the giant raised both his hands, folded them

Figure 3: Jim Button and Luke the engine driver meet Tur Tur, the make-believe giant. In: Michael Ende,[3] Jim Button and Luke the Engine Driver, Woodstock (N.Y.): The Overlook Press, 1963, p. 120–121.

> "Well," said Tur Tur, "there isn't really an awful lot to tell. You see, my friends, if one of you were to get up now and go away, you would grow smaller and smaller till in the end you only look like a dot. And if you started to come back, you would grow bigger and bigger till you would stand in front of us your proper size. You must agree, though, that in reality you would have remained the same size all the time. It only looks as if you've grown smaller and smaller, and then bigger and bigger."
>
> "Exactly," said Luke.
>
> "Well, now," explained Tur Tur, "in my case it is simply the other way about. That's all. The farther away I am away, the bigger I seem. And the closer I come, the better you can see my real size. My nature is simply the opposite to yours."
>
> "You mean to say," asked Luke, "you don't really grow smaller when you come nearer? And you aren't really the size of a giant when you are far away, but it only seems like it?"
>
> "That's right," replied Mr. Tur Tur. "That's why I said I am a make-believe giant. Just as you might call the other people make-believe dwarfs, because they look in the distance like dwarfs, though they aren't dwarfs, really."

3 Reproduced with permission (© Michael Ende, illustrator F.J. Tripp, Jim Knopf und Lukas der Lokomotivführer, Thienemann-Esslinger Verlag GmbH).

> "This is very interesting," mumbled Luke, and he thoughtfully blew a few smoke rings. (Ende 1963: 127)

In the conclusion of the treatise "Aufstieg und Fall der Zentralperspektive" (Rise and Fall of the Central Perspective, 2004), the literary scholar Dieter Borchmeyer explains: "The 'illusory giant' thus turns perspective foreshortening on its head. [. . .] In the inverted world of the illusory giant, perspective appearance becomes a plaything of the imagination – a signal that central perspective, once the proud achievement of a thoroughly rationalised, scientifically dominated world, has played out its historical role forever" (Borchmeyer 2004: 310). To us, the central or linear perspective, an artistic technique developed in Renaissance paintings, has become a by-word for modernity and rationality, in line with the concept of linear time and geometrically measured space.

1 Zooming as a metaphor of knowledge production and heuristic practice

The "birth" of the so-called early modern period in the 16th century was characterised by a fruitful exchange and interplay between new techniques, instruments and experimental practices in both the sciences and the arts and crafts (Rossi 1997). Magic and science were intertwined (Daston and Park 1998), but with the use of instruments such as the telescope and the microscope, the nature of scientific observation changed dramatically – and with it notions of truth, objectivity and reality (Stengers 1993). As "leading instruments" of the early modern process of natural enquiry, both the telescope and the microscope remained rooted in the ancient ideal of visual perception, with the eye being the most trustful and objective sense – seeing is believing (Weigl 1990: 16–17). The ability to get closer to matter, either by zooming in (microscope) or zooming out (telescope), radically changed the perspective of the exploratory mind. It triggered philosophical – today we would say epistemological – debates about the nature of cognition as well as the intricate relationship between our senses and technical instruments in the co-construction of reality. As the etymological roots of the Greek term σκοπέω (skopéō) – "to look, examine, or inspect" or figuratively "to contemplate, consider" – suggest,[4] instruments such as the telescope, the microscope and later the stethoscope in medicine or the periscope in nautical navigation are technologies of knowledge that fostered a whole set of new heuristic practices. These practices had to be appropriated through critical learning and testing, and

4 Accessed on July 23, 2023, https://en.wiktionary.org/wiki/σκοπέω.

it was only once a degree of mastery in handling such instruments had been acquired that they could become epistemic objects in the co-construction of new knowledge (Rheinberger 2008).

As a cultural practice, zooming gained popularity with the development of varifocal lenses in photography in the second half of the 19th century (Kingslake 1989). Preceding this, playing with multiple lenses to create the impression of movement had been a widespread artistic practice employed by so-called lanternists, who produced shows with the help of magic lanterns, theatrical performances and sound effects (Jolly and DeCourcy 2020). As Étienne-Gaspard Robert, an experienced projectionist and inventor of the "Phantasmagoria" – a show combining the projection of glass slides and shadow play – explained, the zoom-like special effects created suspense and surprise amongst the spectators: "At a great distance a point of light appeared; a figure could be made out, at first very small, but then approaching with slow steps, and at each step seeming to grow; soon, now of immense size, the phantom advanced under the eyes of the spectator and, at the moment when the latter let out a cry, disappeared with unimaginable suddenness" (Heard 2006: 97). This scene of a magic lantern show from the 1890s reads like a Victorian anticipation of the Tur Tur scene by Michael Ende – albeit with a different purpose. While the lanternist made use of a visual trick to enchant his audience, Ende aimed to make his young (and no doubt also his adult) readers think about the tension between experience-based visual perceptions and popular imagination and narrative conventions. As Nick Hall has outlined in his study about the aesthetic and narrative functions of zooming in film and television, it is the "impression of being transported forward or backward at high speed" that makes zooming such a powerful technique in dramatized filmic narratives (Hall 2018: 1).

Technically, the zoom lens is a lens with continuously variable focal length. The variation of the focal length creates an apparent movement forward or backward – but this movement is different from a physically moving camera. As Hall explains: "When a camera moves, the position of objects in the images it captures change relative to one another. From these movements, viewers can infer the size, shape, and depth of the space in front of the camera. The zoom, by contrast, simply magnifies the image in front of the camera, and no change occurs to the relative position of the objects in front of it" (Hall 2018: 8). As such, the zoom lens basically magnifies or reduces the size of a picture,[5] but depending on the length

5 The change of scale in the reproduction of an image was also an issue in printing technology. With the "fougéadoire", an invention in lithography patented by the Frenchman Auguste Fougeadoire in 1886, it was possible to reduce or enlarge the size of an illustration based on rubber by stretching or compressing the rubber plate. See https://fr.wikipedia.org/wiki/Fougéadoire, accessed July 17, 2023.

or speed of the zoom shot, its aesthetic effect and dramatic force can vary greatly. The psychological properties of the zoom lens are therefore inextricable from the phenomenology of cinematic or televisual vision (Sobchack 1990). With the "zoom craze" in amateur film of the 1950s and 1960s, zooming conquered the non-professional realm of home movie or family film (Hall 2018: 123–152), preparing a larger audience for the digital revolution to come. Today, zooming in and out on the screens of our mobile phones or desktop computers has become "one of our predominant twenty-first century 'ways of seeing'", argues Tom White. "We zoom in and out on manuscript images in much the same way we zoom in and out on text, maps, websites, and our personal photos".[6]

2 Zooming in/out and the art of scalable reading

Scholars in digital history and humanities are increasingly interested in the metaphor of zooming and scale as a way to imagine and revisit concepts, methods and tools for processing, analysing and interpreting data, and for creating innovative representations of knowledge. New terms and expressions have been added to the digital humanities vocabulary, which convey a particular conceptual frame based on the potential of digital methods and tools to support new forms of data exploration and various types of functionality. The aim may be to balance out the global, universal standpoint of "big data" with a "small data" world view, along with "every point in between", as in the case of the *macroscope:* "What is more, a 'macroscope' – a tool for looking at the very big – deliberately suggests a scientist's workbench, where the investigator moves between different tools for exploring different scales, keeping notes in a lab notebook" (Graham et al. 2016: XVI). To enable the combination of *distant reading* (Moretti 2013) with close reading, a new cultural technique of *scalable reading* is necessary: through changes of perspective by zooming in and out, from a bird's-eye view to close up, new forms of "intertextual analysis" (Mueller 2014) are opened up. The aim of *scalable reading* is to move "gracefully between micro and macro without losing sight of either one", to see "patterns" and "outliers", to zoom in and zoom out and to understand what "makes a work distinctive" within a "very large context" (Flanders and Jockers 2013). In a similar vein, the use of geographic information systems (GIS) and Web-based spatial technologies to build "spatial narratives" that capture multiple voices, views and memories to be seen and examined at "various scales" (Boden-

6 Tom White, "A Working History of Digital Zoom, Medieval to Modern," in *Humanities Commons* (2023), https://doi.org/10.17613/2tfp-de60.

hamer et al. 2015: 5) is promoted as a new form of historical and cultural exegesis of space and time (deep mapping) within what is called the *spatial humanities*.

Some disciplines in the humanities, such as history, have previously integrated the concept of scale into their discourse, thus providing starting points for theoretical and methodological enquiry within a digitally oriented context. Examples from this area include conceptual constructs such as the division of historical temporalities into long-, middle- and short-term history, referring to "quasi-immobile", "slowly paced" and "rapid" processes and events taking place at the environmental, social and individual levels (Braudel 1976: 11–12). Other reflections target the interconnections between the notion of scale in history and its counterparts in cartography, architecture and optics, with reference to the degree of detail or available information at a certain level of organisation, the construction of a historiographic object or the operational metaphors of "magnifying glass", "microscope" and "telescope", as applied to historical discourse (Ricœur 2000: 268–270). Scale in history also serves to define the "historical universe", a continuum in which one pole is occupied by "syntheses of extreme generality – universal histories" while the opposite pole is ascribed to "investigations of atom-like events" (Kracauer 2014: 104). Combined approaches are also possible, with studies in "global microhistory" that integrate micro and macro analysis, sometimes supported by digitised libraries, archival collections and websites dedicated to family genealogies, to connect microhistories of individuals with broader scenes and contexts on a global scale (Trivellato 2011).

Recent theoretical approaches have pointed out the importance of scale, understood as both an ontological and epistemological entity, and the need to consider broader standpoints and a wider disciplinary spectrum when analysing it. Horton's (2021) viewpoint on the *cosmic zoom* provides such an example – that is, a conceptual framework for thinking about scale and its medial manifestations, in an attempt to capture totality as a world view, from the microscopic to the cosmic stance. Starting from Boeke's book *Cosmic View* (1957), and its legacy, *Powers of Ten*, a 1977 film by Ray and Charles Eames, and Morrison's 1979 review of Boeke's book, Horton sets out to examine the cosmic zoom through the lens of media analysis. He considers both analogue and digital media, spanning various representational and compositional scalar standpoints, from literary and cinematographic to database-driven forms of mediation. Similarly, by arguing that scale represents a significant concept in all sciences, as well as in culture, language and society, DiCaglio (2021) devises six thought experiments that serve as a basis for elaborating a general theory of scale, intended to apply to a wide number of disciplines. In the first of these experiments, he defines *resolution* as a key element of scale: "Resolution is the amount of detail one can discern within an observation. [. . .] At different resolutions, different objects are discerned [. . .] Shifts in resolution and shifts in scale go hand in hand: scale tracks the range of observation while resolution points to the amount of detail able to be seen at that range" (DiCaglio 2021: 23). This assumption allows him to distinguish between different types of scaling: he contrasts *Gulliver's scaling*, in the sense of "making objects bigger or smaller", cartographic scaling, as a matter of "representation" and "transformation of reality", and cinematic zooming, as a "result of magnification" or "moving forward", with scaling that involves a change in resolution, a "transformation of observation", as illustrated by the scalar transformations operated in the *Powers of Ten* – from the view of two picnickers in a park to planets and galaxies and back down to cells and subatomic particles (DiCaglio 2021: 26–27, 70, 232). The main goal of the book, grounded in rhetoric, philosophy, science studies and critical theory, is therefore to train the reader in scalar thinking, in other words in understanding how scale reconfigures reality and the main conceptual, perceptual and discursive aspects of scale involved in this reconfiguration process.

3 Playing with layers and perspectives: Bird's-eye view, overhead view, ground view

Despite this variety of theoretical and practical undertakings, which proves the richness and significance of the topic of scale and the interest in it manifested by researchers from different areas of study, the potential and concrete application of this concept to new forms of analysis and knowledge production in digital history and humanities are still largely unexplored. This book proposes a systematic discussion on the epistemological dimensions, hermeneutic methods, empirical tools and aesthetic logic pertaining to scale and its innovative possibilities residing in humanities-based approaches and digital technologies. Taking a variety of viewpoints from scholars experiencing this notion in digital history and digital humanities, the edited volume gathers theoretical and application-related perspectives, from microhistory and visual projections of historical knowledge in graphs to shot scales in television adaptations, scalable reading and cartographic zooming, and fosters reflections on the potential for novelty and creative exploration of the concept of scale when combined with digital humanities methods.

By navigating through various themes considered in relation with the notion of scale, such as historical storytelling, online virality, literary computing, media, text and tool analysis, data-driven narrative and map modelling, the reader can learn about the variety of scales used within these different areas of research. Each chapter encompasses different degrees of theoretical assumptions, practical insights and middle-ground reflections, symbolically expressed through the three conceptual levels: *bird's-eye view*, *overhead view* and *ground view*. While no general theory of scale is defined, the reader is offered the ingredients needed to build such theoretical constructs based on his or her own exploratory and symbolic journey through Zoomland. This variable-scale representation is therefore combined with four categories of enquiry or thematic realms that make up the territory of Zoomland: *History*, *Media*, *Hermeneutics* and *Digital landscapes*.

3.1 History

This thematic area offers different perspectives on the potential of the concepts of zoom and scale for digital history projects. Through a focus on narrative history, **Alex Butterworth** engages the reader in an illustrative and speculative adventure. He combines reflections on semantic modelling and narrative practices from existing projects, such as *The Lysander Flights*, *Tools of Knowledge* and *Crimes in London*, with designs for future graphic interfaces that bring together knowledge graph formalisms, filmic and narrative grammars and conceptualisations of zoom defined along the *detail*, *abstraction* and *cognitive* axes, to support historical storytelling. From a similar vantage point, **Christian Wachter**'s account of the democratic discourses in the press in the Weimar Republic outlines the conceptual bases of a methodological framework that elaborates on theoretical and technical constructs such as the discourse-historical approach, corpus annotation and analysis, and scalable reading, understood as a *digitally assisted* technique for pattern search and identification, as well as close inspection and interpretation. The proposed framework is therefore intended for both quantitative and qualitative analysis, as well as contextualisation and interpretation of discourse in historical research. **Amanda Madden**'s *Menocchio Mapped* follows an intermediate-level line of enquiry that bridges micro- and digital history methodologies and narrative and quantitative approaches. It illustrates the topic by crossing various scales of analysis, from bird's-eye view perspectives on the two fields of investigation to historical GIS projects, such as *Mapping Decline*, *The Atlantic Networks Project* and *DECIMA*, and vivid fragments with a micro-historical flavour, like a revenge poem from the diary of a 16th-century nun. While articulated within the same micro- and digital history setting, **Mariaelena DiBenigno** and **Khanh Vo**'s chapter adopts a different viewpoint that delineates a particular thematic focus. In their study, centred on runaway slave advertisements in the United States in the 19th century, the authors argue that the shift from macro to micro allowed by digital technologies may illuminate how sources and data are used in historical narrative reconstruction and foster new means of historical storytelling, ranging from nationwide accounts to the experiences of individual and marginalised communities.

3.2 Media

Within the second Zoomland area, the reader can explore the use of scale in media-related studies from a middle- and ground-view perspective. **Fred Pailler** and **Valérie Schafer** propose an analysis of the history of online virality based on a range of examples from the early 1990s – *Godwin's Law* and *Dancing Baby* – to the more recent *Harlem Shake* and *Distracted Boyfriend* meme. The authors inspect a series of visualisations and media inventories, from the more traditional press to social media platforms, and the way in which these phenomena spread, to devise an approach that intertwines scalable readings of content, encompassing spatial and temporal dimensions with a cross-media reading of context. Adopting a median approach between empirical and theoretical analysis, **Landry Digeon** and **Anjal Amin** develop a comparative study of shot scale patterns in two TV series, American *Law & Order: Criminal Intent* and its French adaptation, *Paris: Enquêtes Criminelles*. Their methodology explores shot scaling as a cinematographic device and carrier of meaning, while also using machine learning techniques, intercultural models and media, feminist and psychological theories to decode gender- and emotion-related televisual representations across different cultures. Two other media are examined in this section in relation to zooming and scale, this time from a bottom-up, implementation-oriented perspective. In the first study, **Nadezhda Povroznik**, **Daniil Renev** and **Vladimir Beresnev** discuss forms of mediation that allow for zoom-in, zoom-out and zoom-zero modes, as well as the challenges inherent in the digitisation and virtual representation of religious sculpture from the Perm Art Gallery. While the possibility to switch between different zoom modes in a digital environment enables new ways of exploring and formulating research questions, the authors assert that digitising this type of cultural heritage should involve a deeper understanding of the cultural layers and contexts of existence of the sculpture, which may require additional knowledge regarding traditions and local customs in the object's region of origin, going beyond the reconstruction of its environment. The second ground-view study deals with sonic scales, as described in **Johan Malmstedt**'s computer-assisted analysis, which enables him to zoom in and out on a 1980s Swedish broadcasting dataset. It argues that scale and zooming may be related to various methods of detecting sonic diversity, such as differentiating between music, speech and noise, or several types of noise, and that they can help in tracing trends and developments over time in the acoustic style of broadcasting.

Analysis may therefore produce different results, depending on the type of zoom applied, either within the frequency register or along the time axis.

3.3 Hermeneutics

This third area pertains to overhead and ground standpoints on the capacity of zooming and scale to inspire and shape interpretative trajectories. By adopting a continuously scale-shifting perspective that evokes the size-appearance parable of the illusory giant Tur Tur, **Chris** and **Raluca Tanasescu** revisit concepts such as *monstrosity* and *iconicity*, anchored in the realm of intermedial and performative enquiries, to examine digital writing processes and illustrate their complexity through the case of the *Graph Poem*, a network of computationally assembled poems. The authors argue that the multi-scalar architecture of this type of poetry anthology, with algorithms operating at both a small scale, on poetry diction-related features, and a large scale, on network-topology-relevant criteria, coupled with a *monstrous/iconic* reflection filter, may inform more general considerations on the complex and often paradoxical inner mechanisms of text production, interconnection and analysis in a networked, ubiquitous and ever-changing digital space. **Benjamin Krautter**'s four-dimensional reconstruction of Mueller's conceptualisation of scalable reading and its application to the network-based analysis of a corpus of German plays represents another middle-ground exemplar of approaching the question of scale through a combined theoretical and practical line of thought. The chapter unfolds as a detailed discussion and contextualisation of Mueller's concept and the metaphor of zooming underlying it, followed by an illustration of how the various dimensions of scaling and a research agenda based on qualitative and quantitative methods can be brought together when analysing literary texts. From the same intermediate perspective, combining theoretical and practical aspects in scale investigation as a heuristic instrument, **Florentina Armaselu** advances the hypothesis that texts can be conceived as multi-scale conceptual constructs involving various degrees of detail, and devises a method for detecting levels of generality and specificity in a text, applied to analyse a selection of books from micro-global history, literature and philosophy. The proposed method integrates elements from topic modelling, fractal geometry and the zoomable text paradigm to build interpretations and visualisations of *informational granularity* aimed at capturing the dynamics of meaning that emerges from the assemblage of blocks of text considered at different scales of representation. In the last chapter of this section, **Stephen Robertson** proposes a ground view of the construction of the digital history argument, as opposed to a print-based form of argumentation, exemplified through the *Harlem in Disorder* project, a multi-layered, hyperlinked narrative set up via the *Scalar* platform. According to the author, the project demonstrates how different scales of analysis and multiple threads of interpretation can be supported by the digital medium, enabling the user to understand the complexity of racial violence through the interconnection of a multitude of individual events, aggregated patterns and chronological narratives, which are more wide-ranging than could be contained in a book.

3.4 Digital landscapes

The fourth thematic group gathers viewpoints from all three perspectives and focuses on the interplay between scale, tool-building and analysis in envisaging and perusing various forms of digital landscapes. **Natalie M. Houston**'s examination of three open-source network visualisation tools, *Pajek*, *Cytoscape* and *Gephi*, tested on the *Les Misérables* character interaction dataset, proposes a critical approach that analyses the default aesthetics offered by these software packages in order to grasp the meaning and knowledge creation assumptions embedded in the design of this type of tool. From a humanistic standpoint, the author argues that a critical awareness of the ways in which network graphs are produced and facilitate understanding of data structures at a variety of scales contributes to more informed data visualisation practices that acknowledge the role played by aesthetic choices in the production of meaning. **Quentin Lobbé**, **David Chavalarias** and **Alexandre Delanoë** proceed from a similar bird's-eye vantage point to investigate the various ways in which the notions of *scale* and *level* are used in the digital humanities literature. Using the theory of complex systems, a mathematical apparatus, and *GarganText,* a free text mining software, they analyse a *Web of Science* and *Scopus* dataset and build visual representations of evolving branches of knowledge based on the conceptual distinction between *level* and *scale* understood in a more specific sense, as *level of observation* and *scale of description*, in the research and data analysis processes. **Francis Harvey** and **Marta Kuźma** adopt a mid-way approach to discuss and illustrate notions and techniques such as cartographic scale, zooming and generalisation in historical maps. After theoretical considerations and examples, including the analysis of maps of Warsaw and the Vistula River from different time periods, the authors formulate a series of assumptions as to how future interpretative research in digital humanities may benefit from a better understanding of *generalisation* changes, differences between zooming and scaling, and their impact on the graphic representations in historical maps. The *Weather Map* proposal by **Dario Rodighiero** and **Jean Daniélou** offers a ground view of a visual model designed to depict public debates and controversy through the visual grammar of synoptic weather charts, and a Web-based implementation relying on the

Media Cloud archives and allowing for zooming and contextualisation through access to additional information, such as links to sources and statistics. According to the authors, this form of modelling enables users to capture controversy in the making and study the movements and plurality of actors that shape controversial events.

Finally, this Introduction chapter outlined the conceptual framework and the variety of viewpoints related to the metaphorical and physical use of scale and zooming in digital history and humanities. Moreover, our intention was to provide readers with the incentive they need to continue their journey through Zoomland and to discover and explore both its *actual* and its *symbolic* territory.

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History

Alex Butterworth

Adventures in Zoomland: Transitions in Scale and the Visual Exploration of Historical Knowledge Graphs as Sequential Storytelling

Abstract: This chapter proposes a conceptual framework for the design of graphical interfaces to knowledge graphs that employ the concept of 'zoom', broadly defined to encompass levels of scale, resolution and abstraction – to enable exploratory forms of historical hypothesis formation and testing and of narrative elaboration. It does so through a process of illustrative and speculative reflection on a series of recent or current digital history projects in which the author has been involved that involve the semantic modelling of data representing sociabilities, mobilities, temporalities and identity and which seek to encourage a hermeneutic sensitivity to evidential uncertainty. Reference is included to methods of knowledge graph creation and refinement, both automated and participatory, while the extended concept of 'zoom' is located within its media and aesthetic history.

Keywords: exploratory interfaces, digital hermeneutics, knowledge graph, scalable data, historical narrative

1 Introduction

The increasing abundance of historical data in machine-readable form, the progressive refinement of methods for its analysis, and the popularization of innovative interfaces for its exploration, create the possibility of novel forms of historical narrative within digitally mediated environments. What follows in this chapter is a proposed framework for understanding and utilizing the concept of 'zoom' in the speculative design of graphical interfaces that enable exploratory forms of narrative history-making, which are driven by and embedded in semantically modelled knowledge graphs, grounded in formal ontologies. The framework is considered as a foundational requirement for the subsequent development of a narrative gram-

Note: With thanks to Ed Silverton, Andrew Richardson, Sarah Middle and Duncan Hay for stimulating discussions during the design and development of practical experiments in the application of the approaches to narrative data visualization described in this chapter.

https://doi.org/10.1515/9783111317779-002

mar in which the third meaning latent in transitions between modes of zoom applied to configurations of knowledge can be effectively managed, to controlled and expressive effect.

The concept of the *knowledge graph* will be expanded on in Section 2. Such graphs model historical data in a form which is highly plastic and fungible, enabling the virtuous creative cycle of exploration and contribution that is envisaged. In combination with associated domain specific vocabularies and taxonomies that further organize the data contained in the graph, the interrogation of such knowledge graphs may generate complex historical insights. The filmic technique of Zoom, considered more closely in Section 5, may be broadly understood as a range of operations that vary framing and focalization, here applied analogously to the visualization of data within an explorable graphical interface: the *Zoomland* of our envisaged historical adventures.

The conduct of historical enquiry and production of historical accounts that the Zoomland framework enables resonates with many aspects of the consideration of history-making offered by film theorist Siegfried Kracauer in his posthumously published work, *History: The Last Things Before the Last* (2014*)*. History, he observes, is constrained by a “law of levels”, according to which, “the contexts established at each level are valid for that level but do not apply to findings at other levels”. Yet, grounded in his insight that “discerning historians aspiring to history in its fullest form favor an interpenetration of macro and micro history”, he identifies a productive equivalence with the filmic medium in which, “the big must be looked at from different distances to be understood; its analysis and interpenetration involve a constant movement between the levels of generality”. Jolted by this movement across scales, the “historian’s imagination, his interpretive designs” are freed from the canalizing effect of data overload, “inviting less committed subjectivity to take over” (Kracauer 2014: 76; 69; 70; 70). From this may emerge, Kracauer believes, “the historical idea” which, Rodowick notes in his critical consideration of Kracauer’s thesis, “inaugurates a new terrain in which a wide variety of primary historical material may distribute itself and organize itself, illuminating previously unthought patterns of intelligibility” (Rodowick 1987: 117).

Kracauer’s work was written at the dawn of an era in which the potential of filmic zoom to reshape an audience’s relationship to the process of fabulation was fully demonstrated by a new generation of directors, including arguably the greatest proponents of the technique, Robert Altman and Roberto Rosselli. Adopting a fluidity of style that has been likened to improvisational jazz, Altman – according to Jay Beck – placed the audience for his 1970 film *MASH* “in an active spectatorial position, being asked to sift through the audiovisual information in order to follow one of the potential narrative paths” (quoted by Hall 2018: 26). A decade earlier, in his film recounting the nineteenth-century campaign for national independence, *Viva Italia*, Rossellini had already applied zoom techniques to specific history-making effect. Commenting on a scene in which Garibaldi's men fight on a hill, John Belton notes that under Rossellini's direction, "Long shot equals then. Zoom shot equals now. The two shots in tandem are no longer limited to an imitation of event. What we are watching is our own aesthetic and ideological distance from the event" (Belton 1980/81: 24).

In recent years, the notion of the *Macroscope* has become established to describe a form of digital instrument by which the historian can similarly bridge and synthesise the big and the finely curated small data to which the digital turn has given rise. The benefits it may deliver have been variously conceived. For Tim Hitchcock, it makes possible the "radical contextualization" of individuals "by exploring the multiple archival contexts in which they appear or are represented"; for Armitage and Guldi it enables, a "weaving together [of data] into one inter-related fabric of time", while it allows Julia Laite, who quotes the preceding, to "construct a prismatic view of a complex phenomenon, to write a kind of history in the round [. . .] [to] massively expand the synchronic and diachronic connections between people, places, and experiences" (Laite 2020: 965; Armitage and Guldi 2014). The proposed framework seeks to address those desires, reapplying the concept of zoom to an exploratory data environment in which scale is collapsed and "historical ideas" generated. It is a framework that supports a range of manifestations of that negotiated data, from a relatively abstract rendering of data points as graphically arranged nodes to immersive experiences, with the evidential sources, in print or image form, directly accessible.

2 Uncertainty in the work of the narrative historian

Whilst rooted in the observed needs of diverse historians and projects of historical research, the Zoomland framework also foregrounds certain attitudes that I have adopted in my own work as a narrative historian: one whose aim is to present deeply researched historical accounts to a broad and non-specialist audience and readership. Among these is the aspiration to a sophistication in storytelling (or story-building) that equates to both the literary and the cinematic, with their vast but quite distinct toolboxes of tricks and sleights-of-hand and genres: techniques by which the relationship between percipient and story (Propp's *szujet*, at its rawest) is mediated and manipulated into fabular constructions and complex narratives (Propp 1968).

This aspiration could be seen as problematically contrarian for an author of traditional analogue narrative history, though perhaps more congenial in the realm of digital history, since it involves a distrust of the very voice in which historical narratives are expected to be written for a non-academic readership. The nub of this unease is encapsulated for me in the editorial advice I repeatedly received from publishers to be 'magisterially authoritative'. The implication was less that an author should demonstrate a mastery of their subject, which of course entails a full awareness of the absences and lacunae and hermeneutic challenges, than that they should perform absolute confidence as a presiding narrator of the past. Tone, tense and genre were to be employed as mechanisms of gentle coercion: the use of conditional and subjunctive constructions should be eschewed, polyvocalism tightly managed, the knowable facts wielded as talismans.

Both books I have published were written in fierce but subtle tension with such imperatives, favoring implication over forthright assertion, cherishing ambiguity at their core. One book (*Pompeii: The Living City*) examined the social and political networks of a single, uniquely preserved Roman town as a microcosm for a period of imperial rule and Mediterranean trade and culture, interpreted through shards of epigraphical and material evidence; the other (*The World That Never Was*) looked at a late-nineteenth-century milieu of political conspiracies and subversion, in which the global diaspora that spread anarchist doctrine, and the international coordination of its policing, was discerned through the reports of informants to their secret service paymasters (Butterworth and Laurence 2005; Butterworth 2010). The books set out to prompt readers to engage with interpretive positions which might sometimes be uncomfortable or confusing: even leaving the reader suspended, temporarily, in a state of uncertainty, providing space for reflection on the evidential foundation of the narrative.

Techniques for highlighting uncertainty were important when confronted with subjects that exposed the margins of confident knowability, dependent as my books were upon the reconstruction of fragmentary and unreliable historical and archaeological evidence, and demanding of speculative boldness. These techniques are, I believe, even more essential as touchstones when grappling with the design of digital engagements with the past, which rest on data whose biases and absences require constant attentiveness. This engagement must remain open, exploratory and dialogic. In cases where exploration is heavily channeled by authoritative constraints, these will soon be felt as a deterrent by the user who craves the ability to pursue their own instincts of inquiry, frustrating their desire to probe beyond surface appearances and to test multiple configurations of data. Either that, or those constraints will have been so deeply insinuated as to co-opt the liberating process of enquiry itself to rhetorically manipulative ends. The responsibility in designing such engagements is therefore social and political, as well as scholarly.

The proposed framework conceives of digital narrative history as a mode that embraces dynamism, dialogism and multiplicity. Authorship in this environment inheres in acts of expeditionary trace-making performed by each investigator of the dataset. The *data text* (a state sequence, as discussed in Section 10 onwards) that is produced by the investigator may, as they prefer, be deemed ephemeral and discarded, or else preserved and enmeshed with those of others; it may be supportive of other trace-texts or it may contest them, in part or as a whole. The initiating author only proposes a path and rehearses the methods of its pursuit. These start with enquiry and analysis that is more or less informed by the existing knowledge of the investigator, both of the domain and the dataset, with each gradually accumulating. The investigator progresses to hypothecating and iteratively testing these hypotheses, then to the recording of insights, the presentation of argumentation, and its further elaboration as narrative. The narrative forms emerge from the steps and missteps of the investigation, each of which constellates the salient nodes in the knowledge graph, faceting their relations and elucidating their semantic significance. Any externally conferred authority is complemented by the collective recognition of skill in the dance of meaning-making, and the insights afforded by the traces that have been made. I will return in Section 7 to consider this interaction between the individual investigator and the collective acknowledgement of meaning-making.

3 The projects referenced and their datascapes

The conceptual framework proposed here derives from extensive and long-term investigations of user requirements across diverse historical datasets. It is illustrated by reference to a number of recent digital history projects, primarily three with which I am currently, or have been involved. Those three projects (and their associated datasets) are *The Lysander Flights*, *Tools of Knowledge* and *Crimes in London*. *Crimes in London* was an experiment involving the use of machine learning to explore the narratives of criminal activity and witness accounts in the Old Bailey criminal trials, and is distinct from the *Old Bailey Macroscope* created by colleagues from the Sussex Humanities Lab: a project which is also considered, as a key precedent for work in this area.[1] *The Lysander Flights* is a detailed study and exploratory narrative account of the operations in which the low-flying RAF Lysander aircraft flew secret agents and resistance leaders into and out of occupied France between 1940 and 1944: their conduct, context and consequences.

1 “Old Bailey Voices”, accessed February 18, 2023, https://oldbaileyvoices.org/macroscope.php.

The dataset on which it rests is compiled from minute-by-minute operational reports, and records of personnel and strategic planning, the organization of resistance circuits, and the executions of resistance members. *Tools of Knowledge* concerns the creative communities involved in the production and use of scientific instruments in Britain during the four-and-a-half centuries up to 1914, and the instruments themselves as encodings and vectors of both craft and scientific knowledge.[2] At its heart is a large and meticulously curated legacy database, the product of a single curator's long career, which has been semantically remodeled and complemented with artefact data from multiple museum collections, as well as data from diverse sources that broadly contextualizes the entities involved: persons, places, objects, businesses and institutions.

Taken together, these projects present a spectrum of possibilities for complex investigative and narrative methods – covering sociabilities, mobilities, temporalities and identity. As described in Section 3, the datasets on which they rest are semantically modelled, both in order to capture the greatest possible nuance in the data and to enable interoperability with other datasets. Each entity mentioned above is defined as a node within a knowledge graph: each is potentially linked to every other entity type, as the data dictates. These linking edges are themselves additionally typed using controlled vocabularies to describe in detail the nature of the particular relationship, with each relationship characterized as an event. A social relationship between people might be defined as family, or business, or legal, for example, with a taxonomical account of finer grain relations such as husband or brother-in-law (family), partner, apprentice or employee (business), prosecuting lawyer or co-defendant (legal). Each entity node is further characterized by its attributed properties: nationality or gender, for example, in the case of people; type, size or material for an object in a museum collection, with additional relevant and domain specific attributes of *call sign* and engine type for a Lysander aircraft.

Wherever possible, the relations between entities are themselves modelled as events, which may involve actors (animate or inanimate, as individuals or assemblages), locations, activities and times. A crime is modelled as an event, as is a wartime operation, but so too are the atomized constituents of each of these: a button accidentally left at a crime scene, an encounter with anti-aircraft fire over the city of Tours. All of these entity nodes carry properties of their own, which include information about their evidential basis or provenance, and metadata about the reliability of the data. The automated geocoding of a placename against

2 "Tools of Knowledge, Modelling the Creative Communities of the Scientific Instrument Trade, 1550–1914", accessed February 18, 2023, https://toolsofknowledge.org/about/, (AHRC AH/T013400/1).

a gazetteer might have a probability of 78% and may or may not have been human-authenticated, a time might be *circa*, or represented by a span of uncertain start or conclusion ("born before", "died by"), or it might be a spot date standing in for a span (working life: only record, 1756). The qualitative and quantitative characteristics of the data vary, and with these their tractability to more abstract or concrete representation, with the potential for media that actualize the former being linked in to the datasets. This modelling of the historical data will be usefully born in mind in relation to what follows.

4 How to make a knowledge graph

Knowledge graphs are a form of structured knowledge representation, derived from potentially multiple data sets and sources, and modelled at various levels of refinement and authority, according to the interests of those who have contributed to their construction and content. Varied pipelines composed of methods and tools support more or less automated processes to extract the data and then transform and load it (ETL), or extract and load the data and then transform it (ELT): the sequencing of the phases determined by a combination of source type, analytical needs, and storage capacity for processing. The components of the pipelines range from Natural Language Processing methods – including Named Entity Recognition or Cluster Labelling approaches that may leverage word or concept embeddings to capture semantic nuance – through to semi-automated tools such as OpenRefine. At the time of writing the rapid emergence of Generative Pre-Trained Transformers and experimental tools such as GPTIndex promise even higher levels of automation.[3]

At its most refined, the resultant knowledge graph is aligned with a formal schema, which is itself reconciled where possible with published ontologies, including those for source citation: CIDOC-CRM, BIO CRM, VIAF, Fabio, Citeo, etc (potentially using OpenRefine's proprietary near-cousin, OntoRefine, or equivalent tools).[4] Beyond this, specific interest groups that contribute rich and densely modelled data, generated by them during a tightly focused project of research,

3 "Welcome to the GPT Index", accessed February 18, 2023, https://gpt-index.readthedocs.io/en/latest/.

4 "What is the CIDOC-CRM?", accessed February 18, 2023, https://cidoc-crm.org; Jouni Tuominen, Eero Hyvönen and Petri Leskinen, "Bio CRM: A Data Model for Representing Biographical Data for Prosopographical Research", accessed February 18, 2023, http://www.sparontologies.net/ontologies/fabio; https://sparontologies.github.io/fabio/current/fabio.html; https://sparontologies.github.io/fabio/current/fabio.html, accessed February 18, 2023, https://viaf.org.

may either embroider extensions to this core ‘authority’ schema, or devise novel ontologies for their own immediate interest. As Beretta has explained in relation to the symogih.org project, identifying those points of overlap and concurrence enable interoperability, and allow immediate semantic mappings to be made between the core graph’s nodes and those populating its hinterland (Beretta 2021).

Stepping back one degree more in the graph, we find ourselves further distanced from rigid formalizations and edging towards the folksonomical and emergent: bottom-up terms and concepts, linked to the schema only by means of a ‘fuzzy ontology’ that accommodates them loosely. This material, which could encompass free-text comments contributed by Zoomland explorers or digitized historical texts or transcripts of audiovisual account, may in turn be computationally annotated, extracted, abstracted and modelled, using similar methods to those discussed. These processes can preserve the micro-graphs representing, in simple terms, a set of entities linked by their description of an event. At a higher level of abstraction, they may also capture those semantic vectors drawn together by the strength and density of their connecting edges to reveal concepts that have clustered according to some semantic affinity, within the high-dimensional space generated by the representation of the myriad word associations derived from textual sources. The folksonomical free text source may therefore be conceived of, in graphical terms, as loose constellations of nodes floating around the ever more densely modelled data towards the graph’s core, spatially distributed as it would be by a force-directed layout algorithm. Constellations that are barely tethered at the periphery may be more closely integrated to the core, through the step-by-step linkage of nodes by means of newly minted edges. The tasks involved in the identification of these edges – as candidature for semantic interest and contextual relevance – may be performed, in turn, by a combination of machine learning methods and the contribution made by those human explorers of the knowledge graph who are drawn to assist in its development at a more artisanal level.

To most effectively support a virtuous cycle of contribution, the nature of the user’s engagement with the graphical interface, by means of which they can explore the semantic content of the graph, should include exploratory reward and remotivation. The process of contribution should be well considered but relatively frictionless; whatever friction is encountered should result from an intentional choice on the part of the explorer to deviate into a more conscious engagement with the data, or else it should be algorithmically-generated as an injunction to heightened criticality, based on an assessment of the validity of the contribution. Within modes and layouts, however, the operational mechanism for informational and cognitive adjustment is here conceptualized by analogy with cinematic ‘zoom’, as it has variously been deployed.

5 A media archaeology of zoom: Digression and immersion

So, what is meant here by 'zoom' and where does the concept sit in a hermeneutics of data exploration and emergent digital storytelling? In traditional cinematic terms zoom is, at its simplest, a change in the focal length of the lens which, in contrast to a camera move towards a subject, retains the relative size and significance of the subject and background, while narrowing the view-shed. It signals attentive interest, but is only a tentative step towards recentering that interest which a camera move would have advanced a step further, and with a subjective focalization offering the most complete recentering, by means of an edit or *cut*. Whatever the zoom's velocity and extent – a short *whip* or deep *crash*; *buried* and contemplative – its effect is to generate a subliminal sense of provisionality. Like the suspended moment of evidential uncertainty mentioned in Section 3, it offers an instant of self-reflection, in which the viewer wonders where their interest might next be led: whether inward to the soul of the subject, or outward to contextualize its situation, or even displaced onto some other subject which will be viewed relationally to it. Such is the potent effect of Zoom in cinematic form on the spectator.

Fixed in an authored audio-visual or graphical sequence, the speculation engendered by the zoom as by any other composition or camera move, according to the skill of its construction and deployment, propels narrative engagement. For us, in seeking to define the design requirements for an exploratory Zoomland, it might translate into a moment that informs and compels a more active expression of agency in what the next configuration of visual information will be. However, for such progressive choices to be most appropriately informed, the fixed relationship of subject and background that the zoom ensures may benefit from inflections which at least hint at context, or even by previews of those next steps and what they might reveal. The experience here might be conceived as similar to the liminal zone of peripheral vision, where an apprehension of movement or change in light intensity is sufficient instinctually to prompt further investigation. So, for example, the visualization which, on completion of its putative zoom, would switch fully from one faceting of the knowledge graph to another – to a looser temporal granularity, perhaps, or tighter geospatial resolution – here surfaces only those entities algorithmically predicted to be most salient to the explorer. How entities are selected for this proleptic function and how they are evoked will vary by the circumstantial configuration of the interface.

Although the most conventional understanding of zoom – as a tightening of view-shed and loss of peripheral vision – may confer benefits in certain Zoomland scenarios, it should not preclude other applications analogous to the technique. Nor should the interactive application of zoom be inflexibly reverential to its origins in cinematic or televisual media, where its practical use has been limited and often modish. Rather, the core mechanisms of zoom may be beneficially modified for this novel grammar of Zoomland storytelling in combination with other techniques for the manipulation of the cinematic image and their cognitive effects, such as dollying moves (in or out) that either complement or contradict the zoom. Changes in depth of field can blur or sharpen background or foreground, shifting attention between them or altering their respective resolution to suggest varying relationships or impressionistic affinities. The lenticular effects of pulled focus may also redirect us away from an individual subject to the social or collective: a notion developed, with different intent, in the theory of 'lenticular lenses' applied to the digital analysis of text.[5] By embracing an expanded definition of Zoomland's media archaeology, all these translated affordances of cinematic zoom become available for use in varying permutations, sequenced to produce expressively nuanced results.

Of equal relevance and complementary to such cinematic precedents, though, for current purposes, are insights drawn from the great theorist-practitioners of realist and modernist prose fiction: the potency of digression in Hugo and the layering of social and spatial networks; the densely evoked cognitive realism of Balzac, with its accumulation of persuasive detail; Tolstoy's eagle eye that discovers relevance in and between Napoleon's cold and the chaos of the battle of Borodino, as Carlo Ginzburg has referenced with regard to the macroscopic ambitions of micro-historical practice (Ginzburg 2012, 209). All are suggestive of principles for novel modes of storytelling with the historical data, which will refine the ideal interface design framework envisaged. This is particularly so for the more abstract levels of zoomed visualization at which it is the identification of patterns in the data that approximate to contextualizing story beats. The distribution of pickpocketing in eighteenth century London viewed in relation to that of the watch houses that facilitated its policing, for example; or audits of stock held by an instrument maker, derived from probate auction catalogues, with the dimensions of instruments, individually and collectively reckoned against the likely square footage of the display and storage space in their commercial premises; or the intensity of a Lysander pilot's flight record correlated with pilot-related accidents.

Examples such as these may be evocative as well as analytically revealing, even when encountered through the abstract visualization of relevant data. How-

5 Al Idrissou, Leon van Wissen, and Veruska Zamborlini, "The Lenticular Lens: Addressing Various Aspects of Entity Disambiguation in the Semantic Web" Paper presented at Graphs and Networks in the Humanities, Amsterdam (3–4 February, 2022).

ever, to envisage the framework for an exploratory historical storyworld exclusively in these terms would be negligent, at a moment when the dominant media and genres for storytelling are themselves immersive: in their photo-realistically rendered virtuality, their kinetic preoccupations, and often in their exploratory and constructionist affordances too. Indeed, the digital capture of physical objects and environments as point clouds, whether through photogrammetry of instruments that are representative of those from probate auctions, or laser scans of a crashed Lysander's cockpit, or extruded maps of historical London ground plans, raises the prospect of further negotiations between data models, of quite different scales and semantics. The prospect afforded is one that makes digitally manifest Chekhov's widely paraphrased and abbreviated advice to the short story writer: "Don't tell me the moon is shining; show me the glint of light on broken glass" (Yarmolinsky 2014: 14). In such cases, zoom could serve an important mediating and interpretive function, bridging the concrete and the abstract, to simulate the situated immediacy of lived experience, albeit in a form that must be responsibly hedged around with caveats and correctives. So, whilst the suggested framework does not countenance the integration of historical data exploration and ludic environments, I would argue that it should encompass notions of both "playability" (with dual senses of "play": as rehearsal without formal constraint, and of the scope for minor movement within complex structures or in mechanical motion) and of immersion.

6 The idea of scale – the three principal axes

Before progressing further through the speculative design of frameworks for Zoomland visualizations, it will be useful to consider briefly the most familiar affordance to which principles of zoom are applied: that of scale. At every turn in their work, the historical researcher must confront the question of the most appropriate scales at which to scope their subject, or into which their subject may usefully be decomposed. At what level of scale in the data available to them is it possible to detect change and assess the range of causal effect, and with what confidence, as determined in part by the quality and representative claims that can be made of that data. Following directly from this, and further complicated for historians working in a primarily narrative mode, are questions regarding the methods by which any decompositions can be recombined, and the validity of the insights produced by those recombinations. Zoom, in a straightforward conceptualization, allows experimental movement and comparison between the general and specific, the whole and the component. For the conscientious expert historian its products will prompt not only further questions and hypotheses about how each informs the other, but also an implicit problematization of those relations and the assumptions that underlie them.

With its remit to rehearse investigative expertise for a broad public, and to cultivate their capacity for such data exploration, the Zoomland interface must go further than merely making visually accessible such straightforward zoom-in-scale. It must additionally surface these processes, reifying the dialectic interplay between them through the presentation of data that is faceted as contextually apposite, at any point. The scales of data involved in the exemplary projects discussed in this chapter, considered in terms of volume and complexity of modelling or detail, exemplifies a broad range of possible historical datasets. As such they also illuminate issues in the management of faceted data visualization and how these mechanisms may serve to bridge between one scale and another: as understood most directly in terms of spatial and temporal data, and within the graph of actor-relations. Furthermore, they should accommodate varied modes of critical interrogation: visual (pattern-matching), speculative (causal hypothesis-forming) and emotional (situated).

To address these requirements, the proposed framework for zoomable exploration is conceived as comprising three principal *axes*, each interacting with a continuous scaling, calibrated around three recognized *scales* of study (micro, meso and macro) and three core *modes* of visual organization (spatial, temporal and network). The three axes which variously characterize the conceptualization of zoom are defined as: (1) Level of Detail, involving the nature and amplitude of information appropriate to the current zoom level; (2) Level of Abstraction, from statistically evaluative to situated and immersive, or critically reflective to emotionally co-opted; (3) Cognitive, by which the depth and faceting of contextual information is focalized. A fourth potential axis, concerning authority and certainty, will be mentioned additionally in Section 12. 'Level' is used here, in relation to all axes, to describe the level of zoom that is set at any moment, along the range of possible settings.

Zooming on the Level of Detail axis, calibrated for informational resolution, is analogous to the illusionistic methods by which the developers of immersive environments switch in and out images or models, as the zoom reaches different pixel or polygon counts, as imperceptibly as is technically possible within a smooth animation, to avoid the lag that may be caused by loading overlarge image files relative to available processing power. It may also be imagined as an extrapolation of the methods employed on zoomable digital maps, where the most zoomed-out view emphasizes topography and transport infrastructure, for the purposes of long-distance route planning; while the most zoomed in exposes infrastructure for pedestrian way-finding; with an intermediate level which highlights resources or points for interest that may localize the interest of the former user, or expand the horizons (or advertise to the consumerist needs) of the latter. In this respect, it begins to intersect with Cognitive Zoom.

This third axis of zoom, Cognitive Zoom, has the greatest novelty as a principle for visualizing data and also involves a greater complexity of dynamic calculation in transforming the graphed data according to rules customized for individual datasets. It may be understood most straightforwardly as the constellation of context that is deemed most revealing at any moment in relation to the immediate objective of the exploration. Or in presentational terms, the context that the viewer needs to know at this point on their narrative journey to make fullest sense of what follows. Its close antecedents lie in the work of Marian Dörk, his formal conceit of the "information flaneur", and the visualization styles prototyped in his work on monadic exploration. This draws on Tarde's concept of the monad to challenge the distinction between whole and part, while more recent collaborative work progresses to the concept of the 'fold', the latter elaborating the former as a topological model that exists in a continual state of dynamic folding of space, movement and time (Dörk et al. 2011; Brüggemann et al. 2020). For present purposes, though, the concept is animated rather through reference to filmic technique – the dollied zoom – by means of which the central object of interest is simultaneously approached focally and actually, with the foreground held steady while the background is advanced or, in this case, made informationally salient.

Level of Abstraction is probably the most readily understood as being, at one extreme of the axis, photorealistic immersion whose verisimilitude produces a sense of situated presence, potentially involving haptic, tactile and olfactory senses in addition to the visual. It is, or might be conceived, crudely, as the ultimate historical theme park experience. More difficult to envision is the other extreme of the axis where the information contained in the knowledge graph into which the dataset has been modelled is expressed at its rawest: a dense tangle of nodes and edges that exist only in a condition of illegible high-dimensionality. As discussed in Section 12, for whatever purpose this is thought tractable to human interpretation, this multivariant data must be reduced to the simplest form at which it can be visualized, in two or three dimensions (or possibly four, if some means of filtering by time is included). Between these poles of the axis lie innumerable possible calibrates: progressing away from the highest point of abstraction, at each of these the visualized dimensionality of the data is further reduced, by means of the application of algorithmic or graphical filtering. Conversely, we may approach this from the concrete extreme of the Level of Abstraction axis, by which the relations concealed in the data that drive the immersive simulacrum with which the participant is first presented are incrementally decomposed for analysis. Here again, intersection with the axis of Cognitive Zoom is likely to occur, whilst intersection with the Level of Detail axis of zoom is also possible.

7 How authority is conferred, indicated and deployed

For the user, the drift towards Abstraction in this interplay of axes is liable to entail a gradual weakening of those points of intellectual and imaginative purchase derived from immediate human experience, and a drift towards ever higher levels of abstract conceptualization, that invoke and require more scholarly domain knowledge. An immediately comprehensible example of this might relate to time and human memory. The experience of a day or a week or a month or a season is familiar to a contemporary reader or data explorer and may be tacitly invoked to afford points of identification with historical experience. The temporal divisions, rhythms and functions of these time spans are, of course, often radically different according to context, historical and otherwise, as reflected even in their naming: the exigencies or planting and harvest, of economic behaviors dependent on sailing seasons, of *fasti* and *nefasti* or feast days and fast days, of lives lived by daylight or by standardized railway time. Nevertheless, the shared experience of time at these scales can provide imaginative purchase on that difference, which an author may more or less explicitly evoke.

It is this potential to analogize, however approximately, which is drawn on by techniques such as the graphical distortion of an otherwise uniform segmentation of time to communicate more subjective temporal experiences – intensity of activity, the anxiety of waiting – in relation to timeline visualization.[6] Career courses, lifespans, even generational shifts are similarly amenable to an analogizing approach, to produce an immediacy of narrative engagement. In static forms of data visualization, convention insists on regularity in the relationship between any property and its spatial distribution or proportional scaling, with any deviation from this rule considered as irresponsible rhetoric which risks misleading the interpreter. Such techniques may be afforded a different legitimacy, however, where the information space is itself recognized as a dynamically expressive environment. In this case, the relationship between background and foreground can itself be experimentally adjusted by the configuration of zoom settings, on any axis, while comparison between sequential animated states makes apparent any rhetoric devices. As when toggling between maps that represent geographies in Euclidian space according to conventional projections, and cartogram representations that morph according to the geospatial distribution of additional data, the agency of the ex-

6 Alex Butterworth, "On the growth of my own mind: Visualising the creative process behind Wordsworth's autobiographical epic, 'The Prelude', in context", accessed February 18, 2023, https://searchisover.org/posters/butterworth.pdf.

plorer and the perception of narrative development converge to generate imaginative engagement and suggest new interpretations (Dorling 1996).

The effect of such techniques becomes increasingly etiolated, however, as the temporal duration expands. When we reach the level of historical periodization, of longue durées and epochal change, an effective historical hermeneutic is likely to depend on specialist scholarly frameworks, often particular to a field or domain. The application of these collectively tuned knowledge-producing practices may reveal significance, suggest hypotheses and even bring to the surface provisional narratives in the patterning of data which to a layperson will remain mute and perplexing. The design of visualization layouts at such a level of zoom on the Abstract-Concrete axis must, it could be suggested, primarily serve the requirements of these more sophisticated users, even at the risk of presenting a complex and deterrent appearance to the non-expert. A visual form that is as simple as a scatterplot, such as that produced by Hitchcock and Jackson for their *Old Bailey Macroscope*, with its axes representing number of words per trial and sequential trial references numbers, is interpretable, even in the most basic terms, only with implicit knowledge of file naming conventions (and their relationship to chronologies, at micro and meso scale), as well as changes in methods of court recording or relevant legislation. A deeper analysis of change in trial length over a period of centuries might require more "microscopic" knowledge of courtroom architecture and its effects, and/or an instrumentalized understanding of the impact on judicial practices of changing carceral regimes or the imperatives of the political economy.

An analogue author of a narrative history can more easily be inclusive. In the course of ostensible story-telling they may educate the reader almost imperceptibly, skillfully seeding and integrating the necessary information through subtle and contextually apposite digression or allusion. Interfaces to data-driven zoomable analysis can and should seek similarly to mitigate the obstacles to properly informed interpretation by the broadest possible range of users. It is something that Hitchcock and Jackson's macroscope attempts, generously and engagingly, in relation to the example of courtroom architecture mentioned, through the provision of a three-dimensional visualization of the Old Bailey courtroom (styled for one historical arrangement, although potentially in multiple period-accurate manifestations).[7] Within this virtual space, users may position themselves to emulate and gain analytical insight from the experience of witnesses, lawyers, jury, judge or the accused as they were spatially situated in an environment that em-

7 Tim Hitchcock, "Big Data, Small Data and Meaning". Historyonics, 9 November 2014, accessed June 17, 2023, http://historyonics.blogspot.com/2014/11/big-data-small-data-and-meaning_9.html.

bodies and demands an almost theatrical performance of roles from those participating in the courtroom proceedings.

As will already be apparent from these relatively simple examples of the highly varied states into which data can be configured, all of which would conform to the framework for a Zoomland info-graphical environment, there is a high risk that the data explorer will experience both visual and cognitive disorientation, unmoored from reassuringly familiar conceptual models. The simultaneous availability of multiple options and functions for changing position, layout, filters or parameters is a necessity for freedom of enquiry but offers no firm footholds. It is therefore imperative that the explorer be best equipped to make meaningful progress, which here implies a forward movement through sequential meaning-making. Which bring us to the principle of the *subject-in-transit,* introduced here as a necessary complement to the earlier described principles of zoomable axes.

8 The subject-in-transit

The principle of the subject-in-transit proposes a mechanism for the multi-factorial means of ensuring a situated focalization while exploring the Zoomland datascape of an historical knowledge graph. The subject-in-transit comprises a single-entity node – a person, object, place, moment in time – or could involve a set of nodes which constitute and are contained within an event entity. This node provides a persistent object of attention travelling through varying states of data selection (by means of filtering and faceting) in combination with a range of graphical layouts: until a deliberate decision is taken to transfer focus, the node retains its identity through any transition in graphical presentation. Different permutations of selection and layout, which may be adjusted experimentally or with particular intention, enable varying interpretive possibilities to be discovered in the graphed data. Nodes may be laid out according to time or spatial properties, or in a network form, with each subject to rules of reorganization triggered by passing designated points in any of the axes of Zoom.

In simple terms, nodes might stack or aggregate on a Level of Detail Zoom, with the aggregation determined variously by polygonised proximity (map), temporal subdivision (hours, days, months, years, decades), or different gauges of network clustering and affiliation (membership of a guild, apprenticeship to a master; frequency of association with a particular crime or area of London; involvement in a resistance network or military organization). On the Cognitive axis, nodes linked to the subject-in-transit in the graph – directly or indirectly, though only via edge types which are dynamically determined to reflect contextual semantic relevance to the current layout – may be exposed and constellated to suggest new analytical perspectives for the user, with the degree of allowable graph traversal determined by the adjustable Zoom level that is set. In this way, related people, ideas or objects (spatial/network) or locations and events (spatial/temporal) are displayed, to a greater or lesser extent, and according to further dynamically determined principles of relevance. The operation of Zoom on the Abstract-Concrete axis cross-references the type of data and associated media that are available with the layout type to define the mode of presentation: in spatial layout mode, the zoom might run from organizing nodes into an abstract bubble graph visualization according to type (country when in combination with a low Level of Detail, parish when high) through to the vertical extrusion of a historical map underlay at one extreme of the axis, or at the other, an explorable 3D representation of the street in which the subject-in-transit was located at that moment in historical time. Matrices that define how nodes manifest visually in each permutation or Layout, Axis and Zoom level are pre-configured in the course of data preparation and management.

Such an approach is consistent with a mode of historiographical knowledge production that seeks to induce reflexivity, and which embraces *zoom* as a means to engage and shift affective identification. It enables more nuanced engagement with the polyvocality, uncertainty and ambiguity generated by the tensions across scales of data, while enabling narrative devices that may challenge the user-actant with the unrecognized biases encoded in their exploratory choices. Drawing on Marian Dörk's theorization of the "information flaneur" as an imagined percipient casually constellating their information environment, the principle of the subject-in-transit emphasizes instead the chosen ego node within the knowledge graph as a sustained guarantor of coherence (Dörk et al. 2011).

Hitchcock and Jackson's *The Old Bailey Macroscope* has already sketched an application of the principle, although not explicitly elaborated as such or grounded in a knowledge graph.[8] Within the *Macroscope*, the user is able to switch between layout views while maintaining a persistent focalization on a single subject-entity, in this case the trial. Consequently, the hearing that has been presented in immersive form may also be identified and highlighted in the scatterplot, or vice versa, the 3d courtroom may be accessed via the selection of a single scatterplot glyph. It may also be examined, singly or comparatively, as a sequence of standardized courtroom discourse elements, derived from a dataset created by Magnus Huber and here presented as a sequence of strips on a horizontal bar graph, color-coded

8 "Old Bailey Voices", accessed February 18, 2023, https://oldbaileyvoices.org/macroscope.php.

by discourse type and linked through to the transcript of the trial.[9] Whilst sometimes available in a dashboard form, meaning is inherent more in the counterpoint of layouts, yet the transition between layouts is abrupt rather than fluid. That is, when compared with filmic grammar, it aligns more closely with a "cut" than an animated zoom, although the shifts in scale certainly embody something of the latter effect, albeit with a loss in selectively carried over context. *The Old Bailey Macroscope* therefore offers a highly revealing prototype and illustration of zoom, notably on the abstract-concrete axis, with two distinct explorable visualizations of data that sit respectively towards – but not quite at – its two extremes.

These identifiable lacunae in the *Old Bailey Macroscope* are, however, themselves usefully suggestive of challenges and opportunities. The scatterplot layout positions its visual representation of data on axes that carry human-readable meaning, albeit requiring implicit expert knowledge to interpret, while the 3D courtroom scenario intentionally eschews (even alienates) the user from a sense of immersion: the space is not "skinned" in surface detail, the human figures are near-skeletal maquettes; the voicing of the trial is machine-generated, uninflected and not distinguished by speaker. It is a project that leaves the dramatization to the television fictions that it has informed. However, the extreme of the abstract-concrete axis might allow for further progress in that direction, which in turn could activate a data-orientated negotiation between the levels of evidential certainty (Section 11) and the speculative affordances involved in immersive evocation. Moving from the 3D courtroom, along the axis in the other direction, towards abstraction, it has not yet tested either the territory of meso-level abstract-concrete zoom where, for example, the visual interface might allow for the experimental correlation of trial duration data directly with modification of courtroom design, expressed perhaps in more diagrammatic terms of space syntax and topic-annotated graphs of courtroom discourse. Nor does the *Old Bailey Macroscope* venture to the further extremes of abstraction, of the underlying multi-dimensional knowledge graph, in whose visualization even the guide ropes of expert knowledge must be cast aside in favor of the emergent, if imminently inchoate: one whose analytical potential will be touched upon in Section 12.

9 The data finds its shape within the framework

For the three projects which I have discussed as exemplary case studies for a prospective Zoomland approach, however, the balance of considerations is different.

9 http://hdl.handle.net/11858/00-246C-0000-0023-8CF, accessed February 18, 2023.

In two of these, the scale of the data is somewhat or substantially smaller, in terms of the total sources, indicating the aforementioned focus on meso and micro scales of zoom on most axes, but the detail of the modelling substantially greater, while its semantic grounding amplifies the structure of the graph itself, as a carrier of meaning. In the third case study, coincidentally developed from the Old Bailey dataset, the data in question is derived from textual analysis at scale and is loosely semantically modelled, and for purposes of zoomable analysis, roughly compatible with that of the other two projects. The effect envisaged is to increase the amplitude of analysis along the Abstract-Concrete axis, most notably in combination with Cognitive Zoom, by which the Subject-in-transit can be contextualized.

A recent and highly effective use of Virtual Reality for historical evocation, consonant with the Second World War in the air subject matter of the *Lysander Flights*, was *1943 Berlin Blitz*, produced by the BBC.[10] The experiment is situated in a Lancaster Bomber as it flew in formation through heavy flak to rain incendiary devastation on the German cities below. The experience creates a powerfully immersive visual and physical effect, with its emotional impact intensified by the use of a voice over contemporary report by Wynford Vaughan-Thomas, a radio journalist who accompanied a mission with his sound engineer. For fifteen minutes, in an abbreviated version of the eight-hour journey, the lived experience of the terrified crew is reanimated. Its position on the Abstract-Concrete axis is clear, with the voice of the reporter, equipped with contextualizing information (carefully censored and skewed towards propaganda), fulfilling something of the function of Cognitive Zoom. How though might Cognitive Zoom, deployed at a more abstract point on the axis, generate an equivalent intensity of understanding and even empathy by revealing patterns in the data that evoke the inner world and thought processes of subject's situated experience?

The subject-in-transit here might be, by closest analogy, the pilot of the Lysander aircraft on an equally hazardous operation to infiltrate agents into occupied France. We might be introduced to the interiority of the experience by visualizing data that reveals the intensity of their schedule of sorties, how much recovery time they have enjoyed between, or how much leave they have taken in the last month, from which we might derive the imagined level of stress and fatigue; or the same question might be approached through how many crews' and colleagues' names they have watched wiped from the blackboard in the previous forty-eight hours of 1943 as casualties on similar missions (by way of reference to a common visual trope of combat films).

10 "1943 Berlin Blitz in 360°", accessed February 18, 2023. https://www.bbc.com/historyofthebbc/100-voices/ww2/360berlin.

Or it could be a criminal defendant, or an instrument maker, or even a scientific instrument. What, we might ask, are the chances of conviction for a girl of sixteen brought to the Old Bailey in the 1760s for the theft of a gentleman's handkerchief in a theatre, what is the likely sentence they will receive, and in what language are they most likely to hear themselves described? Or for a young Italian immigrant maker of chronometers who has just won a silver medal in the Greenwich Observatory trials of 1854, coming in behind a prominent London-based company with a three-generation lineage of supplying the admiralty, how many chronometer makers who have been in a similar position to him still have a going business two decades later. In summary, is this a world hospitable to talented incomers and, if so, what are the secrets of success? Perhaps that is a question for which the answer is carried by an object rather than a person: a chronometer that has been in service for decades, was assembled from parts supplied with recognition by half a dozen artisanal enterprises, with the elegant housing made of an unusual alloy of unknown origin detected by X-ray Fluorescent analysis, was stamped by an eminent Edinburgh maker, and which had been regularly repaired by the same workshop twice a year, before its retirement from Admiralty service and acquisition by the National Museums of Scotland, its eminence secured by careful curatorial preservation and thanks to its regular exhibition. Yet how truly representative is it of the hundreds of similar instruments supplied to the Royal Navy's ships throughout the nineteenth century?

10 Narrative exploration as hypothesis forming and testing

For the data to be so revealingly articulate, of course, it must be sifted and sorted, filtered and faceted using compound Boolean arguments, and rendered legible to others as a set or sequence of related insights, graphically presented and, where necessary, commented with explanation. The initial experience of such multi-axial zoom environments is almost certain to be haphazard, even in the hands of an expert operator, and resistant to easy interpretation. Its navigation and the construction of meaning with it entails an iterative process of trial and error, of hypothesis formation and testing, and a responsiveness to unanticipated possibilities and unexpected insights. In terms of a design specification for a supportive graphical interface, it must encourage rather than inhibit speculative forays, with the operator confident of retaining or easily regaining their orientation.

Where a user-authored sequence of states departs from an existing argument or narrative account, with which it shares certain states or state-pairs in common – having started, by definition, with all in common – or where its structure in development *ex nihilo* is algorithmically identified as correlating with significant states and state-pairs within such an existing account, the points and the extent of agreement or divergence between the new and prior sequences may also be graphically indicated. It is quite possible that such relationships will be discovered between the current authored sequence and *multiple* analogous but somewhat contesting accounts, each of which will offer its distinct interpretation, to produce further graphing of intersection and divergence. In such cases, the comparison that is graphically indicated at any time will be between the active account and a single correlated sequence, but with the option to cycle through the other sequences, for paired comparison. By these means, a dialogic approach to negotiating authority is encouraged whilst the legibility of difference is also ensured, by dint of managing its parameters. The sense of empowerment experienced by the explorer in turn prompts them to contribute additional evidential data in support of their narrative or argument.

The comparison of arguments and narrative accounts requires, of course, a state machine – actively recording states of layout preference and data configuration – in order to ensure that the branching paths of experimentation can be followed, backtracked, retraced and deviated from, in an arborescence of growing complexity but also redundancy. Ideally, this state machine management would include some means to mark those paths most favored, as the argument that they represent becomes more established, whether by authorial annotation or frequency of iteration: tracks through a network of states and edges that the interface may inflect with visual prominence, as in the erosion of desire lines in physical landscapes.

11 Variable authority as a further axis of zoom

To complement our three core axes of zoom, a fourth and distinct type is implied by this capacity for anticipatory probing of the data: one that runs from looseness to certainty, or from a dispersed to a hierarchical authority. The axis of zoom is, in this case, manifest within the graphical environment as a scalar of inclusiveness that can be adjusted – or, in more tangible User Experience terms, 'brushed' – to produce either a more generously broad, or a narrower and more tightly defined focalization of the interpreted graph. This conceptual focalization – which may also be considered as the amplitude allowed by the chosen depth of focus – is technically realized as the degrees of node-traversal in the knowledge graph, filtered for availability by their confidence scores, that that are enabled during the resultant query.

To this end, the (metaphorical) tuning-dial is calibrated to winnow data according to their provenance metadata, against two measures. The first is by type and level of authority, conferred by externally validated status. This might be variously by reference to a relevant publication with a Unique Identifier that has been validated by an authority source, or else by reputation acquired among the contributing community, for example by the collective validation of contributions, of which scored records are maintained internally. The second is conferred by the reliability of the interpretation of the relationship between data represented by that edge: calculated as a combination of the confidence score as assigned by contributors and/or as probabilistically determined in the machine-learning process.

Whilst an aggregation or disaggregation of nodes occurs during a zoom-in-resolution, a zoom-in-certainty is manifest simply as the addition or removal of nodes, as they fall within or without the acceptable range. The node and edges constellated in the micro-graph freeze and preserve user-focused interest at moments of transition between layouts and modes: concepts which are themselves explicitly modelled within the knowledge graph. However, at any time it should be possible for the user to surface – with minimal active enquiry (one or two steps of interaction) – the specific provenance data pertinent to the set of nodes and edges currently filtered, or to any individual node or edge visible, and to access this data either as an annotation or wherever possible, at one further remove, by direct linkage to source. Such information is then presented: displayed as text, perhaps, either in a floating pop-up window associated with graphic elements, or within a dedicated side bar window, or as speech, whether pre-recorded or synthesized using speech-to-text methods.

12 Conclusion: Towards a narrative grammar of zoomable exploration

Behind the framework for managing the fluid visualization of historical data in narrative form that is described in this chapter, lies a process grounded in the modelling and later querying and analysis of the knowledge graph. This involves, fundamentally, the translation of one graph form into another: from a knowledge graph formalized by alignment with formal ontologies that carry rich implicit knowledge, into contextually determined sub-graphs that are extracted and made accessible to the data explorer according to the specific requirements of the moment. These sub-graphs constellate ego networks which are centered on the subject-in-transit, with various allowed affordances of graph traversal and with exploration possible to varying degrees of amplitude. Neither a general nor particular definition of the algorithmic substrate of such a graph translation system, by which the constraints are dynamically applied, will be attempted here. It will develop through accretion, as a product of the repeated practice of expert exploration and enquiry: rehearsals of human expertise that are manifest as the authoring of narrative sequences out of visualization states. This contribution of candidate edges and the new micro-graphs that they link together will be amplified through the application of machine learning methods, trained on those human-produced accounts, whether narrative or argumentative in form.

In conclusion, it is possible to note how this more sophisticated level of knowledge extraction and narrative modelling depends on abstraction in two axes, combined with concrete specificity in another. The abstraction takes the form of high-dimensionality vector spaces, on the one hand, representing the graph of semantic associations, in which a process of clustering by variable similarity or affinity of vector pairs – or, in more refined instances, of matrices – signify potential relevance. Within the Zoomland graphical environment, these might be inspected for utility and interest through the application of unsupervised non-linear dimensionality-reduction algorithms, such as UMAP or T-SNE, and may even be human-labelled *in situ* to augment the explicit record of the knowledge graph. Meanwhile, and by extreme contrast, Concrete specificity is to be discovered in the character of those more visually immersive states, ranging up to the level of three-dimensional photorealism. As will be apparent, a crucial role is played in this by the second axis, of Abstraction-Concreteness.

The interplay of these two axes may be effectively combined in narrative sequences, with the modes and layouts of each state determined by the specific permutation by the axial configurations. To achieve the desirable coherence of narrative construction, however, will additionally require the application of a narrative grammar of state sequencing, one whose definition might draw on research such as that by Neil Cohn into the 'structure and cognition of sequential images', in which the ordering and interplay of knowledge faceting has the potential to generate 'third meanings' as powerfully as more purely figurative imagery (Cohn 2013). These meanings may be apprehended analytically or in more purely affective terms, with the most skilled exploratory authors orchestrating their arrangements into compelling, informative and persuasive accounts. The anticipated outcome of this next step into Zoomland will be exploratory adventures that may stand comparison with the best linear forms of narrative history.

In the fullest realization of this half-prototyped medium, we can imagine Chekhov's moon seen through the eyes of an agent in the secret war of 1943 – a passenger in the rear cockpit of a Lysander aircraft, exfiltrated from a field in occupied France and huddled over a thermos of coffee laced with rum – as it reflects off the silvery French waterways below: a living map by which the pilot is tracing a route to safety. That tangible journey, though, is also a trace through contextual knowledge: the spine of a story, dynamically rendered across the myriad synapses of a semantically modelled knowledge graph.

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Christian Wachter

Capturing Discourse through the Digital Lens: Towards a Framework for the Analysis of Pro-democratic Discourse in the Weimar Republic

Abstract: Scalable reading has become a pathbreaking approach for discourse studies in Digital History. While large-scale analysis broadens the examination of primary sources and explores discourse features independent from the historian's experience, close inspection evaluates findings in light of the historical context. However, if we want to bring the best of both worlds together fruitfully, methods must be geared to the material, the discourses under scrutiny, their historical contexts and our epistemic interests. This paper proposes a methodological framework of scalable reading, specifically for pro-democratic discourses in the Weimar Republic. Accessing democratic thinking in Weimar Germany's fragmented political culture has been a significant concern of historical research. This includes examining newspapers, as they represent opinion-shaping mass media. However, historians have not exhausted this potential, and they have hardly engaged with scalable reading. This paper aims to close this gap by outlining the primarily heuristic benefits of scalable reading for studying democratic discourses in Weimar's press.

Keywords: scalable reading, discourse analysis, heuristics, Weimar Republic, democracy

1 Zooming in, zooming out: Extending the toolset for examining the political culture of Weimar Germany

1.1 Research on discourses as scalable reading

The digital humanities have invented an array of large-scale text analysis techniques, which make it possible to access extensive document collections that scholars could only partially read manually. While these quantitative techniques have successfully been applied in various research domains, such as historical discourse analysis, many scholars rightfully warn that analysis results still need contextuali-

https://doi.org/10.1515/9783111317779-003

zation and interpretation. As Silke Schwandt put it in a nutshell, quantification results are not per se meaningful, numbers are not the same as representativity, and analysis visualization, too, requires interpretation (Schwandt 2016). What is needed are approaches to fruitfully combine the computer's potential of gathering statistical information on the material's contents and the scholar's experience to contextualize and interpret that information. This challenge has been addressed for some time with respect to concepts of "scalable reading"[1] or "blended reading" (Stulpe and Lemke 2016). These umbrella terms stress the metaphor of zooming in and out on document collections. However, only concrete methodologies aligned to specific research questions and objects clarify how the zooming movements may and should work. In research on the History of Concepts, for instance, we might want to detect all the occurrences of a specific term and have a closer look at them. Discourse studies, in contrast, typically depend less on word occurrences. Zooming into text passages of a particular discourse does not (solely) require finding keywords but also identifying discourse contents independent from specific terms (Oberbichler and Pfanzelter 2022: 136–137). What we need is to achieve a solid understanding of scalable reading methods as defined areas of application that demonstrate the potential and limits of those instrumental means.

In this chapter, I draw from existing projects of digitally-asissted discourse analysis and extend its methods in order to substantiate scalable reading for historical discourse analysis. In my view, scalable reading approaches are of great value for studying discourse because they substantially support the common challenge to examine complex networks of semiotic practices while working with many primary sources. Regardless of any specific theoretical and methodological underpinning or definition of discourse, the quest is, broadly speaking, to identify *meaning*. Meaning is expressed by historical actors and attributed to different (social, political, cultural) phenomena. Historians impose epistemic questions and perspectives on these phenomena, thus also inscribing meaning into their research objects. Therefore, discourse is a complex phenomenon that often requires looking over a vast number of primary sources, which underscores the importance of heuristics – the historian's traditional task of identifying, selecting and gathering material relevant to a specific epistemic interest.

Sarah Oberbichler and Eva Pfanzelter (2022) reasoned about the potential and challenges of digitally assisted discourse analysis with a focus on heuristics. To do so, they discussed remigration discourses in modern and contemporary Austrian history, traced by historical newspaper analyses. Oberbichler and Pfanzelter argue

1 Martin Mueller, "Scalable Reading," Scalable Reading (Weblog), accessed May 2, 2022, https://scalablereading.northwestern.edu/?page_id=22.

that searching digital newspaper archives, compiling a corpus of relevant texts, and exploring and interpreting these texts comes with extra challenges. For instance, simple keyword searches and frequency analyses cannot trace the discourses of interest sufficiently because discourses tend to be independent from concrete wording, as mentioned above. In promoting digital source criticism and methodological reflection, both authors propose combining different means like absolute and relative frequency analyses and text mining techniques. The latter can find new keywords and statements that the historian might not have thought of before. In total, Oberbichler and Pfanzelter provide valuable methodological insights into how to (1) compile a corpus of relevant primary sources, (2) enhance the overview and orientation for exploring the corpus, and (3) "dig deeper into the historical-critical method in the digital age" (2022: 127). This innovative understanding of digitally assisted heuristics expands the toolset for discourse research because it complements the historian's experience-based searches with techniques "making the search less influenced by the researcher's prior knowledge" (2022: 147).[2] In doing so, Oberbichler and Pfanzelter are aware that any specific design of heuristic methodology depends on the contents and nature of discourses at hand, the discourse arena, and, ultimately, the research interest. When dealing with predominantly emotionalized language, for instance, sentiment analysis techniques become more relevant than for discourses of a rather pragmatic and rational language use.

My attempt at scalable reading follows a similar approach to Oberbichler's and Pfanzelter's, geared to the specific case study of the Weimar Republic. Germany's first democracy was highly contested in many respects (Büttner 2008: 729). In a fragmented and polarized landscape of political discourse between the two World Wars, much uncertainty existed about fundamental concepts of German society. For instance, stakeholders of different political orientations battled over the definition of "democracy." Drawing from the existing research on Weimar's political culture[3] and its engagement in discourse studies, I consider this case highly relevant to approach a methodology of scalable reading: Weimar's intricate discursive landscape has forced many historians to downsize their research scope to specific groups, local contexts, discourse topics, or smaller collections of primary sources. I intend to show that scalable reading promises to broaden the scope and include more discourse contributions to deepen our understanding of political thinking. I focus on pro-democratic statements in newspapers, especially by defenders of the

2 Here, the authors specifically refer to text mining methods.

3 Historical research on political culture focuses on modes and contents of perception and the constitution of meaning by historical actors in political contexts (Hardtwig 2005a).

republic reacting to far-right attacks on Weimar's democratic system and democracy as such. By tracking these statements, their connections, and proliferation, scalable reading techniques, as I discuss them in this chapter substantially support historical heuristics. This potential is even enhanced when scholars visualize their heuristic findings in a well-structured overview for subsequent interpretation. Consequently, these methods must be chosen and geared to the underlying research context. Instead of reasoning about scalable reading "as such," I try to demonstrate its benefits for a defined area of historical discourse studies that, at the same time, can serve as a springboard for similar research endeavors.

Therefore, I aim at contributing to a genuine digital history methodology. Simultaneously, this chapter contributes to the research on the Weimar Republic, which has hardly seen studies that employ a scalable reading approach on discourses. In conducting pilot studies, I intend to get insights into Weimar's democracy discourses, on the one hand. I also aim for receiving feedback for adjusting the methodological framework. Ultimately, my approach is primarily thought to enhance the toolset for examining political discourses to understand better the ideas and opinions on democracy during an essential period of Germany's history of democracy.

1.2 Getting a grip on the complexity of discourse

Discourse is a phenomenon frequently described by spatial and pattern-based metaphors: People have ideas and perceptions of reality, and they utter them in a discursive *space*, a specific cultural, social, political, etc. arena of sense-making. Fueled by such contributions, discourses often *overlap*, for instance, when criticism of governmental decisions goes hand in hand with general demands for more public participation in politics. Discourse participants affirm or object to each other, forming a *network* of discursive negotiations. Some comments have a larger impact than others or might even be hegemonial. Following statements then replicate or build on the original message – a discursive *line* emerges.

To be sure, there is much more to say about discourse, its competing definitions, or analytical approaches. What the metaphors above already reveal, however, is that discourse analysis deals with a complex phenomenon consisting of many constituents. Researchers must detect and interrelate them to gain knowledge from their investigation. And that is, above all, learning about the discursive creation of meaning – meaning that shapes reality, in the Foucauldian sense: It makes a difference to call an anti-governmental uprising a "freedom movement" or "insurrection." If one of these topoi becomes dominant for large parts of society, it is not just a difference of personal opinion. Instead, it is a difference in perceived reality – a reality that influences subsequent political judgments, power relations and actions.

Getting a grip on such a complex research object often demands access or selection from large collections of primary sources, regardless of any analog or digital methodology. In detective work, one must identify essential stakeholders, prominent discursive subjects, and the proliferation of topoi in society. While quantitative research answers this challenge by accessing material masses, qualitative studies carefully find cross-sections for downsampling. It might seem that digital humanities methods facilitate mainly quantitative approaches, given that enough machine-readable material is available. This is because distant reading techniques allow the inspection of massive amounts of text. For example, topic modeling traces potentially meaningful clusters of words as they occur in large corpora. These corpora are meaningful because they comprise documents selected by relevance for specific research interests. On this basis, topic modeling statistically captures terms with patterns of co-occurring words hinting at candidates for relevant subject matters. This can give insights that are not possible to achieve without the computer. However, DH scholars regularly warn that the term "topic modeling" is misleading because the computer does not model topics in a narrow sense, but instead statistically identifies word groupings that *might* signalize topics. Scholars still must interpret the analysis results. As Amelie Kutter (2017) pointed out more generally, large-scale analyses have their limits and their promises can be all too tempting. She argues that corpus analysis does not help us much to reveal the (social, political, etc.) context that is decisive for the meaning of a statement. The occurrence of specific terms or concrete phrasing often does not reflect the underlying discourse, which is the real object of scrutiny. Dodging formulations, indirect references, coded language, neologisms, irony, etc. are to be mentioned here. These challenges add up to obstacles like misspellings, idioms or abbreviations, which affect the word level of keyword searches and can be tackled by the use of controlled vocabulary (Blair and Carlson 2008). Moreover, discourse analysis is usually interested in what has *not* been uttered at all and why this is the case (Kutter 2017: 172). The absence of a particular phrasing or the neglect of a specific topic might point to different things, for instance, censorship. Additionally, the political climate could be heated to a degree so that political stakeholders strategically refrain from stating claims that are, in fact, part of their convictions. In her study on the normalization of contemporary far-right discourse, Ruth Wodak points out that anti-immigrant statements operate on the verge of the sayable: Ambivalent messages "require great efforts in terms of argumentation and legitimation strategies, which always have to accommodate the routinely sayable and unsayable in a specific context" (Wodak 2021: 58). Identifying what was sayable and unsayable in a given context bears important information on the nature of particular discourses, political and social developments, also in historical research (Steinmetz 1993).

To be sure, topic modeling, word embeddings or other digital approaches and tools do address these challenges. Textometry[4] and SCoT,[5] for instance, are specialized in comparing texts and corpora to trace the (changing) meaning of terms. They also spot absent or underrepresented words and phrases. This can be utilized to compare discourse contents and style. As another example, DiaCollo targets diachronic collocation analysis:[6] Users may explore the surrounding wording of a defined signal word and compare such findings between corpora to identify word meaning shifts over time. The collocations may point to different thematic contexts in which a signal word was treated. They may reveal that the word under scrutiny was consistently uttered in statements of emotional language. Another finding could be that the focused term received changing meaning, observable for specific periods. Word embeddings have been utilized similarly (Hengchen 2021). Such techniques bear great potential, especially for discourses circling around particular names.

In her study on Irish collective identity construction and nationalism Maëlle Le Roux examined the Irish periodical Capuchin Annual from 1930 to 1977, with a case study focusing on representations of 17th-century English statesman Oliver Cromwell as an object of projection for anti-English and pro-Irish sentiment. To do so, Le Roux analyzed articulated references to Cromwell but also their absence, "as an absence is a representation in itself" (Le Roux 2021: 49). Irish identity construction is thus traced by occurrences of the name Cromwell and other signal words, by co-occurrences of neighboring terms, and concordances that reveal characterizations of Cromwell. Complementarily, Le Roux spotted missing occurrences and descriptions in articles of different issues, years and authors. The statistical results were inspected in close reading and interpreted with regard to the historical context, combining approaches of history of representations, Critical Discourse Analysis (CDA), and corpus linguistics. In doing so, Le Roux gained a better understanding of the construction of collective Irish identity because the research design successfully revealed the contexts and connotations of (missing) Cromwell representations. However, her example also points to the limits of analyses that focus on specific words and phrases. This is because scholars often do not know (yet) what particular phrasing to look for, or the wording is not at all consistent for a given discourse. Topic models and co-occurring adjectives may lead to some patterns of how historical actors are characterized in nationalist statements. These adjectives might be tested on their co-occurrence with further

4 "Textométrie," TXM, accessed October 5, 2022, https://txm.gitpages.huma-num.fr/textometrie/.

5 "SCoT: Sense Clustering over Time: a tool for the analysis of lexical change," ACL Anthology, accessed October 5, 2022, http://dx.doi.org/10.18653/v1/2021.eacl-demos.23.

6 "DiaCollo: Kollokationsanalyse in diachroner Perspektive," *CLARIN-D*, accessed October 5, 2022, https://www.clarin-d.net/de/kollokationsanalyse-in-diachroner-perspektive.

words for exploring more nationalist formulations. But what if we do not have enough of such initial stepstones and miss key signal words? In this context, Le Roux herself underscores the challenges of identifying paraphrases used in the examined texts (Le Roux 2021: 36).

Analyzing and clarifying ambivalent language use, as I address in this section, still requires a great deal of close reading in the initial stages of analysis. This begs the question of the role of qualitative and quantitative approaches in a discourse research design. Should the investigation be primarily qualitative, with large-scale analyses complementarily exploring terms and phrases that a historian has not thought of? Are quantitative approaches, in that sense, of auxiliary use in methodological triangulation? Or do they build the fundament of the analyses? The answer surely depends on the applied definition of discourse and the concrete research interest. As I want to substantiate in the following sections, I follow the first option. Keyword or phrase searches can, in my opinion, only provide a rough entry point for spotting, collecting and interrelating primary sources for assessing pro-democratic discourses in the Weimar Republic. At its core, the heuristic methodology must respect the discourses' pronounced independence from specific word use. Therefore, scholars may manually choose cross-sections of material, for instance, newspaper issues published right after political events that impacted political discourse. This way, the scholar's experience and intuition compensate for what word-based or phrase-based analyses miss. This observation is in sync with Kutter when she argues that corpus analysis is no appropriate replacement for thorough interpretation "[p]recisely because of its selective focus on the distributional properties of words" (Kutter 2017: 184). Instead, corpus analysis is understood as an "explorative technique for heuristic and reflexive purposes" (Kutter 2017: 170).

1.3 Discourse analysis and scalable reading

Following such warnings, the purpose of large-scale analyses should be conceptualized to identify conspicuous spots and patterns that are worth being consulted for closer inspection. This makes nuanced concepts of scalable reading salient. Martin Mueller emphasizes the notion of "digitally assisted text analysis", while the operative word is "assisted."[7] In that sense, literary studies profit from searching and identifying textual features like grammatical patterns (zooming out) as a

7 Martin Mueller, "Morgenstern's Spectacles or the Importance of Not-Reading," *Scalable Reading* (Weblog), accessed May 2, 2022, https://scalablereading.northwestern.edu/2013/01/21/morgensterns-spectacles-or-the-importance-of-not-reading/.

basis for close inspection and interpretation (zooming in). Similarly, Alexander Stulpe and Matthias Lemke understand "blended reading" as a framework to access social reality. The two authors consider the large-scale perspective of text-mining congruent to sociology of knowledge approaches (Stulpe and Lemke 2016: 28–30). This is because both create a distance to the research objects. Therefore, the distant reading part would not just provide a pre-structuring of data for heuristics, but it would also bring fourth analytical insights. Stulpe and Lemke see this potential for analyzing semantics and discourses alike. They regard close reading as a means of quality check, looking for any contradictions between the results of distant reading and hermeneutic examination (Stulpe and Lemke 2016: 55).

From a theory/philosophy of science point of view, such contributions offer innovative perspectives on methodology for the digital humanities in general and discourse analysis in particular. They do so by converging different traditions and cultures of research for a genuine methodology of digital humanities research – beyond any mere adaptation of methods that have been developed in the computer or data sciences. Such contributions foster self-reflection and methodological depth in DH research, but they are largely absent, particularly regarding quantitative digital methods.[8] Taking this aspiration and the mentioned notions of scalable/blended reading seriously, distant reading does not add to or 'enrich' close reading. Instead, it is about a genuinely complementary relationship of epistemic importance that accommodates the need for an "update of hermeneutics" that Andreas Fickers demands for digital history: Historians must face the task of critical reflection of search algorithms, digitized sources, digital tools and interfaces. Without "thinking in algorithms" [my translation], research would be in danger of losing evidence and transparency when engaged with digital sources (Fickers 2020b: 167). This is because data and tool literacy should be considered necessary and logical extensions of traditional core components of historical research. These are, in particular:

1) Heuristics

In the sense of Johann Gustav Droysen: "Heuristics gather all the material we need for historical examination; heuristics resembles the art of mining, to find and to bring to light" (Droysen 1977: 400) [my translation]. This fundamental task for every historical research has always been laborious. Historians must often probe into vast amounts of primary sources, scattered in various archives to find

8 Cf. Michael Piotrowski and Fafinski Mateusz, "Nothing New Under the Sun? Computational Humanities and the Methodology of History" 173–177 (paper presented at CHR 2020: Workshop on Computational Humanities Research, Amsterdam, November 18–20, 2020), accessed October 6, 2022, http://ceur-ws.org/Vol–2723/short16.pdf.

anything relevant to their specific inquiry. The critical challenge is to gain an overview, orientate and collect significant material. As for digitized or born-digital sources, information retrieval and text mining techniques analyze massive amounts of data under predefined parameters. These techniques assist manual and qualitative searches when metadata provide well-structured information on the sources; this may be information on the document's creator, time and location of creation. A summary of the contents makes document filtering highly flexible and fast. Whatever the details of such digitally assisted heuristics may look like, the task still requires a great deal of attention, for the search parameters must be aligned to the sought material (which full-text keywords can be expected in a personal file, a progress report on a building construction, or in parliamentary protocols?). The parameters must also harmonize with the type of metadata provided by the repository. Beyond that, different tools enable different searches, for instance, by employing a specific query language. All this demands consideration to prevent poor or biased results. Digitally-assisted heuristics is intense work. However, flexible and well-structured searches through vast amounts of material help battle the traditionally challenging demands of heuristics.

A subsequent task of heuristics is organizing the collected sources in a way that supports their systematic interpretation. Historians must store the material alongside commentary notes in a structured fashion, best according to a data management plan and in a database. This enables them to keep track of the material's relevance for different aspects of a research project. Why has it been collected, in the first place? Why is it interesting? Often, a document must be reconsulted to discuss it in a new context that has arisen while analyzing other material. Here, we deal with challenges for orientation again, for which metadata of the above-mentioned kind provide structured information.

As I will argue in the next sections, manual annotations expand the potential of digitally assisted heuristics. When investigating intricate objects like discourses, historians annotate the topics and contents of the collected source material. In doing so, they enrich the metadata that can be retrieved in later searches. In doing so, they create semantic relations between the primary sources when these sources share a subject matter or discursive topoi. Linking sources in this way is powerful because it grants easy and quick access whenever historians must orientate and (re)consult documents.

2) Source criticism

Outer source criticism inspects how, why, and under which circumstances source material has been created and passed on to the present. For digitized or born-digital material, there are extra challenges to be considered. For instance, historians must be aware of file formats because they precondition which analytic tools to select and how to utilize them. Additionally, not every existent source has been digitized, so the work on digital resources may become too selective.

Inner source criticism traditionally deals with the contents of source material and questions on what information can be gained. For digital sources, there are also metadata and its schemata to be considered. They predefine how historians may employ software tools for analysis, and they impact the results of such examination. Aspects like these have raised the awareness of specified digital source criticism (Föhr 2019; Fridlund 2020; Hering 2014; Pfanzelter 2015).[9]

3) Interpretation

The quest to find in-depth insights brings us back to the critical role of context, as Kutter addressed it. As contextualization is paramount already for source criticism, its importance increases in interpretation. For historical scholarship (beyond editing or any sort of basic research), identifying linguistic properties, patterns or even trends of word use represents valuable 'raw material' for scrutiny. However, it does not represent any significant gain in knowledge. It is the interpretation of such results – what they mean when we make sense of the past. For historians, interpreting events in the light of preceding and succeeding events (diachronic contextualization) is as much important for this task as respecting synchronous political, social or cultural contexts. Zooming into the results of corpus analysis for interpretation might subsequently be the departure for new digital analyses. This is because thorough reading and insights might raise new questions on the horizon of the given research project. Further search terms become relevant and new resources must enter the corpus. Therefore, the macro-perspective of zooming out and the micro-perspective of zooming in are not to be applied in a strict consecutive order. Instead, it is a repetitive process until no further loop seems worthwhile. In a sense, this is a digitally enriched version of the hermeneutic circle – the iterative and deepening attempt of approaching a work's meaning through thorough perception, accumulated context information and interpretation.

All these issues of heuristics, source criticism and interpretation demonstrate that digital techniques contribute to the "array of methods and the toolbox historians have at their disposal" (Lässig 2021: 6), to perform nothing less than the discipline's core tasks. Digital methods open up new possibilities of mastering these tasks, but they also impose new challenges in terms of technological skills, on the one hand, and critical reflection of the expanded methodology, on the other hand. James E. Dobson addressed challenges like these and criticized that DH re-

9 "Living Handbook 'Digital Source Criticism'" ATLAS.ti, accessed May 10, 2022, https://atlasti.com.

search does not sufficiently reflect on the epistemic dimensions of digital methods. Dobson particularly emphasized diachronic contexts that researchers would seldomly consider when analyzing data. He also urges digital humanists to better understand technical steps when applying digital techniques. Dobson's focus may be narrowed by his emphasis on quantitative methods, his critique of alleged structuralist and formalist assumptions in the DH, and his far-reaching disregard for research outside North America.[10] He is, however, right in reminding us that the "incorporation of digital methods into humanities research requires more methodological awareness and self-critique" (Dobson 2019: 6).

I would like to argue that one way to tackle this task is to develop methodological frameworks for specific research domains, for instance, analysis of the Weimar Republic's political discourses. Such frameworks outline epistemic interests, theoretical implications, the material to be analyzed and analytic procedures. They then reflect on how digital – in conjunction with analog – methods accommodate this kind of research. Methodological frameworks are broader than concrete workflows, for which they serve as a fundament. They need adaptation for specific research projects and unique research questions. Thus, despite their conceptual elaboration, methodological frameworks are, to a certain extent, eclectic models and work-in-progress. On the other hand, such frameworks are more concrete than generic reflections on distant or scalable reading per se or on techniques like topic modeling. This is because they stress the instrumental function of digital methods for a *defined* research area, tailoring these methods to the needs of that research area. At the same time, they make purposeful application easier.

1.4 Capturing political discourse in the Weimar Republic – towards a heuristic framework

This paper outlines first thoughts on a methodological framework based on the considerations above. As a conceptual proposal, I intend to reflect on primarily qualitative analyses of political discourse in the Weimar Republic. To be more precise, the framework aims at identifying statements that countered anti-liberal and anti-republican discourse by Germany's far-right. It focuses on keyword searches performed on newspaper repositories and manual selections of newspaper articles. This combinatory approach is meant to crystalize a selection of rele-

10 Cf. Evelyn Gius, "Digital Humanities as a Critical Project: The Importance and Some Problems of a Literary Criticism Perspective on Computational Approaches," review of *Critical Digital Humanities: The Search for a Methodology*, by James E. Dobson, *JLTonline*, January 24, 2020, 11–12, accessed June 28, 2023, urn:nbn:de:0222-004298.

vant text material for the analysis of democracy discourses – a selection to build a digital and structured text corpus. Manual annotations enrich the corpus with information on discourses, structuring and relating the texts for qualitative analysis. All this aims at making pro-democratic attitudes articulated in the vast and complex landscape of Weimar Germany's newspapers more accessible than before for historical interpretation.

Research on Weimar's political discourses has shown that right-wing rhetoric vilified the political system as "western" and deeply "non-German," thus employing a culture-based language. Criticizing Germany's first democracy was part of an identity agenda, advocating for the strict rule of a leader and a strictly hierarchical order as political and social alternatives to the status quo. While several historical studies have addressed such anti-republican and anti-liberal statements, the defenders of Weimar Germany have received less attention in discourse history. Therefore, I focus on discourses that pick up or criticize the far-right rhetoric to get a clearer picture of one strand of pro-democratic discourses in the Weimar Republic. The material base for that are newspapers as integral parts of a highly polarized and fragmented landscape of harsh political discourse. Weimar's newspapers formed an important arena for expressing and consuming political ideas.

While newspapers of the Weimar era have already been examined primarily in regional discourse studies, my proposal for a methodological framework has a broader scope. The approach does not favor or exclude any newspapers. However, it must be considered that gazettes of the Weimar era have only partially been preserved and much less digitized. The digitized papers mostly have huge gaps between the years and issues. One could argue that de facto we must limit the scope to regional or other contexts to make justifiable selections of papers apt to answer relevant research questions. I agree from the perspective of empirical research. Notwithstanding, I would object that methodological proposals of a broader scope still are worthwhile in terms of what Fickers calls "thinkering:" the combination of experimenting with methods ("tinkering") with theoretical reflection ("thinking") on this practice (Fickers 2020a). I would argue that "thinkering" methodological frameworks are even more justified in the face of ongoing digitization of historic press media, as it is happening in many countries with great effort. In the German context, the recently founded *Deutsches Zeitungsportal*[11] stands out. As a central portal for historic German newspapers, it brings together digitized collections of myriad archives and libraries. On the one hand, the ever-

11 "Deutsches Zeitungsportal," Deutsche Digitale Bibliothek, accessed October 10, 2022, https://www.deutsche-digitale-bibliothek.de/newspaper.

growing availability of digitized newspapers and increasing interest in digital press analysis justifies the development of frameworks in good time to make use of the available resources.[12] On the other hand, timely developed frameworks can directly be applied to analyze new resources as they become digitized.

Having said this, any methodological framework should, indeed, be tested on relevant digital resources and appropriate use cases. Their analysis delivers empiric insights that should always go hand in hand with theoretical reflection. A promising and feasible example is the analysis of social democrat discourse. Social democrats stood at the forefront of Weimar's democracy and its defense. They used its Berlin-based party organ *Vorwärts* as a mass medium of political discourse. The *Friedrich Ebert Foundation* has digitized every issue from 1876 to 1933.[13] The resources are available with OCR in *Deutsches Zeitungsportal*. Due to its completeness, *Vorwärts* is a good material base for identifying and tracking social democratic discourse over time. From the discourse research point of view, one might object that this focus is one-sided and material-driven. Indeed, *Vorwärts* is just an individual newspaper, and social democratic debates also happened elsewhere. Narrowing the analysis in that way cuts connections to the broader discursive space and blurs overlapping discourses. Furthermore, projects that concentrate on "the digitally available" may give the impression of comfortable enterprises, ignoring too many not (yet) digitized resources. However, since I make a methodological proposal sketching a conceptual framework of how to conduct discourse analysis with digital techniques, this objection does not apply. The framework is flexible enough to cover other newspapers, and even other types of writing. It also suggests how to manually digitize and integrate newspaper articles as qualitative selections from archival records.

I agree with Kutter's understanding cited above that large-scale analysis is of explorative and heuristic value. Zooming out provides us with a rough overview, and it hints at promising constituents of discourse, not necessarily expected there but awaiting close inspection by zooming in. I intend to sketch how applying digital techniques can reach that goal. In doing so, I broadly adopt the methodological framework that Sarah Oberbichler (2020) developed to analyze anti-migrant discourse in South Tyrol's contemporary history. Oberbichler convincingly demonstrated how to grasp discourse in newspaper corpus analysis, mainly using the tool *Atlas.ti*[14] for investigation. The framework I propose orients broadly at Oberbichler's research design but makes adjustments to take Weimar's complex and

12 As the most recent contribution to this research vein see Bunout et al. 2022.

13 "Digitalisierungsprojekt 'Vorwärts bis 1933,'" Friedrich-Ebert-Stiftung, accessed October 7, 2022, https://www.fes.de/bibliothek/vorwaerts-blog/vorwaerts-digitalisierung.

14 "ATLAS.ti," ATLAS.ti, accessed May 10, 2022, https://atlasti.com.

polarized discursive landscape into due consideration. In contrast to Oberbichler, I take *CATMA*[15] as the central tool of choice. Like *Atlas.ti CATMA* is primarily designed for qualitative text annotation and analysis, though the functionalities of both tools also support quantitative research. They facilitate collaborative workflows of text annotation or individual annotation to categorize text parts in primary sources and attribute information to them. This enriches the material semantically, and it creates relations between text passages. Scholars may explore the annotations by customized search parameters and analyze the results with a set of built-in visualization features. *CATMA* has the benefit of being a free-to-use tool that brings all the features needed to qualitatively analyze and visualize discourse data. Furthermore, it provides extended means to evaluate annotations by the programming language Python: *GitMA*[16] is a Python package utilizing the distributed version control *Git* to flexibly access, process, analyze and manipulate annotations. As another contrast to Oberbichler, I reference *Critical Discourse Studies* (*CDS*) to develop my discourse analytic perspective. This socio-linguistic field focuses on social relations of power and is well suited to analyze the use of language of culture. More precisely, I follow the *Discourse-Historical Approach* (*DHA*), for it focuses, among other things, on qualitative analyses complemented by quantitative methods such as text linguistic techniques in methodological triangulation. It also takes longer time spans under scrutiny, (Reisigl and Wodak 2016) which fits well to trace the evolution of democracy discourses along the course of Weimar's eventful history. Oberbichler instead chose another branch of discourse analysis that focuses on argumentation strategies and patterns, namely the Düsseldorf School of discourse analysis as it developed from the work of Martin Wengeler (2003). The theoretical perspective of the DHA steers the "digital lens" to parts of the corpus that are to be examined. It plays, therefore, a fundamental role in the scalable reading framework.

Taking up the metaphors of "zooming" and the "digital lens", I borrow from the vocabulary of movie production to make the conceptual implications of the framework clearer: The first section of my paper outlines a "screenplay" that serves as a fundament for the heuristic framework. It engages with the state of research and, on this basis, formulates an epistemic interest that any (discourse) study, ultimately, must formulate. Here is also the place to give remarks on the intended "camera perspective," meaning the DHA viewpoint that is to be applied to the investigation of the digital resources. Using the language of movie produc-

15 "CATMA," CATMA, accessed May 10, 2022, https://catma.de/.
16 "GitMA," CATMA, accessed October 6, 2022, https://catma.de/documentation/access-your-project-data/git-access/gitma/.

tion in this way simply underscores that my framework employs perspectivity. Weimar's political discourses form a specific research domain and the DHA imposes concrete concepts and epistemic interests. All this necessarily affects the methods I outline. I do not present a "generic" or "neutral" framework for general discourse analysis, because digital and analogue methods always have an instrumental purpose in the context of a specific research interest and, therefore, are set up by choices and adjustments. Against this background, I consider the "camera" the better metaphor to describe the perspectivity of digitally assisted methods than the popular "microscope" or "telescope." Discourse in the Weimar Republic is not observed, it is instead "captured."

The second section is dedicated to the basic structuring of data (Stulpe and Lemke 2016: 43–45; Oberbirchler 2020: 471, 474–476), which is necessary for corpus-building: In a first step, we would have to meet data management as an organizational affordance for later data analysis and documentation. Next, we need to spot relevant source material, which ultimately depends on the imposed theoretical perspective. This searching for material I metaphorically refer to as "location scouting." To fulfill this task, I propose manual selections as well as defining keywords that would presumably, but not necessarily, occur in the discourses of interest. Frequency analyses of such search terms yield a rough idea of where to find relevant text passages, beyond the manually selected material. The manual and analogous searches build the fundament at this heuristic stage, firstly because the relevant newspapers and newspaper issues are just partially available as digital resources. Second, the phrasing in the newspaper articles might deviate from the keywords. In this context, not only does the term occurrences necessitate a closer look, but also the absence of occurrences might be interesting when we would expect a specific word used in a given context. Additionally, we should consider "negative keywords", meaning terms that we would hardly expect regarding the convictions of pro-democrats because their political opponents usually utter them. Hits in frequency analysis might surprise us or simply indicate where pro-democratic statements picked up the phrasing of political rivals for counter-statements. Both cases are informative for discourse analysis, and they are worthwhile to have a closer look.

After that, the corpus can be compiled. To build thematic sub-corpora, dedicated to specific topoi of discourse (e.g., "western democracy") or thematic emphasis (anti-republicanism in conjunction with antisemitism), the digital resources need qualitative annotation. This "pre-processing" is the procedural basis for deeper inquiry. Language use, both against the Weimar Republic and in defense of it, are to be visited, as the third section outlines. It is also *re*visited because the findings of prior research become questioned for identifying new discursive connections. Or those findings are extended by analyzing newspaper articles that have remained out of scope of traditional discourse analyses. During this heuristic framework step, historians must still find original gazettes in archives. In qualitative search, they may define cross-sections oriented at specific dates of political importance. The so retrieved material may then be digitized and processed using tools like *Nopaque*.[17]

The versatile "digital lens" makes it possible to quickly "pan" from one individual text passage to another or to thematically related material. This can be helpful for source criticism and interpretation whenever we "have a tilt" at a specific text segment by close reading, and when we find new articles of other newspaper issues worthwhile consulting. This is the case, for instance, when we examine the treatment of a political event in politically different oriented newspapers or if we make diachronic comparisons. The latter is the case when comparing pro-republican statements of *Vorwärts* shortly after Weimar's constitution came into effect with statements of the same paper on the annual constitution's commemoration (*Verfassungstag*, "Day of the Constitution," August 11, 1921 to 1932). Complementarily, visualization of the distribution and semantic relations between the annotated material provides orientation for "panning" and for finding new interesting discursive connections. An interactive visualization opens up a "bird's-eye-view" for that and, at the same time, makes it possible to "zoom" into the "worm's-eye-view".

All these steps are to support thorough discourse analysis according to CDS and the DHA, with the historian bringing in contextual considerations and critical interpretation, thus capturing discourse through the digital lens.

2 Screenplay: Countering anti-democratic attacks

2.1 Epistemic interest: Defining and defending democracy in the Weimar Republic

The era of the Weimar Republic counts as one of the best-examined periods of German history, with early research focusing on the demise and failure of Germany's first democracy. National Socialism served as the vanishing point for historiography, and this tendency developed at times when the Federal Republic of Germany engaged in democratic self-assurance after 1945. Weimar served largely as a negative contrast for Germany's second parliamentary democracy (Ullrich

17 "nopaque," Bielefeld University, SFB 1288: Practices of Comparing, accessed May 10, 2022, https://nopaque.uni-bielefeld.de/.

2009: 616). Fritz René Allemann's (1956) famous words "Bonn ist nicht Weimar" ("Bonn is not Weimar") represent the belief of many political observers in the old Federal Republic, following Dirk Schumann (2017: 102). At the same time, Allemann's quote was a central reference for many subsequent studies on the history of the Weimar Republic. As Ursula Büttner argues, *Zeitgeist* and the development of Weimar research have always had a strong and clearly visible interdependency (Büttner 2018: 19).

After the First World War, Germany's economic, political and social life was burdened by tremendous structural and event-driven problems, despite intermediate tendencies of stabilization. Against this background, early historiography nourished the narrative of "crisis" for the young republic (Peukert 1987: 282). On the one hand, this does not surprise, given the radicalizing political and social development and the republic's dramatic end. On the other hand, more recent positions have increasingly criticized the one-sidedness of that narrative (cf. esp. Föllmer and Graf 2005). Around the new millennium, the Weimar era's image has become one of an era of its own right, with historians emphasizing chances of consolidation and progress. When "anti-democratic thinking in the Weimar Republic" (Sontheimer 1962) had been of pronounced interest before, now democratic forces, "democratic thinking" (Guys 2000), and the multi-faceted "understanding of democracy" (Braune et al 2022) gained more attention. This change began when Germany represented a grown-up and firm democracy, after the Cold War, and in a globalized world. Back then, the turbulent years between the World Wars seemed less fitting for political references (Schumann 2017: 102). Subsequently, recent research has taken up underexposed aspects of Weimar's history, such as rural society, religious life, mass culture, youth culture or international aspects of Weimar's interpretation of modernity (Rossol and Ziemann 2021).[18] Political culture with respect to democracy's chances has as much become a significant concern as the contingency of Weimar's fate (e.g. Canning et al. 2013; Hacke 2018; Hacke 2021; Hardtwig 2005b; Lehnert and Megerle 1990; Schumann et al. 2021).

Despite such reorientation, the "crisis" has not entirely vanished. If anything, we find the image of a contested democracy with chances and failure often close to each other, as Franka Maubach summarized it (Maubach 2018: 5). This opinion has become pertinent against the backdrop of contemporary political and social developments: Western democracies are facing massive attacks on their values and institutions. Those attacks primarily come from the far-right and challenge democratic culture, urging the respective societies to engage in self-defense and

18 For an overview of former and recent tendencies in Weimar research see Kolb and Schumann 2022.

self-assurance. To do so, debates have frequently referred to warning examples of failed and fallen democracies of Europe's 20th century. The Weimar Republic plays a particularly important role for that in Germany, catalyzed by its current centennial jubilee. As seismographic feedback on the relevance of these debates in society, historians have questioned if we really can observe "Weimarer Verhältnisse?" ("Conditions like in Weimar?") (Wirsching et al. 2018) and stated that "Berlin ist nicht Weimar" ("Berlin is not Weimar") (Schuhmann 2017). In such publications, often directed toward a larger audience, historians bring in their expert knowledge and often warn that comparisons have their limits. On the one hand, they acknowledge certain structural similarities with, for example, aggressive right-wing attacks exploiting mass media to spread anti-governmental discourse. On the other hand, they criticize anachronisms that disregard distinctive differences between Weimar's and present Germany's social conditions, democratic systems and political cultures.

This brief characterization of major research strands brings us back to the relevance of analyzing discourse on democracy in Weimar's mass media. Bernhard Fulda enriched the debate with his study on Berlin and its surroundings, while focusing on political newspapers, tabloids, and the local press of Berlin's surrounding area (Fulda 2009). In doing so, Fulda showed that the major newspapers generally had little impact on voting decisions by the masses but noticeable impact on politicians as professional readers, political and parliamentary debates. Karl Christian Führer addressed similar questions for Hamburg, investigating political effects of the press and anti-republican discourse on readers (Führer 2008). Local newspaper studies like these have significantly enriched our knowledge of Weimar's political culture, as have other discourse analyses of specific topics and topoi such as "Volksgemeinschaft" (Wildt 2009) ('people's community,' 'folk community,' or 'racial community'),[19] or antisemitism in the Reichstag (Wein 2014). Further studies apply a selective focus on the early period of the Weimar Republic (Kämpfer et al. 2014; Lobenstein-Reichmann 2014), or they concentrate on a political camp such as leftist parties (Seidenglanz 2014).

The framework I propose here is meant to be a methodological contribution to this area of research, not limited to any local or temporal context. It has, however,

19 Proper translation depends on the speaker's political standpoint and contextual use of the term. It was prominently – but not exclusively – used by Germany's far-right. The idea of German unity in a "Volksgemeinschaft" had become popular since the First World War. For an introduction to the extensive research and academic debate on this term see Mergel 2005; Bajohr and Wildt 2009; Wildt 2012; Michael Wildt, ""Volksgemeinschaft": Version 1.0," *Docupedia-Zeitgeschichte*, 2014, accessed October 13, 2022, https://doi.org/10.14765/zzf.dok.2.569.v1; Kershaw 2011; Schmiechen-Ackermann 2012; Uhl 2021.

a specific focus on discourse contents because any discourse analysis approach must live up to guiding epistemic interests and perspectivity. The proposed framework addresses the defenders and supporters of liberal representative democracy as it was institutionalized in Weimar's political system. Other concepts, such as the council republic favored by the far-left, are excluded. It is the supporters of the Weimar Republic who I have in mind and who deserve more attention by historians. More precisely, I would like to promote a concept of discourse analysis that focuses on how defenders of liberal and representative democracy reacted to far-right rhetoric of "non-German" liberal democracy and culture-based anti-republican discourse. This approach could also focus on how far-left attacks were countered. For Weimar's discourse history this would make a lot of sense, since the political factions did not just attack opponents on the other side of the political spectrum. On the contrary, prior research revealed that groups on the same side of the spectrum were seen as competitors, and they harshly attacked each other. However, I exclusively address pro-republican and far-right discourse in this paper, for this represents a clear dichotomy in terms of basic political convictions. Reactions and democratic counteroffers to right-wing discourse, therefore, stand at the center of the framework. Case studies with a specific regional or national scope may make use of it and adapt it. Such projects would shed light on the republic-friendly discourse contributors' concrete understanding of democracy. What "democracy" meant and how it should be institutionalized was highly controversial across the political camps and even within social *milieux* of Weimar Germany. Thus, discourse analysis promises to enhance research on political culture by providing a sharper picture of political ideas in the Weimar Republic.

In this context, Thorsten Eitz and Isabelle Engelhardt present a rich linguistic analysis of discourses (Eitz and Engelhardt 2015), including a chapter by Eitz on the disputed form of government (Eitz 2015). Here, Eitz presents detailed results from his extensive newspapers inquiry, with particular regard to the political press. He carved out the polysemic use of the terms "democracy" and "republic." In doing so, Eitz identified significant "flag words," which the political camps used for their agendas, not least for the republic's defense or attacks on it. The results, however, rather represent a linguistic account of discourse properties, lacking extensive historical interpretation. This might not have been Eitz's goal. However, according to historical discourse analysis, one would expect to learn more about contextualization of the examined utterances, discursive relations between them, and pronounced historical interpretation of the overall results. Thomas Mergel demonstrated that for the terms "Führer," "Volksgemeinschaft," and "Maschine" (Mergel 2005). Mergel convincingly argued for this selection by pointing out that the three terms counted as important for various political camps. While intensive use of the terms does not imply the same meaning for all discourse participants of the political spectrum, their use nevertheless reveals a set of political expectations and hopes behind the utterances. Mergel interpreted the (different) usages as signifiers for shared topics, ways of speaking and a shared perception of political reality. Against this backdrop, "Volksgemeinschaft," for instance, cannot count as a right-wing term per se. Instead, it was a projection surface. The political right utilized it to sell their strictly hierarchical and racial interpretation of the term. As another interpretation, pro-democratic political discourse accentuated the ideal for the parliamentary system to represent the "Volksgemeinschaft" with all its social diversity – an ideal that had not yet been fulfilled in the eyes of many discourse participants.

To conclude, the framework I present in this paper is a first methodological approach sketching heuristic means to render detailed discourse analysis possible. It focuses on defenders of liberal democracy against the far-right. In this way, I intend to contribute to the methodology of a prolific research strand that faces much uncharted terrain. Digital analysis techniques, on the other side, have hardly been utilized for the discourse history or the history of newspaper discourses of the Weimar Republic.[20] Therefore, I argue that scalable reading has a lot to offer for the heuristic exploration and innovative inquiry of political discourses in Weimar Germany.

2.2 Camera perspective: A theoretical viewpoint from Critical Discourse Studies (CDS)

CDS or Critical Discourse Analysis (CDA) is a research area that Kieran O'Halloran defined as "a branch of linguistics that is concerned, broadly speaking, with highlighting the traces of cultural and ideological meaning in spoken and written texts" (2003: 1). CDS falls into a multitude of approaches with different methods and research programs. Eclectically drawing on a range of theoretical traditions (cf. Forchtner and Wodak 2017), the underlying goal of all approaches is "to understand the complex workings of language within society, a concern for how socio-

20 Giulia De Paduanis' Master thesis on the *Aachener Anzeiger* is an exception. De Paduanis focuses on language changes over time, and how to interpret them in the context of political and societal discourses. The epistemic interest of the study is to deliver historical insights in the face of contemporary challenges for democracies. De Paduanis analyses a sample of one newspaper issue per month for the Weimar era by applying a scalable reading approach with *Voyant Tools*. Giulia de Paduanis, "Learning from the Past: The Case of the Weimar Republic: A Proposal for Historical Analysis, Revision and Digitization" (Master thesis, Department of Cultural Sciences, Linnaeus University, 22.01.2023).

cultural structures influence and, at the same time, are influenced by, language use" (Forchtner and Wodak 2017: 135; cf. Fairclough and Wodak 1997: 258). Wodak specified that "CDA highlights the substantively linguistic and discursive nature of social relations of *power* in contemporary societies. This is partly the matter of how power relations are exercised and negotiated in discourse" (Wodak 1996: 18 [emphasis in the original text]). Against this background, the relationship between discourse and power is situated on several "levels," as Bernhard Forchtner and Wodak pointed out: "Yet, approaches generally view power as being present 'in discourse' (some positions will hold greater potential to influence others), 'over discourse' (for example, the question of access and agenda setting), 'and of discourse' (an understanding of power which points to latent conflicts [. . .]" (Forchtner and Wodak 2017: 135).[21] The emphasis on culture-based language use and power makes CDS instructive for analyzing discourse in political culture. While CDS has broadly been applied to the analysis of contemporary discourses, it can also be used for historical discourse analysis (e.g., Richardson 2017).

More precisely, I follow a definition of discourse that Martin Reisigl and Wodak formulated for the *Discourse-Historical Approach* (DHA) of CDS. The two authors regard "discourse" as:

– "a cluster of context-dependent semiotic practices that are situated within specific fields of social action;
– socially constituted and socially constitutive;
– related to a macro-topic;
– linked to argumentation about validity claims, such as truth and normative validity involving several social actors with different points of view." (Reisigl and Wodak 2016: 27)

This definition is fitting for the examination of Weimar's political discourse landscape. While Reisigl and Wodak highlight argumentation in the last step, it is noteworthy that hereby also different modes of language use are addressed. For instance, one might find arguments that have an ideological tone, trying to justify why democracy would be "non-German." Or the tone is more pragmatic, emphasizing that the democratic state brings political participation to the people.

For the heuristic framework as presented in this paper, pro-democratic statements are understood as a means to (re)gain power within the polarized discursive landscape of Weimar's contested democracy. The tone of this landscape was more than controversial; it was oftentimes harsh. Hateful and defaming attacks

21 Forchtner and Wodak draw from Steven Lukes's "three-dimensional view of power" (Lukes 2005: 25–29).

were the usual. The far-right employed a language of culture and identity to discredit the republic as "foreign," "western" or "French." In racial terms, it was frequently characterized as "Jewish." The goal was to stigmatize the political system, to move the limits of the sayable in the political culture of the Weimar Republic. This shift of the sayable should allow for new radical political changes and acts that would, ultimately, get rid of the hated liberal democracy, which describes the power dimension in far-right discourse. Having said this, pro-democratic opponents should not be considered entirely defensive in their efforts to expose, counter and substitute anti-democratic discourse. They took an active part in shaping Germany's democratic culture – in coining what "democracy" should mean for postwar Germany. In that sense, pro-democratic statements, too, are to be regarded as a means of power within the discursive battles of Weimar's political culture.

3 Setting up the digital lens: Heuristics and data pre-structuring

3.1 Data management plan

Digital discourse analysis becomes more accessible and more structured when data and metadata are stored and documented in an organized way, best utilizing versioning means such as *Git*. At the same time, data management lays the fundament for transparent data publishing, thus facilitating reuse and critical assessment by other scholars. Finding an appropriate repository is another key component of data management and reuse. All in all, this stage of the methodological framework must accommodate to the fundamental *FAIR* principles: Findability, Accessibility, Interoperability, and Reuse of digital (meta-)data.[22] According to the serial character of newspapers and their local, regional, or national distribution, the primary data naming parameter should be date, accompanied by location.

3.2 Identifying far-right discourse and keywords

Research on Weimar's political culture has produced much knowledge about far-right discourse. The well-examined account of anti-republican topics and topoi re-

22 "The FAIR Data Principles," FORCE11, accessed May 19, 2022, https://force11.org/info/the-fair-data-principles/.

veals a culture-based language use that features distinct keywords: “Führer” (‘leader,’ as a political title), “Volksgemeinschaft,” “System,” “Organismus,” “Liberalismus,” “Parlamantarismus,” “Demokratie,” “neue Freiheit” (‘new freedom’), “neue Politik” (‘new politics’), “Judenrepublik” (‘republic of the Jews,’ ‘Jewish republic’), to mention just a few. These keywords serve the identification and analysis of discourses that pick up and counter far-right attacks. At the same time, the list should include terms that previous research has emphasized for genuine pro-republican and democratic language use, such as Eitz’s “flag words.” Such terms do not just mark concepts of democracy and the republic, but they function as counter-concepts to the political opponents’ thinking. This relation must always be considered for the overall discourse on contested democracy. Relevant are, among others: “Demokratisierung” (‘democratization’), “Sozialismus” or the dichotomic figure “Demokratie oder Diktatur” (‘democracy or dictatorship’).

Later frequency analysis will utilize these terms and their grammatical variations, enabling a first glance into the discourses of interest. They will have to be followed by close reading of manually selected articles, as outlined in the following sections. This is because paying attention to the utterance of the keywords alone ignores text passages of altering phrasing that nevertheless are relevant in terms of their discursive contents. Still, frequency analysis provides a first rough overview and, simultaneously, gives an idea of where else to look.

The keywords defined in this heuristic step should be organized in a database. They represent an existing vocabulary, carved out by prior research, and utilized for newspaper analysis. Christian Schneijderberg, Oliver Wieczorek, and Isabel Steinhardt referred to such course of action as deductive approaches (both quantitative and qualitative), whereas inductive approaches try to find the analytical categories in the material (Schneijderberg et al. 2022). The goal of my framework is to combine the deductive and inductive. The latter is the case when exploration and close analysis reveal new topics and keywords. They must enter the database and new frequency analyses, which renders possible new insights into the nature of political discourses. Ultimately, this step marks the beginning of an iterative looping through the texts until no further loop appears necessary. This exploratory approach checks for more keywords, more discursive topoi and topics than previous research has addressed to this day. Moreover, it is an attempt to gain a more detailed image of the discourses, given the enhanced capacities of the computer to (1) quickly search through myriad texts, (2) let historians flexibly jump from one passage to another, and (3) rapidly revisit text that becomes interesting again in the light of later examined further text passages. These are, fundamentally, heuristic benefits of the digital.

3.3 Corpus compilation

A corpus comprises relevant material for in-depth discourse analysis, compiled after the findings from the prior step. Therefore, corpus compilation is a critical stage of filtering and gathering source material, thus fulfilling core demands of heuristics, as I have characterized them above.

The corpus should be coherent and fitting to the project's research question. Suppose we want to analyze pro-republican discourse over time by the social democratic organ *Vorwärts*. In that case, we might integrate the complete collection of issues for the Weimar era, since the paper is wholly digitized. This would allow for identifying significant articles and statements, even for dates and contexts that one might not have anticipated.

However, most other newspapers have only fragmentarily been digitized. This makes it challenging to conduct cross-newspaper analyses solely on digital collections. Historians still must confront newspaper articles in archives and manually digitize them when engaging in scalable reading. While this would be nearly impossible for quantitative analysis, given the vast amounts of relevant issues scattered over various archives, the task is more feasible for qualitative selections. Historians would have to create cross-sections, choosing material from specific dates and focusing on influential newspapers. These selections might concentrate on critical political events, such as the assassinations of Germany's former secretary of the treasury, Matthias Erzberger, and foreign minister Walther Rathenau. Qualitative selections could also focus on the passing of essential acts, international treaties or the *Verfassungstag* ('Day of the Constitution'), Germany's national holiday from 1921 to 1932. On these occasions, the political discourse lived up, often flamed up, contesting Weimar's political system in fundamental debates. On the one hand, manual article digitization demands considerable extra effort. On the other hand, this challenge is outweighed, to a certain extent, by gaining flexible searchability within the collected material for later analysis. Scholars benefit from this structured accessibility by receiving more orientation when comparing different text parts and relating them to each other. They thus increase the heuristic value of the corpus.

Tools for manual digitization have become user-friendly, even for those who are not tech-savvy. *Nopaque*, for instance, combines file setup, OCR (even HTR by the *Transkribus*[23] pipeline), NLP, and corpus analysis in an easy-to-use toolchain.

23 "Transkribus," READ COOP, accessed May 10, 2022, https://readcoop.eu/transkribus/?sc=Transkribus.

This makes the, still laborious, task of manual digitization and data processing better manageable.

3.4 Keyword frequency analysis

CATMA counts frequencies of the keywords and represents them in a distribution chart. Additionally, the tool counts all the newspapers that contain the keywords. These first statistical results provide a rough overview of occurrences and temporal distribution of utterances. They are anchors for zooming into the search hits for close reading.

3.5 Identifying discourse topics by close reading

After frequency analysis, the found text passages need thorough inspection to evaluate the hits on keywords that have been defined in step 3.2. This procedure determines which text parts really address the topics and topoi of interest and which are false hits. Complementarily, new relevant discourse topics and contents might become apparent. They must be documented and enter another iteration of frequency analysis and close reading.

Other digital methods enrich the so far conducted heuristic and pre-structuring steps. For instance, co-occurrence analysis and topic modeling identify anti-democratic terms that pro-democrats have picked up to counter them. For example, the Social Democrat Hermann Wendel reacted to the far-right topoi of “Judenstaat” (‘Jewish state’) and “Judenkanzler” (‘chancellor of the Jews’) in an article of the Social Democratic newspaper *Vorwärts* in 1929 (Wendel 1929). Here, Wendel exposes such rhetoric as arbitrary and contradictive by showing that even national heroes like the old empire’s chancellor Otto von Bismarck had been defamed in that way. We find co-occurrences in the Article hinting at citations that associate “Bismarck” as an “Abkömmling von Juden und Krämern” (‘Descendent from Jews and grocers’. Here, ‘grocer’ is an anti-capitalist pejorative). This way, Wendel employs a strategy of mocking and delegitimizing far-right attacks on the Weimar Republic that operate with the same antisemitic rhetoric. Digital techniques that analyze the surrounding phrasing of a term or expression can help identify such patterns. They may also track down synonymic usages of different words, revealing semantic networks in far-right and pro-democratic vocabularies. They also help identify distinctive connotations of a single term, as used in specific contexts.

3.6 Compilation of sub-corpora

The information gained in the prior steps serves the definition of more specified keywords for the explored discourse topics and topoi. These keywords help compile thematic sub-corpora for specific discourse topoi or strands that refer to, for example, antisemitic attacks on liberal democracy. Another sub-corpus might collect sources that defend parliamentarism. Defining such specified sub-corpora increases the visibility and findability for the texts, in order to facilitate later qualitative analyses. This is because sub-corpora support contextualization of statements.

The specified keywords are used in searching the whole corpus. Every text passage that returns a hit receives a respective annotation in *CATMA*. While doing so, the passages should be read carefully to define new relevant keywords. They enter search runs on the whole corpus to replenish the annotations. The process loops until no more keywords are identified, and no new hits appear for the source texts.

4 Zooming and panning: (Re)visiting text passages for new insights

4.1 Discourse analysis: Examining and annotating the resources

The above steps of heuristic assessment and pre-structuring are followed by hermeneutic analysis of the annotated text passages. With the DHA as the guiding perspective for that, the focus lies on conceptions of democracy that oppose culture-based attacks on the republic (i.e., “the system of Weimar is a non-German institution”). These statements should be examined with regard to their temporal, local, political, and socio-cultural context. All matching passages of the whole corpus should get an annotation for the corresponding democracy concept. Project teams profit from *CATMA*’s undogmatic capacities of collaborative annotation to find “gold standard” annotations.

Whether by teamwork or individual efforts – all annotations should not depend on the exact wording of the statements. Instead, the DHA aims at identifying relevant semantic contents. This is the primary task of hermeneutic interpretation at this stage of analysis. And this means that manual choices of text passages complement the keyword-based approach. As outlined above, qualitative cross-sections help identify significant articles that do not feature any anticipated phrasing, which keyword searches necessarily miss.

Annotation of the resources' formal aspects is also relevant. These are, for instance, date of publishing, type of text (e.g., article, reader's letters), etc. Annotating and thereby documenting these features helps differentiate between the source types in further interpretations or when revisiting text passages becomes necessary.

4.2 Structuring the annotated text passages

The next step connects the instances of pro-democratic topoi by utilizing *CATMA*'s query feature. It picks out every relevant text passage and displays the different topoi and their semantic relationships (e.g., when pro-democrats pick up the far-right statements "liberal democracy is alien" and "Jews control the republic"). *CATMA* visualizes the results as a word cloud or a distribution chart combined with Keyword-In-Context, thus providing a structured overview. Users can click on its elements and explore the annotated text passages in their original contexts. Users might also test different parameters for the display, such as specific subcorpora or types of text, to have a more precise view. In total, the outlined features are genuinely powerful in structuring the representation of the corpus and, ultimately, heuristically supporting text interpretation.

4.3 Source criticism and interpretation

After annotating and structuring the texts, they are ready for thorough source criticism and interpretation. The visualizations help quickly zoom out from an individual statement to the context of the whole source text. It also helps to jump to other semantically related newspaper articles for criticism and interpretation, keeping track of the manifold facets and contributors of pro-democratic discourse and contexts. One statement can be interpreted in the light of another, and differently dated utterances can quickly be compared in diachronic inquiry. Regional specifics, too, may be considered by selecting only respectively annotated newspapers. Revisiting text resources becomes relatively easy when new insights require repeated examination. The digitally implemented heuristics of this framework thus support context sensitivity and in-depth insight.

5 Conclusion

Scale and zooming are metaphors that scholars of digital humanities and history use for diverse parts of research: Data processing, analysis, knowledge representation, methodological documentation, and more. In terms of text analysis, "scalable reading" or "blended reading" stands for innovative approaches to combining large-scale examination and in-depth inquiry. As much as this general theoretical concept might sound convincing, the actual potential of scalable methods still manifests itself in research with a defined theoretical and methodological orientation and epistemic interest. Only instrumental use of scalable reading techniques can prove the benefits of "zooming in and out." This is to say that scaling techniques – as any technique – are not per se productive but can only be fruitful for what they are employed for.

This chapter attempted to bridge the level of general reflections on scale and the level of specific research projects that apply scale. On a mesosphere, I outlined a methodological framework that is not intended as a blueprint to be strictly followed. Instead, it sketches the heuristic fundament for explorative analyses of pro-democratic discourse in the Weimar Republic. This framework surely needs refinement once empirical analyses address demands for applied methods. However, it is my conviction that frameworks are productive tools when they are based on epistemic objects (here: historical discourses), address epistemic interests (how did pro-democrats counter anti-democrats?), and put theoretical and methodological programs (the DHA) into practice. If digital analytic tools provide a "lens" for research, this lens must be set up and directed at objects of interest. The framework I outlined in this chapter is a proposal to do so.

It is largely based on the instructive approaches that Oberbichler and Pfanzelter developed to analyze anti-migrant discourses in contemporary history, but it has several modifications. I agree with those commentators on close and distant reading that see in large-scale techniques a primarily heuristic value. This starts with finding relevant primary sources and ends with flexible possibilities to visit and revisit text passages of a corpus, supporting not just quantitative analysis but also qualitative inquiry. This is because we often become interested in repeated reading of texts when new insights bring up new aspects of the examined topic. Or even further research questions may arise. For the analysis of pro-democratic discourse, this might mean that statements of older newspapers become more important when diachronic comparisons to later articles reveal that the early texts anticipated topics and topoi that are particularly relevant years later. One might say that this is perfectly possible with pure close reading. But given the intricate nature of discourse and the complex interconnections between many discourses, we profit a lot from the digital heuristic support, not least for applying the hermeneutic circle. As a result, the heuristic framework outlined in this chapter is meant to gain a clearer and deeper picture of pro-democratic discourse in Weimar Germany. Beyond that, the results provide transparent demonstration when highlighting the scaling steps, providing an overview by visualization, and publishing research data. This may take shape as a multimodal publication for enhanced transparency and reproducibility.[24]

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Amanda Madden

Menocchio Mapped: Italian Microhistory and the Digital Spatial Turn

Abstract: This article looks at the juxtapositions of Italian microhistory and digital spatial history. While microhistory and digital history are in opposition to one another in terms of scale, they have similar aims, particularly a commitment to a methodology whose partial purpose is overcoming the silences of the subaltern and underrepresented in the archive. Digital history can help microhistorians find the exceptional normal in a cache of documents, follow clues, and illuminate the mentalities, particularly the spatial ones, of their subjects.

Keywords: microhistory, digital history, spatial history, GIS

In 1562, in Modena, Italy, Sister Lucia Pioppi wrote in her diary the following verses:

> Do not grieve uncle, so many friends and family remain
> that will punish this senseless malice
> and will take vengeance so fatal that the infinite abyss will be amazed.
> (Bussi 1982: 42)

When I read these lines for the first time, the incongruity of such vicious words in an early modern nun's diary was striking and uncanny. The rest of the diary is quotidian enough. She wrote of visitors to the convent parlors, larger geopolitical events, earthquakes, deaths, marriages, births and other news from relatives; the contrast between the furnishings of daily life and the revenge poem made these lines even more striking. Who were these friends and family? What was the senseless malice? These questions and how a nun came to speak of vendetta and revenge deserved an answer.

After following the trail of clues from this poem in Sister Lucia's diary, I discovered a complex story of fractious nuns, murders in churches, jurists breaking the law, and a bloody vendetta between two noble families, the Bellincini and the Fontana. To quote Carlo Ginzburg in the preface to *The Cheese and the Worms: The Cosmos of a Sixteenth-century Miller*, "As frequently happens, this research too, came about by chance." (Ginzburg 1980: xv) Digging through the letters of the Modena's governors to the Duke of Ferrara, chronicles, and family papers looking for those named in Sister Lucia's poem, I discovered that these families were in a vendetta for over a century. There was abundant documentation on this vendetta, thousands, and thousands of pages worth, and even more valuable still—first-

https://doi.org/10.1515/9783111317779-004

hand accounts; eyewitness reports of vendettas, despite the ubiquity of the practice in sixteenth-century Italy, are rare.

It was also by accident that I discovered that the Bellincini and Fontana were neighbors. While taking an introductory GIS for the Humanities course, I was looking for data to practice with and found the data for the Bellincini and Fontana assassinations on my thumb drive. After a quick google search, I was able to find a sixteenth-century map which identified historic buildings, including family palazzi and churches. After plugging in the information and tracking down the coordinates on the geo-rectified map, I realized what I previously had not been able to put together—the warring factions lived around the corner from one another. Even though the factions would have encountered one another daily, no assassinations or fights had taken place on the streets they lived on. This challenged my assumption that vendetta fights were spur of the moment, opportunistic encounters in the streets. Indeed, after I mapped the murders, I realized they were in public places—mostly piazza and churches—and had been carefully planned for months or years. By using the methods of microhistory and digital spatial history, I learned about vendetta.

As a microhistorian in the field of Italian history and a digital historian primarily working on spatial history, I experience these two methodologies as mutually enriching. While following the trail of a normative exception in the archive, I have often turned to digital history to map spaces, visualize patterns, and contextualize events. Such affordances, in turn, offer fresh paths of inquiry that must be pursued by more traditionally textured and confined investigation; the macro sometimes leads down avenues that can only be traversed by a turn to the micro. Nor is my experience particularly unusual; productive interactions between digital history and microhistory are becoming more common. How this synergy might develop remains to be seen, particularly because of the key role digital history currently occupies. As a methodological subdiscipline, digital history is a marked growth area and a driving force for change. If dissertation and hiring trends are a bellwether of methodological trends in the field, then narrative microhistories are likely to push towards topics on a macro-scale-the Atlantic world, the global, the transnational. Whether digital projects will be equally productive of microhistorical research is, as yet, unclear.

Microhistory, for its part, retains a steady role but not necessarily a leading one. Prominent journals and academic presses regularly publish microhistories of the working classes, persons of color, colonial subjects and LGBTQA+ persons. This methodology in particular, and a disciplinary commitment to narrative in general, continue to excite scholars, inform graduate training and provide new insights. However, examining the fifty or so most well-known microhistory monographs written by Anglophone scholars in the last five decades, one would be hard pressed to find junior scholars' books among them; most were written by tenured faculty at elite institutions. And while microhistory has benefitted from the proliferation of digital archives and access to new materials, it is apparent that early career scholars are not encouraged to write microhistories in the Anglophone world. They are, however, encouraged and incentivized to do digital work. The proliferation of source materials, digitized books and archival material at our fingertips, and the increasing pressure to do comparative work at scale, seem to have resulted thus far in a privileging of synthesis over narrative. However, these conditions may eventually fuel new, more traditionally narrative work at all career stages. And if so, the particular strengths of microhistory will continue to matter. Indeed, in the writing of histories of subaltern subjects, for instance, the responsible and nuanced care of microhistorical methods will likely be crucial. Even as digital tools and methods unearth a host of new potential stories, dealing with them responsibly will require telling them with texture and depth.

Such present and potential realities should not, of course, obscure an essential and mutually enriching compatibility that is already evident. While microhistory and digital history are in opposition to one another in terms of scale, they have similar aims, particularly a commitment to a methodology whose partial purpose is overcoming the silences of the subaltern and underrepresented in the archive. Many digital projects also have the aim to inject agency into the subjective. Digital spatial history, particularly geospatial history using methods like GIS and deep mapping, can help us get at particular modes of agency in ways that were more difficult before, fulfilling some of the original priorities of microhistory in unexpected ways.

1 A macro-history of digital history

Before the development of what is known as global microhistory, the geographic scale of microhistory was typically narrower in scope. In the past twenty years, digital methods have dramatically expanded the possible scale of historical research in ways that have transformed the profession, but not microhistory per se. Nonetheless, digital methods present distinct new affordances, and challenges, to microhistorical practice moving forward. It is also the case that digital history could greatly benefit from microhistory, particularly as it comes to a focus on agency and narrative. This essay explores the twists and turns of these developing and potential relations.

The potentials worth exploring here emerge from the dizzying multiplication of computer-based tools, web archives and digitized materials that have transformed the practice of history in the past twenty years. As Laura Putnam pointed out in her article on scale in history, “technology has exploded the scope and speed of discovery for historians” in ways that have had profound impact on our research (Putnam 2016: 377). Not so long ago, when most historical research meant traveling to an archive, sometimes at great expense of time and resources, calling up information from typed inventories or card catalogs, requesting specific materials, and transcribing data from them by hand, the collection of evidence was necessarily limited by the nature of the research process. Now, when a researcher need only travel as far as their favorite chair while poring over fifteenth-century Veronese wills, digitized copies of seventeenth-century plays, or medical remedies from seventeenth-century Japan, the very notion of limits works much differently. Even when traveling to archives is still necessary, technology eases the process; phone cameras with the capacity to take professional-quality pictures of documents, then store them in the cloud, offer greatly enhanced levels of data gathering. Likewise, digitized archival materials are becoming available online at an accelerated rate.

If collecting materials has allowed research to scale up, tools have likewise allowed us to speed up in a range of ways. The process of organizing and then analyzing documents has, by degrees, also become much easier. Programs like Tropy and Omeka allow for document organization and the creation of metadata for digitized collections both large and small. OCR and programs like Transkribus are moving closer to automated transcription of even the most difficult handwriting.[1] Interfaces like Voyant allow us to perform keyword searches, analyze proximity and terms, and trace when and where a word is used.[2] If I want to research cultural perceptions of dueling in the seventeenth century, a quick Google Books search turns up the entry on dueling in a seventeenth-century French/Italian dictionary, numerous Italian treatises on dueling, an eighteenth-century musical, some poetry, sermons, and accounts of historic duels, all within the course of a few minutes-generating more material than can be analyzed without computational methods in any one lifetime. In short, the digital revolution has widened the research pipeline exponentially.

Not only has the computer changed the way we research primary sources, but the online availability of monographs, articles and teaching materials has also changed the practice of historiography and reading in the field. Journals are available online and easily searchable; some are freely available and open access, as are the articles of this collected volume. Monographs, likewise, are easily accessible in electronic copies. Digital book repositories like Cambridge Core, ACLS e-books on-

1 Readcoop, accessed June 28, 2023, https://readcoop.eu/transkribus/.

2 Voyant, accessed June 28, 2023, https://voyant-tools.org/.

line, and Perlego have made entire libraries available at considerably reduced expense. Scholars can upload articles and presentations to Researchgate, academia.edu and Humanities Commons. A quick JSTOR search on the history of prostitution can turn up hundreds of articles; fifty years of scholarship on the Italian Renaissance resides on ACLS e-books online and Cambridge Core. The net effect is that decades of research are easily available at our fingertips, frequently obviating the need for a trip to a physical library, a search through bound book indexes or a glance at printed bibliographies.

In the context of an ongoing, or potentially reinvigorated, interest in more conventional historical methods, these developments are not wholly unproblematic. In her seminal article "The Emmett's Inch-Small History in a Digital Age," Julia Laite articulates the ambivalence of digitization:

> The boundlessness of the past has always been kept in check not only by the boundedness of the archive and library but also by our own cognitive and physical abilities to identify, search, collect, and connect records. This, argues Rigney, is where history meets the sublime—where historians admit the limitations of their ability to know, comprehend, and represent a boundless past. So, what happens now that our ability to chase so many people out of the bounded archive has become so much greater, faster, and finer grained? (Laite 2020: 968)

As Laite points out, context can be key for understanding materials. Returning to our examples above, does it make a difference if one can see the folder which contains the Veronese wills? Does it make a difference which collection they are housed in? Will seeing and touching the scroll for the seventeenth-century Japanese remedy for headaches make a difference to interpretation? Will touring the royal theater that premiered the 1780 play about dueling make a difference in our interpretation of it? As critics have pointed out, sometimes digital work elides context in ways that can make historical work more shallow.[3]

Other drawbacks to the scale afforded by digitization can be seen in the constraints that search algorithms place on research. At once they enable broader searches while shaping them in ways that the user may not intend. Google Books search is dependent on algorithms that index imperfectly. Article databases require searches to be precise at the metadata level in order to be effective. Online digitized collections still require the same labor as the in-person archive and in some cases more, depending upon organizational structures and the availability of a search function. And the sheer number of materials to work with can create a sense of vertigo more severe, in many cases, than that prompted by the physical

3 See, Mykola Makhortykh, Aleksandra Urman, and Roberto Ulloa. "Hey, Google, is it What the Holocaust Looked like?" *First Monday* 26.10 (2021), accessed June 28, 2023, https://firstmonday.org/ojs/index.php/fm/article/view/11562.

process of exploring a material archive, however large its footprint or extensive its holdings. At the biggest risk of loss, perhaps, is the tangible serendipity of the archive and the library, the mental catalogs of collections in the minds of archivists, and the expertise of years spent sifting through dusty and crumbling documents. Computers are not yet able to suggest with any precision a collection that one may want to consult if one is interested in the history of prostitution in sixteenth-century Venice. Folders upon folders of inquisition cases have yet to be consulted.

Methodologically speaking, microhistory would naturally seem opposed to the scaled-up practices afforded by digitization and digital methods. One relies on metadata and computer-aided searches, the other on serendipitous archival finds. Unsurprisingly, when asked about digital humanities in a recent interview, the microhistorian Carlo Ginzburg had the following to say:

> As for big data, are they able to detect anomalies? Or do they tendentially erase them? I have actually debated this topic in a written dialogue with Franco Moretti. The danger of working with big data lies in the erasure of anomalies because they focus on convergences and norms. (Dayeh 2022: 218)

In Ginzburg's view, it is hard to find Menocchio in a spreadsheet.

Many microhistorians who are highly vocal about the debates in their own field, however, have not weighed in at length on the digital revolution. Even though they have much to contribute to the debates about digital history, they have been mostly silent observers, aside from a few notable recent examples that will be discussed later (Trivellato 2015: 122). The silence is particularly notable when remembering the sometimes vociferous critics of cliometrics and social science methodology. Indeed, it was these developments in historical methodology that inspired microhistorians to take a different scope. Despite their sometimes resemblance to cliometrics, digital methods also have a great deal to offer the microhistorian. New digital tools and methods allow us to trace these clues in new and novel ways. The digitization of little-studied, hard to find records, manuscripts, early printed works, and archival collections has made uncovering context and tracing clues easier. Tim Hitchcock argues that digitization has allowed us to 'radically contextualize' by hunting down clues in physical archives and online archives (Hitchcock 2013). Does digitization give us access to hundreds if not thousands of Menocchios making the normative exception, in fact, normal?

Indeed, digital history may be helping to bring about a resurgence in microhistory. Whether motivated by fear of losing sight of the historical subject entirely in a sea of numbers, online archives and maps, or desires to carve narrative out of electronic frontiers, the number of microhistories or reflections thereof appears to be growing and not decreasing in number.[4] As Thomas Cohen mused in a recent article commemorating the fortieth anniversary of the publication of Carlo Ginzburg's *The Cheese and the Worms*, "microhistory is alive and kicking; it still intrigues writers, beguiles readers, and charms abundant students" (Cohen 2017: 53). Cohen's observation seems to hold true; as already noted, microhistories are still being published both in monograph and article format along with robust discussions of methodology.

In fact, looking at recent titles and monographs, one could have the impression that microhistory is not only alive and kicking, but is experiencing something of a revival. To name a few notable examples from the past five years, articles employing microhistory as a methodology have been published on the life of a workhouse pauper in nineteenth-century London, on lesbian persecution by the Gestapo, and on black women's social activism in St. Louis (Jones 2022; Marhoefer 2016). Moreover, several prominent journals have given microhistory particular attention. In 2017, the *Journal of Medieval and Early Modern Studies* published a special issue on microhistory with reflections from Thomas Cohen and Ivan Szijártó.[5] The social history journal *Past and Present* recently published a special issue on the conjunctures between global history and microhistory.[6] The *American Historical Review* published the reflections of several prominent historians on scale in history in 2016. The cumulative effect of these journals' special issues has been to keep microhistory visible in discussions of scale.

Books are still being published in the genre by academic presses, including recent works on the microhistory of the picaresque novel with contributions by prominent microhistorians Giovanni Levi and Matti Peltonen (de Hann and Mierau 2014). Under the editorial helm of Sigurður Gylfi Magnússon and István M. Szijártó, with an editorial board featuring Carlo Ginzburg, Simona Cerutti, Edward Muir, Giovanni Levi, Jacques Revel and Matti Peltonen, among others, Routledge began publishing a new generation of microhistories in 2018.[7] Perhaps most tellingly, the *Journal of Social Science History* recently published Richard Huzzey's work, which uses prosopography and network analysis to examine British antislavery petitions (Huzzey 2019). Such developments might well reduce our concern that the changes wrought by digital tools and affordances are, on balance, a threat to microhistorical work.

4 A non-scientific and cursory scan of the number of indexed works using the term microhistory in the title shows that there is indeed an increase since 2011.

5 Special issue on Microhistory*, Journal of Medieval and Early Modern Studies* 47.1 (2017).

6 *Past & Present*, Volume 242, Issue supplement 14.

7 This series follows Sigurður Gylfi Magnússon's and István M. Szijártó's *What is Microhistory? Theory and Practice* (London & New York: Routledge, 2013).

Spatial humanities also offer some potential solutions to the potential unease associated with scaling up, bringing into relief understandings of geography, place and space as sometimes interconnected, sometimes separate realms of experience. How we understand space in a kinetic sense shapes our 'personal space,' including our tolerance for touch by strangers and non-strangers, feelings in crowds and wayfaring. How we understand space in a conceptual sense leads to our sense of direction and perception of the landscape and our place in it. There are a multitude of varieties of space and place all shaped by historical, cultural, social and political contingencies.

Moreover, the visual and spatial elements available through locative affordances can bring striking new dimensions to narration as conventionally understood. Menocchio's sense of place was prominent and his cosmopolitanism clear, and it could certainly be illuminating to walk in the same streets as Menocchio guided by a tour app. One could get a feel, both spatially and phenomenologically, for the world that undoubtedly shaped his worldview by seeing the views he saw, visiting the sacred places he frequented, studying the church frescoes he gazed upon, exploring the building in which he did his business as mayor, and surveying the river on which his mill was built. Thus the advantage to the combination of spatial history with microhistory in particular-the ability to find the exceptional normal with more richness and precision.

Very few would argue that points on a map convey the same detailed information or narrative punch as the tale of Menocchio. Microhistory could teach digital history a great deal about how to tell stories. As Lincoln Mullen points out:

> historians have long prized the art of storytelling and have often focused on the particulars of history, including individual lives, as a mode of communicating the complexities of the past. Yet digital history (at least computational history, rather than digital public history) has tended to pull historians toward the abstract and the generalizable at the expense of storytelling and historical particulars. (Mullen 2019: 383)

Works in digital history often fall short of what we call the braided narrative or interweaving of method and story.

2 A brief history of microhistory

To understand further how microhistory could benefit spatial history and vice versa, we should first outline it with a bit more precision. Ivan Szijártó defines microhistory by three characteristics: 1) microscopic focus on a well-delineated object of study; 2) engagement with the "big" historical questions, partially in response to the annales school and the longue-durée; and 3) a stress on the agency of the historical subject, particularly in the case of Italian microhistory (Szijártó 2022). Specifically, the historian is to look for Grendi's definition of "exceptional normal", or the normative subject. The scale of observation is reduced-the curious miller in the Friuli, the village exorcist, the returning soldier, the New England midwife and the scorned young woman. This allows for "a meticulous reconstruction of events and relationships, and a juxtaposition of conflicting sources concerning the same event" (de Vries 2019: 23).

Alongside Giovanni Levi's *Inheriting Power* (1988), Carlo Ginzburg's *Cheese and the Worms* (*Il formaggio e il vermi*) was at the forefront of microhistory and remains the most well known work in the field to an Anglophone audience. Published in 1976 in Italian, *The Cheese and the Worms* made the methodological claim that focused attention on one biography can tell us as much information about large topics such as the Counter-Reformation, the diffusion of print culture, the Venetian empire and the everyday lives of the non-elites as history at the more traditional scale. The establishment of the journal *Quaderni Storici* gave another forum to microhistorians and helped disseminate their work in Europe, the UK and the United States. As microhistory leapt across the Atlantic, Anglo-American histories adopted the methodology. Works like Laurel Thatcher Ulrich's, *A Midwife's Tale*, Robert Darnton's *The Great Cat Massacre* and Natalie Zemon-Davis's tour-de-force *The Return of Martin Guerre* became popular instances of this adoption. Anglophone historians of Renaissance and Early modern Italy also began to write works of microhistory, including Gene Brucker's *Giovanni and Lusanna*, Thomas and Elizabeth Cohen's *Words and Deeds in Renaissance Rome* and Judith Brown's *Immodest Acts*. Microhistory took its place in the methodological toolbox alongside social history and cultural history. And the increasing popularity of global history and transnational history did not signal the death of microhistory as some feared. In fact, the field was transformed and enriched by new approaches and particularly by what has come to be known as global microhistory (Ghobrial 2019).

Tonio Andrade and subsequent others argued for a world history less social science in approach and more attentive to narrative as the sheer scope and scale of analysis in global history tends to elide the stories and voices that most matter. Such elision on the part of global historians has been judged shortsighted: "we've tended to neglect the human dramas that make history come alive. I believe we should adopt microhistorical and biographical approaches to help populate our models and theories with real people" (Andrade 2010: 574) The microhistorian Francesco Trivellato has argued similarly and advocated for more productive conversations between microhistory and global history.

A recent example, Daniel O'Quinn's 2018 monograph, *Engaging the Ottoman Empire: Vexed Mediations, 1690–1815* for example, focuses on the linkages between Europeans' and Ottomans eighteenth-century itineraries by tracing a series of nodes and networks (O'Quinn 2018). In a series of connected microhistories, O'Quinn contemplates geographical connections, maps and space or the lack of. Using microhistory and cultural analysis, O'Quinn explores "a series of intimate encounters, some of which have lasting geopolitical ramifications" (2018: 7), for what he calls constellatory analysis. His combination of quantitative, qualitative, microhistory, and global history promotes new insights on the global early modern.

Global history, however, is attentive to space as an important object of historical analysis in the way that some other methodologies are not. As Lara Putnam points out, there are many geographic claims in history (Putnam 2006: 616). Many of these claims are local, regional, state-level and nation level but that simplifies the complexities of interactions with and within space. In their introduction to a special issue on the space and the transnational, Bernhard Struck, Kate Ferris and Jacques Revel point to this contradiction in perception of space and the accompanying trap that can ensnare historians, noting that "historical and social processes cannot be apprehended and understood exclusively within customary, delineated spaces and containers, might they be states, nations, empires, or regions" (Struck et al. 2011: 573–574). Indeed, historians tend to under-theorize space:

> As historians, we know we must draw artificial but useful boundaries in time in order to be able to make meaningful statements about historical developments. We call this periodization. We also need to do the same thing for space. That is, we need to think consciously, argue intelligibly, and reach (ever-provisional) collective conclusions about the spatial units that will allow us to talk about large-scale trends and patterns in a meaningful way. As far as I know, there is no consensus term for this process. (Putnam 2006: 620)

Geographies lend themselves to history, easily, but space doesn't shape the discussion of history outside of the geographic. This is a problem when one considers that the nation-state is a construct that social actors don't necessarily live within. Actors are more likely to be shaped by streets, fields and landmarks than they are by the fact that they live within the Venetian Empire or Colonial India. When asked about their experiences, they give us different impressions of space than we impose upon them in our field definitions of history: Latin America, Eastern Europe, Indian Ocean and the Atlantic World.

In general, microhistory, thanks to its discrete focus, is still attentive to actors in space, especially in a symbolic and cultural way. George R. Stewart wrote several influential books in the field specifically focused on place (Ginzburg et al. 1993). His book, *Pickett's Charge: A Microhistory of the Final Charge at Gettysburg, July 3, 1863* analyzed a decisive battle in the American Civil War that lasted less than half an hour (Stewart 1987). As Ginzburg notes in a discussion of this work, "the outcome of the battle of Gettysburg is played out in a matter of seconds between a clump of trees and a stone wall"(Ginzburg et al. 1993: 12). Microhistory also had its origins in local history. In *Inheriting Power* and subsequent reflections, Giovanni Levi addressed this focus:

> Microhistory is more concerned with the symbolic significance of space as a cultural datum: it concentrates therefore on a precise point, but one which may be invested with different characteristics by the different players involved, and be defined not only by its geographical situation but by the significance attached to a place and a given situation that may be contained or determined by a broad range of connections and thus linked to other, widely distributed spaces. It seems to me to be less characterized by spatial dimensions than by the network of meanings and interrelations set up by the particular phenomenon being studied, and reads places as ever-evolving cultural and social constructions. (Levi 2019: 40)

There are many commonalities between Levi's above dictum and the approach of spatial history.

Influenced by Lefebrve, Foucault and Baudrillard's theorizations of space, the spatial turn was a push past an exclusively geographic understanding of space.

3 The spatial turn

Despite its conflation, however, spatial history is not the same as GIS. While it is hard to pinpoint the precise moment(s) of the (or a) spatial turn in history, not least because space and history cannot be disconnected from one another, it is a little easier to identify the point at which mapping and geospatial approaches, particularly those using Geographic Information Systems (GIS), became more prevalent. Anne Kelley Knowles' monograph, *Placing History: How Maps, Spatial Data, and GIS are Changing Historical Scholarship* was one of the first influential discussions of this approach, followed by the work of Ian Gregory, Tim Cole, and many more scholars (Knowles and Hillier 2008; Knowles et al. 2014; Gregory and Ell 2007). Research groups such as The Spatial History Project at Stanford were established, courses and institutes were offered, tutorials were written and projects proliferated.

The reasons for the increasing popularity are clear, since the goals and benefits of historical GIS are manifold. Not only is it a means of visually representing spatial information, but also the quantitative and qualitative techniques that underpin GIS allow for multi-layered investigation. As Tim Cole has pointed out, this combination of methodologies is one of the innovations of doing this sort of work:

> It is the integration and almost seamless passage between one set of tools and another, from one method and technique to another, that makes GIS a powerful tool within a broader

> range of digital humanities approaches that draw on the processing power of computer technologies to read the archive differently. (Cole and Giordano 2021: 274)

GIS can put historical maps, hundreds of analyzable data points, geographic referents and powerful visualizations at our fingertips. It can make it easier to exchange data, share research and do large-scale comparisons. Historical GIS can readily allow for the creation of public-facing, interactive exhibits, projects and experiences for non-historians. It may seem that historical GIS is simply a return to geographic-based history. After all, part of the methodology involves drawing geographic boundaries: creating maps, delineating them with lines and incorporating topography. Many projects are built upon streets, fields and land-surveys.

Yet within the past decade, spatial humanities scholars have begun to repurpose GIS for investigations of space and place. Tim Cole and Alberto Giordano used GIS to look at what they called the "geography of oppression" in Budapest and Italy during the Holocaust (Giordano and Cole 2018). In particular, Cole and Giordano argue for a definition of space consisting of three dimensions: location, locale and sense of place. In their view, a GIS of place will bridge the gap, both epistemological and ontological, "between the humanities and GIScience" (Giordano and Cole 2020: 842).

Several recent historical GIS projects are starting to realize similar goals. Notable projects include *Mapping Decline: St. Louis and the American City*, which allows a user to examine changing racial demographics and their impact on an American city from a variety of types of data collected during the last century.[8] The Atlantic Networks Project helps visualize the North Atlantic slave trade, including patterns of death and the seasonality of the passage.[9] The Atlas of Early Printing allows researchers to map trade routes, universities, fairs and borders on the networks of early printed books.[10] The Digitally Encoded Florentine Census (DECIMA), which will be discussed more presently, allow users to explore and map several early modern Florentine censuses and explore various aspects of the urban environment including where people with certain occupations lived, the composition of women's convents and the diffusion of prostitution across the city.[11]

Historical GIS can, of course, favor the sort of work that microhistorians are critical of, especially quantitative approaches. Indeed, microhistory evolved as a

8 "Mapping Decline: St Louis and the American City", accessed June 28, 2023, http://mappingdecline.lib.uiowa.edu/.

9 Andrew Sluyter. "The Atlantic Networks Project", accessed June 28, 2023, https://sites.google.com/site/atlanticnetworksproject.

10 University of Iowa. "The Atlas of Early Printing", accessed June 28, 2023, http://atlas.lib.uiowa.edu/.

11 Decima, accessed June 28, 2023, https://decima-map.net/.

partial response to the turn towards social scientific methods in history, particularly the use of large datasets and statistical methods. This turn towards social science was itself enabled by the development of machine-readable datasets and hastened by personal computers and programs like SPSS that made storing and crunching data possible at an unprecedented scale. Historic demographic and population data could be more freely analyzed, plague mortality rates could be traced, economic crises outlined and birth rates scrutinized. David Herlihy and Christiane Klapsich-Zuber's computerization and analysis of the 1427 Florentine Catasto was an example of a history of this type (1985). First published in French in 1978 and in an English translation in 1985, *Tuscans and Their Families* breaks down a historic Florentine census, analyzing household demographics and wealth including data on professions, marriage rates, birth rates and the gender of heads of households.

Reviews of Herlihy and Klapsich-Zuber's quantitative work exemplify the critiques of such approaches. Many of the reviews pointed out that numbers could be fuzzy and sloppy and thus be hard to generalize from. Like many works of social scientific history, *Tuscans and their Families* made big claims that did not hold up to scrutiny under a magnifying glass. And from the beginning, a persistent criticism of quantitative approaches was that, in turning important histories into numbers and percentages, they could make for dull reading. Whether or not works like *Tuscans and their Families* are slow going for individual readers, they certainly elicited other kinds of backlash, particularly for claiming to get at history from below. Demographic numbers on the marriage age of peasants were indeed novel in that they focused on peasants as an object of analysis. However, from such data, one could not actually get a sense of the peasant, the range of his or her marriage choices, the influence of family preference and the real terms of the dowry or bridal gift, whether it consisted of a silver spoon or a promise of cash in the future brought about by the sale of crops. While social scientific history illuminated some things previously difficult to see, particularly without the aid of computer analysis, it still, intentionally or otherwise, made structure and thereby the elites a persistent focus in historical analysis. While the Florentine Catasto provided certain insights concerning, for instance, the number of female-headed households, it did not aid an understanding of the everyday life of women. Instead, the Catasto is in many ways a document that tells us more about the desires of the elite to understand how they could enhance the practice of tax farming. Enter microhistory.

In some ways, microhistory vs. digital history is a false methodological dichotomy. Very few historians are exclusively microhistorians any more than digital historians are exclusively digital. Most of us borrow methods and materials as sources and subject dictates. In some ways, however, both are the outliers methodologically.

4 Playing with scale

While microhistorians rarely become digital historians, many digital historians borrow from microhistory. One obvious explanation for this is that microhistory is a more established approach than digital history as we have now come to think of it. Another explanation is that digital history as a methodology is only now being taught more widely in graduate programs. Yet another reason is that the ego-documents that form the basis for many microhistories lend themselves to certain types of digital humanities analysis. One example of microhistory's influence on digital history is Cameron Blevins's topic-modeling of Martha Ballard's Diary-a source that was to become the basis for one of the first Anglophone microhistories-Laurel Thatcher Ulrich's *A Midwife's Tale: The Life of Martha Ballard* (1990). Martha's diary contains over 10,000 entries which by any standard is difficult and time-consuming to analyze.[12] Using a package for natural language processing (NLP), the algorithm generated a list of thirty topics and thematic trends in the diary, confirming some of Ulrich's hypothesis concerning an increase in the usage of certain words over time. Blevins noted that in some cases, the NLP analysis was more useful than traditional hermeneutics. Blevins's work and interpretation of the data enriches and augments Ulrich's reading.

Approaches that rely on larger quantitative datasets might seem antithetical to the endeavor of microhistory. Much of the work of GIS, for example, is quantitative, and often it includes hundreds if not thousands of data points. Indeed, much of the work is quantitative enough that many practitioners of historical GIS have colloquially described it as 70 percent data collection and preparation. Historical GIS would seem to be the least compatible with microhistory for quantitative and technical reasons. Yet GIS and spatial history have a great deal to contribute to microhistory. In *Geographies of the Holocaust*, Tim Cole, Alberto Giordano, and Anne Kelly Knowles point out that investigating events like the Holocaust must be conducted using a variety of methods, quantitative and qualitative alike:

> Investigating the where of these Holocaust events necessarily means working at a variety of scales, for they took place from the macro scale of the European continent; through the national, regional, and local scales of individual countries, areas, and cities: and down to the micro scale of the individual body. (Knowles et al. 2014: 12)

Cole, Giordano, and Knowles thus advocate for this mixed-methods approach that includes GIS, visual analysis and qualitative methods. They argue further that

12 Cameron Blevins, "Topic Modeling Martha Ballard's Diary," April 1 2010, accessed June 28, 2023, https://www.cameronblevins.org/posts/topic-modeling-martha-ballards-diary/.

"spatial analysis and geo-visualization can complement and help specify the humanistic understandings of space and place by exploring and quantifying relationships among things and people to discover and visualize spatial patterns of activity" (Knowles et al. 2014: 15). By using a braided-narrative approach, they zoom in and out on the various geographies, spaces and places that were impacted by, and had impact on the Holocaust.

Other works are illustrative of the productive insights of this approach that combines GIS and microhistory. In the most recent book in Routledge's Microhistory series, *Neighbors of Passage: A Microhistory of Migrants in a Paris Tenement, 1882–1932*, Fabrice Langronet, argues that digital methods and tools can in fact make microhistory easier: "microhistory from scratch, so to speak, is now within the realm of possibility. New digital tools and databases make it easier to track specific individuals in the sources" (2022: 10). To produce a microhistory of a tenement, Langronet collected data about the tenement's occupants in birth and death registers and explored municipal archives, naturalization files, police registers and other quantitative sources for those who populated this community. Following the clues and seeking contextualization with mapping, he produces a rich history of the geographies as well as spaces and places of migration.

Newer studies like these align with Istvan Szijártó's idea of microhistory as a junior partner, or microhistory "built on a partnership rather than a rather than a rivalry of the two macro and micro approaches", or a microhistory that would inform and benefit from macrohistory, quantitative history or digital history (Szijártó 2022: 211). The combination of macro and micro approaches has been labeled as Microhistory 2.0 or even as a third wave of microhistory, though what such terms mean is open to debate (Renders and Veltman 2021). Part of the resurgence in microhistory, these new forms of microhistory retain the earliest goals of the methodology while also incorporating insights from newer fields like global history. Microhistory 2.0 aims to be particularly attentive to non-western perspectives and the colonization of archives.

Other advocates of Microhistory 2.0 have argued for an incorporation of digital humanities. Fabrizio Nevola has talked about a Microhistory 2.0 that productively incorporates digital humanities methods, tools and techniques to create interactive narratives (Nevola 2016). He and his colleagues developed the Hidden Cities phone app, which allows users to interactively experience Renaissance Florence. Users are led on a guided tour narrated by a series of archetypes, including Cosimo de'Medici, a female silk weaver, a widow and a policeman, actualizing what Nevola has labeled a new form of microhistory. Digital history projects can also lead to a Microhistory 2.0. The growth of larger scale digital humanities projects, datasets and new tools has transformed the field of Italian history in particular. Projects like, DECIMA, a historical GIS project which maps early modern census data from Renaissance Florence on the sixteenth-century Buonsignori map, have reshaped the field and allowed researchers to reconsider scale in unprecedented ways. With DECIMA's web-GIS interface, for example, one can Zoom in and out and play with scale in ways that elicit narratives that would be impossible to make visible through conventional methods. In a companion edited volume, for example, several scholars reflect on how they have used DECIMA to zoom in on histories of nuns and prostitutes to reconstruct otherwise inaccessible stories. Working on nuns, Julia Rombough and Sharon Strocchia examine placement patterns of female religiousness in relation to their social networks and world in which they lived. As they point out, "the convent has rarely been utilized as the main lens through which to view how Italians constituted social networks, distributed religious patronage, and strengthened ties to other people and places within the early modern city" (Rombough and Strocchia 2018: 89). Using the 1548–1552 Florentine census of nuns and the 1561–62 population census, they mapped the women of religious houses and their proximity to their familial palazzos and neighborhoods. Their research showed that placement of women in geographically distant convents, instead of religious houses closer to their family complexes, was part of a wider pattern to diversify economic and social ties outside neighborhoods many families had been living in for centuries. The mapping also highlights how female networks, in which convents were key nodes, played crucial roles in family strategies and fortunes. It also sets into relief how powerful these institutions were in the urban landscape:

> Because these socio-spatial networks permitted both people and information to flow into and out of the convent with both rapidity and regularity, cloistered religious women could stay abreast of neighborhood news, keep tabs on property values, grasp dynamics of heated disputes and participate in broader forms of civic discourse. (Rombough and Strocchia 2018: 97)

Rombough and Strocchia's findings challenge the claims of previous scholarship that Florentine women were confined to and operated exclusively within the private space of the home and convent almost wholly unconnected to the wider world apart from their husband's family (in the case of married women) or their fellow nuns (in the case of religious women). Thus, this sort of analysis opens up understanding for varieties of spaces: social, cultural, mental, relational and so forth.

Such projects show that the macroscale of digital humanities projects with tens of thousands of points of data and the microscale of a thick inquisitorial deposition are not incompatible. For historians of early modern Italy in particular, GIS and spatial history have increasingly become a path to doing both qualitative and quantitative investigations that complement one another. GIS and spatial history are not just looking at thousands of Menocchios; geospatial approaches can allow historians to zoom in and out to explore both the threshold of a noble palazzo, the working class tavern and the neighborhoods prostitutes lived in as well as bandits on the borders between Bologna and Modena and the spaces where guns were most likely to be used. Carlo Ginzburg's Menocchio is easier to understand if you have a basic concept of where Domenico Scandella lived. In a Special issue of the *American Historical Review*, David Aslanian argued that

> there seems to be an inverse relationship between scale and human agency; in other words, the greater the scale of analysis (temporally or spatially), the less room is left for accounts of human agency. (Aslanian et al. 2013: 1444)

A combination of digital spatial history and microhistory, may allow us to uphold microhistories' political commitment to understanding agency. Since the unfolding of microhistory, scholars have been criticized for disentangling the original political focus of Italian microhistory in favor of narrative and novelty (Guldi and Armitage 2014). While many of these criticisms are unfair, there is no question that microhistory is sometimes branded as more palatable history that is suitable for public consumption, irrespective of political commitments to the narrative project and a desire to tell the stories that have been pushed aside in favor of narratives of structure. Digital spatial history and GIS could help return microhistory to its conceptual and ideological roots.

In her article, "Mapping Working-Class Activism in Reconstruction St. Louis", Elizabeth Belanger advocates for this type of GIS work:

> Blending the tools of micro-history with historical Geographical Information Systems (GIS) permits us to chart the social networks and everyday journeys of black working-class women activists and the middle-class men with whom they came into contact. Social and spatial ties shaped the activism of St. Louis' working-class women; mapping these ties reveals the links between everyday acts of resistance and organized efforts of African Americans to carve a space for themselves in the restructuring city and make visible a collective activism that crossed class and racial boundaries. (Belanger 2020: 354)

Bellanger's work highlights the extent to which black activists mobilized space to protest segregation and the political spheres of influence in which they operated. By geolocating black churches and activist homes in post-reconstruction St. Louis, she unfurls the stories of black, working class women. GIS and mixed methods can provide agency for communities that have literally been erased from the map. In the Rosewood Massacre, Edward Gonzalez-Tennant uses geospatial analysis and anthropology to recover the stories of lost communities like Rosewood, Florida, a town that was literally burned to the ground in 1923 (Gonzáles-Tennant 2018). As Simone Lässig has noted of these approaches that combine the two:

> digital history makes it possible to productively intertwine macro- and microhistory, also freeing historical figures from an anonymity that the logic of archival collections had previously relegated them to [. . .] digitization offers paths to new sorts of history from below – an approach to less prominent people historians have pursued since the 1970s. (Lässig 2021: 18)

Digital spatial history is particularly suited to this endeavor. Digital spatial history can help us follow clues, uncover structures that were previously not apparent and focus on and better understand the agency of historical actors.

The methodologies of microhistory may now be more important than ever with the scaling up of history:

> microhistory's central argument-that a variation of scales of analysis breeds radically new interpretations of commonly accepted grand narratives-has acquired new urgency as globalization and its discontents demand that historians produce new grand narratives about the ways in which interconnections and hierarchies have developed on a planetary Scale. (Trivellato 2015: 122)

Similarly, this scaling up of history can be put to microhistorians' use. Methods of digital history could help microhistorians find the exceptional normal in a cache of documents, follow clues and illuminate the mentalities, particularly the spatial ones, of their subjects. The methods of digital history could help microhistorians track down clues with more ease, particularly if those clues are in far-flung archives or could be found in collections that haven't been touched. Apart from archival clues, digital spatial history can help establish a foundational sense of place in a way that further illuminates the subjects of microhistory. In addition to sharing similar aims, microhistory and digital spatial history have much to offer one another.

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Scaling Digital History and Documenting the Self-Emancipated

Abstract: This chapter explores scale in public and digital history projects by examining runaway advertisements from nineteenth-century Virginia newspapers placed by members of the Founding Generation. As digital history allows for new scalability, the chapter documents existing databases to frame microhistories of enslaved individuals within the larger historiography of slavery, agency and resistance. The microhistories captured within runaway advertisements are often fragmented and unfound, creating evidentiary gaps within the scholarship of enslaved narratives. Our digital project's intervention proposes reading each runaway advertisement as micro-maps of the enslaved individual's life and historical environment. This interdisciplinary approach uses the digital humanities method of thick mapping to juxtapose temporal, spatial, geographic, environmental and historical data into a layered reconstruction of networks, community and kinship within enslaved communities from the early United States.

Keywords: digital humanities, digital history, public history, slavery, community networks

In the United States, debates about the history of slavery involve those who center it in national origin narratives against those who deny its critical role in our current society. A *digital* history of slavery adds further tension: how can the history of bondage be both a national and personal narrative, and how might technology help us examine mythologized historical periods using documents produced in those eras? Runaway slave advertisements, in particular, help to complicate flattened representations of the American Revolution and its elevation of Enlightenment ideals.[1] That the Founding Generation surveilled and pursued self-emancipated individuals generates powerful discussions about life, liberty and the pursuit of happiness.[2]

1 Morgan (1975) and Taylor (2021) write of the paradox of the American Revolution, that the rise of liberty and equality in America accompanied the rise of slavery. Within this paradox is the republican ideal of freedom, formed from the distinct English conception of freedom born out of Enlightenment thinking that permeated England's national identity and imperialization efforts.

2 The 1688 Germantown Quaker Petition is the earliest known document that called for outright abolition of slavery in the American colonies on grounds of universal human rights, drafted by Francis Daniel Pastorius for the Germantown Meeting of the Religious Society of Friends in Pennsylvania. In 1790, Benjamin Franklin and the Abolition Society put forth a similar petition to the

https://doi.org/10.1515/9783111317779-005

There are also primary source examples of these advertisements because of their attachment to historically privileged persons. Does this wealth of records skew our understanding of enslavement? Is this just another example of how the Founding Generation dominates knowledge production about the early United States?

Here, it is important to consider the upcoming 250th anniversary of the United States. Public historians and museum professionals are working to "reframe history" in the congratulatory aftermath of the 1976 bicentennial in the United States.[3] Planning organizations remind us to "make sure that Americans of all ages and backgrounds and in all places that see themselves in history".[4] Scale is useful as we work to focus on the underrepresented and zoom away from traditional top-down versions of history. Mapping the advertisements of enslaved individuals connected to the Founding Fathers raises questions about whose history gets told and exemplifies the complex, snarled system of slavery. However, questions still remain: how far-reaching is the 250th? What are its borders and boundaries? How far does it extend geographically, temporally, topically? Who deserves inclusion?

Digital history might answer some of these questions. From online classrooms to virtual museum tours, digital engagement with American history requires a reinterpretation and rescaling of datasets and informational repositories. In our reflection on the different dimensions of scaling history – of past and present, micro and macro, individual and state – we propose to create a digital history project that maps runaway slave advertisements from the eighteenth and nineteenth century United States placed by members of the Founding Generation. By examining a singular historical source from a particular community, we narrow the scope of our discussion to storytelling, examining perspective shifts from broad, general narratives to marginalized communities and individual experience. The shift from macro to micro further illuminates issues of how sources and data, often missing, are manipulated in historical narrative reconstruction. From there we can engage with visions of what scholars can do when history is made digital.

U.S. Congress to end the slave trade and provide means for the abolition of slavery. The petition was rejected on grounds that the U.S. Constitution limited Congress's power to end the trade and emancipation of enslaved people. By the issue of the Missouri statehood in 1820, in a letter to John Holmes, Thomas Jefferson expressed the struggle between upholding national ideals and slavery's expansion in the infamous line, "we have the wolf by the ear, and we can neither hold him, nor safely let him go". Thomas Jefferson, "Letter from Thomas Jefferson to John Holmes (April 22, 1820)," *Thomas Jefferson Papers*, Library of Congress, accessed June 28, 2023, http://hdl.loc.gov/loc.mss/mtj.mtjbib023795.

3 See the Association of American State and Local History initiative, "Reframing History", accessed June 28, 2023, https://aaslh.org/reframing-history/.

4 See the AASLH's 250th field guide, accessed June 28, 2023, http://download.aaslh.org/Making+History+at+250+Field+Guide.pdf.

In the following example, the story of George and Phebe shows us how American independence was not guaranteed post-1776; that place mattered for communities seeking refuge and freedom; that belonging and citizenship were long-denied to specific groups; that the Revolution created a nation that viewed Black persons as commodity, as labor, as chattel; and finally, that we should ask new questions of old documents to obtain more truthful interpretations. This is not new history; it has been here all along, obfuscated by white supremacy, requiring appropriate technologies to reveal it.

We strive to map these experiences, but we do not want to speak for the experience or impart our own thinking onto these historically marginalized persons. As witnessed by recent digital projects, this type of interpretation can be done poorly and cause further harm.[5] In our ongoing work, we strive to let the available primary sources speak for themselves. Instead of offering a revision of these microhistories, we rescaled to locate enslaved agency – not enslaver apprehension.

1 George and Phebe, July 1826

> Ten Dollars Reward
>
> Ranaway [sic] from the farm of James Monroe, Esq. in Albermarle county, on Monday nights last, a negro man named George and his wife Phebe.
>
> GEORGE is about 30 years of age, strai[-]made, six feet high, tolerably dark complexion, had on domestic cotton clothes; but he will no doubt change them.
>
> PHEBE is about 28 years of age, common size, dark complexion, and when she went away was clad in domestic clothes. The above negroes are supposed to be making for the county of Loudon, or probably have obtained free papers, and are endeavoring to get to a free state. If taken in this county, I will give a reward of Ten Dollars : or Fifteen Dollars if taken out of the county and secured in any jail so that I can get them again.
>
> WM MOON,
>
> July 8, 1826 For COL. JAMES MONROE

In the summer of 1826, two people chose to self-emancipate. Their names were George and Phebe, and they were husband and wife. They were enslaved by James

5 In July 2022, digital humanities scholar Jessica Marie Johnson called out the "Runaway slave project" (http://runawayproject.info/): "Enough with these projects and websites about slavery that have no faces, no authors, no attribution, and no accountability. No descended engagement. No Black staff. No Black leads. No Black praxis. Just DH and vibes". We acknowledge and respect Johnson's anger. We aim to create a DH project that is transparent, transformative and non-extractive of available and rapidly digitized sources. See Johnson's July 21, 2022 Twitter feed, accessed June 28, 2023, https://twitter.com/jmjafrx/status/1550072236928909317.

Monroe, fifth president of the United States and Revolutionary War veteran, at his Albemarle County, Virginia, plantation then known as Highland. As of this writing, this runaway slave advertisement is the only known documentation of George and Phebe's existence. However, there is much to learn from the 135 word text.

Runaway adverts provide physical and relational details about enslaved persons. "Col. James Monroe" placed a ten-dollar reward for the return of Phebe and George. Their provided ages were approximate: Phebe "about 28 years of age" and George "about 30". Some of the physical description is vague and nonspecific: Phebe is "common size" while George is "straight made". However, other details are more particular. Complexion, height, and clothing are noted for both individuals, as well their possible final destination, "the county of Loudon" where Monroe owned another property. The ad assumed Phebe and George went there "endeavoring to a free state". Interestingly, the ad also suggests the two may have "obtained free papers" to ensure easier travel. This specific line begs two questions: who could have supplied them with such documents, and what networks of freedom did they operate within?

In the 1820s, freedom seekers like Phebe and George were most likely heading north. However, it is noteworthy that they ran away together. It was easier to evade capture alone. The fact that they chose to self-emancipate as a couple provides insight into their relationship and desire to remain together.[6] Historian Anthony Kaye's work defines enslaved neighborhoods by plantation lines and kinship ties that crisscrossed physical and psychic boundaries (Kaye 2007: 4–5). Runaways were not often accepted into new neighborhoods; they often returned to their old neighborhoods where help was easier to obtain (Kaye 2007: 129, 133). Was this also the case for George and Phebe, as they absconded to a county where their enslaver also owned a plantation? Kaye's academic work helps us consider George and Phebe within a larger community:

> Despite planters' attempts to control mobility [. . .] slaves forged enduring bonds to adjoining plantations [. . .] extended networks of kinfolk, friends, collaborators, and Christians; gave permanence to their neighborhoods by creating and re-creating the bonds that held them together, even as slaveholders constantly sold people in and out of the place. By pressing social ties across plantation lines, in short, slaves attenuated the power relations of slavery and cleared some ground for themselves to stand on. (Kaye 2007: 6)

George and Phebe's advertisement speaks to agency, resistance, community and scale. We learn about a married couple's commitment to a life free from enslave-

6 "Ten dollars reward," *The Central Gazette* (Charlottesville, Virginia) July 15, 1826, Special Collections, University of Virginia, accessed June 28, 2023, https://encyclopediavirginia.org/george-and-phebe/.

ment, family separation and forced labor. We see an explicit decision to take a specific journey. We see geography relative to where George and Phebe came from and where they may have gone. We can also imagine the weight of their decision to self-emancipate. The choice came with bodily and psychological risks that may have weighed heavily on both individuals.

When studying the United States, the scale of chattel, race-based slavery is massive. Slavery infiltrated every aspect of public and private human experience, and we see its afterlife in contemporary racism deeply embedded in medicine, politics, the economy and criminal justice system, to name but a few (Hartman 2007: 6). For George and Phebe, the scale of slavery begins as movement between locations, such as fleeing Albemarle County for Loudoun County. It also connotes the immense and claustrophobic scale of racialized power dynamics in nineteenth century Virginia. Finally, and most expansively, the scale of slavery acts as a theoretical concept to explore how historical knowledge is produced by zooming in on one specific hegemonic narrative. In what Michel-Rolph Trouillot terms "a particular bundle of silences" (Trouillot 1995: 27), George and Phebe's individual journey to self-emancipation are rendered as archival silence, obfuscated by collective narratives of surveillance and recapturing of fugitives from slavery. By recognizing what scale means discursively, we "encourage fresh thought" about these runaway slave advertisements and shift focus from enslaver oppression to enslaved agency (Ball 2010: 11).

A note on terminology

Before we continue the discussion of rescaling digital history, it is necessary to briefly address the terminology and languages, particularly of the history of American slavery, that we will use throughout this chapter. In 2018, P. Gabrielle Foreman and other senior slavery scholars created a community-sourced document to guide discussions of slavery in its historical and global context. The document is a call to action for scholars to acknowledge the evolving ways that slavery and those kept in bondage and oppression are analyzed. Considering language to adopt and avoid confronts the brutality of the system as well as reconstitute agency to those who were enslaved.[7]

The frequent terms used to describe enslaved people who endeavored to be free are "fugitive", "runaway", and "self-emancipated". The dataset we are using

7 P. Gabrielle Foreman, et al., "Writing about slavery/teaching about slavery: this might help," community-sourced document, accessed May 14, 2022, https://docs.google.com/document/d/1A4TEdDgYslX-hlKezLodMIM71My3KTN0zxRv0IQTOQs/mobilebasic.

for our digital history project have been historically called “fugitive slave advertisements” and “runaway slave advertisements”. The Fugitive Slave Act, first codified in the United States Constitution and then refined in the 1850 legislation, cemented this language in the historiography of slavery. The Act demanded the return of enslaved individuals, even from free states, legally required enslaved people to stay enslaved. It allowed federal commissioners to determine the fate of alleged fugitives without benefit of a jury trial or even testimony by the accused individual. The historical term of “fugitive slave ads”, denotes a racial divide between the unquestioned privileges for white Americans and unchallenged illegality of Black Americans who lived and labored in the United States to be free. On freedom as a condition by which a subject may have a body – as opposed to a captive who is flesh – “self-ownership or proof of being able to own (and therefore use) property emerged as part of an uniquely U.S. racial history of citizenship and liberal subjectivity” (Atanasoski and Vora 2019: 194). By criminalizing the act of seeking freedom for a selected group, usage of terms like “fugitive”, even if it is historically accurate, sets the enslaved body as the site of unfreedom that deprived women and men who were enslaved of the right to consent. Enslaved people’s self-emancipation constituted not just a moment of refusal, but also an affirmation of agency, of claiming ownership over themselves and their own interpretation of slave codes and manumission laws. “Self-emancipation”, then, reflects the decision and act of the enslaved individual to pursue freedom outside of the realm of legal means of emancipation.

We have chosen to use the term “runaway slave advertisements” to reconcile with issues of scaling historical context between narratives of oppression and narratives of agency. “Runaway” carries notes of illegality for individuals who sought self-emancipation. However, unlike “fugitive”, runaway advertisements have been historically used to address all forms of escaped labor. The earliest of such advertisements in *Virginia Gazette*, published from 1736 to 1780, were for missing indentured servants, often Irish or Scottish. A 1713 notice in the *Boston News-Letter*, widely acknowledged as the first continuously published newspaper in the American colonies, listed a runaway manservant alongside advertisements for an enslaved Black woman and enslaved American Indigenous boy.[8] The terminology of “runway” encompasses a wider breadth of historical subjects and allows us to read resistance in and through the advertisements when we address the authorship of these historical documents.

8 “Advertisements from the Boston news-letter, 1713,” *ANCHOR: A North Carolina History Online Resource*, accessed March 23, 2022, https://www.ncpedia.org/media/advertisements-boston-news.

2 Runaway slave ads: A brief historiography

Humanities scholars have long examined runaway slave advertisements, but we identify a scholarly shift in understanding enslavement through them. Newspapers are a technology long studied for their contemporary perspectives on historical events. Runaway slave advertisements included ads placed by enslavers, overseers, estate administrators and jailers who held enslaved individuals in their custody under the construct of people as property for which we acknowledge within the historical context, but do not align with. As runaway advertisements became a staple in eighteenth and nineteenth century American newspapers, the content underwent a standardization. Since the goal of these ads was to facilitate the recapture of the escaped enslaved – and therefore, labor – standardization meant faster printing and transmission by word of mouth as the contents could be easier read in public gathering places like local shops and taverns. We have long known about runaway slave ads, but when researchers ask different questions about them, we can identify different answers.

In 1974, Lathan Windley conducted research based around the runaway advertisements of Virginia and South Carolina, later published in 1995 in *A Profile of Runaway Slaves in Virginia and South Carolina from 1730–1787*. For many historians, Lathan Windley's work was groundbreaking. His search through the multiple editions of the Virginia Gazette and related newspapers of similar name revealed 1,276 runaway advertisements throughout the publication's history. Windley focused on "personal variables" and the escape specifics, transforming these advertisements into datasets for scholars to use in new ways. It is a spectacular collection devoid of interpretation, though it elevates enslaved persons as the primary focus of study.

Windley's analog database for runaway advertisements seemingly set a standard in how future digital databases have been cataloged and structured these advertisements. The two most prominent are "Northern Carolina runaway slave notices, 1750–1865" from University of North Carolina Greensboro and "Freedom on the move" from Cornell University. Both digital databases expand Windley's initial work to encompass great geographic dimensions and scope, recognizing the potentiality of runaway advertisements as historical sources.

"Northern Carolina runaway slave notices"[9] was one of the first of its kind to provide a comprehensive digital archive of runaway slave advertisement. Although regionally focused on predominantly advertisements in and of North Carolina and drawn from published works of Freddie L. Parker's *Stealing a Little*

9 "North Carolina runaway slave notices," *University of North Carolina Greensboro*, 2011, accessed March 15, 2022, https://dlas.uncg.edu/notices/.

Freedom: Advertisements for Slave Runaways in North Carolina, 1791–1840 and Lathan Windley's *Runaway Slave Advertisements*, it sets a standard for this type of digitization project that makes its materials accessible to all users through its easy-to-use interface. Before, these ads were available in bound volumes and microfilms, not in an online open access format. As the project was done in collaboration with the University's library, it is an example of how histories are made public using library digitization, cataloging and transcription. It is important to remember that libraries and archives are also scalable sites of public history. Its focus on the usability and sustainability makes the project open for all types of scholarly interventions and educational engagement because the database itself does not attempt to interpret or create its own narrative and intellectual work.

Similarly, "Freedom on the move",[10] created in 2017, is the largest digital collection runaway slave advertisements published in North America. The database is sustained through its extensive funding, expert team assembled and crowdsourcing its dominant force of labor. The scope of the project extends the discussion of enslavement as not only a Southern phenomenon. The system of surveillance, labor management and capture of enslaved people were not contained to the Deep South, but embedded into American capitalism (Johnson 2013; Baptist 2014; Beckert 2014). It illustrates a broader picture of the process of self-emancipation by highlighting the mobility and networks that enslaved people had within the system meant to entrap them. Enslavers knew this too, which is why they place ads beyond their own region, in places up North.

That most digital humanities projects take place at higher education institutions is unsurprising. "Northern Carolina runaway slave notices" was funded through grants from the Institute of Museum and Library Services (IMLS) and North Carolina ECHO. "Freedom on the move" also was funded through grants from the National Endowment for Humanities, the National Archives and Cornell University. As it is a collaborative project between several institutions of higher education including University of Kentucky, University of Alabama, University of New Orleans and The Ohio State University, the labor of compiling, transcribing and maintaining the project is shared. One of the advantages of creating a national database of runaway advertisements through collaborative effort that moves beyond simply collecting and transcribing, is the ability of such projects to capture a more complete narrative of an individual enslaved person on their quest for self-emancipation. Included might be the ability for these projects to trace runaway individuals over time to show multiple attempts to escape to free-

10 Edward Baptist, William Block, et.al., "Freedom on the move," *Cornell University*, 2017, accessed March 15, 2022, https://freedomonthemove.org/.

dom, the length of time of their escape, successes or recaptured, etc. A limiting factor of existing databases (some of which is due to a lack of available materials) is that most enslaved persons attempting for freedom are reduced to a single advertisement.

Additionally, digital pedagogy does not necessarily happen when a project or scholarship is made digital. Projects like "Northern Carolina runaway slave notices" and "Freedom on the move" are, at its current stage, digital repositories that link educational and informational networks through content exchange. They have yet to become fully realized platforms for how educators, students and scholars might use to facilitate digital learning. How might we build on and harness existing digital history projects and how might we depart from previous schools of knowledge?

Windley's close reading spurred scholars to think expansively about self-emancipated individuals. Over twenty years ago, David Waldenstreicher first argued that "[r]unaway advertisements [. . .] were the first slave narratives – the first published stories about slaves and their seizure of freedom". In these texts, Waldenstriecher sees how an enslaved human being escaped and how their skill sets might enable their freedom quests. Though written by enslavers, these advertisements show "slaves' capitalizing on the expectations of masters by contravening these roles" (Waldenstreicher 1999: 247–248). Other scholars paid attention to what was not printed. For example, Marisa Fuentes's work reminds us that "the archive encompasses another space of domination" for enslaved women. She argues for an examination of what is "emanating from the silences within the runaway ad", specifically how historical location and physical description reveals the vulnerability of self-emancipated women not explicitly addressed in the advertisements (Fuentes 2016: 15). Fuentes reminds us of what remains unwritten. We should consider the risk, trauma and potential violence when running away (Fuentes 2016: 42).

Scholars also unite existing methods that show the complex ecosystem of enslavement, in biography, theater and geography. Erica Armstrong Dunbar's study arose from a runaway slave ad from first U.S. president, George Washington. He sought Ona Judge, who self-emancipated while in Philadelphia, without any "suspicion [. . .] or provocation to do so" to use the advertisement's language. Dunbar uses contemporary correspondence and newspaper accounts to "reintroduce Ona Judge Staines, the Washingtons' runaway slave". Though we initially learn about her through an enslaver, Dunbar conducts a biographical recovery that shows the complexity of enslavement and the desire for freedom and agency (Dunbar 2017: xvii). Antonio T. Bly builds off Waldstreicher to read "advertisements for fugitive slave" as "complex living pictures or *tableau vivants*" that reveal "short vignettes" of courage, bravery, agency and co-authorship when enslaved individuals were denied literacy. Bly uses the language of dramaturgy to illuminate the "concealed" narratives: "By running away, slaves compelled their masters to respond"(Bly 2021: 240–241). Christy Hyman studies runaway slaves as a human geographer. She looks at where enslaved persons went to "build a spatial model of fugitivity" that centers "enslaved placemaking" rather than reliance on colonial mapping paradigms.[11] Hyman uses runaway slave ads to show how fugitives moved through "punitive landscapes" and facilitated or created new networks of geographic knowledge.[12]

The changing discourse in how historians examine slavery and acts of self-emancipation recognizes runaway slave advertisements as a mechanism of surveillance that monitored and traced not only the escaped enslaved, but their network of support as well. Enslavers often placed within the advertisements potential locations where they presumed their property might have fled. It created a communication network between enslavers, slave catchers, overseers, jailers and everyone vested in upholding the racial order of slavery to monitor, identify and recapture so-called "fugitive slaves". Yet, these geographical markers pointed towards family – wives, children, husbands, parents – and relatives in neighboring counties or acquaintances who might endeavor to help the enslaved person escape North. Their need to stay close to their loved ones confronted the forces that broke up the family unit in systems of slavery. This formed a basis for a new subjectivity reinforced through kinship and community support. Their ability to evade recapture for months, years and even forever attests to the strength of the network of care and mutual aid between enslaved communities (Johnson 2020).

3 An interdisciplinary approach to mapping self-emancipation

In following and mapping the routes of self-emancipation documented in runaway advertisements, our proposed digital history project seeks to reconstitute agency and refute geographical practices of colonialism in documenting the histories and lives of those enslaved. Colonialism brings with it a fracturing force – most evident in the colonial practice that geographically breaks up parts of the

11 Christy Hyman, "GIS and the mapping of enslaved movement: the matrix of risk." *Environmental History Now*, August 19, 2021, accessed March 25, 2022, https://envhistnow.com/2021/08/19/gis-and-the-mapping-of-enslaved-movement-the-matrix-of-risk/.

12 Christy Hyman, "The Disappearance of Eve and Sall: escaping slavery in North Carolina," *Black Perspectives African American Intellectual History Society*, October 6, 2020, accessed June 28, 2023, https://www.aaihs.org/the-disappearance-of-eve-and-sall-escaping-slavery-in-north-carolina/.

world via color-coded maps and redlining practices in urban planning. American chattel slavery facilitated the segmentation of enslaved families through "being sold down river", acts of self-emancipation, sexual violence and coercive reproduction and death. Within the archives of the Federal Writers' Project in the Library of Congress sit thousands of records and accounts of forced separations used by enslavers as part of the mechanism of control and the multitudes of ways enslaved people have tried to mediate and transcend those circumstances. The Library of Congress is but one archive with the means and resources to preserve such stories from the margins. Runaway slave advertisements present another archive to conduct the same work.

Historian Elizabeth Maddock Dillion noted that authorship is interaction between multiple roles. While she is referring to the structure of the archives that often reproduces colonialist narratives by prioritizing materials most prominent in the larger narratives of the state or national story, it is useful and necessary to disembed narratives literally placed at the margins – in footnotes, appendices or altogether unmentioned – out of the colonist context.[13] Antonio T. Bly similarly asserted that the silent actions of the enslaved in forcing their enslaver to respond to their escape, in refusing a name given by the enslaver, and in the identifiers they take on implies their co-authorship in the subtle subtext of the runaway advertisement (Bly 2021: 246–247).

Although runaway advertisements varied in length, they commonly featured the enslaved individual's physical appearance, speech, manner of dress, behavior and, when applicable, trade skills – all attributes that were thought to easily identify him or her and would lead to their recapture. The narrative biographies offered within runaway advertisements enable a fuller understanding of these documents.

One of the earliest digital history projects to specifically examine runaway advertisements was "Geography of Slavery in Virginia" from the University of Virginia in collaboration with its Center of Technology and Education.[14] Funded through grants from the National Endowment for the Humanities and Virginia Foundation for the Humanities, the digital project built on a HTML platform compiled not only a repository of runaway slave advertisements in Virginia, but also incorporated static maps of the routes of enslaved individuals and timelines. The project, built in 2005 and intended to host collections of student projects on slavery in Virginia, is dated and has not been updated or maintained with intent to complete.

13 OIEAHC Lecture Series, Elizabeth Maddock Dillon and Alanna Prince, "Decolonizing the archive," April 15, 2019.

14 Tom Costa, "Geography of slavery in Virginia," University of Virginia, 2005, accessed March 15, 2022, http://www2.vcdh.virginia.edu/gos/.

"Geography of Slavery in Virginia," like many digital humanities works done as individual projects, emphasizes the microhistories of its subjects and usage of digital tools to extrapolate new interpretations and storytelling. It is hindered by lack of necessary labor and resources to carry it forward. This is a component of scaling digital history and humanities projects that cannot be overlooked. The technology available for the project limited the visualization of interpretations and how its microhistories might interact – such as each enslaved individual is mapped separately. Nevertheless, the project used a digital medium to consider the same questions and build on work previously done. It integrated digital technology to examine alternative and overlooked sources. It facilitated digital learning for a project of its time and technological period.

As humanities scholar Patrik Svensson on the state and future of pedagogy in the humanities, the core values of "a predominantly textual orientation and a focus on technology as tools"[15] seems to ignore the interdisciplinary nature of digital humanities work that moves beyond the fields of English and history. Luckily, new digital tools from Kepler.gl to ArcGIS are offering new ways of thinking about and doing history. Data visualization is emerging from textual analysis to provide nonlinear, nonconventional methods of reinterpreting existing datasets and archives. Different methods for interpretation offer new sets of questions we may not have thought of asking before. Data visualization shows ghosts within the archives by giving visual presence to missing and erased voices and that which cannot be quantified. Through mapping, it provides an added layer of spatial narrative for large datasets that might otherwise be ineligible for historians and scholars.

Yet, digital technology cannot be treated simply as digital tools. They come with their own sets of limitations and possibilities. Scaling digital history requires context in both content and technological awareness; both should work in tandem to take a closer look with the ability to zoom out as needed. Our project proposes mapping the routes of enslaved people's attempts to self-emancipate to highlight and focus on individual narratives that can contextualize within the national narrative on slavery. Well-documented stories of self-emancipation are those that have captured national attention as in the case of Margaret Garner, Henry "Box" Brown, and Elizabeth Freeman. Yet, more often they are compilations of partially told stories that, if fortunate, have been collected into archives and stitched together to create a more cohesive narrative. Most stories of self-emancipation, however, disappear. Rarely do we find or know the outcome of

15 Patrik Svensson, "Envisioning the digital humanities," *Digital Humanities Quarterly* 61 (2012), accessed June 28, 2023, http://www.digitalhumanities.org/dhq/vol/6/1/000112/000112.html.

whether an individual has made it to freedom or has been recaptured and returned to slavery. How do we continue these narratives when so much is missing? More importantly, how do we fill in the missing pieces of the story without speaking for those enslaved whose stories remain perpetually co-opted and revised?[16]

The propensity of scholarship to sideline the microhistories of enslaved people due to the impasse in evidentiary gaps – missing and unfounded data in the archives – might be mitigated by layering and juxtapositioning with existing and available environmental, ecological and geographic data. This laying of temporal, spatial and historical data utilizes the concept of thick mapping (also called deep mapping) in the digital humanities to construct and reconstruct fragmented social and cultural moments (Presner et al. 2014: 15–18). Hard data (climate, demographics, geolocations) layered with soft data (images, events, oral histories) creates a more cohesive intertextual reconstruction of fragmented and missing narratives.

This evidentiary parsing of the past requires an interdisciplinary approach to reconstructing individual narratives of seeking self-emancipation and necessitate the incorporation of other forms of data. The materiality of mapping, when made digital, allows more networked relationships between "multiplicity of layered narratives, sources, and even representational practices" (Presner et al. 2014: 17). If we view runaway advertisements as a form of micro-maps, revealing the destinations and projected routes enslaved people took, other establishing factors become evident as new geographic markers within the narrative:

1. Sites of transgression such as plantations, farmhouses, towns and cities, churches, commemoration events, etc.
2. Sites of surveillance such as mills, markets, general stores, jails, etc.
3. Sites of communications such as taverns and inns, waterways, ports, printing offices, etc.
4. Sites of punishments such as jail stocks, auction blocks, plantations, etc.
5. Sites of safety and sites of danger such as safehouses on the Underground Railroad, homes and communities freed Blacks, woodlands and swamps, weather conditions, presence of wild animals, etc.

16 The aforementioned *Runaway Project*'s Twitter Account utilizes artificial intelligence to generate tweets based on runaway advertisements in a series of tweets called "Tweets_from_runaway_slaves." An algorithm is used to extract information from each inputted advertisement that are then restructured and reworded into first-person accounts from the enslaved individual-using artificial intelligence to literally speak for enslaved people from information written by their enslaver. See *Runaway Project* 2020 Twitter feed, "Tweets_from_runaway_slaves," accessed June 28, 2023, https://twitter.com/FromSlaves.

Returning to George and Phebe's story, we learn more about their escape from bondage by examining environmental details from early July 1826. Many come from previously digitized maps, newspapers and personal correspondence. From one 1827 map, we can list the many counties crossed: Orange, Madison, Culpeper and Facquier. This same map shows the industrial and natural topography: busy turnpikes, rushing waterways and active mills along George and Phebe's purported flight along the edge of the Blue Ridge Mountain system (Böÿe et al. 1827).[17] The natural landscape paradoxically offered protection while camouflaging hazards. An encounter with domesticated and/or wild animals could mean further danger (Silkenat 2022). From newspaper accounts, we know it was rainy across the region.[18] From the July 8, 1826 advertisement, we know George and Phebe left on "Monday night last" – or Monday, July 3. This would have been the night before the 50th anniversary celebrations for the signing of the Declaration of Independence. It was also the night before Thomas Jefferson, author of the Declaration, died at his home approximately two miles from Highland. Did George and Phebe also know that the old friend and mentor of their enslaver, James Monroe, was on his deathbed? Did this impending death preoccupy the Highland household, in addition to the "unfavourable weather," offer the perfect cover for the couple to escape together? Uniting these factors via digitized primary sources allows for a nuanced read of the runaway slave advertisement. In this way, the ad almost becomes a map of a moment. It is a microhistory where commemoration, weather, and mortality link up. Under this situation, conditions may have been as good as they would ever get for George and Phebe to escape together. What if we could replicate this layering of increasingly available sources for other runaway slave advertisements, thus creating fuller depictions of enslaved agency and interconnected historical processes?

George and Phebe's story, in many ways, are not unique. Thousands of enslaved people have endeavored a path to freedom. Most of these stories are lost, erased and fragmented within the historical archives. Often what remains are described singularly within a short runaway advertisement. An interdisciplinary approach to creating micro-maps from each advertisement can certainly function as a way to scale history and combat the fragmentation of evidence to bring these individual's stories back into our collective history and memory. Throughout our collaboration, we discussed scale and scalability in a variety of modes. First, we looked at fugitive slave advertisements for *geographic or spatial mode*: where

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17 See also Map of Virginia, accessed June 28, 2023, https://www.loc.gov/item/2012589665/.

18 "The Jubilee," *The Richmond Enquirer* July 11, 1826; "Chesterfield celebration," *The Richmond Enquirer,* July 18, 1826.

were enslaved human beings headed, and where were they coming from? This is often the first level of interpretation within the humanities and humanistic social sciences. Second, we continued with the *temporal*: when did these advertisements get placed? The "where" and "when" were both determined by our available archive, the *Virginia Gazette,* as well as our primary site of interest.

From concrete modes, we moved into the emotive or subjective realms of scale. With careful close reading, these advertisements connote a *relational or emotional scale*, as they are vignettes of desperate escape and feared re-enslavement. Within this emotive space, we also examined *community and family* within each text, as evidenced in the above example of George and Phebe: couples running away together, conceivably into networks of care and assistance. Finally, perhaps most obviously, we looked at these advertisements as relational, between *enslaver and enslaved*. These advertisements demarcated individuals by skin color, dress, skillset and kinship. There is a form to these texts. They indicate the system of enslavement as a process where certain human beings were denied their own bodies, their own systems of knowledge and they could be ruthlessly and violently apprehended to maintain the free/unfree binary that undergirded all aspects of life in the United States.

In addition to these modes of historical scale, we also considered how digital projects introduce additional scalability, primarily through *access and funding*. This is particularly tied to institutional support and/or cross-institutional collaboration. When reviewing projects, we considered their relative impact and influence: what audiences were they reaching and how easy is their interface to navigate? Much of this accessibility is contingent on funding mechanisms that sustain both the interface and the content. Access, in particular, has become a fundamental pedagogical tool amid an ongoing pandemic where virtual programming has become central to spaces of instruction, including school classrooms and museum spaces.

4 Making histories public

Our proposed project translates the aforementioned academic history into public history – scaling content for a broader audience. Public history does not water down content. Rather, it shifts according to its audience. However, this does not make public history an equitable space of knowledge production; it too must reckon with how its own disciplinary history in the United States centered on whiteness for over a century (Meringolo 2012: iiv). Under this rubric, histories were untold. If artifacts were on display, they were often linked to white historical personages or elevated for their "physical qualities" (Meringolo 2012: 72). Without observable presence in archives, many historical narratives disappeared into their respective oral traditions. Sites of public history were constructed to privilege white audiences' understanding of the United States as a superior and innocent global entity. By ignoring Thomas Jefferson's rape of Sally Hemings or Andrew Jackson's slaughter of Native Americans, public history absolved the Founding Generation and sanctified the abstract American values of liberty, justice and equality as inalienable rights for white men only.[19]

Through the efforts of historians, anthropologists, archivists and community activists, the white supremacist monolith of public history now shows cracks – often most visible in online venues. How does public history relate to digital history? Ideally both fields bring audiences into private and public spaces – transforming the idea of site visitation – to encourage cross-institutional projects, provide models for future projects and "to democratize history: to incorporate multiple voices, reach diverse audiences, and encourage popular participation in presenting and preserving the past".[20] Public history and digital history migrate across multiple mediums, and with varying results. Trial-and-error operates in both fields too, and some interpretative devices work better than others. Digital public history can help undo entrenched and colonialist orderings of the past. Uniting history done beyond academia with available and accessible technologies helps to challenge colonial epistemologies and share new interpretative frameworks to privilege the historically marginalized.[21] Most importantly, digital history shows that revision is a part of any good historical process, public or otherwise. The digital might never be done; it just needs to go live with corrections and updates welcome – encouraged, even.

We ground our proposed project in the realm of digital public history. We do not want to reinscribe racist, colonialist, normative reads of these advertisements but use them to display new networks of agency, resistance, migration and community (Risam 2018: 4). Despite our framework, rooted in theoretical approaches, we have deliberately limited our own use of academic jargon to create an accessible, relevant and readable body of literature. This is known history and we are privileging another perspective over more traditionally, well-documented ones, such as those of enslavers. By examining runaway slave advertisements from a specific time period and a specific place, we also shed light on how the system of

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19 By American, we specifically mean the United States of America.

20 "Our story," *Roy Rosenzweig Center for History and New Media*, accessed May 8, 2022, https://rrchnm.org/our-story/.

21 "Digital history & historiography" *Luxembourg Centre for Contemporary and Digital History*, accessed May 8, 2022, https://www.c2dh.uni.lu/research-areas/digital-history-historiography.

chattel slavery in the United States reverberated across time and space into our current moment. The implications are tremendous: displaced systems of kinship and community knowledge; generational trauma through family separation; and the mechanisms by which people found freedom included new names and new backgrounds.

5 Conclusion

For us, the question is clear: how can technology reveal history's *tableau vivants*, to return to Antonio Bly's work – the "exploded moments of life" buried within historical documents? The methodological and pedagogical goals of any digital humanities work is to avoid replicating colonialist practices and superstructure of these projects. The danger lies in treating stories as data, which further dehumanizes and delegitimizes the potential of digital history to make positive change. We need to be aware of the cultural history of the technology we are using. The project has a history that must be acknowledged in order to be undone.

Let us return to the opening example of George and Phebe. Often the scaling of history necessitates the movement across multiple platforms and media. Through the printed advertisement, we see their biography unfold despite their enslavement. We digitally map their relationship, their community centers, their environments, their trajectory of self-emancipation. How powerful would it be to use available and accessible technology to place George and Phebe on the landscape of early nineteenth century Virginia? It would show enslaved human experience beyond the plantation boundary. How might this boundary-breaking behavior in 1826 Virginia also break scholarly boundaries of historical interpretation in 2022?

In doing digital history, we cannot lose sight of the humanity found in runaway slave advertisements. These were individuals who endured unfathomable violence and trauma. What epistemological and methodological approach might we engage with in the digital realm to acknowledge the dignity of enslaved persons? In this, we look to the landing page for *(Un)Silencing Slavery: Remembering the Enslaved at Rose Hill Plantation, Jamaica*: "The Purpose of the (Un)Silencing Slavery at Rose Hall Project is to respectfully and lovingly remember and hold space for the enslaved Africans and their enslaved African-born and Caribbean-born descendants who lived and labored at Rose Hall Plantation in Jamaica". Before you can explore names, dates and documents, you must confront this statement centered on your computer screen. *(Un)Silencing Slavery* is "a memorial [. . .] a site of mourning and grieving [. . .] a gesture of gratitude and appreciation, and [. . .] a catalyst for the ongoing recognition, exploration, and presentation of the enslaved persons of African descent at Rose Hall”.[22] If we acknowledge the dignity of enslaved persons – and not their potential as data points – we move towards more respectful and transformative digital humanities scholarship.

Where most accounts of George and Phebe began and ended with a single advertisement placed by their enslaver, we reassert their agency and voice by stressing their conscious movement. By re-scaling focus on their personal journey, revealed through the powerful act of self-emancipation, we can see their human forms more clearly.

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Media

Fred Pailler and Valérie Schafer

Keep Calm and Stay Focused: Historicising and Intertwining Scales and Temporalities of Online Virality

Abstract: After explaining why spatialities and temporalities, as well as platforms, matter in the historicization of virality, this chapter takes the Harlem Shake as a case study to demonstrate how a scalable and medium reading may allow to reconstruct past virality. It discusses the challenges of flow and circulations of memes, the sources and tools that may be used to renew an approach that may benefit from a contextualization, which is not only dedicated to content and to a semiotic approach, but also to the containers, the communities and stakeholders involved in these flexible and deeply adaptable phenomena. By intertwining sources from the live and archived web, by crossing corpora, based on the press, the archived web and social networks (Twitter in this case), the authors enlighten the complexity at stake in the reconstruction of past virality.

Keywords: memes, virality, Harlem Shake, scalable reading, medium reading

The history of the Internet and the Web was boosted by leaving behind a rather US-centric vision (Russell 2017), in favor of analyses that shed light on more tenuous aspects, missing narratives (Campbell-Kelly and Garcia-Swartz 2013) and national appropriations (Schafer 2018; Siles 2012; Goggin and McLelland 2017). The history of digital cultures also benefited of this change in scale. It favored studies that were more focused on specific domains, be they national, dedicated to some stakeholders such as early adopters (Paloque-Bergès 2017), fan communities (Horbinski 2018) or previous communication networks (Driscoll 2022). The study of so-called "Internet phenomena", such as memes, also requires this type of approach: they must be anchored both in a general digital movement, supported by technical platforms that allow the international, near-instant circulation of content – a movement linked to the more general phenomena of the circulation of globalized information – and in an approach that fully incorporates the spatial and temporal variations of their circulations. This is necessary when it comes to memes, as circulation, flow, appropriation are inherent in their definition: based on the genetic metaphor created by Dawkins (1976), the notion relies on the idea of cultural units that circulate and are transformed. *Memetics* is actually a theory based on a dissemination model for cultural elements that are able to replicate themselves and spread within a cultural space. However, the deeply adaptable, flexible and

https://doi.org/10.1515/9783111317779-006

shifting character of memes makes sense in context and this context has to be reconstructed as it can't remain a blind spot: the semiotic transformations of memes are constituted within social groups and follow a logic that touches on the very history of the relationships between these groups (Milner 2018).

This chapter thus takes online virality as its starting point, specifically that of memes and the question of their historicization,[1] to question how they may be resituated in a context of production and circulation, taking social, spatial and temporal logics into account. To do so, a multi-scalar reading must be applied to them and full advantage must be taken of both "scalable reading" and "medium reading" (Schafer 2019). Indeed, the intent "to move 'gracefully between micro and macro without losing sight of either one' in a collection, to see 'patterns' and 'outliers', to zoom in and zoom out and to understand what 'makes a work distinctive' within a 'very large context'" (Flanders and Jockers 2013: 17, 30) is key. However, we will show that the question of scalability is as much about constantly zooming in and out, switching between distant (Moretti 2007) and close reading, as it is about a cross-functional, multiplatform, media-based reading: one must also consider the infrastructures and players enabling its distribution/circulation, as well as the heritagization/preservation of these Internet phenomena. This implies complementary levels of reading, which can't focus solely on content, but also have to dig into the conditions of production, circulation, preservation and even on access to data (Dobson 2019). After a discussion of the scalable reading as applied to virality, with specific emphasis on spatial and temporal aspects, we will propose a case study based on the Harlem Shake.

1 Temporal and spatial challenges of online virality

Several disciplines have shown a particular interest in the study of virality, and notably of memes, be it semiotics, communication studies or media studies (Shifman 2014; Milner 2018 and many others). However, these studies often focus on one platform (YouTube is largely at the heart of Shifman's pioneering work), or on their meaning, be it political (Denisova 2019) or semiotic (Cannizzaro 2016; Wagener 2020). A historical approach, situated and contextualized over the short lifespan of

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1 The historicization of online virality is at the heart of the Hivi research project, "A history of online virality", that we are conducting at the University of Luxembourg with the support of the FNR (C20/SC/14758148). See hivi.uni.lu.

the web's history – but one that is dense, given the extremely fleeting and rapid virality of certain phenomena, is less often considered. Yet both the spatial and temporal dimensions – to which scalable reading can be applied – are essential. These dimensions are at the heart of all viral phenomena at many levels: at the origin of the phenomena, their circulation, resurgence and posterity.

1.1 Temporality, spreadability and trends

The temporal dimension is evident in the case of the oldest Internet phenomena, whether we think of Godwin's Law (which spread from the first half of the 1990s), the Dancing Baby (1996) or the Hampster Dance (1997). These three examples, among others, are admittedly different in nature. The first phenomenon, which circulated in the early 1990s in Newsgroups, initially in text form, states that "as an online discussion grows longer, the probability of a comparison involving Hitler approaches 1";[2] the second owes its success to its 3D realization, which was remarkable for the time; the third to the catchy nature of the Disney music and the animation created in 1998 by a Canadian student, whose website rapidly gained in popularity. Their origin is well documented in the press titles, along with on platforms such as Know Your Meme (KYM) or Wikipedia. There is a variety of actors, from Deidre Lacarte's individual composition of hamster GIFS on Geocities to the more complex journey of the Dancing Baby, which was created in 1996 by Michael Girard and Robert Lurye, with a program designed by Character Studio and used with 3D Studio Max and a Microsoft computer. The popularity of the Dancing Baby benefited then from its format's adaptation and circulation through e-mail by Ron Lussier, who worked for LucasArts, and, from 1996 too, from its transformation by John Woodell, a software engineer who created a GIF (Pereira 2022).

These pioneering phenomena are thus deeply rooted in a technical context (i.e., development of gifs and animated images) and in uses (BBS, emails, popularity of Geocities, etc.). It is difficult to get an idea of their real circulation in this first age of the Web beyond the indirect traces that allow us to grasp their influence. Some phenomena remain elusive and are not preserved, such as the chain emails that existed even before virality developed on the Web. However, when Mike Godwin published an article in *Wired* in 1994 referring to his law, there was evidence of a growing popularity, which the publication of the article could only

2 See Mike Godwin, "Meme, Counter-meme", *Wired*, 10 January 1994.

reinforce. The Dancing Baby, that has become a symbol of the vernacular Web, appeared in the series *Ally McBeal* and was thus further opened up to the general public, while Lussier began to wonder how to deal with the re-uses of his creation in the face of the Dancing Baby's success (McGrath 2019: 511). The Hampster Dance and its animated GIFs (Eppink 2014) gave rise to commercial derivatives (i.e., "The Hampsterdance Song", which was produced by the Boomtang Boys and released on July 4, 2000). Such elements help to measure the popularity of this kind of content. A distant reading applied to Geocities would also undoubtedly enlighten some concrete uses of the Dancing Baby or hamsters in online pages, as Ian Milligan (2017) did for instance, for the bounding tiger from the Enchanted Forest community.[3] Milligan's study is based on archived Geocities pages. This study is only possible thanks to image extractions on a determined, circumscribed corpus, when for example the dancing baby circulated via email and on very different websites.

Whether it is these pioneering memes or other Internet phenomena that span time, they are often presented in the form of detailed chronologies, either in the KYM platform or by Wikipedia.[4] This is the case of the Rickroll, a famous prank inspired by an ancestor, the Duckroll, which first appeared in 2007. The Rickroll involves inviting online users to click on a hypertext link by proposing attractive content, in order to direct them to the song (and often the video) *Never Gonna Give You Up* by Rick Astley, released in 1987. The White House and the Anonymous got on board with the Rickroll,[5] making it more popular. These demonstrations happened sometimes in the public space: in 2014, the group Foo Fighters "rickrolled" an anti-gay demonstration organized by the Westboro Baptist Church. These cases allow us to monitor the visibility of viral phenomena, but remain focused on "major" events, as it is difficult to grasp some more discreet uses.

Though we can ascertain success by the number of views regularly mentioned in KYM and Wikipedia,[6] or by their circulation in traditional culture (song,

3 Using Images to Gain Insight into Web Archives, accessed July 11, 2023, https://ianmilli.wordpress.com/2014/08/11/using-images-to-gain-insight-into-web-archives/.

4 The reason why these two rather different platforms are mentioned in parallel is that both have chosen an encyclopaedic style, a collaborative model and are interested in Internet phenomena.

5 In 2011, the White House Twitter account responded to an online user by referring him to the Rick Astley clip. Praetorius Dean, "The White House 'rickrolls' its Twitter Followers", huffpost.com, 27 July 2011, accessed July 11, 2023, https://www.huffpost.com/entry/white-house-rick-roll-twitter_n_911345.

In 2015, after the terrorist attacks in France, Anonymous flooded pro-ISIS accounts with rickrolls to disrupt DAESH communications on digital social networks.

6 KYM mentions for the Hampster Dance: "LaCarte told the webzine that over the course of 4 days in March 1999, the site acquired nearly 60,000 new hits. Three months later, it broke 17 million views". Accessed July 11, 2023, https://knowyourmeme.com/memes/hampster-dance.

series), it is difficult to accurately measure past viewers. Wikishark or Google trends may provide some general information.

Wikishark (Vardi et al. 2021) measures the number of views of a Wikipedia page, as in the case of the Dancing Baby on English-language Wikipedia since 2008 (the Wikipedia page dedicated to the phenomenon was created in 2006). More recent visits in May 2022 (Figure 1) are probably related to announcements that HFA-Studio plans to release a digitally restored, high definition 1/1 artwork by the original creators as NFT.[7] Google trends also deliver results, but these contain noise. A Dancing Baby search will thus refer to a U.S. dance show. The refined search “Dancing Baby gif” provides some conclusive results, while also referring to the film *Dirty Dancing* whose female character is nicknamed Baby (not to mention the fact that Google trends remain a reading tool focused on Google consultations, which obviously leave out other search engines and audience[8]).

These trends, which have obvious biases (Google consultations, Wikipedia in English, etc.), remains indicative and they must be refined by cross-referencing sources.

1.2 Spatiality, transmediality and contextualization

In addition to the temporal aspects of virality, its spatial aspects are also key: for example, Matt Furie’s famous creature, Pepe the Frog, was appropriated by the U.S. far-right under Trump, and at the same time used to denounce police violence in Hong Kong in 2019 (Pettis 2021). It is therefore decisive to grasp the areas of deployment of a viral culture: presented as globalized, it has also national, local or even community variations, as well as circulation across several digital spaces.

Looking first at the circulation between platforms and media, there are many examples of complex circulation. This is for instance illustrated by the Distracted Boyfriend meme, a stock photo made famous from 2017. It initially appeared on Instagram, inviting users to “Tag that friend who falls in love every month” (Esposito 2017). A few months later its success was assured by its use on Facebook targeting Phil Collins turning lustfully towards “pop”, embodied by the young woman in the red dress (recalling the strong links between pop culture and memetics). On Twitter the image macro was associated with comments for each character, gradually increasing in abstraction. In addition to the fact that three platforms assured the suc-

7 See https://edition.cnn.com/style/article/dancing-baby-meme-nft/index.html, accessed July 11, 2023 and https://www.macobserver.com/news/longtime-internet-meme-the-dancing-baby-to-be-minted-as-nft/, accessed July 11, 2023.

8 Search for “dancing baby gif” in Google trends: https://trends.google.com/trends/explore?date=all&geo=US&q=dancing%20baby%20gif.

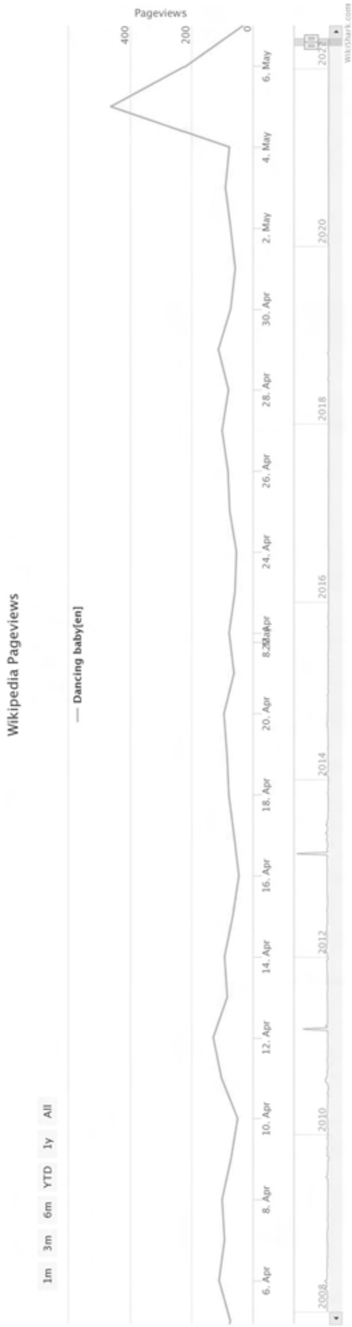

Figure 1: Wikipedia (en) Pageviews from 2008 for the Dancing Baby.

cess of this famous meme, the variations in meaning that appeared over the course of these circulations were also worth tracing, along with changes in audience that did not necessarily overlap. As such, it is essential to look at the platforms that ensure the circulation and transformation of memes. The logic of such platforms is not neutral, either in terms of curation, economic model or uses, or in terms of circulation and affect. Some more specific networks, in particular famous forums such as Reddit and 4chan, stand out since they often play a role in the early days of memes. For instance, a search in KYM of cat celebrities distinguishes spaces of creation and dissemination of these cats and their entry into culture at large, as shown by the extraction of 1,044 entries devoted to famous internet cats and their analysis via Gargantext.[9]

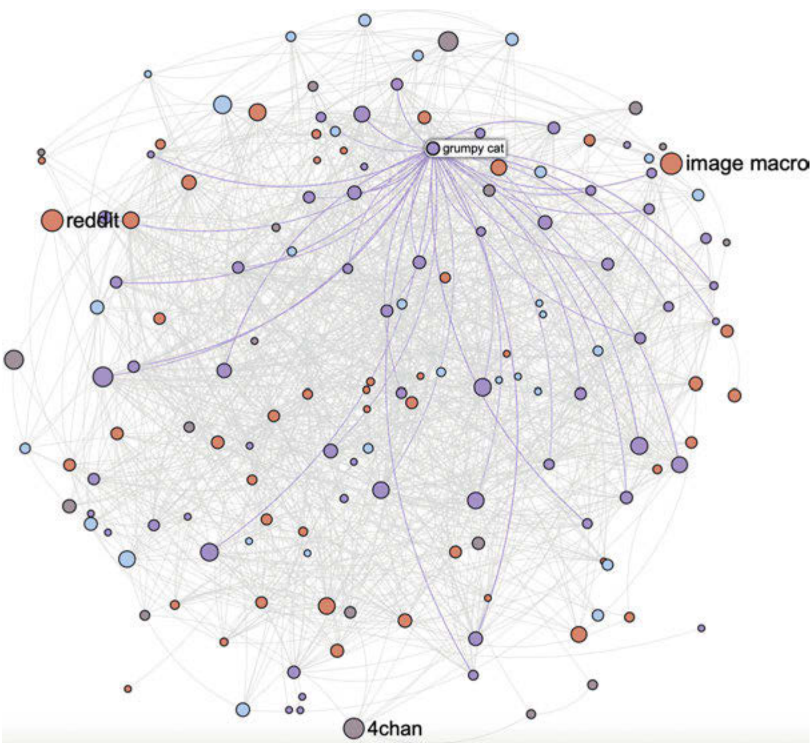

Figure 2: Extract 1 of a visualisation of cat celebrities in Know Your Meme through Gargantext.

9 This study was conducted in March 2022 with the support of Quentin Lobbé (Institut des systèmes complexes, Paris). We sincerely thank him.

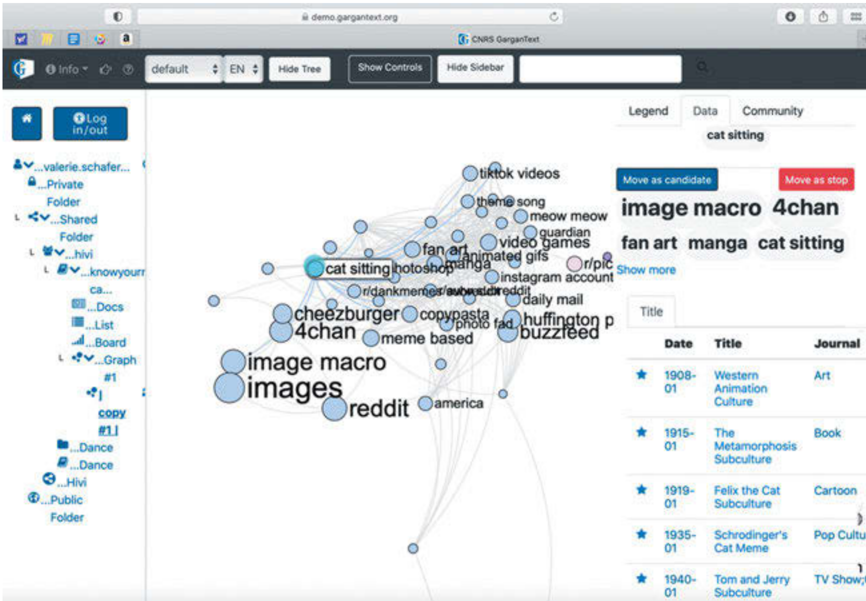

Figure 3: Extract 2 of a visualisation of cat celebrities in Know Your Meme through Gargantext.

Distant reading as applied to these 1,044 entries, which range from Felix the Cat and Schrodinger's Cat to Nyan Cat and Grumpy Cat, clearly shows the importance of the formats (macro image for Grumpy Cat, see Figure 2) and the previously mentioned platforms (e.g., 4chan, Reddit or Cheezburger for cats, see Figure 3), on the first steps towards success and virality.

Since the role of these platforms is undeniable in the creation and visibility of Internet phenomena, it invites us to closely look at the medium that ensures their dissemination, or even the media at large, since all these phenomena are cross-platform. Thus, the Rickroll mentioned above circulated on Twitter, on Vine, before the platform closed in 2019,[10] on forums (specifically video games, while the Rickroll of a Grand Theft Auto IV demonstration was the starting point of its success), and so on. Grasping all these occurrences is difficult, even when relying on web archives, for example those of the INA (French audio-visual institute).

Once again, the researchers must be fully aware of the limits of their research and of the results and the distant reading offered through the INA's interface (Figures 4 and 5): on the one hand, INA is limited in France to archiving audio-visual

10 "Vine Gets RickRolled: 16-Year-Old Developer Hacks App To Upload Full Rick Astley Music Video", *International Business Times*, 4 June 2013.

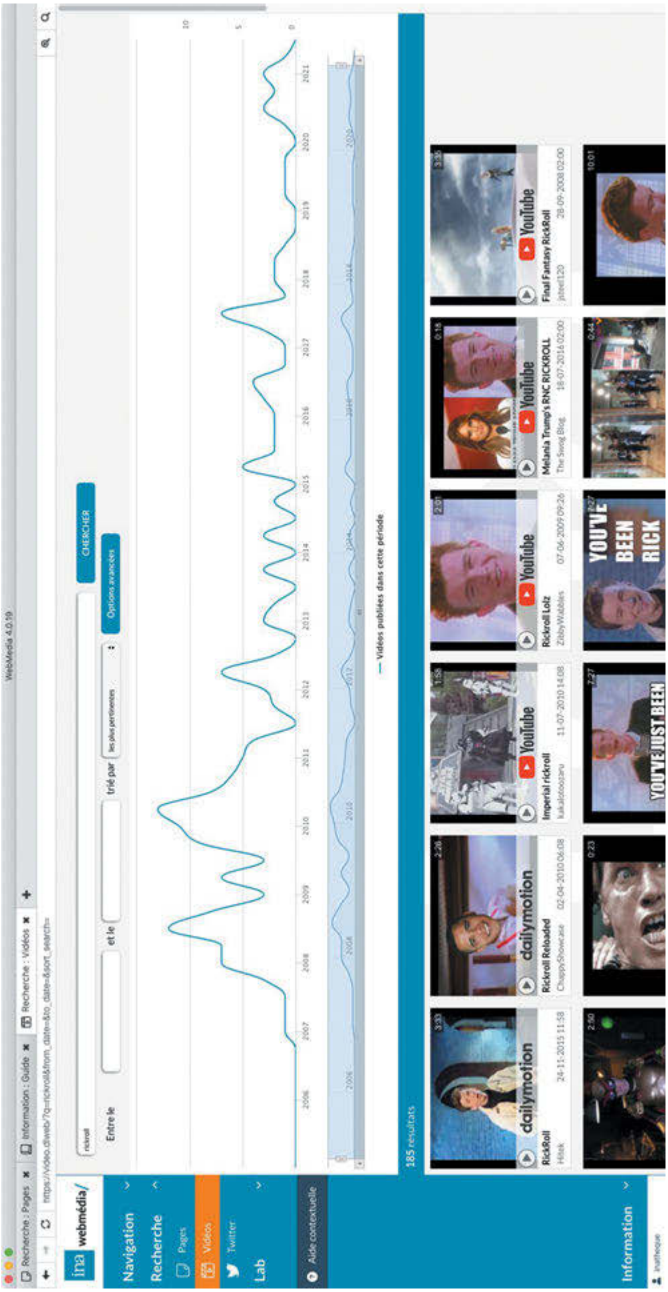

Figure 4: Capture of the INA results for videos related to the Rickroll. © INA.

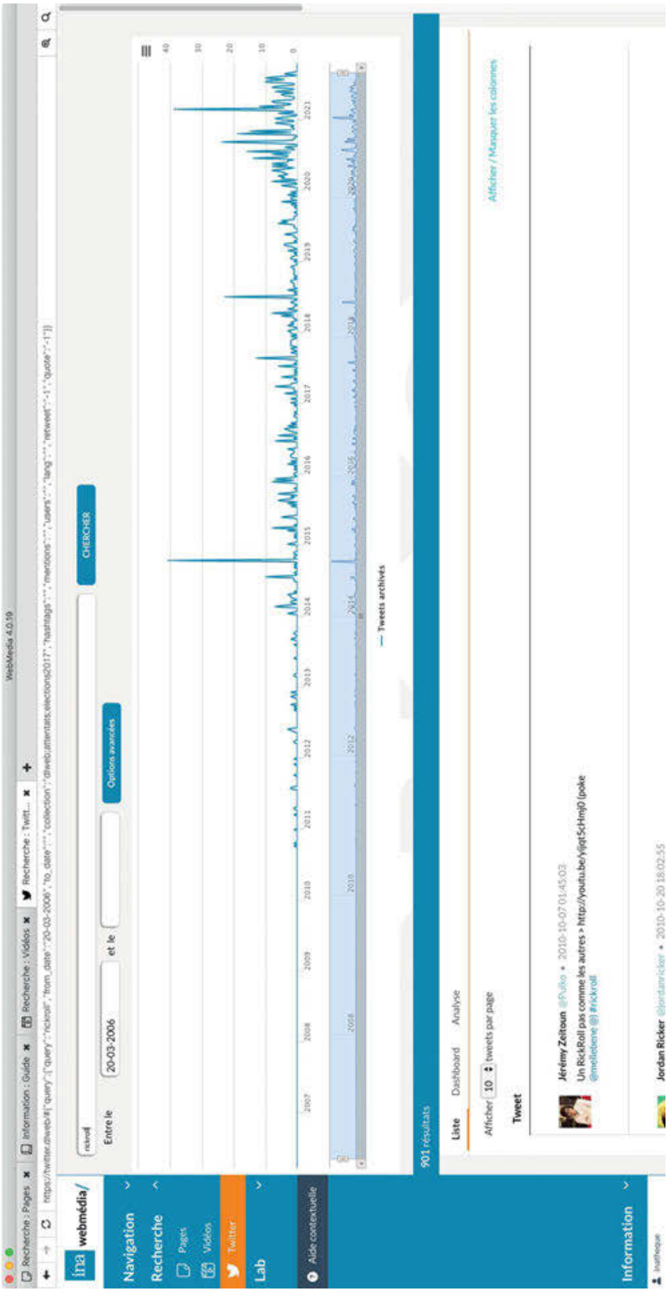

Figure 5: INA results for a query on tweets related to the Rickroll from 2006. © INA.

content, while since 2006 the BnF (National Library of France) archives "the rest" of the French "national Web". Thus, the Twitter accounts followed and archived by INA are essentially linked to the audio-visual sector (journalists' and channels' accounts). They do not represent the entire Twitter sphere, though the discussion threads do, of course, broaden the content. Moreover, the results contain noise (for example, a search for Numa Guy will yield results concerning not just the famous Lip Sync cover of the O-zone song, but also excerpts from interviews with a French researcher named Guy Numa). Above all, web archives are not intended to be exhaustive, rather representative (Brügger, 2018). In addition, virality spreads mostly on several digital social networks and we must often face their lesser archiving (Facebook) or total lack of archiving (Periscope, TikTok until recently). There are also issues of searchability in the web archives: virality is often difficult to name and find, as it is not necessarily based on a specific website or a single search term. Our BUZZ-F project, related to French virality and conducted jointly with the BnF Datalab over the academic year 2021–2022,[11] highlights these searchability difficulties in collections that are not yet fully indexed in plain text. There is a need for developing strategies to find traces of a viral phenomenon via, for example, the selection of URLs explicitly containing terms associated with it (Figure 6).

The experiment, conclusive on lip dub, a lip-sync phenomenon, nonetheless raises genuine methodological precautions. First, the lip dubs identified in the URLs are not representative of all mentions of lip dub which can be found on sites with another URL and in more generic pages. Second, lip dub, whose popularity was of particular note in 2011, is archived by the BnF within its methods and bounds at the time: many sites ending in .org, .com and blogs were not collected within BnF's 2011 collections, while lip dub is very much linked to uses in the corporate world. In addition, "the budget in terms of number of URLs defined per domain at the time of collection may have proved insufficient to allow archiving of all the content of a given site," noted Antoine de Sacy and Alexandre Faye during our collective work at BnF.

The above examples therefore push us to consider viral phenomena in terms of platforms and their conditions of selection, preservation, production, archiving and circulation, in addition to spatial and geographical contextualization. In his "*If It Doesn't Spread, It's Dead*" series of texts, Henry Jenkins (2009) developed the concept of *spreadable medias*. He constructed a model based on the convergence of media, the cross-media dissemination of content, and voluntary dissemination. These media must be placed at the center of the historicization of virality. In this sense, a scalable reading that restricts itself to a zoom effect is insufficient, as the

11 See https://bnf.hypotheses.org/19155, accessed July 11, 2023.

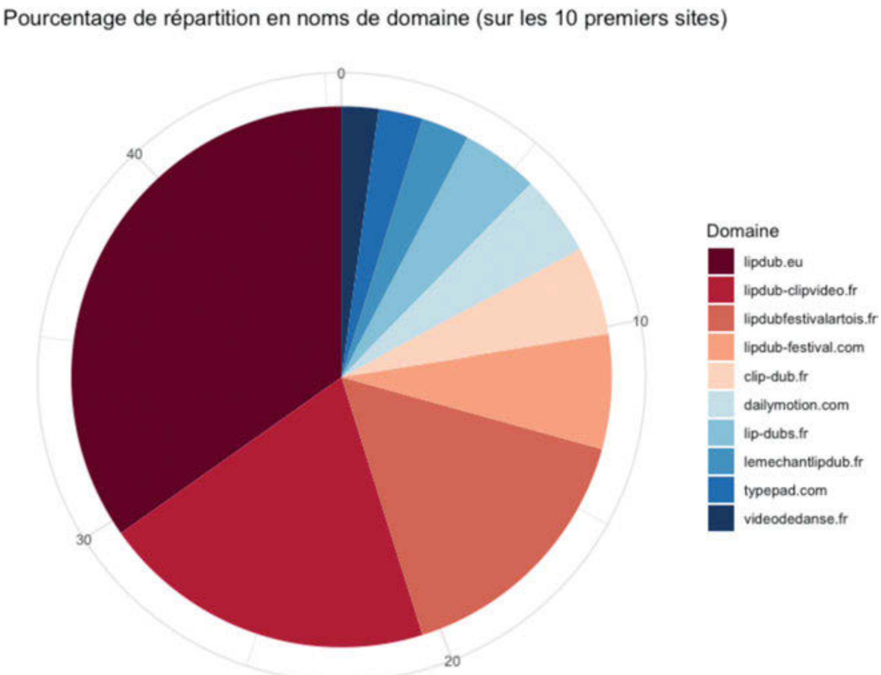

Figure 6: Percentage distribution of lip dub in domain names (on the top 10 sites) in BnF web archives (a visualization made within the BUZZ-F project by Antoine de Sacy and the BnF Datalab). © BnF.

medium (and its technical and socio-cultural conditions) must itself be constantly considered to conduct digital source criticism (Föhr 2017). Infrastructure studies and platform studies add an essential dimension to a semiotic, cultural or communicational study. They invite us to consider a "medium reading" in addition to a scalable reading, i.e. a reading via the (cross-)media context, and as much via the content as by its container. In the following section we will use the Harlem Shake as a case study to illustrate this approach.

2 "Keep calm and do the Harlem shake"

The Harlem Shake is a dance video that follows several compositional rules and was often uploaded to YouTube. It was a viral phenomenon in early 2013, combining characteristics such as the global, cross-cultural dimension with cross-platform circulation of an ephemeral nature. The Harlem Shake, which is in some ways a "mise en abyme" of viral contagion (Marino 2014) serves here as a salient example, though its characteristics do not correspond to all Internet phenomena. Indeed, some memes can circulate intensely on a single platform or in a single country. Some others such as the Rickroll can, unlike the Harlem Shake, be less spectacular in terms of audience and spread, but more consistent over time. However, the approach we conducted on the Harlem Shake through the BUZZ-F project with the support of the BnF datalab and through the Hivi project (i.e., scalable and medium reading, cross-analysis of live web, press and web archives and notably those of social networks) are applicable to other Internet phenomena.

2.1 A metaphor of viral content and memes

On 30 January 2013, George Kusunoki Miller,[12] an Australian-Japanese student living in the United States, posted a video of himself dancing in his room to the music by DJ Baauer, accompanied by three friends dressed in zentai costumes.[13] On 2 February 2013, an Australian skateboarder collective (The SunnyCoastSkate) responded to this publication by imitating the video[14] and added a two-step narrative construction: a helmeted character dances alone in an environment where other people are absorbed in routine tasks. Then, when the music drops, everyone suddenly finds themselves dressed up and swept into a bumpy trance. As the video went viral during February 2013, it was remixed and replayed by thousands of people.[15] They kept the narrative structure and the costumes, while adding new recurring elements to the Zentai suits, such as men in underwear mimicking sexual acts, a rubber horse mask and so on. Remaining faithful to the "original recipe" and to the "Harlem shake" title is central to the readability and identification of the remixes, and the absence of linguistic elements allows for easy dissemination across several geographical areas.

At the same time, major players in the sports and cultural industries participated in the massive dissemination of the initial videos. The viral nature of the Harlem Shake did not come first from a horizontal movement, from one individual to another, but instead from major relays that amplified the visibility of original content

12 Miller has long been active on YouTube, where he has a channel featuring various characters, filthy frank or pink guy (with the pink zentai costume seen in the clip). The viral nature of his video made his channel famous and launched his career as a singer-songwriter.

13 Miller's original video, accessed July 11, 2023, https://www.youtube.com/watch?v=8vJiSSAMNWw.

14 The "Harlem Shake v.1" video that set the standard for remixes, accessed July 11, 2023, https://www.youtube.com/watch?v=384IUU43bfQ.

15 An example of a Harlem Shake compilation, accessed July 11, 2023, https://www.youtube.com/watch?v=X6GSVYL6rwo.

posts (Ashton 2013). For example, on 8 February, the Original Skateboards company performed a Harlem Shake, making the most of the free publicity generated by a poster of the brand hanging on the wall in the young Australian skaters' video.[16] Much larger players became involved in the promotion of the original videos. The various members of Baauer's label, Mad Decent, mentioned the track produced by the DJ on Twitter. The label's YouTube channel redirected to the original videos which included Miller's, the Australian skaters', and a few others, thus offering a higher visibility to their respective accounts. This strategy was also based on the fact that YouTube's "Content ID service" made it possible to monetize Baauer's track, both for the version produced in 2012 as published on the label's channel and for the content uploaded by others, i.e. thousands of videos that used the same soundtrack (Soha and McDowell 2016). The Harlem Shake therefore strongly benefited from the work and investments of various players in the cultural industries. There was a convergence of multiple and diverse interests, linked to the possibility of publishing content individually and of the management of copyright by the video platform.

In addition, Miller's Harlem Shake and its thousands of remixes are largely part of a tradition of collective performance videos, whether sung, danced or both. The previous summer, 2012, saw the release of the "Gangnam Style" music video by Korean pop star Psy. The latter reached 1 billion views on YouTube in a matter of six months (the Harlem Shake reached the same figure in two months). Psy's clip presents a dance routine ("ride the pony") that is fun and easy to copy. In this way, it gave rise to gigantic *flash mobs*, such as the one at Le Trocadéro in Paris, organized by Universal Music and the French radio station NRJ, which brought together some 20,000 people.[17] Even earlier, other viral phenomena involved singing and/or dancing performances (for example in TV talent and reality shows, see Hill 2014) and giant flash mobs, such as the one at the start of Oprah Winfrey's show in Chicago in 2010 by the Black Eyed Peas. We may also mention lipdubs by political parties, companies or supermarkets, from the middle of the 2000s onwards, as well as reprises of dance routines by dance schools or by pupils in school or university playgrounds. The Harlem Shake comes from a broader chronology of dance or even collective mayhem: it stands at the crossroads between commercial strategies and previous media and public practices, and reasserted as part of the dissemination and monetization of Facebook.

16 The Original Skateboards video, accessed July 11, 2023, https://www.youtube.com/watch?v=-unIOs_Yt3w.

17 https://web.archive.org/web/20121108041729/http://www.france24.com/en/20121105-psy-draws-thousands-gangnam-style-paris-flashmob.

The Harlem Shake was also performed in North Africa and the Middle East during March 2013. Groups of students and high school pupils filmed the dance in turn. The fact that this happened in educational establishments or in public spaces took on an immediate political meaning. Indeed, some of the dancers were severely punished (Hawkins 2014).

The traditional media echoed these political tensions. They also played a major role in the dissemination of the phenomenon. Television and the press have regularly highlighted the videos uploaded by their listeners or readers. Moreover, regional and local press played a role in both reporting on the global phenomenon and documenting its local consequences.

2.2 Scalable reading of a “glocal” phenomenon through press and web archives

The press is an interesting source when examining the local importance of the Harlem Shake in addition to the global nature of its circulation. It can be analyzed thanks to digitized press databases such as Europresse and Factiva, but also coupled with online press web archives, which for France are preserved at the BnF. We also supplemented this media corpus with web archives kept by INA (the French Audio-visual Institute).

In a bilingual French-English corpus of international, national, regional and local press, retrieved from Europresse (which combines print and web editions),[18] the virality is seen to peak at the beginning of 2013. It then fell throughout the year, until the anniversary of the phenomenon in early 2014. In the following years (Figure 7a), articles appear sporadically on the subject. In fact, these articles tend to evoke the Harlem Shake as a paradigm of the viral phenomenon related to YouTube and social platforms in general.[19]

The Figure 7b focuses on the first half of 2013 and shows a peak starting slowly a week later than YouTube, towards the end of March. A kind of plateau during the first half of March could be attributed to different elements, either the increase in the local and regional press of mentions of Harlem Shake videos, or the authoritarian responses to which African and Middle Eastern dancers were subject.

18 The daily press corpus retrieved through Europresse contains 2,362 articles, which are then observed only for the period of the first half of 2013, thus retaining 408 articles.

19 Figures 7a, 7b, 11 and 13 were produced by Fred Pailler as part of the HIVI project.

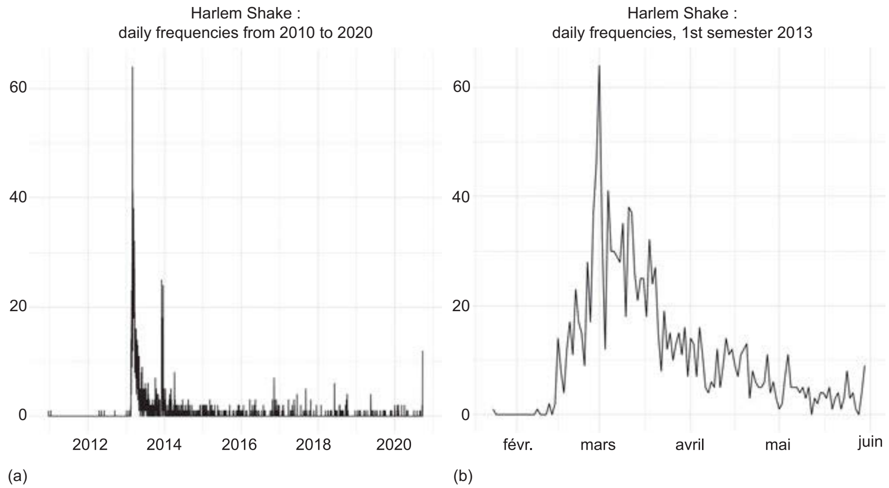

Figure 7a and 7b: Daily frequencies of articles related to the Harlem Shake in our Europresse corpus (7a. from 2010 to 2020, 7b. for the 1st semester of 2013).

The INA web archives show the same chronology of the phenomenon in terms of audio-visual media.[20]

A capture (Figure 8) dedicated to the French audio-visual web pages also clearly shows a peak in mentions in February 2013 and to a lesser extent in March.

In another corpus, that of the BnF web archives related to French online press articles published during the first half of 2013,[21] regional daily press websites stand out primarily (Figure 9).

In the BnF's web archives, a search from January 2013 to May 2013 by frequency of appearance of the term "Harlem Shake" in the DNS (domain names system) clearly highlights regional press alongside video platforms (Figure 10).

According to the Europresse database, regional dailies (i.e., *La Montagne, Le Berry Républicain, Le Dauphiné Libéré*) each published between 12 and 23 articles, while a national daily such as *Libération* published 12 articles and *Le Figaro* 10 articles over the same period. In the international and bilingual corpus from

20 For the Harlem Shake, the INA web archive provides 547,521 results for web pages and 27,161 results for videos (although there is some noise in the results, which also mention the booty shake for instance).

21 The corpus was made available by the BnF Datalab in connection with the BUZZ-F project.

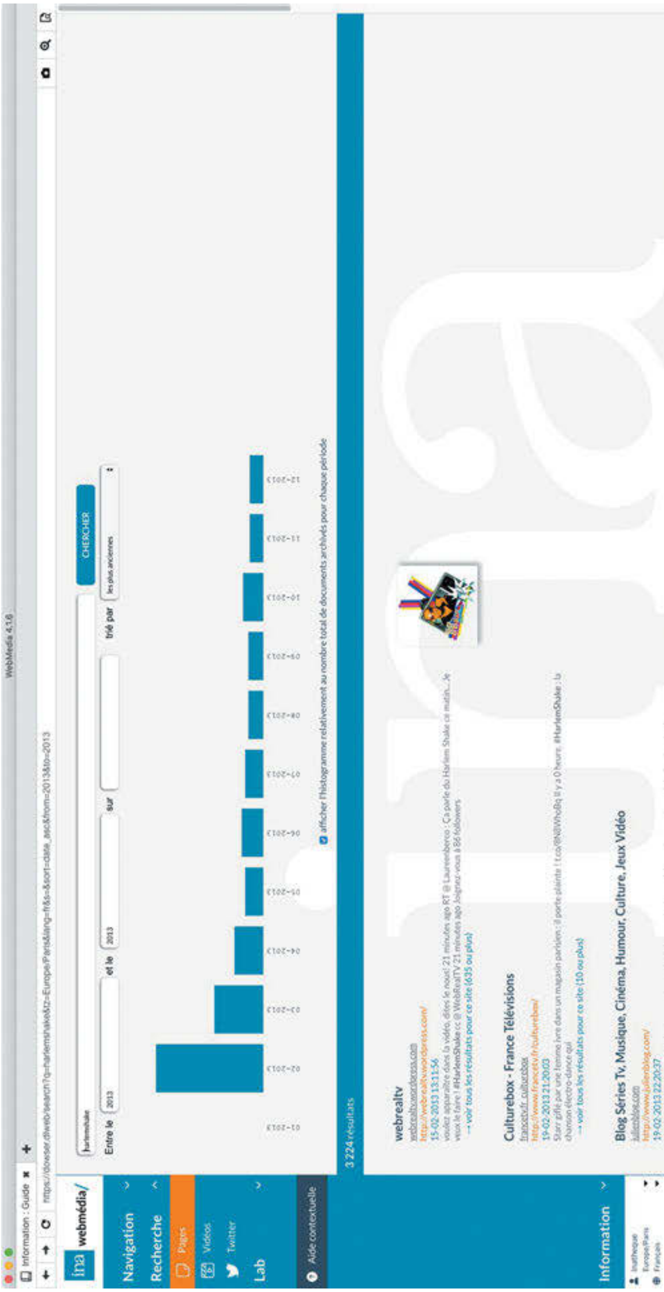

Figure 8: Web pages related to Harlem Shake in 2013 and archived by INA. © INA.

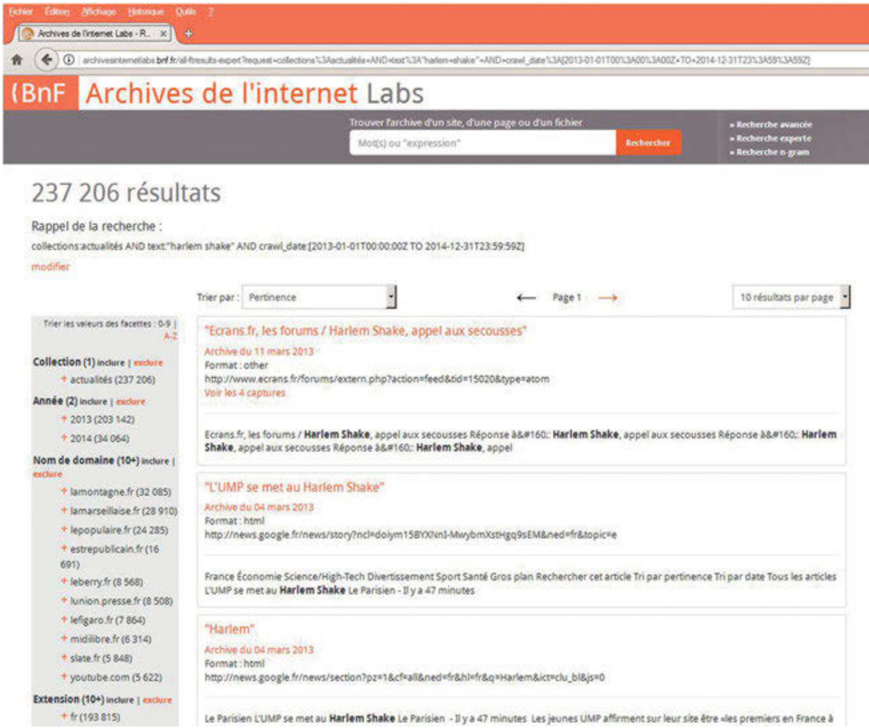

Figure 9: BnF web archives related to Harlem Shake in the collection Actualités (News) from 1st January 2013 to 31 December 2014. © BnF.

Europresse, we find a substantial presence of the regional and local press in France, the United Kingdom and Canada.[22]

Although the selection of titles via Europresse cannot produce representative figures for each country,[23] it is still possible to compare the newspapers' profiles. The regional daily press published articles on the Harlem Shake for a longer period than the international and national press. The purple boxplot (Figure 11) covers practically

22 It should be noted that, depending on the size and linguistic composition of the countries, the regional or local press may hardly exist or, in contrast, may be disseminated over territories comprising hundreds of thousands of people, i.e. larger than the territory of some national presses.

23 The corpus extracted from the Europresse database with the query "Harlem Shake" is made up of 65% French newspapers, 66.3% articles in French (mainly from France, but also from Canada, Belgium, Switzerland and Algeria), and 66.2% regional press (again mainly French, but also British and Canadian).

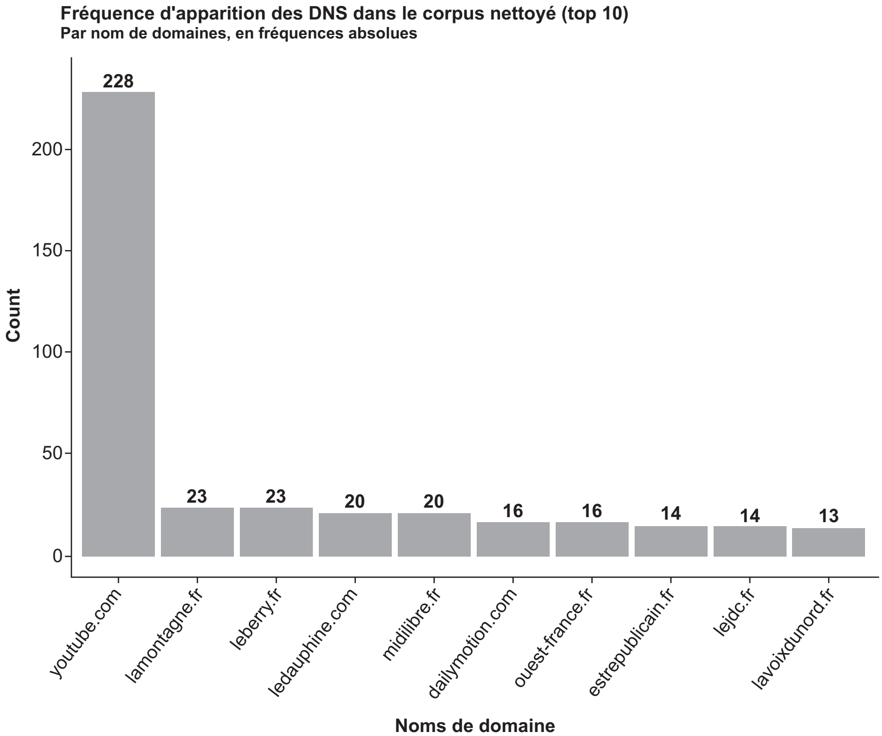

Figure 10: Frequency of appearance of Harlem Shake in DNS (domain names systems) in the cleaned corpus (top 10) of BnF web archives (January 2013 to May 2013). BUZZ-F project, BnF Datalab.

the entire period from the beginning of February to the end of June 2013, while the number of articles in the national press falls from mid-May. In the international press, articles become sporadic from late March onwards. 50% of articles published in the international press appeared prior to 1 March 2013, prior to 11 March for the national press and prior to 18 March for the regional press.

We may then have a further look at the various types of Harlem Shake treatment according to the territorial dissemination of newspaper through words frequency (Table 1). If we list the most common context-words[24] in the title or body of national and international English-language press articles related to Harlem Shake, we notice "craze", "meme" and "viral", while the regional press uses "craze", "new"

24 The results are based on a 10-term window around the phrase "Harlem Shake". The calculations are performed using the "KWIC" (Key Words In Context) function of the "Quanteda" text mining package (R. Benoit et al., 2018).

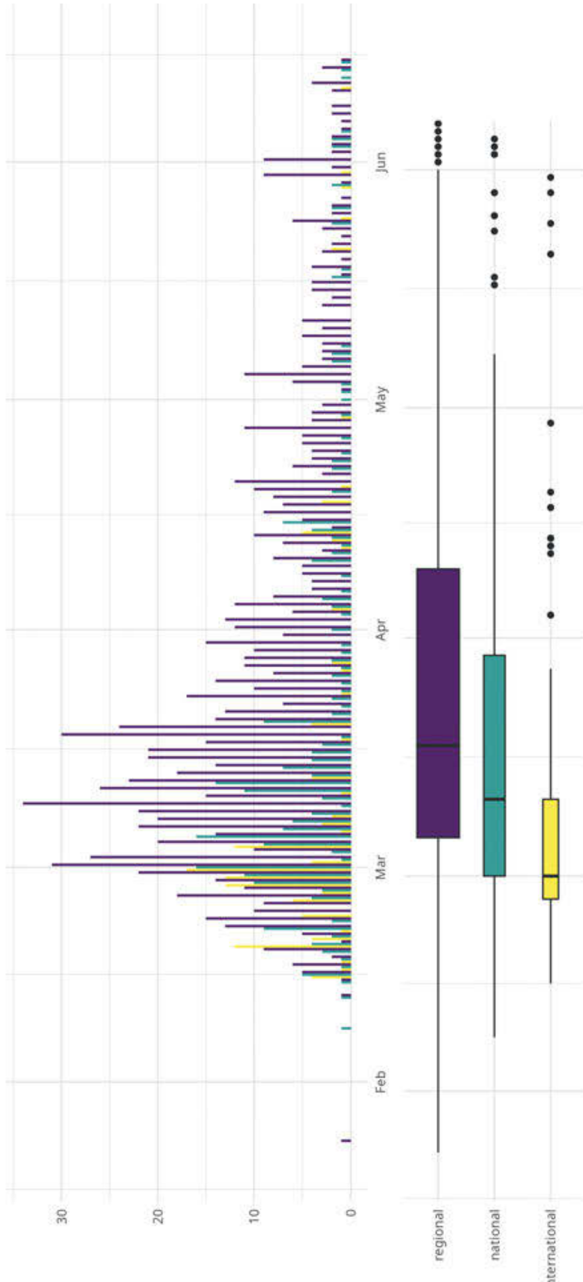

Figure 11: Daily frequencies of press articles by type of dissemination (regional, national and international newspapers).

Table 1: Words frequency in the Europresse corpus related to Harlem Shake.

EN nat/internat press		EN regional press		fr nat/internat press		fr regional press	
word	**n**	**word**	**n**	**word**	**n**	**word**	**n**
dance	81	harlem	24	a	110	harlem	812
harlem	62	shake	22	harlem	103	shake	810
shake	60	dance	20	shake	101	a	516
videos	46	videos	18	danse	63	vidéo	409
said	41	new	15	aussi	37	phénomène	318
youtube	38	hit	13	d'un	37	plus	302
video	36	video	13	youtube	36	c'est	255
week	30	craze	13	phénomène	33	personnes	232
craze	29	internet	12	plus	32	jeunes	203
song	29	students	11	c'est	31	internet	203
one	26	songs	11	vidéo	31	musique	185
new	25	permission	11	style	30	fait	182
hot	21	viral	11	tout	29	vidéos	180
baauer's	21	seeking	10	fait	28	harlemshake	174
style	19	compensation	10	depuis	27	buzz	166
real	18	people	10	gangnam	26	mode	164
people	18	student	9	tunis	25	danse	161
like	17	without	9	février	25	groupe	160
billboard	17	class	9	dj	24	place	156
dancing	17	miners	9	quelques	23	baauer	156
students	16	dancing	9	vidéos	23	youtube	154
crazy	16	song	9	web	23	loufoque	152
also	16	two	9	nouveau	22	dansant	134
just	16	said	9	tunisie	21	deux	129
worldwide	15	st	9	jeunes	21	faire	128
times	15	york	9	secoue	20	samedi	126
meme	15	used	9	l'education	20	tout	124
online	14	north	9	étudiants	19	manière	124
viral	14	australia	8	lire	19	février	124
thousands	14	recorded	8	ça	18	morceau	120

and "hit". For the French-speaking press, the noun "phénomène" (phenomenon) and the verb "secouer" (to shake) are favored by the national and international press. The regional press also uses "phénomène", along with "mode" (fashion/mainstream) and "buzz". The articles explicitly mention the viral nature of the phenomenon, adding a performative dimension to the journalistic treatment of virality.

The audio-visual media play on the same performative codes and vocabulary. For example, the francetv.fr webpage in the INA web archives also uses the French verb "secouer" (to shake), alongside "nouvelle tendance" (new trend) (Figure 12).

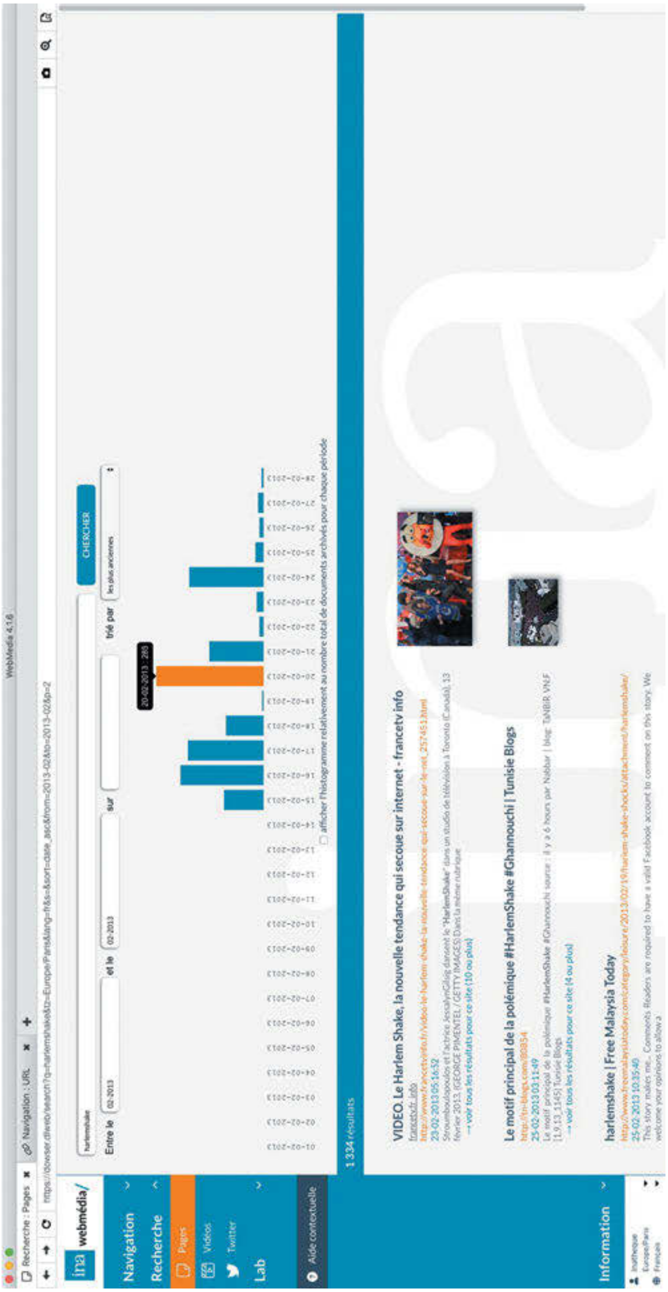

Figure 12: Timeline of web pages archived by INA in February 2013 and first results. © INA.

The vocabulary of collective organization (“gathering”, “square”, “leisure center”, etc.) is present in two ways in the articles of the regional daily press: either prior to the event, in a short article indicating the arrangements to take part in the performance[25] or afterwards, by reporting both the dance and its uploading to YouTube.[26] In both cases, the regional press amplifies the phenomenon, as it gives it more visibility and echoes, either by enabling its organization or by publicizing its completion, conferring it a local social value. Some amateur videos stand out for instance: in Chauny, in the Aisne region of France, people getting married, and their families took part in a Harlem Shake that was deemed scandalous by the town council team. The article in the local newspaper, embedding the video in its web version, further publicized the phenomenon.[27] Entertainment music was subsequently banned from the town hall during weddings.

A special case is also that of young people who have performed Harlem Shake in countries such as Tunisia and Egypt and have been punished by the authorities or harassed by Islamist militants. On this occasion, the national press commented on this political opposition to the dance, even though they had not necessarily commented on the video production practices of youth before. It was the change of sociopolitical context that revived the mention of the Harlem Shake in the national press, but also in the regional press, which added an international element to its pages.

Although the Harlem Shake was born mainly thanks to the YouTube platform, many videos only had a very modest audience, contributing above all to the mass of videos that characterizes the phenomenon. The treatment of Harlem Shake by the press expands the perspectives on the original content and its uses. This diffraction of the phenomenon is also clear on social platforms.

2.3 Spreadability through Twitter

While the press and traditional media are crucial to analyze viral phenomena, particularly because they qualify this virality from a relative exteriority (indicat-

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25 For example, “Un HarlemShake in Hénin. Les flashmobs sont morts, vive les HarlemShake”, *La Voix du Nord*, 5 April 2013.

26 For example, “300 people for a Harlem Shake in Clermont-Ferrand. The appointment had been given via Facebook. 300 people answered the call of a Clermont-Ferrand DJ on Saturday afternoon to dance this very fashionable choreography on the Place de Jaude: the Harlem Shake. The video of the shoot can be seen on lamontagne.fr.” (our translation). Published in *La Montagne* on 9 March 2013.

27 https://www.aisnenouvelle.fr/art/region/chauny-depuis-l-incident-du-harlem-shake-les-ia16b110n393024, accessed July 11, 2023.

ing how it happens "online"), the discussion around the Harlem Shake has rather taken place on Facebook and Twitter.

We applied a distant reading to a corpus of some 7 million tweets covering the period of the first half of 2013[28] and containing "harlemshake" or "Harlem shake", making it possible to identify some information flows. The daily frequencies of tweets in the corpus form a particularly regular peak (with the exception of the peak of more than 300,000 tweets on 1st March), which is steadier than the peak observed for the press (Figure 13).

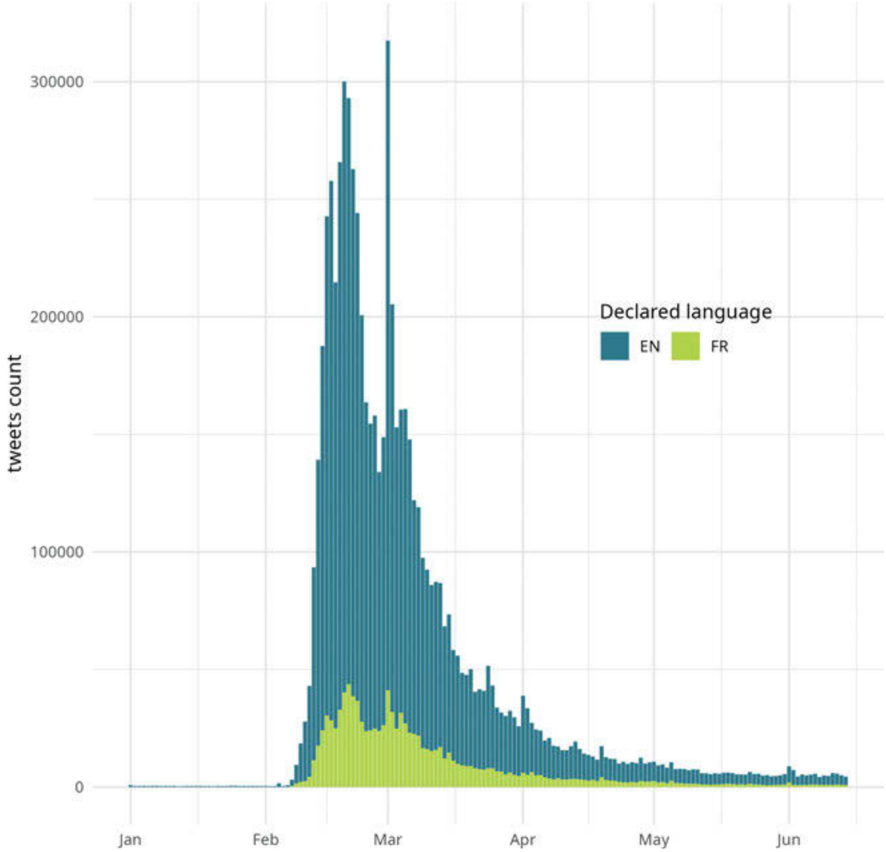

Figure 13: Daily frequency of tweets about Harlem Shake during the 1st semester of 2013.

28 We would like to sincerely thank Frédéric Clavert who helped us collect the tweets through the Twitter API and Twarc.

39.7% of tweets contain URLs. The URLs show that the virality of the phenomenon is not only due to the strategies of the cultural industries: the social platforms have an essential role in the circulation of these contents, by the presence of URLs referring from one to another. The corpus contains 2,777,125 tweets that include URLs from more than 24,000 different DNS. YouTube's DNS appears app. 1,464,000 times and Facebook's DNS app. 131,000 times. Photo and video sharing platforms such as Instagram, Tumblr, Vimeo also feature prominently, regularly linking to Harlem Shake pages (e.g., http://harlem-shake.tumblr.com/ which tried to capitalize on the publishing wave by sharing some videos). One would expect links to the knowyourmeme.com platform to be numerous, but this is not the case, with only some 300 URLs.

It is also interesting to note that the press websites figure largely in the top 100 DNS, but in a much lower proportion (less than 50,000 URLs in all) than social platforms. The articles are linked to directly, rather than commented on (unlike the practice of live tweeting TV programs). The regional press is only marginally present, with about fifty URLs pointing to the French newspaper *Midi Libre*, and a little less than a hundred URLs to *Ouest France* (with articles covering the tensions in Tunisia or with articles on the Harlem Shakes of local football teams). On the contrary, it is mainly the major international newspapers (*New York Times*, *Wall Street Journal*) and pure players (huffington post, quarz.com, mashable.com, buzzfeed.com, etc.[29]) as well as the BBC and CNN editorial offices that appear in the top 100 URLs. Without the preliminary study of the regional press in the press corpus, its role would not have emerged from an analysis of the tweets.

On Twitter, hashtags may be used to mark positions and social groups participating a controversy (Cervulle and Pailler 2014). This is not the case with the Harlem Shake, which remains a rather consensual phenomenon. Hashtags mainly describe the phenomenon and its reception and experience. Around 4,747,000 tweets even mentioned the Harlem Shake without a hashtag, i.e. without trying to include a collective indexing criterion, as it is usually the case with political movements (#metoo) or entertainment events (#eurovision2022 or #championsleague). Unsurprisingly, the three most used hashtags are #harlemshake (app. 1,445,000 times), #harlem and #shake (app. 30,000 and 20,000 times). The other most popular hashtags point out its origin (#youtube, 19,000 times) and its relationship with another viral dance, the #gangnamstyle (app. 16,000 times). #egypt and #tunisie appear in the top 100, with 2,384 and 1,934 occurrences respectively, a modest presence in the corpus compared to our press analysis.

29 buzzfeed.com was the first media to point out the phenomenon and it immediately attracted 300,000 views on the videos' pages (Soha and McDowell 2016).

Of the hundred most used hashtags, ten or so correspond to pure players[30] or TV shows (*The Simpsons, Saturday Night Live, VladTv, WorldStarHipHop, Touche Pas à Mon Poste,* etc.), one-off entertainment or cultural events (*Kids Choice Award, South by South-West, SXSW, Soundwave Festival*) and sports teams (Manchester City Football Club for example).

If we take a closer look at the app. 500 tweets containing #SNL, the hashtag for the TV show "Saturday Night Live" (SNL), one can see that as early as 3 February 2013, some tweets were calling for a Harlem Shake. This took place on 10 February at SNL. Some tweets praised it, while others were already expressing their fatigue at hearing Baauer's title. During the month following the show, after the video of SNL's Harlem Shake was uploaded on YouTube, the last tweets expressed their offbeat amusement. The same "fan request – live commentary on the performance – later replay" logic can be found in tweets about other shows, such as the French show "Touche Pas À Mon Poste". This temporal pattern corresponds to community management work that has been widely integrated into entertainment media production since the 2010s.

While Twitter was a media hub throughout the Harlem Shake viral peak, the variety of accounts that took part in the conversation around the videos, whether held by humans or bots, remains to be questioned. More than 6,823,000 different users tweeted about the Harlem Shake, indicating a very low ratio of Harlem Shake-related tweets per user. Most users only expressed themselves once on the topic. Amongst the 500 Twitter accounts that published the most about the Harlem Shake, no known users had a prolonged impact on the phenomenon.[31] We can also identify bots: the most prolific account tweeted 44,655 times about the Harlem Shake in less than six months (which amounts to an average of about 250 tweets per day), leaving little doubt about the hybrid human/bot nature of the account. There is also a series of accounts with the terms "harlem" and "shake" in their handle, which were created to capture the attention of the viral phenomenon and have produced around 15,000 tweets.

Although different type of actors and business strategies have played a role in shaping both content and audience related to the Harlem Shake, the unique tweets published by average users remain a key element to understand how virality arises. In many cases, those users only told their followers that they liked or hated watching a Harlem Shake video, or that they had taken part in one of them. These tweets create the mass that makes the Harlem Shake looks viral. This is

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30 Media companies that only operate digitally.

31 The Mad Decent musicians initially promoted the #harlemshake through their twitter accounts in early February 2013, but each of them only tweeted few times on the topic.

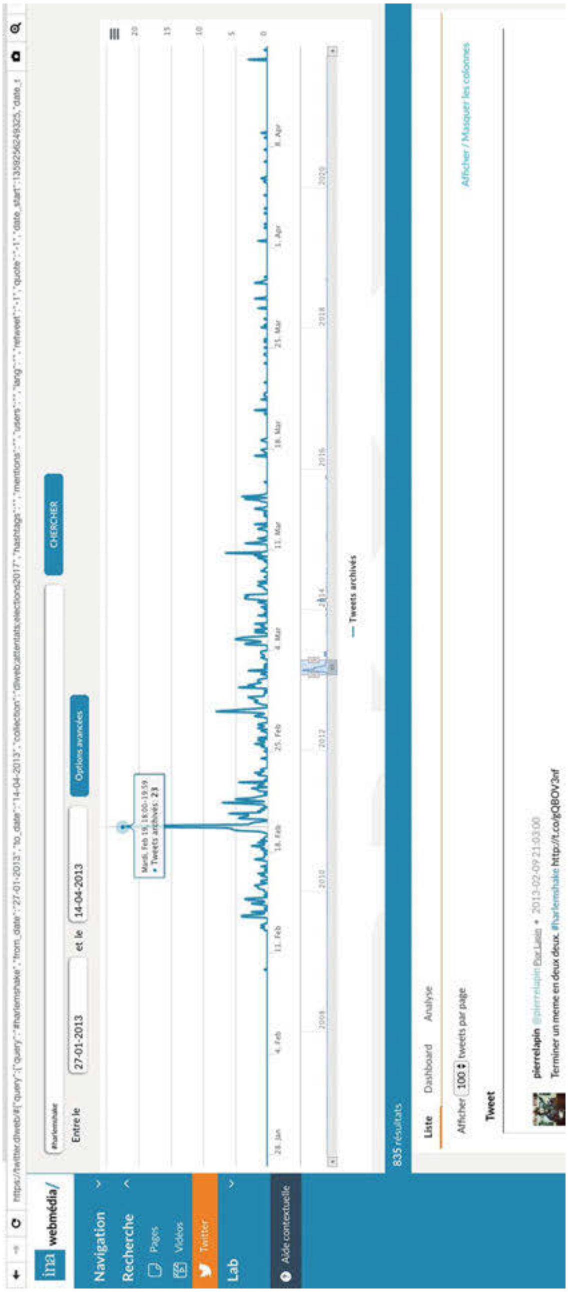

Figure 14: Timeline of archived tweets related to the Harlem Shake by INA from 27 January 2013 to 14 April 2013. © INA.

consistent with the conclusions drawn by Goel et al. on what they labelled "structural virality", a notion "that interpolates between two conceptual extremes: content that gains its popularity through a single, large broadcast and that which grows through multiple generations with any one individual directly responsible for only a fraction of the total adoption" (Goel et al. 2015: 180).

This mass of users has semiotic imprints (the numerous remixes of original videos and content variations about the topic), statistical imprints (via analytics and ubiquitous metrics on social platforms) and social imprints (the more the users know about the videos, the more varied the experiences will be). However, this mass is not really visible as such outside of social platforms. For example, if we zoom in on the Twitter archives collected by the INA for the French audiovisual domain (Figure 14), we can see differences compared to the global tweets analysis carried out previously.

The INA archives show a clear peak linked to the TV show TPMP (*Touche pas à mon poste*) and give insights about how show business reacted to the Harlem Shake (in France). However, they don't show the bigger audience on Twitter due to the frame of the web archives which focus on audio-visual content. Once again, this demonstrates the need for scalability, but also for a medium reading, attentive to platforms, perimeters and containers.

3 Conclusion

Keep calm and stay focused . . . by choosing to hijack the now-memetic phrase "Keep Calm and Carry On" in the title of this article, we aimed to underline the historical origin of certain Internet phenomena and their need for historicization. In particular, the "Keep Calm and Carry On" wording and its history perfectly illustrate the need to put viral phenomena into context and to take an interest in their dissemination, their audience and even their marketing: these propaganda posters and motto produced during the Second World War were never seen by the population at the time, as they were produced for distribution in case Germany invaded Britain. They only emerged when they were discovered and popularized by a bookstore owner around 2000, before being used as a slogan on mugs or T-shirts sold cheaply on the web.

"Keep calm and stay focused" also enlightens the need of a scalable and medium reading of past memes, in addition to a semiotic approach. Crucial issues are overlooked when communities, infrastructures, spaces and temporalities of memes are neglected.

Though this article suggests answers to the temporal and spatial issues raised by viral phenomena, it also opens several methodological options, which do not have the same cost in terms of work and technical skills: the first consists of building a complete database for each phenomenon, the second consists of making observations and analyses by entwining a close reading with increased quantitative contextualization, as set out in this paper. The later methodological approach is less comprehensive, but can be put into practice realistically, while being open enough to a multitude of adaptations and new interpretative approaches.

A database must deal with the complexity of the field in itself, in particular the broad diversity of sources and formats: how to aggregate second-hand data (collected from APIs or scraped), initially designed for the needs of platforms, i.e., for the capitalist exploitation of (user generated) content and digital traces? The series of choices to be made regarding what should be preserved or transformed or interpreted (i.e., recoded) from one platform to another is difficult, not to mention the question of data circulating in messaging systems such as Messenger, WhatsApp, Telegram, Snapchat or Signal (Rogers 2020). These services do not easily provide data unless researchers get involved in ethnographic observations and first-hand data production. As our research is a historical one, that often comes after the phenomenon has vanished, it does not allow to intentionally observe the phenomenon as it unfolds. These insights are lost for historians and unpreserved by design.

Furthermore, the platforms themselves are not necessarily predisposed to providing well-developed display tools for viral phenomena. Traceable objects like hashtags as used in digital methods for diffusion analysis (de Zeeuw et al. 2020) are not enough to recover these phenomena, that also claim for cross-platform analysis (Rogers 2017). Creating and finding ways of translating data and making them interoperable (for example, metrics are very difficult to translate term-for-term), of comparing several platforms, several stakeholders producing, delivering or heritagizing data, several contents, periods and geographical areas, are fully part of the investigation.

Thus, our alternative is much more modest, but realistic and, when reiterated for different platforms and different periods, it may help to identify some patterns of circulation, replication, and transformation of original content. The research we presented in this article can be further developed by classifying/clustering visual and textual contents for example. The classification of images, be it manually or with the assistance of computer processing, tackles semiotic problems by distinguishing images that may be either variations on an initial image, or resignifications of the initial image, or even contain iconic motifs that refer back to the original image, while making it difficult to technically establish a formal link with it (Julliard and Pailler 2023). Topic modelling, sentiment analysis or the Reinert method (via Iramuteq software or R package Rainette, for example) can also apply to the texts related to images. Text analysis can help understanding circulation in different ways: comparing different contexts (different times or cultural/linguistic areas), and even, in very specific cases, identifying the match between social graph and semantic clusters (Ratinaud & Smyrnaïos 2014). In any case, this implies a combination that takes advantage of a scalable and medium reading which affords the container as much importance as the content, while enlightening the meaning in context.

Acknowledgements: We sincerely thank Quentin Lobbé, Frédéric Clavert, as well as the BnF Datalab and INA for their support in this research.

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Landry Digeon and Anjal Amin

Zooming in on Shot Scales: A Digital Approach to Reframing Transnational TV series Adaptations

Abstract: This pilot study illustrates an empirical cross-cultural comparative analysis of transnational TV series adaptations. It investigates patterns of shot scale distribution in conjunction with gender and display of emotions to uncover and compare cultural representation in France and the US. The study showcases 16 episodes of *Law & Order: Criminal Intent* and its French adaptation, *Paris Enquêtes Criminelles*, for a total of 44,602 frames. Relying on the deep learning toolkit, the Möbius Trip, we propose an objective shot-scale model to frame and quantify a large quantity of data. We propose a layered, four-level reading of the data through intercultural models, media theories and feminist and psychological approaches to articulate cultural decoding. This study provides insights into the ethics of televisual representations of male and female characters on screen across cultures and the process through which cultural proximity is achieved.

Keywords: transnational TV series adaptations, artificial intelligence, culture, big data, cross-cultural comparison

1 Introduction

This pilot study investigates the impact of emotion display and shot scales on cultural and gender representation in transnational TV series adaptations. Showcasing eight episodes of the American TV series *Law & Order Criminal Intent,* and their equivalent French adaptation, *Paris Enquêtes Criminelles,* amounting to 44,602 frames, we seek recurring patterns of shot scales in conjunction with gender and characters' expressions of emotions to uncover and compare cultural representation in France and the US. We rely on our AI toolkit, *The Möbius Trip,* a multimodal analysis engine based on machine learning techniques, to conduct our research. We establish a shot-scale model based on strict conventions that provides a steady rationale to label, classify, measure and compare visual data. Following a dynamic model of *close/distant reading,* we conceptualize different levels of reading of the audiovisual text by gradually zooming in on the data. We propose four levels of reading as we include new variables. We first focus on shot scales between the French show and the American show at a cultural level. Next,

https://doi.org/10.1515/9783111317779-007

we zoom in and analyze male and female characters through shot scales. Lastly, we zoom in again and look at the character's emotions through shot scales. The episodes are reorganized in the shape of graphs and visuals to better discern patterns and ease comparisons between the French and the American version. There are substantial differences between both versions of the show exposing the context and values of the societies they are embedded in. Big data combined with extremely detailed depictions help us understand the intricacies of cultural representations on-screen between France and the US. Our innovative approach offers unprecedented data and opens the arena for new comparative cultural studies in film and TV series. The project is still developing, and we are presenting tentative results of pilot projects to experiment with and evaluate the validity of the current stage of our work.

2 Concepts

2.1 Framing / Reframing

Our comparative research on transnational TV series between *Law & Order: Criminal Intent* and its French adaptation *Paris Enquêtes Criminelles* is framed within *framing theory.* This theory, pioneered by sociologist Erving Goffman in 1974, contends that frames enable people to "locate, perceive, identify, and label" the flow of information around them (Goffman 1986: 21). The primary function of framing is thus to describe, organize or structure message meaning. To Goffman, framing is a system through which people can understand culturally determined definitions of reality and make sense of the world. It is, therefore, a necessary part of human communication. Framing plays an important role in how a particular issue is presented before the people and how they perceive it.

In cinematography, framing refers to all the elements that appear in the frame, as well as the way they are arranged to convey meaning. It makes audiovisual texts intelligible by decoding the meaning system carried in each frame and allows us to understand better how directors fill the screen to manipulate the audience. The director has access to multiple techniques, such as shot scale, camera angles, color, light and aspect ratio, among others (Doane 2021: 76; D'Angelo and Kuypers 2010: 248). In addition to film techniques that explore the possibilities of cinema, Renita Coleman refers to *visual framing* "to mean media content that is processed by the eye alone" (D'Angelo and Kuypers 2010: 236). Coleman explains that visual framing research is concerned with the portrayal of race and gender stereotyping as well as emotions elicited by images and their effects on viewers

(D'Angelo and Kuypers 2010: 244). This approach is appropriate for our research, which is concerned with gender representation on screen.

We study transnational TV series adaptations, which consist in adapting a narrative structure to a domestic context. We rely on framing theory to analyze elements that constitute a televisual text and understand how it is reframed to suit another cultural environment. Comparing the two crime shows highlights the framing choices (e.g., film techniques) through which cultural representation is achieved. Such research emphasizes the importance of framing and the ways in which it impacts how a story is told; as French film theorist Jean Mitry points out, "The story will be the same, but the impressions, emotions, ideas and feelings expressed will be utterly different" (Mitry 1997: 135). The comparison makes data meaningful by providing a point of reference for aesthetic choices and cultural differences. Russian philosopher Mikael Bakhtin stated, "In the realm of culture, outsideness is a most powerful factor in understanding. It is only in the eyes of another culture that foreign culture reveals itself fully and profoundly" (Bakhtin 2010: 1). The aesthetic choice of the adaptor is motivated by *cultural proximity* – the idea that audiences favor media that reflect their own local culture (Burch 2002: 572). Hence comparative study informs us about the communication style of each culture, its cultural norms (e.g., emotions display), as well as its tradition of filmmaking.

The framing theory also applies to our analytic method. Managing a large quantity of visual data is contingent on objective framing (identifying, labeling and classifying) of gender representation, emotion display and shot scale. We reframe shot scale conventions by challenging the loosely defined conventions and proposing a new framework to objectively quantify, measure and compare shot scale.

2.2 Shot scale

Our research focuses on the implications of shot scales in transnational TV series adaptations. Shot scale is defined as "the apparent distance of characters from the camera, is one of the most effective visual devices in regulating the relative size of characters' faces, the relative proportion of the human figure to the background and arranging film content according to its saliency (Carroll and Seeley, 2013)" (quoted in Rooney and Bálint 2018). It is one of the vital cinematographic features that regulate the relative size of characters' faces, the relative proportion of the human figure to the background (Salt 1992; Bowen and Thompson 2013), arranging film content to emphasize an element (Rooney and Bálint 2018) and directing the audience's gaze on particular elements (Cutting 2021: 2). Shot scaling is not just a film technique part of the film language; it is an element of representation that might carry meaning.

Film studies scholar Annette Kuhn defines shot scales as “An informally agreed and widely accepted set of conventions that describe and define different framings of a film image, or apparent distances between camera and subject” (Kuhn 2012: 1321). Depending on the model, shot scales are divided into seven or nine categories. Shot scales typically range from Very Long Shot (VLS), Long Shot (LS), Medium Long Shot (MLS), Medium Close-up (MCU), Close-up (CU) and Big Close-up (BCU). Though shot scales are a fundamental expressive tool of the film language, the terminology is quite elastic and deals mainly with concepts (Arijon 2015: 31). The terminology is approximative and not always consistent. As Monaco describes, “One person’s close-up is another’s ‘detail shot,’ and no Academy of film has (so far) sat in deep deliberation deciding the precise point at which a medium shot becomes a long shot or a long shot metamorphoses into an extreme long shot. Nevertheless, within limits, the concepts are valid” (Monaco and Lindroth 2000: 197). Shot scale frameworks (Figure 1(a, b)) highlight the difference between Barry Salt’s scale in terms of proportion as well as in the terminology (e.g., MLS and Knee shot) and that of Daniel Arijon. We can see that a big close-up (BCU) is sometimes referred to as an extreme close-up (XCU). Likewise, a medium-long shot (MLS) can also be called a knee shot; it is different from an American shot that starts above the knees but is not always considered in formal frameworks. In sum, the convention often diverges and the contrast between shot scale models can be significant.

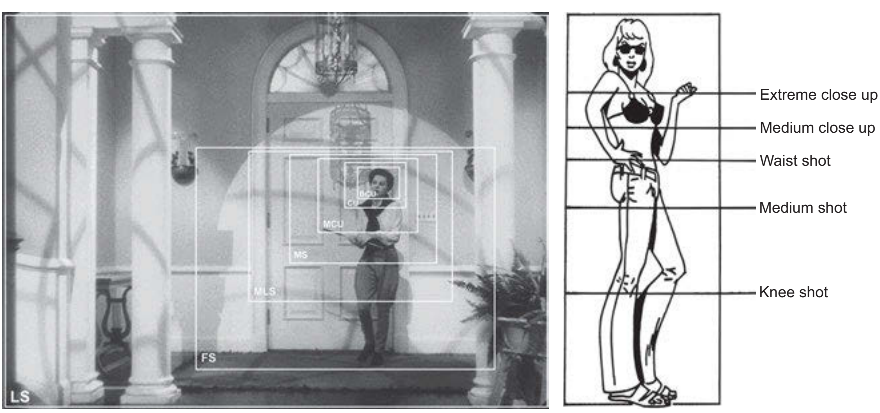

Figure 1: (a) *Barry Salt’s shot scale framework,* Barry Salt, https://cinemetrics.uchicago.edu/salt.php, accessed July 31, 2023. (b) *Daniel Arijon’s shot scale framework,* Daniel Arijon. *Grammar of film language*, Figure 3.6: “Types of shots”, p. 36 of 706.

2.3 Aspect ratio

Law & Order: Criminal Intent and *Paris Enquêtes Criminelles* share the same narrative but are shot in different aspect ratios. Movies and TV series tell a story through time, and the aspect ratio plays a part in how the story comes across. Aspect ratio is the ratio of the width to the height of an image. The format evolved following technological progress and cinematic trends. For TV shows, the aspect ratio is forced to follow the evolution of television devices. For decades, the standard ratio for television used to be 4:3 (1.85:1) to fit the squarish frame of the television of the time. 4:3 is also known as the Academic Ratio because it was standardized by the Academy of Motion Picture Arts and Sciences as the standard film aspect ratio in 1932. The 4:3 was replaced by the 16:9 (1.77:1/1) aspect ratio in the 1990s with the advent of widescreen HDTV. The rectangle widescreen display offers a more immersive and cinematic experience to the viewers. It is a compromise that allows the audience to watch blockbuster films as well as regular television programs.

Aspect ratio plays "a fundamental, determining role in forming and framing television's spaces" (Cardwell 2015: 83). Aspect ratio impacts filmmakers' creative choices. Bordwell explains, "Because home video might crop part of the image, some directors compose their shots so that the key action is concentrated in an area that will fit smaller displays" (Bordwell, Thompson, and Smith 2017: 47). In altering the artistic choices, the aspect ratio can impact a TV series' style and mood. For instance, *The Wire* creator David Simon refused to conform to switching from a 4:3 to 16:9 ratio because the creators decided to "use 4:3 to connote both a classic televisual aesthetic and unglossy, social realism, and to explore the not-yet-fully exploited spatial possibilities of 4:3" (Cardwell 2015: 95). For instance, a 4:3 ratio can provide an *old-timey* feel that contributes to the style of the show; it can also give a *real feel* because the ratio allows filling the frame without standing too far from the character, which is the preferred format by comedies and drama.

3 Framing the research

This section introduces the theoretical framework that structures our comparative analysis on shot scales and emotion display in *Law & Order* and *Paris Enquêtes Criminelles*. We frame our layered reading analysis on four levels, namely intercultural, media, feminist and psychology.

Each level will provide us with a lens to read our empirical data as we zoom into more granularity.

3.1 Level 0: Intercultural framing

This level looks at emotion display norms in different cultures. It introduces Edward T. Hall's *Contexting Model* to account for these differences.

3.1.1 Emotion display

Many studies suggest that emotions are genetically hardwired into all human beings and that basic emotions such as happiness, sadness, anger, surprise, fear and disgust are universally shared (Grodal 1999: 90; Waller et al. 2008: 435) (Figure 2). Patulny et al. explain, "People share emotions independent of age and gender, education, status, and cultural practices, thus corroborating the universality of emotion sharing" (Rimé 2009, quoted in Patulny et al. 2019: 104). While emotions are perceived as innate and, therefore, transcultural, they play out differently and take on different meanings according to a culture's communication style specifics. Patulny et al. explain that cultural norms rule the display of emotions and are learned early in life. Culture display rules "function to regulate expressive behavior depending on the social context" (Patulny et al. 2019: 137). Appropriate emotion display is proof that a member of a community is well integrated.

Figure 2: Facial expressions data set: joy, anger, disgust, sadness, surprise, and fear.
Source: Cohn-Kanade (quoted in Crawford 2021).

3.1.2 Contexting model

Anthropologist Edward T. Hall proposes the *Contexting Model* to frame how emotion display plays out in the communication style in different cultures. He presents two different cultural approaches to communication: high-context and low-context. Hall explains,

> A high-context (HC) communication or message is one in which most of the information is either in the physical context or internalized in the person, while very little is in the coded, explicit, transmitted part of the message. A low-context (LC) communication is just the opposite, i.e., the mass of the information is vested in the explicit code (Hall 1989: 79).

Members of high-context cultures like the French culture tend to share implicit knowledge with their fellow community members. Consequently, interactions rely less on words and more on non-verbal communication cues, including facial expressions. In contrast, in low-context cultures like the American culture, people communicate with explicit content because the goal of communication in an American context is clarity. Hence, Americans rely less on facial expressions and therefore display fewer emotions.

3.2 Level 1: Media framing

This level frames the media aspect of this investigation. It provides us with technological evolution, style and genre and spectatorship practices. This level of analysis is concerned with technical elements and how they inform us of the cultural tradition of film and TV series practices.

3.2.1 Technology

David Bordwell approaches the stylistic evolution of shot scales from a technical and historical perspective in cinema and TV series.[1] He explains that technological progress forces directors to rethink their aesthetic approach and adapt their cinema techniques (Bordwell, Thompson, and Smith 2017: 46). For instance, the rise of CinemaScope in the 1950s led to a new cinema screens aspect ratio, which in turn impacted the way directors use shot scale. This change in cinema also operates in the television industry. Older generation smaller TV sets with a 4:3 ratio and poor definition forced “the TV series directors to rely on closer, more visible

1 Cinema conventions impact TV series.

shots" (Bordwell, Thompson, and Smith 2017: 47). In the 2000s, the surge of wider and bigger screens resulting from technological advances spread worldwide and became the new standard for the TV industry. The ratio had an impact on directors who had to rethink their artistic choices. One of the impacts is that medium shots and long shots appear to be of *normal scale* (Doane 2018). The point of contention resides in whether the close-up is compatible with a wider ratio. For Bordwell, a wider screen made close-ups unnecessary when he states, "Directors even refrained from using close-ups, perceived as too aggressive, and enticed them to use distant framings and full-size figures" (Bordwell, Thompson, and Smith 2017: 47). In turn, French film critic André Bazin believed that the close-up could be sustained with wider screens, and "the 'useless' space that surrounds faces is thus not as useless as all that; on the contrary, it highlights those faces, not in relation to the frame but in restoring them to a natural relation with space" (Cardwell 2015: 92). Media scholar Paul Frosh takes a cautious approach when he says, "the headshot—although by no means entirely eroded—has become less dominant in the televisual repertoire than previously since it does not fully exploit the more contextual and epic dimensions of the widescreen format" (Frosh 2009: 98).

3.2.2 Style and genre

Jason Mittel explains that television genres result from a body of production techniques, textual aesthetics and historical trends (Mittel 2004: xi). Indeed, technology impacts production techniques, which in turn impacts the style of the movie and, consequently, its genre. Hence, the TV series genre is defined through historical periods and the changing use of this aspect over time. Shot distances are often dependent on the film's narrative, genre and overall style (Edgar-Hunt et al. 2015: 123). Focusing on the impact of shot scale on TV crime shows, Barry Salt concludes, "The main variations in shot scale seem to depend on genre" (Salt 2001: 112). For instance, western, war, and adventure contain high amounts of very long shots, whereas melodramas and comedies are generally shot from closer (Roggen 2018: 10). Relying on a corpus of twenty crime shows, Salt concludes that crime TV shows are predominantly shot with a vast majority of CU, towering over any other shot scale (Salt 2001: 104).

Genre is a fluid concept that includes a group of procedures regarding composition, style and topics (Albera 1996: 144). Typically, film techniques abide by the codes and conventions of the genre they portray. For instance, Nick Redfern established that comedy and romance have bright colors (Redfern 2021: 265). James Cutting demonstrated that action films tend to display a faster average shot length than drama (Cutting 2014: 76) and that a faster pace correlates with closer shots (Cutting and Candan 2015: 41). Upon comparing both shows, Digeon and

Amin have determined that Paris Enquêtes Criminelles is a hybrid version of the American original (Digeon and Amin 2021). The French version is almost twice as fast, has brighter and warmer colors and contains more music. Based on these findings, we can say the French are a hybrid version of the original show because it contains elements related to comedy and action.

3.2.3 Spectatorship cultural practices

In the same way that technology and genre are markers of time, historical periods, and domestic tradition of filmmaking affect the use of shot scales, domestic consumers' habits also influence directors' artistic choices. Comparing the use of Shot Scales in Hollywood and German Cinema from 1910 to 1939, Nick Redfern claims that early cinema scale convention was to mimic the point of view of an audience in live theaters resulting in "long-shot distance, frontal perspective, unity of viewpoint, and relative narrative autonomy" (Redfern 2010: 7). Consumers' habits evolve over time, influenced by other media as well as global practices. Globalization seems to lead to the uniformization of consumers' habits. Redfern concludes that both the German and the US evolved from the distant framing of the medium-long shot and long shot to increased use of medium shots and medium close-ups.

The recent growth in the size of home cinema TV sets since the 2000s also impacts viewers' habits and modified directors' TV series practices. Troscianko et al. found that "bigger is better" for faces and for landscapes (Troscianko et al. 2012: 416). They mean that featuring faces and landscapes offers a more immersive, more engaging experience for the viewer. Hence, we can imagine that TV series directors need to follow the trend to add more CU and LS to comply with consumers' habits.

3.3 Level 2: Feminist framing

This section is concerned with a feminist approach to gender representation in film and TV series. The theories presented here enlighten us on gender inequality on screen, emotion display rules and the gaze of the camera. They reveal the blatant inequalities between genders and shed light on the practices that breed them.

3.3.1 Gender representation on screen

Women have been widely underrepresented on screen. Non-profit research organization Geena Davis Institute stunned the world in 2004 when it exposed the blatant inequality and under-representation of women in terms of screen time in the film and TV series industries. According to Geena Davis, "for every one female character, there were three male characters. If it was a group scene, it would change to five to one, male to female" (Savage 2011). Such inequality is also reflected in the TV industry at a world level. The Conseil Supérieur de l'Audiovisuel (CSA), a French institution that regulates the various electronic media in France, concurs with Geena Davis Institute's findings, showing a similar imbalance in gender representation in the TV industry (CSA 2020: 8). In a previous study on *Law & Order: Criminal Intent* and *Paris Enquêtes Criminelles*, Digeon and Amin revealed the overwhelming domination of male characters' screen time with a 75%–25% average (Digeon and Amin 2021: 15).

3.3.2 Emotion display

In addition to cultural differences and social context, emotion display rules depend on gender. Each society abides by different gender norms. These gender norms play out in every aspect of everyday life and rule the display of emotion. Anger display is typically more accepted in men, while women are tacitly encouraged to hide their anger early. In turn, men are taught to hide their feelings of sadness (Patulny et al. 2019: 137). These cultural norms are represented on screen because TV series mirror the society they are embedded in. As Chesbro et al. point out, "While depictions of men in film have tended to be extremely masculine, depictions of women have tended to be extremely feminine" (Chesbro et al. 2013: 325). TV series mimic the behavior and reinforce it. Doane explains, "women are more emotive, with access to a greater range of facial expressions than men" (Doane 2021: 128).

In *Emotions, Genre, Justice in Film and Television*, Deirdre Pribram takes a cultural approach to representations of emotions on screen. Showcasing a close reading of the movie *Crash*, she states, "Police officials, detectives (public or private), and legal personal are often motivated by anger: moral indignation the transgression committed by the offending party; sympathy for the victims, which usually comes displaced as an outrage at the perpetrator" (Pribram 2012: 33). Digeon and Amin's empirical study on gender and emotions of *Law & Order* and *Paris Enquêtes Criminelles* (Digeon and Amin 2020) concur with Pribram's findings. They demonstrate that both American and French male characters display more anger and female characters show more fear. They suggest that men could be the perpetrators of the crimes while women would be more likely to be the victims.

3.3.3 Camera gaze

Rooted in a psychoanalytic approach, feminist film theory has been a substantial component of film theory since the 1970s. It focuses on gender as the centerpiece of theoretical analysis of cinema and TV series (Kuhn 2012: 617) and deals with the unconscious of the text and symbol of the image. In her foundational article "Visual Pleasures", Feminist film theorist Laura Mulvey coined the term male gaze "male gaze" to describe the use of the camera as the eye of the dominant heterosexual white male (Mulvey 1989: 347). The camera becomes the media in which "women's bodies are objects that give pleasure through voyeuristic and fetishistic forms of scopophilia, pleasure in looking" (Oliver 2017: 452). The concept of the male gaze assumes that the camera operates as the eye of a white heterosexual man who typically objectifies women. Based on this idea, shot scales are consequential and become a pivotal indicator of the conscious (or subconscious) expression of sexual desires. Among all the shot scale types, The CU raises the most interest because it "tends to celebrate an intimacy of scrutiny that both magnifies the attractiveness of the film and produces an undue pleasure of looking, one that empowers an aggressive sexual instinct to conquer a desirable object" (Deppman 2021: 2). CUs have a mystique that seemingly glorifies women while oppressing them. For male characters, the CU is also equivocal because, it is "aligned with castration, a psychic threat to masculinity" (Doane 2021: 138). Because of these reasons, we can assume CU is more prevalent for female characters. However, Doane warns us, "It would be highly inaccurate, of course, to suggest that only women have close-ups" (2021: 138).

In contrast to the CU, the long shot seems to do the exact opposite. "A long shot is just as stylistically compelling, morally problematic, and theoretically suggestive as the close-up in the study of the complex relations ethics, film style, and female power" (Deppman 2021: 5). A long shot desexualizes women's appearances because the audience has a complete picture of a woman that looks like real life (Deppman 2021: 4). Bazin called it the natural "fact" of life (Bazin 2005: 35). Based on Deppman's argument, some types of shots are connoted and might convey meanings beyond a shot scales' aesthetic and dramatic potential.

3.4 Level 3: Psychology framing

For this level of framing, we introduce the cognitive film theory and the Theory of Mind (ToM) to examine the impact of shot scale and emotion display. Cognitive film theory informs us on the shot scale distribution at the narrative level and how the aesthetic, artistic and creative choices allow the audience to understand film. In turn, ToM is concerned with audiences' emotional involvement through shot scale combined with characters' emotions display.

3.4.1 Cognitive film theory

Cognitive film theory focuses on movies that are structured to convey their narratives to viewers. A cognitive approach allows us to "study the predispositions of the mind — its perception, cognition, and affect" (Cutting 2015: 192). Salt and Kovac find systematic regularity of shot scale distribution patterns in directors' work (Kovács 2014: 2; Salt 2009: 403). However, Kovács suggests that consistent shot scale distributions cannot result from a conscious decision by the movie director. To explain what makes filmmakers use similar kinds of shot scales in different films, he proposes a *cognitive hypothesis*. He explains, "there are some psychological, perceptual constraints that rule the relative rate of closer or longer shots independently of the conscious choices of the authors (Kovács 2014: 12). Directors might unconsciously follow aesthetic rules, narrative types, style trends or genre conventions.

In fact, television genres rely on viewers' familiarity with forms and conventions. As per a cognitive process, the viewer has an understanding of the framing of the film and the preemption of its codes and conventions (Bordwell 1992: 184). "These processes involve the 'construction' of perceptual or cognitive 'conclusions' based on nonconscious inferences, which are in turn constituted by 'premises' offered by perceptual data, internalized rules and schemata, and additional prior knowledge" (Bordwell 1985: 31, quoted in Nannicelli and Taberham 2014: 8). Spectators tacitly agree with the conventions of a particular style and its mood. They preempt characters' representation, display of emotions and film techniques that characterize a show. They unconsciously understand the informative and dramatic functions of shot scales and feel emotionally engaged with the narrative.

3.4.2 Theory of mind

Theory of Mind (ToM) refers to the psychological process by which people recognize and understand the mental states of others. ToM plays out on the audience's affect as it is concerned with the way shot scales impact film viewers. Along with other film techniques that contribute to regulating emotional involvement in a show, it is accepted that "the closer the image, the more it raises emotional arousal, the more distant the image, the more distant the viewer's emotional relation to the image" (Kovas 2014: 1). Several empirical studies have confirmed such a precept. Shot scales have been widely considered the most potent means to convey emotional intensity to an audience (Benini et al. 2016: 16501); it impacts viewers responses related to “character engagement, such as theory of mind, emotion recognition, and empathic care” (Savardi et al. 2021: 3). Among the different shot scales, the close-up is often perceived as the most effective tool to display facial expressions and convey emotions to an audience. French philosopher Gilles Deleuze calls the close-up the “affection image” *par excellence* (Bordun 2017: 90). Framing a strong emotion with a close-up increases an emotional response from the audience. As Rooney and Bálint put it, “Close-ups of sad faces produced higher levels of ToM-self than other conditions” (Rooney and Bálint 2018). Hence, a sad close-up is most likely to trigger a stronger response than the neutral close-up because it is associated with higher levels of Theory of Mind. The other types of shots are not as thoroughly addressed as the CU, which is perceived as the most important shot type. Nonetheless, Canini et al. explain, “Medium shots are probably not specific to a definite set of emotions, thus finding a fair level of employment in all types of filmic material” (Canini et al. 2011). Long shots do not convey as much of an emotional response. Therefore, we can speculate that characters’ emotional responses will be portrayed in a higher proportion of closer shots.

The intercultural, feminist and psychological approaches frame the present investigation. These well-established disciplines offer a broad understanding of film and TV series that is already quite sophisticated and certainly a pertinent approach. We base our cultural shot scale and emotion display comparison of the shows on this framework. On the one hand, each level provides a lens through which we read our empirical data and reveal a different aspect of the show. On the other hand, the levels are an arena where we confirm or challenge the theories mentioned above with our empirical data. Our layered reading of the data in the Reading the Data section follows the same sequential order as the one proposed in the Framing the Research section above.

4 Method

4.1 Digital approach

Our research is at the intersection of digital humanities, film and TV studies, intercultural communication, multimodality, cultural analytics and artificial intelligence. Because film and TV series are, in essence, multimodal, we take a comprehensive approach with equal emphasis on the multiple modes to frame the cinematic text. We are driven by *Datafication*, the concept of turning real-life occurrences into computational data of moving images to uncover trends. We follow the footsteps of quantitatively motivated approaches, such as Barry Salt's *statistical style analysis*, Larkey et al.'s digital comparative approach, Lev Manovich's Cultural Analytics, and Geena Davis' Inclusion Quotient; we propose a corpus-based model supported by digital tools. In the context of this comparative cultural study on *Law & Order: Criminal Intent* and *Paris Enquêtes Criminelles*, we focus on cultural and gender representation, emotion display and shot scale distribution.

Inspired by software such as *Videana*, *Atlas.ti*, the *Multimodal Analysis Software*, and other digital tools, we have developed *The Möbius Trip,* a multimodal analysis engine based on machine learning techniques. *The Möbius Trip* compiles the software's attributes in one and operates automatically, removing time constraints and human errors. The toolkit transforms visual characteristics into quantifiable elements to identify broad tendencies and non-obvious patterns in TV series (Digeon and Amin 2020). It is equipped with automated facial recognition processing that can objectively identify, label, and quantify the gender of the characters on screen, the emotion they display (Digeon and Amin 2020), as well as the shot scale in which characters are portrayed. The Möbius Trip frames audiovisual content, manages extensive volumes of metadata, makes complex predictions and generates visuals. It zooms into the data by crossing a wide range of elements with each other at a large scale to obtain comprehensive, precise and complex recurring televisual patterns.

4.2 Analytical procedure

We propose a *distant reading* approach to the episodes to find and compare otherwise invisible patterns or representations. The term "distant reading" was coined by digital humanities scholar Franco Moretti in the 2000s to refer to a digital-driven quantitative approach being applied to a text and turning it into graphs, maps and trees. It uncovers the governing system that generates trends and patterns. We follow the precepts of digital humanities scholar Craig Saper's zooming-in approach to the smart set. Saper breaks the boundaries between close and distant reading and proposes a dynamic, layered reading of the data (Saper 2021: 115). Saper states, "Counter to Moretti, and the critics of digital humanities alike, there is no close reading or distant reading: one can zoom in or zoom out on all data in the same readings" (Saper 2015: 206).

Because this chapter is a pilot study, our distant reading approach is limited to four levels of reading. For each level of reading, we combine variables (e.g., culture, emotions, genders and shot scales) and address them through the lens of culture, media, feminism and psychology (Figure 3).

- Level 0: Intercultural Reading compares the emotion display between both versions of the show from a cultural standpoint. We analyze this reading through intercultural models.
- Level 1: Media Reading compares the use of scale shots between both versions of the show. The analysis is rooted in media theories.
- Level 2: Feminist Reading, we compare male and female characters' representation through display of emotions between both versions of the show. We add the shot scale variable for a camera gaze reading of the text.
- Level 3: Psychological Reading compares the display of emotions of male and female characters' using shot scale between both versions of the show. We analyze the data via psychological approaches.

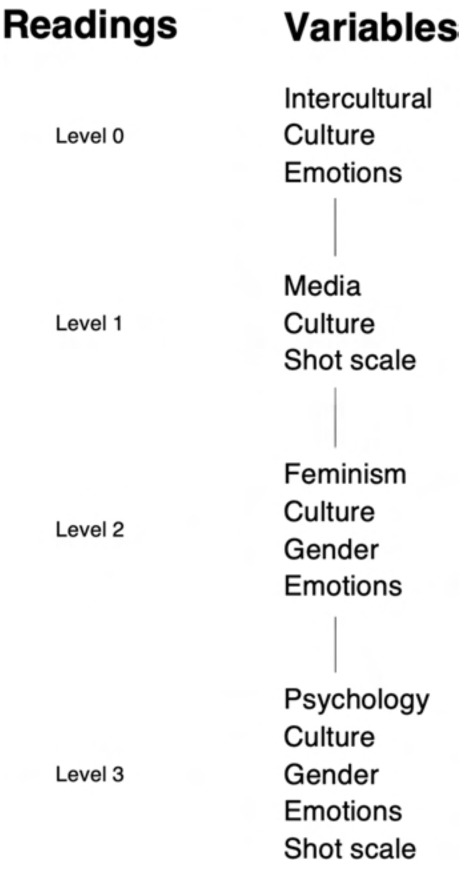

Figure 3: Digeon and Amin's proposed layering approach.

4.3 Measuring emotions

Kate Crawford explains that artificial intelligence is misreading human emotions. Kanade et al. point out several issues hindering the emotion recognition process, such as “the level of description, transitions among expression, eliciting conditions, reliability and validity of training and test data, individual differences in subjects, head orientation and scene complexity, image characteristics, and relation to non-verbal behavior” (2000: 1). Acknowledging the reliability issue and potential bias, we rely on FER Python package to frame emotions and improve the accuracy of the data by training the toolkit multiple times. We estimate our emotion recognition to be 70% accurate.

4.4 Reframing shot scale framework

The ambiguity of shot scale terms and conventions addressed earlier in this chapter impacts the film industry but also affects researchers. A lack of a formal framework hampers the discussion and may lead to potential misunderstandings, inaccurate findings and inexact interpretations. The advent of new media and large-scale computational approaches to film analysis urges us to reframe shot scales with objective and consistent standards. Hence, we introduce an AI-based shot scale framework with strict conventions (Figure 4).

Our attempt to define shot scale conventions with stricter edges is fueled by the need for a coherent and reliable ratio to proceed with our large-scale data analysis. A detailed framework is vital to replicate a similar study with other shows using this approach. Furthermore, a common structure with shared conventions is needed to facilitate dialog in the film and TV series community between film scholars and film industry professionals. Our proposed approach is an attempt to fill this gap by utilizing an objective convention to reframe the shot scale framework. The software extrapolates the relative distance of the character’s body within the space. It reconciles the *ratio-to-frame* and *imagined distance* approaches and determines strict edges based on learned patterns.

Figure 4: Digeon and Amins' proposed shot scale framework.

4.5 Sampling

To conduct this case study, we showcase *Law & Order: Criminal Intent* and its adapted French version *Paris Enquêtes Criminelles*. *Law & Order: Criminal Intent* ran from 2001 to 2011 for a total of 196 episodes in 10 seasons. In turn, the French ran from 2007 to 2009 for only three seasons and 20 episodes. The corpus for this quantitative study consists of 44,602 frames. It includes eight episodes of *Paris Enquêtes Criminelles*, released in 2007, and the eight corresponding episodes of *Law & Order: Criminal Intent,* released in 2001 (Table 1).

Table 1: List of Episodes sample: *Law & Order: Criminal Intent* and *Paris Enquêtes Criminelles*.

Paris Enquêtes Criminelles Episodes	Law & Order Episodes
1. S01E01 Fantôme	1. S01E16 Phantom
2. S01E02 Requiem Pour un Assassin	2. S01E04 The Faithful
3. S01E03 Le Serment	3. S01E01 One
4. S01E04 Addiction	4. S01E03 Smothered
5. S01E5 Scalpel	5. S01E09 The Good Doctor
6. S01E6 Ange de la Mort	6. S01E07 Poison
7. S01E7 Un Homme de Trop	7. S01E06 The Extra Man
8. S01E8 Le Justicier de l'Ombre	8. S01E11 The Third Horseman

Source: own processing, 2021.

5 Reading the data

5.1 Level 0: Intercultural reading

At this level, we perform a cultural comparison of emotional display in male and female characters in *Law & Order* and *Paris Enquêtes Criminelles*. The data shows that emotion display follows a similar overall pattern (Figure 5). Characters predominantly displayed facial expressions that convey sadness (45%, 40%), followed by neutrality, anger, happiness, fear, surprise and disgust (Figure 5). Table 2 mirrors the graph in Figure 5; it highlights the fact that characters display a wider range of emotions in *Paris Enquêtes Criminelles* than in *Law & Order: Criminal Intent*. The French appear to display more neutral features compared to the Americans (+2.7%), but they display more anger (+0.40%), more fear (+0.7%), more happiness (+0.8%), more disgust (+10%), and more surprise (+0.10%). In turn, the American characters appear much sadder **(+5.20%).**

Table 2: Emotions display comparison between *Law & Order* and *Paris Enquêtes Criminelles*.

	Emotions	
	American	**French**
Sad	45,30%	40,10%
Neutral	31,30%	34,40%
Angry	13,80%	14,20%
Happy	8,50%	9,30%
Fear	0,70%	1,40%
Surprised	0,40%	0,50%
Disgust	0,00%	0,10%
TOTAL	100,00%	100,00%

Source: Own processing, 2022.

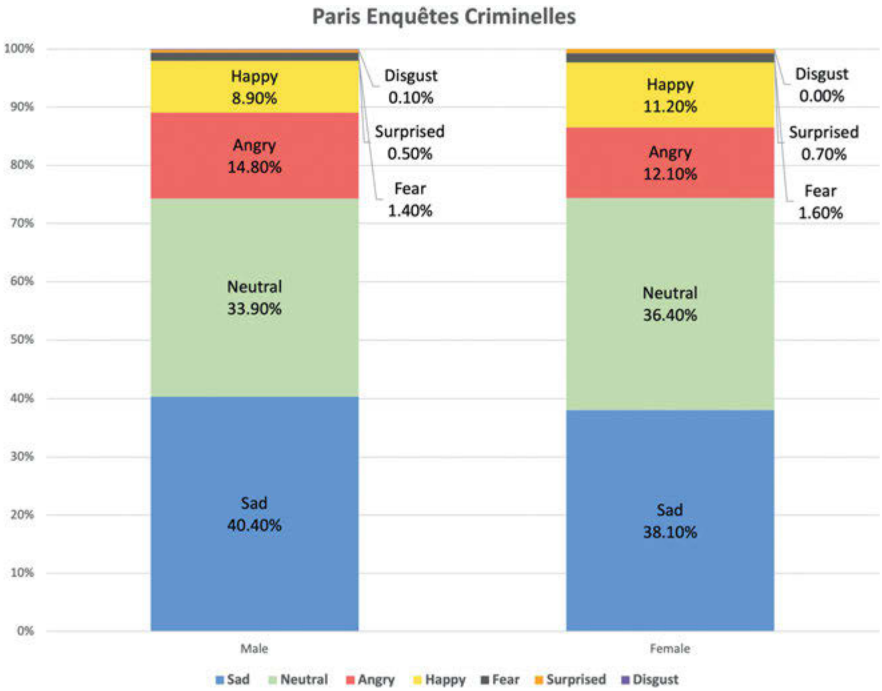

Figure 5: Emotions display comparison Between *Law & Order* and *Paris Enquêtes Criminelles*. Source: Own processing, 2022.

The data signal that both the French and American cultures display the same range of emotions, broadly speaking. They both follow the same trend of emotion display conventions in responding to crime, grief and judicial procedure. However, the data demonstrates that the French male and female characters are more emotionally expressive and show a wider range of emotions than their American counterparts. This finding is congruent with Hall's context cultures model, positing that high-context culture members rely on non-verbal communication and facial expressions more than low-context cultures. France is considered a high-context culture; accordingly, the French characters show a wider range of emotions than the American ones. The American characters, in turn, display substantially more sadness, which seems to emphasize the tragic nature of the show.

5.2 Level 1: Media reading

Level 1: Media Reading compares how shot scales play out in *Law & Order: Criminal Intent* and *Paris Enquêtes Criminelles*. Gender and emotion display elements in this part are disregarded to focus solely on shot scale and culture. We aim to find patterns to support and challenge the claims from the media theories by looking at shot scale distribution through the lens of technology, genre and cultural tradition.

The data show that both American and French versions of the show follow the same overall shot scale distribution trend: MCU, followed by MS, CU, MLS, LS, CS, and BCU (Figure 6). Table 3 sheds light on the differences; The French use more MCU (+3.8%), CU (+ 1.4%), CS (+0.40%), LS (+2.20), and BCU (+0.40). The Americans rely more on MS (+6.7%) and MLS (1.6%).

The fact that both versions of the show follow the same overall shot scale distribution pattern is significant. The data is congruent with the idea that TV series follow a similar trend based on Hollywood conventions. We find that Americans and French rely mostly on MCU and MS to portray characters in a crime show. When combined, MCU and MS account for 80% of the shot scale distribution in the US version and 77% in the French version. Our findings do not align with Barry Salt's claims that close-ups dominate crime shows. In fact, close-ups represent a small portion of our data set. We suspect, however, that such a drastic difference might be related to the discrepancies in shot scale conventions and lack of common reference. Such a misunderstanding calls for a standard framework like the one we propose here.

Zooming in on the apparent similarity of the shot scale distribution trend, we observe that the French use a wider variety of shots (more MCU, CU, CS, LS, BCU). The French version, more recent than its American counterpart, exemplifies the impact of technological progress on aesthetic choices. This finding concurs with Bordwell's idea that smaller cameras enable more flexibility for directors. Likewise, the cinematic look of the 16:9 aspect ratio in *Paris Enquêtes Criminelles* might impact shot scale preferences, encouraging wider shots. Taking advantage of the ratio, the French use more LS (+2.20%) to highlight the Parisian background. They also display

Figure 6: Shot scale distribution comparison between *Law & Order* and *Paris Enquêtes Criminelles*. Source: Own processing, 2022.

Table 3: Shot scale distribution comparison between *Law & Order* and *Paris Enquêtes Criminelles*.

	Shot Scales	
	American	**French**
MCU	53,50%	57,30%
MS	36,80%	30,10%
CU	4,40%	5,80%
MLS	3,70%	2,20%
CS	0,90%	1,30%
LS	0,60%	2,80%
BCU	0,10%	0,50%
TOTAL	100,00%	100,00%

Source: Own processing, 2022.

more MCU (+3.80%) and more CU (+1.40%) than the American version (Table 3). This trend signals that the French explore closer shots, supporting Bazin's claim that the close-up could survive and even thrive with a wider aspect ratio.

Finally, stylistic choices based on film techniques might explain the higher use of tighter shots (e.g., MCU, CU, BCU) in the French version. Digeon and Amin already suggested that the French version is a hybrid version of the original show based on pace, music, and color. They observed that the pace of the French version was almost twice as fast as the American. Hence, the French show, using more MCUs and CUs, corroborates with Bordwell and Cutting, who equates shorter lengths with shorter-scaled shots (Bordwell 2006; 137; Cutting and Candan 2015: 56).

5.3 Level 2: Feminist reading

At this level of reading, we look at the representation of women on screen based on screen time, display of emotion and the camera gaze. First, we contextualize this section by calculating the screen time per gender per show to put our data in perspective. We find that male characters make up 79.4% of the gender displayed on screen, while female characters represent 20.6% in *Law & Order: Criminal Intent* (Figure 7). In *Paris Enquêtes Criminelles*, male characters make up 78.5% of the gender displayed on screen, while female characters only represent 21.5%.

Our findings reveal that female characters are overwhelmingly underrepresented in both the French and American versions of the show. This trend complies with Geena Davis Institute and the CSA's claim that men dominate screen time in film and TV series. However, the drastic gap between genders is wider than in more recent shows analyzed by the Institute. Such a contrast might be

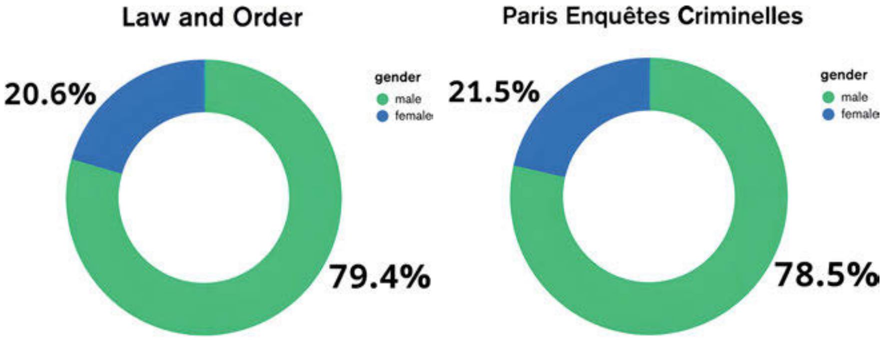

Figure 7: Gender screentime in *Law & Order* and *Paris Enquêtes Criminelles*.
Source: Own processing, 2022.

symptomatic of shows from the late 1990s and early 2000s, where gender difference on screen was not addressed as it is today.

Therefore, we analyze the display of emotions between male and female characters as represented in both cultures. The data (Table 4) show that American male characters display more anger than female characters (+2.8%). In contrast, American female characters show more sadness (+1.2%), more happiness (+2.2%) and more fear (+0.6%). The French male characters display more sadness (+2.30%), more anger (+2.8%) and more disgust (+0.10%). In turn, French female characters appear more neutral (+2.30), happier (+2.4), more scared (+030%) and more surprised (+0.2%).

Overall, the data show that both male and female characters in both versions of the show display a similar hierarchy of emotion display. Sadness is the dominant emotion for all the characters, followed by neutral, anger, happy, fear, surprised and disgust (Figure 8). This trend confirms emotions as a universal value.

Nonetheless, we observe variations in the display of emotions at the gender level in both the US and French versions. Female characters show a wider range of emotions than their male counterparts in both cultures. Our data confirms Doane's claim that the display of emotion is also contingent on gender and that women show a wider range of emotions. While this is exact, the gap between male and female characters is narrower in the French context. Our findings suggest that the gap in emotion display between gender is culturally specific. Further investigation is needed to quantitatively measure the display of emotion gender gaps across cultures and establish the validity of such a statement.

The underlying pattern also suggests that male characters in both versions of the shows display more anger than female characters. The data concurs with Patulny et al.'s statement that "women tend to either suppress their anger or express it by either crying, pouting or being unhappy, despite the fact that both men and women experience the *feeling* of anger with the same frequency" (Patulny et al. 2019: 139). Indeed, the wider range of female characters' displays of emotions supports Patulny et al.'s claim. Our findings also match Geena Davis' claim that men are more violent in a show and women are more fearful. We can speculate that male characters' display of anger combined with female characters' display of fear is representative of a crime show, in which men are most likely to be the perpetrator of the crime, displaying violent behavior, and that female characters tend to be portrayed as victims (Digeon and Amin 2021).

Pribram's close reading of films and TV series, relying on scenes and examples, provides us with in-depth analysis. She appropriately describes the most common emotions in crime shows, namely anger and sadness (elicited by sympathy). Yet, focusing on the binary opposition of primitive emotions implies that other emotions are overviewed. Our multimodal empirical approach takes into

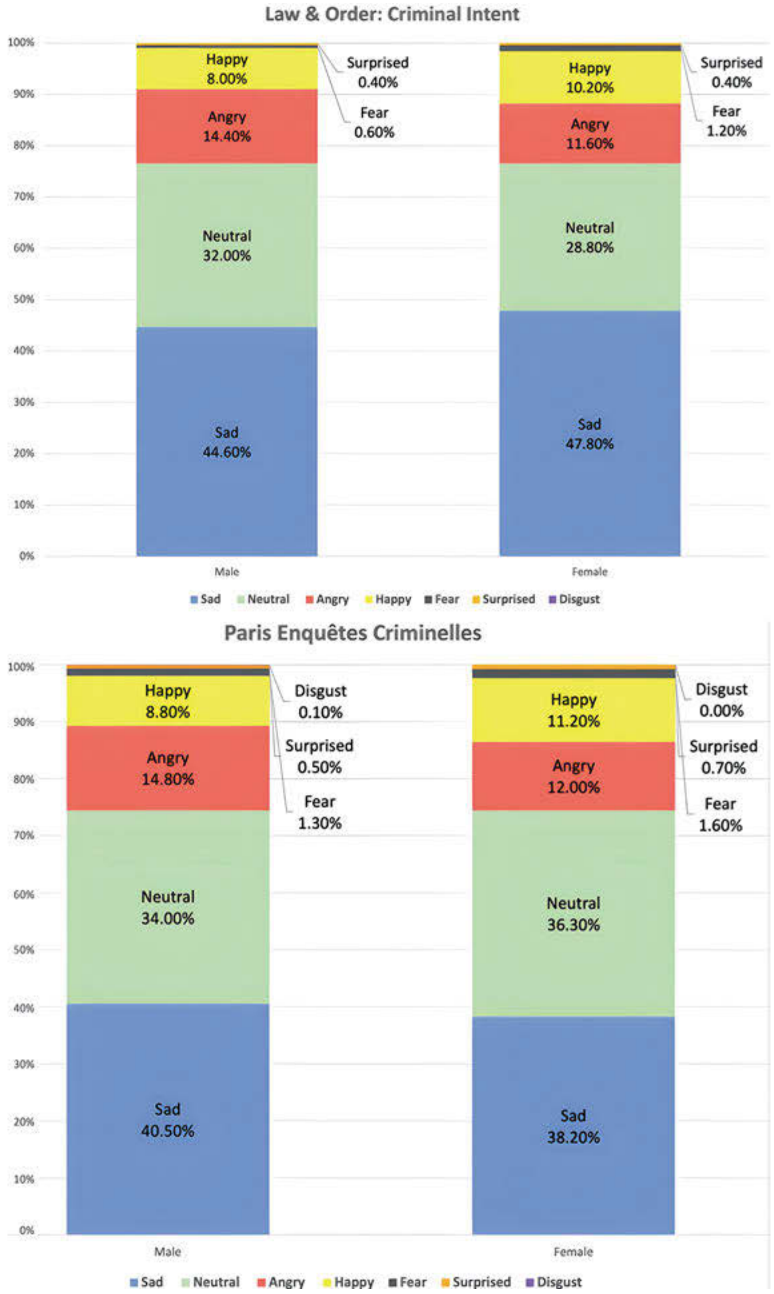

Figure 8: Emotion display comparison per gender between *Law & Order* and *Paris Enquêtes Criminelles*. Source: Own processing.

Table 4: Emotions display comparison per gender between *Law & Order* and *Paris Enquêtes Criminelles*.

	Law & Order		Paris Enquêtes Criminelles	
	Male	**Female**	**Male**	**Female**
Sad	44,60%	47,80%	40,50%	38,20%
Neutral	32,00%	28,80%	34,00%	36,30%
Angry	14,40%	11,60%	14,80%	12,00%
Happy	8,00%	10,20%	8,80%	11,20%
Fear	0,60%	1,20%	1,30%	1,60%
Surprised	0,40%	0,40%	0,50%	0,70%
Disgust	0,00%	0,00%	0,10%	0,00%
TOTAL	100,00%	100,00%	100,00%	100,00%

Source: Own Processing, 2022.

consideration the entire range of emotion display because they all contribute to a character's representation. Quantitative data allows for distant reading by revealing trends and patterns to support objectively claims such as Pribrams'. Our findings underscore the importance of a close/distant reading approach to TV series.

We have established that the French use a wider variety of shots than the Americans in Level 1 Reading. In the last step of Level 2 Reading, we zoom into the data and analyze the shot scale used by gender. This level informs us of the impact of shot scales on the representation of male and female characters in both shows.

The data show an apparent similarity in the shot scale distribution trend. Figure 9 shows that all the characters, both gender and cultures included, are mostly depicted with MCU for more than half of the time, followed by MS for about a third of the overall shot scale framing. CU has a limited role in depicting characters as it only represents 4–6% of the general depiction of the characters. BCU, CS, MLS, and LS represent a fraction of this overall depiction. Table 5 highlights the diversity of shot scale to depict French female characters.

The results do not signal any significant camera gaze biases toward female characters. No intense focus on women's depiction with a scrutinizing camera that sexualizes women has been observed. Consequently, no clear trend supporting Laura Mulvey's male gaze is in this show.

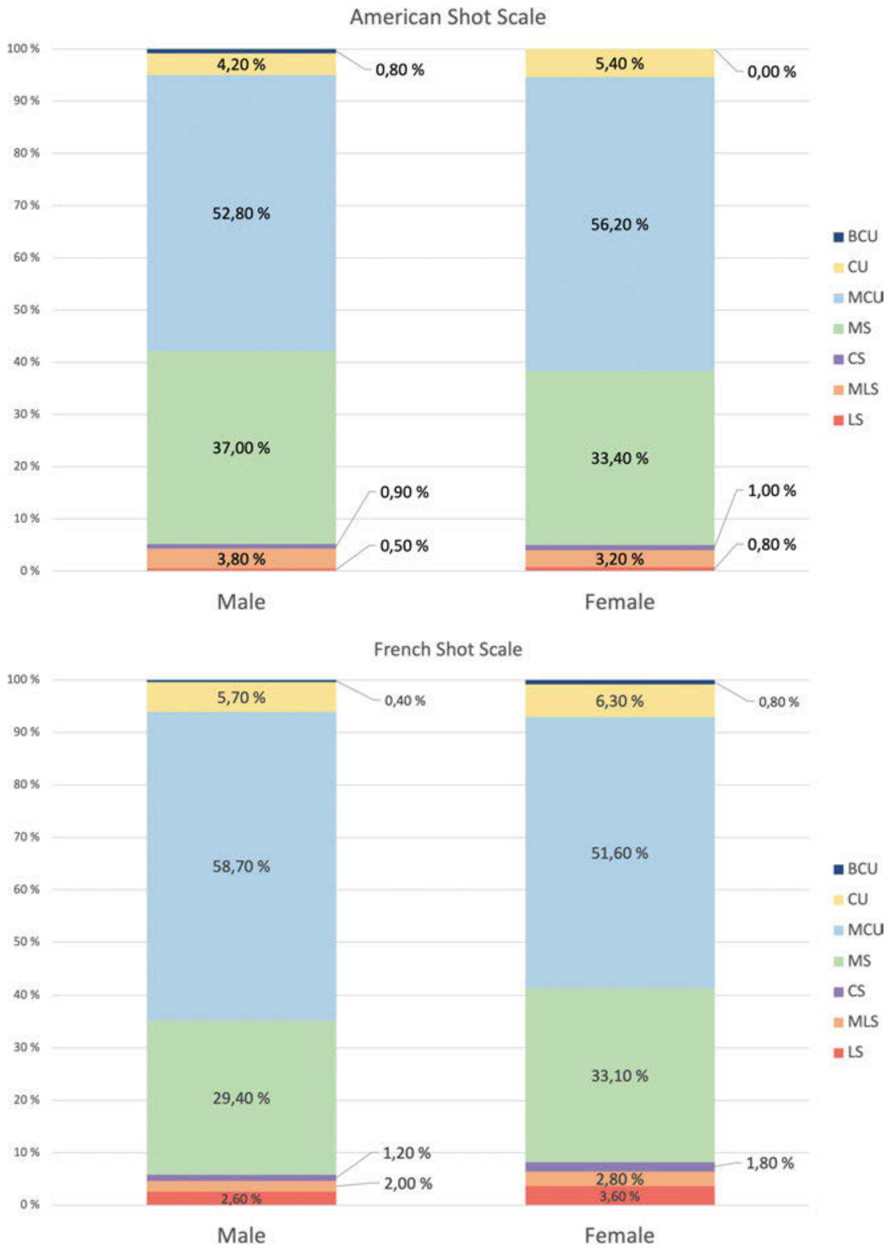

Figure 9: Shot scale distribution comparison per gender between *Law & Order* and *Paris Enquêtes Criminelles*.
Source: Own processing, 2022.

Table 5: Shot scale distribution comparison per gender between *Law & Order* and *Paris Enquêtes Criminelles.*

	Law & Order		Paris Enquêtes Criminelles	
	Male	**Female**	**Male**	**Female**
MCU	52,80%	56,20%	58,70%	51,60%
MS	37,00%	33,40%	29,40%	33,10%
CU	4,20%	5,40%	5,70%	6,30%
MLS	3,80%	3,20%	2,00%	2,80%
CS	0,90%	1,00%	1,20%	1,80%
LS	0,50%	0,80%	2,60%	3,60%
BCU	0,80%	0,00%	0,40%	0,80%
TOTAL	100,00%	100,00%	100,00%	100,00%

Source: Own processing, 2022.

5.4 Level 3: Psychological reading

This level of reading is concerned with the underlying psychological processes that govern a director's aesthetic choices and an audience's emotional response to a character's display of emotions in correlation to shot scale distribution. We analyze the correlation of shot scale distribution with a display of emotions through cognitive film theory to shed light on the directors' unconscious decisions and the audience's affect. Earlier in this study, we have established that both versions of the show rely on a majority of MCUs followed by MS. We have also demonstrated that French characters display a wider range of emotions and that they are depicted with a wider variety of shot scales. This level of reading builds on these established results and offers a more detailed view of a character's representation in the French and American context.

The data reveals that both shows follow a similar shot scale distribution pattern when portraying emotions (Figure 10). The trend similarity implies there is a tacit rule of shot scale distribution to depict emotions that transcends a director's conscious decisions. Such findings support Benini et al.'s idea that "statistical distribution of different shot scales in a film might be an important marker of a film's stylistic and emotional character" (Benini et al. 2016: 16501). Both the French and American directors of the series use the same conventions to build tension and suspense. The French director did not fundamentally change the shot scales conventions, tacitly implying that the French audience is familiar with this global pattern of representation. They are already cognizant of the genre and the film techniques.

Figure 10: Display of emotions combined with shot scale distribution comparison between *Law & Order* and *Paris Enquêtes Criminelles*.
Source: Own processing, 2022.

We thereupon zoom into the data to achieve a more granular view by adding male and female characters' emotion depictions combined with shot scales within and across cultures. Looking at the patterns of representations from a ToM perspective allows us to understand audience emotional engagement techniques. Earlier in this study, we established that female characters in France and the US display a broader range of emotions. We also demonstrated that they are depicted with a wider variety of shot scales. Building on this new knowledge, we seek a pattern of emotion display combined with a specific shot to achieve ToM. In lieu of describing all the data, we focus our attention on variations and seek outliers that might be significant.

The results follow the patterns previously described, where all the characters are depicted with a majority of MCU and MS (Figure 11, Table 6). We find that MCU is the most prevalent shot scale to feature all the emotions. When featuring fear, this ratio increases for male and female characters in both versions of the show (78.10% and 74.50%). This finding partially aligns with ToM, which states that a closer shot increases emotional response and more engagement from the audience. Though not as intense as a CU, an MCU shows a character from chest level up and still spotlights facial expressions. Hence, focusing on the characters' fear with an MCU certainly contributes to raising the psychological tension of the narrative and consequently transferring it to the audience. Along with fear, the display of surprise stands out in how it is featured. Surprise is also portrayed with a high amount of MCU in male and female characters in both versions of the show. Surprise, often a fleeting emotion, requires a close depiction of the face, focusing on displaying the emotion to the audience. The French version contains a greater quantity of CU and BCU proportionally to any other emotion. We notice that American male and female characters display anger with a greater variety of shot scales than other emotions. Unexpectedly, anger is framed with MS, MLS, CS, and LS instead of MCU, CU, or BCU. Such information signals that anger is expressed with body language for both genders over facial expressions. In fact, CU is the least-used scale to show the emotion of American males (2.5%). This finding suggests that an American audience might feel uncomfortable with a close shot of angry faces.

The data does not show any significant attempt to feature sadness with tighter shots; it goes against Rooney and Bálint's principle that a sad close-up is most likely to trigger a stronger response than the neutral close-up (Rooney and Bálint 2018). It turns out that the French female character's neutral emotion is accentuated with a CU. In fact, the CU, which raises a disproportionate amount of attention from the multiple theories we review, plays a limited role in the representations of characters and the depiction of their emotion.

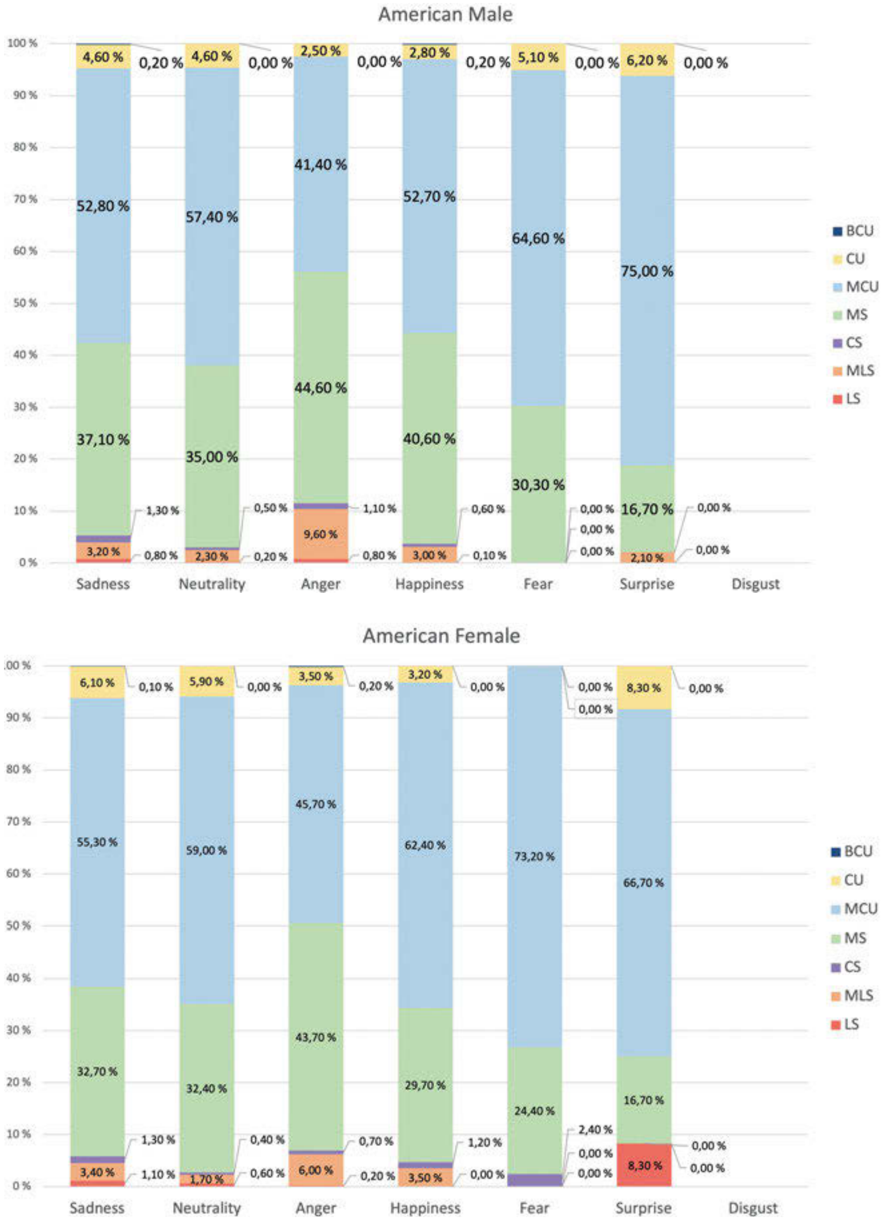

Figure 11: Emotion display combined with shot scale distribution comparison per gender between *Law & Order* and *Paris Enquêtes Criminelles*.
Source: Own processing, 2022.

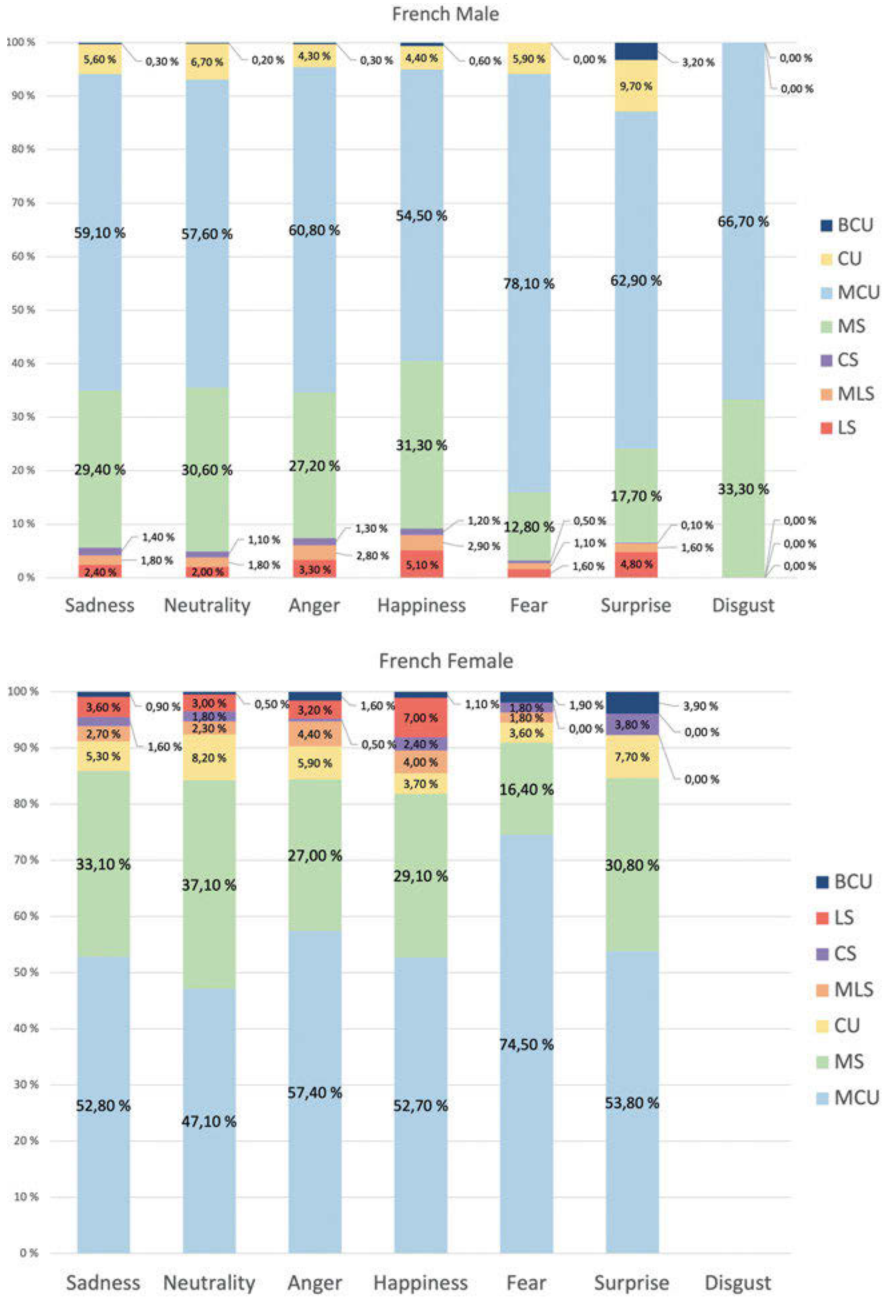

Figure 11 (continued)

Table 6: Shot scale distribution comparison per gender per emotions between *Law & Order* and *Paris Enquêtes Criminelles*.

	American Male						
	Sadness	**Neutrality**	**Anger**	**Happiness**	**Fear**	**Surprise**	**Disgust**
MCU	52,80%	57,40%	41,40%	52,70%	64,60%	75,00%	0,00%
MS	37,10%	35,00%	44,60%	40,60%	30,30%	16,70%	0,00%
CU	4,60%	4,60%	2,50%	2,80%	5,10%	6,20%	0,00%
MLS	3,20%	2,30%	9,60%	3,00%	0,00%	2,10%	0,00%
CS	1,30%	0,50%	1,10%	0,60%	0,00%	0,00%	0,00%
LS	0,80%	0,20%	0,80%	0,10%	0,00%	0,00%	0,00%
BCU	0,20%	0,00%	0,00%	0,20%	0,00%	0,00%	0,00%
TOTAL	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	0,00%

	American Female						
	Sadness	**Neutrality**	**Anger**	**Happiness**	**Fear**	**Surprise**	**Disgust**
MCU	55,30%	59,00%	45,70%	62,40%	73,20%	66,70%	0,00%
MS	32,70%	32,40%	43,70%	29,70%	24,40%	16,70%	0,00%
CU	6,10%	5,90%	3,50%	3,20%	0,00%	8,30%	0,00%
MLS	3,40%	1,70%	6,00%	3,50%	0,00%	0,00%	0,00%
CS	1,30%	0,40%	0,70%	1,20%	2,40%	0,00%	0,00%
LS	1,10%	0,60%	0,20%	0,00%	0,00%	8,30%	0,00%
BCU	0,10%	0,00%	0,20%	0,00%	0,00%	0,00%	0,00%
TOTAL	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	0,00%

	French Male						
	Sadness	**Neutrality**	**Anger**	**Happiness**	**Fear**	**Surprise**	**Disgust**
MCU	59,10%	57,60%	60,80%	54,50%	78,10%	62,90%	66,70%
MS	29,40%	30,60%	27,20%	31,30%	12,80%	17,70%	33,30%
CU	5,60%	6,70%	4,30%	4,40%	5,90%	9,70%	0,00%
MLS	1,80%	1,80%	2,80%	2,90%	1,10%	1,60%	0,00%
CS	1,40%	1,10%	1,30%	1,20%	0,50%	0,10%	0,00%
LS	2,40%	2,00%	3,30%	5,10%	1,60%	4,80%	0,00%
BCU	0,30%	0,20%	0,30%	0,60%	0,00%	3,20%	0,00%
TOTAL	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%

Table 6 (continued)

	French Female						
	Sadness	**Neutrality**	**Anger**	**Happiness**	**Fear**	**Surprise**	**Disgust**
MCU	52,80%	47,10%	57,40%	52,70%	74,50%	53,80%	0,00%
MS	33,10%	37,10%	27,00%	29,10%	16,40%	30,80%	0,00%
CU	5,30%	8,20%	5,90%	3,70%	3,60%	7,70%	0,00%
MLS	2,70%	2,30%	4,40%	4,00%	1,80%	0,00%	0,00%
CS	1,60%	1,80%	0,50%	2,40%	1,80%	3,80%	0,00%
LS	3,60%	3,00%	3,20%	7,00%	0,00%	0,00%	0,00%
BCU	0,90%	0,50%	1,60%	1,10%	1,90%	3,90%	0,00%
TOTAL	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	0,00%

Source: Own processing, 2022.

6 Conclusion

This pilot study introduces an empirical cross-cultural comparative analysis of transnational TV series adaptations. Showcasing 16 episodes of *Law & Order: Criminal Intent* and its adapted French version *Paris Enquêtes Criminelles*, we quantify characters' screen time, display of emotion and shot scale distribution. Taking a deep learning approach to the data, we cross these elements to achieve greater granularity. We zoom in and propose a layered, four-level reading of the data through the lens of intercultural models, media theories and feminist and psychological approaches. We have established a shot-scale model based on AI technology to conduct our data gathering. Our approach proved effective in automatically labeling, classifying, measuring and comparing a large quantity of visual data. This study provides insights into the ethics of televisual representations of male and female characters on screen across cultures and the process through which cultural proximity is achieved.

Our layered reading highlights different elements and enables us to confirm or challenge the theories we rely on. Level 0 Intercultural Reading reveals that the French characters display a wider variety of emotions than their American counterparts. It corroborates Hall's contexting model positing that high-context cultures, such as France, display more emotions than low-context cultures when interacting. Subsequently, in Level 1 Media Reading, we demonstrate that both the French and the US shows follow a similar shot scale distribution pattern, featuring mostly MCU and MS. This arrangement suggests the genre conventions are homogenous across the two cultures. Despite the similarities, we observe that the French version features a wider variety of shot scales than the American. Such variations can be explained by the technological progress of screens and cameras. Lastly, the French use more CU, confirming the correlation of a faster pace with closer shots and leading to a hybrid genre. Next, Level 2 Feminist Reading reveals the drastic inequality of female characters' screen time in both shows. The findings confirm that the display of emotions is contingent on culture and gender. Part of a high-context culture, the French female characters display a broader range of emotions than American female characters. Interestingly, men in both versions display more anger than female characters; in turn, female characters display more fear than their male counterparts. These findings align with the previous research led by Digeon and Amin. The study shows no trend depicting the sexualization of women based on shot scale, challenging Laura Mulvey's male gaze. Lastly, Level 3 indicates an underlying psychological process that rules the shot scale distributions. This trend can result from the directors' unconscious application of genre conventions and audience expectations. This reading highlights minor differences in representation between genders.

Our methodology and toolkit, the Möbius Trip, contributes to digital humanities research methods. The comparative study could be extended to genres, periods, directors, themes and across cultures. It offers excellent potential for further application in different fields. It has the potential to contribute to the study of TV series, impact feminist film theories, and contribute to psychological research. To do so, we need an exhaustive corpus of TV series and more data to truly achieve Large-Scale Granularity.

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Adapting the Optics: Zoom-in, Zoom-out, and Zoom-zero Modes to Understand Religious Sculptures

Abstract: This paper is devoted to the significance of the scale and physical dimensions of cultural heritage objects for their study and reuse in virtual environments. The paper focuses on digitization and virtual representation of religious sculptures from the Perm Art Gallery. The gallery's collection includes wooden sculptures of gods and saints, various decorations from churches, and a large carved iconostasis in the late baroque style, which is 25 meters high. The paper focuses on the analysis of mediation through Zoom-in, Zoom-out and Zoom-zero modes for the study of cultural heritage by objects recontextualization and reconstruction of these contexts and addresses the issue of authenticity of digitized heritage. The conclusion discusses the optics of the objects' representations as well as the limitations and benefits to variate the scales and coordinates.

Keywords: digital representation, cultural heritage, wooden sculpture, research optics, authenticity

Adaption of optics is an important component of successfully carrying out complex research. The ability to get closer to see the details and move away at a maximum distance provides a complete picture of the phenomenon under study. Digital means provide a basis for tuning research optics to obtain high quality results. Regarding cultural heritage, digitization predefines quality of data for the subsequent use and performs as a core-pillar in high grade digital representation.

Digitization of cultural heritage objects refers to various issues such as documentation of cultural heritage (Gladney, 2007), dissemination of knowledge (Cimadomo, 2013), publication in the electronic environment, providing public access to heritage (Ruthven and Chowdhury 2015), building infrastructures (Povroznik 2018), analysis of the current physical state of objects by restorers and conservation specialists (Uueni et al. 2017), interpretation of digital heritage (Rahaman 2018), expanding the possibilities of studying objects based on information technology, and reusing objects in creative industries and beyond (Terras 2015), etc. Each of these tasks requires adjustment of optics to interact with the objects in a digital environment; the focus of our current project is on religious wooden sculptures.

Orthodox religious wooden sculptures form a part of material culture and are necessarily tied with intangible heritage referring to the historical and cul-

https://doi.org/10.1515/9783111317779-008

tural features of the region. The specifics of the spread of Christianity in the Perm region lies in the later development of these processes compared to Western Europe. The main reason is the slow colonization of the territory of the Kama region by the Russian population (Makarov 2009). During the period of active construction of Christian churches, a specific phenomenon expressed in the Orthodox wooden sculpture was formed. The wide distribution of wooden sculptures in the north of the Perm region dates back to the seventeenth-nineteenth centuries. It can be assumed that sculpture has become a kind of ethnic and spiritual-cultural identification of the local population in the circumstances of Orthodox colonization, reflecting the complex processes of the cultural and spiritual turn (Vlasova 2010). Therefore, the multilayered character of religious wooden sculpture has to be taken into account in the project.

The collection of religious wooden sculptures, which is preserved by the Perm Art Gallery, is the largest and most complete in comparison with similar collections of other cultural heritage institutions in Russia (Fond of Perm wooden sculpture 2022). In general, the collection at the Perm Art Gallery differs from other similar museum collections in that most of the exhibits have a detailed description, including the place of existence before appearing in the museum, which creates fundamental opportunities for studying the distribution and localization of sculpture in spatial, quantitative and qualitative dimensions. The collection of religious sculptures inherently complements the iconostasis of the Transfiguration Cathedral in Perm. The iconostasis has an obvious cultural and historical value, as one of the oldest preserved carved wooden iconostases in the Perm region. The current project has been undertaken to digitize a part of the collection of religious sculptures of the Perm Art Gallery and the iconostasis of the Transfiguration Cathedral.

The digital space allows users to view electronic objects and creates conditions for human interaction with them. This is especially important in cases where objects are fragile or interaction with them in the physical environment is impossible. In the case of wooden sculpture and iconostasis, both of these restrictions are valid. This paper is devoted to the possibilities of adapting optics in a digital environment as an introduction to the religious sculptures, their comprehensive study and further implementation of other projects involving digitized artifacts. The paper discusses the features of user interaction with religious sculpture in Zoom-in, Zoom-out and Zoom-zero modes, and shows the advantages of each of the modes to obtain the most effective results for the study and reuse of cultural heritage.

1 Background

Perm religious wooden sculpture is the treasure of the Perm region and one of the iconic collections that shapes its brand. The Perm Art Gallery has the largest collection of such Orthodox sculptures, which currently consists of 501 items, and many of them are recognized as masterpieces of art and are widely exhibited in Russia and abroad (Vlasova 2010). The collection of wooden sculpture is diverse in terms of chronology (the exhibits date back to the late seventeenth – early twentieth centuries), by types of objects (there are widely represented sculptures of saints, gods, persons from biblical scenes, relief and sculptural images of angels, cherubim and seraphim, crucifixes, complex sculptural compositions), according to the technique of execution (the sculptures were created by representatives of different schools of carving, art workshops and individual authors), according to iconography (different subjects and motifs are presented).

Iconostasis is a large wooden partition with several lines of icons placed in a particular order. It is aimed to separate altar from the rest part of the Orthodox church (Tradigo 2006). The unique carved wooden iconostasis which is under discussion in this paper was created in the eighteenth century in the village of Pyskor in the north of the Perm province. It includes the large curved frame luxuriously decorated in barocco style, painted icons and Holy gates (Vlasova 2011). It was brought to Perm at the beginning of the nineteenth century. For this valuable iconostasis, the Transfiguration Cathedral in Perm was built in the early nineteenth century.

In the 1930s, during the period of propaganda of atheism by the Soviet government, religion was under pressure. Churches were destroyed, often being blown up or dismantled, or the purpose of buildings could be reassigned to hospitals, warehouses and even stables. With regard to the Transfiguration Cathedral in Perm, similar measures were also taken and the cathedral building was seized from the Russian Orthodox Church and given to the Perm Art Gallery for exhibitions. To expand the space for the gallery activities in the building, the main hall of the cathedral was transformed from one large floor to three floors of newly created exhibition spaces. For this reason, two additional floors surrounded with walls were constructed. One of the walls was built close to the iconostasis. The distance between the wall and the iconostasis is about 1 meter. It significantly limits the access to the iconostasis for viewing. At the level of the first and second floors of the newly created constructure, the observation of the iconostasis is practically impossible due to the very narrow space remaining between the wall and the iconostasis. We can only appreciate the beauty of the upper tier of the iconostasis from the third floor. In general, in the physical space of the cathedral, the view of the iconostasis is significantly limited and digital technologies are purposed to partially solve this problem to provide access to the masterpiece of cultural heritage via digital means. To open the iconostasis to the public, such as researchers and other audiences, the digitization of the iconostasis and the further publication of materials in an open virtual environment is necessary.

At present, the process of restoring the building is underway. In the 2010s, it was decided that the Transfiguration Cathedral, where the Perm Art Gallery is now located, would be transferred to the diocese of the Russian Orthodox Church. The process of relocation of the gallery was delayed due to the fact that artworks require a special place to store and exhibit, which was difficult to ensure in a short time. However, the gallery will move location from the cathedral and establish its activities in another building.

In the current exhibition, the unity of religious sculpture placed on the third floor of the gallery, the iconostasis and the space under the dome of the cathedral form a unique exposition environment, conveying one common idea. The iconostasis and the exhibition of sculptures in the cathedral together created a unique atmosphere and organically complement each other, in a sense revealing the contexts in which the sculpture existed.

In the new premises, when the gallery leaves the cathedral this unity will be broken, since the iconostasis will remain in the cathedral and the sculptures will 'move' along with the other gallery's collections. The religious wooden sculpture will be exhibited in new spaces according to a different curatorial idea. Therefore, digital technologies are aimed to solve a whole range of tasks, including:

1) digital preservation of the exhibition space on the third floor with an exposition of wooden religious sculptures. At the moment, a virtual tour of the exposition of wooden sculptures has already been implemented and it is freely available online (Virtual tour on the exposition of Permian wooden sculpture 2022);
2) providing opportunities for viewing the entire iconostasis based on the creation of a 3D model and its publication in a virtual environment;
3) expanding the possibilities of interaction with individual sculptures and their study by creating 3D models of a part of a collection of wooden sculptures and publishing them online.

2 Digitization

At the moment, photographs of sculptures with descriptions and short metadata are published on the gallery's website in the public domain (Foundation of Perm wooden sculpture 2022). Each page of the digital collection in the virtual gallery is dedicated to an object and contains one or more photographic images with the possibility to Zoom-in at about 50%. Along with the frontal image, separate photographs with details of the sculpture are presented in some cases. That is, the technologies of photographing and presenting images in 2D used to be involved in the digitization processes. Thus, this format of the Zoom-in mode had been partially implemented to examine some features of the object.

An initiative project undertaken to further digitize the iconostasis and religious wooden sculptures, described in more detail in this paper, uses laser scanning, photogrammetry and spatial modeling technologies. The implemented methods and technologies are aimed to complement and deepen the possibilities of reuse of the collection. To digitize the sculptures and to create 3D models, photogrammetry technology has been selected as a main instrument. It provides an opportunity to create a fine three-dimensional model based on photographing an object. The advantage of this technology is the detailed reproduction of the texture of the object in a color scheme very close to the original and building a high-quality geometric shape of the sculpture.

The experimental digitization and creation of 3D models of the gallery's objects started with the selection of the sculptures that are meaningful from different points of view. As part of the initiative project, it was important to obtain a relatively small, but at the same time diverse digital collection of religious sculptures. As a result, it included sculptures from different themes and schools of iconography. The selected objects are sculptures of saints, Jesus Christ, the Mother of God, angels and Bible characters. The sculptures are made with different techniques and belong to different territories of the Perm region. The 3D models of the selected sculptures have been published online (Center for Digital Humanities 2022). Diversity is necessary to test the possibilities of representing sculpture in the virtual space in order to determine the best approaches to digitization and create the final information resource.

Moreover, the choice of objects for digitization was influenced by technical limitations associated with the photogrammetry technology itself. For example, due to these restrictions, those objects that were predominantly monochromatic, black, lacquer, shiny, containing transparent elements were not selected for digitization. In addition, since the photogrammetry technology is aimed to create 3D models of visible surfaces; objects with complex interior structure were not involved in the work as well. These limitations are specific to the photogrammetry technology and require development of the individual solution based on the selection of a combination of technologies.

The digitization of the iconostasis is a much more complicated process due to the fact that physical access to the iconostasis is blocked by constructions of Soviet times as mentioned in the beginning of the paper. The distance from the built wall to the iconostasis itself is about a meter, which makes it difficult for the visitor to access it for viewing, and also negatively affects the possibilities of digitization. To create a 3D model of the iconostasis, laser scanning technology was involved. It is widely in use to digitize places of worship and their fragments (Barrile et al. 2017). The current project is designed to solve the technologically more complex problem of creating the 3D model of the iconostasis. Due to the lack of direct access to the object and the presence of barriers (walls) that block access to the iconostasis, it is required to digitize the iconostasis in parts.

The upper part of the iconostasis is visible for the visitors at the top level of the current exhibition devoted to the wooden religious sculpture and it is depicted in Figure 1.

Figure 1: The photograph of the exhibition on the religious wooden sculpture with an upper part of the iconostasis as a background. Photo by Nadezhda Povroznik.

The Figure 2 demonstrates the lower part of the iconostasis hidden behind the wall.

Figure 2: Point cloud of the lower part of the iconostasis obtained by laser scanning. Screenshot of the point cloud was made by Nadezhda Povroznik.

The digitization of the iconostasis is carried out on the basis of laser scanning of separate fragments of the object, followed by the merging of elements. Laser scanning of the iconostasis was carried out by specialists from the Faculty of Geology of the Perm University. Fragments of the iconostasis were scanned using a high-precision scanner. Then, the point clouds were connected, the texture was improved, the illumination and colors of the images were aligned on the darkened areas of the iconostasis, which were closest to the wall.

The created 3D models of the sculptures and the iconostasis are currently stored on local computer drives and they will be published on the website of the Perm Art Gallery in the near future. Digital facsimiles represent the physical object in maximum degree of detail and quality. High-resolution copies provide an opportunity to document the current state of the object in order to trace its decay and undertake necessary restoration measures. However, digital facsimiles require a lot of resources from digital platforms to be placed on. Therefore, it is essential to choose the optimal resolution of objects and the method of their representation. Consequently, simplification is required for publication of objects online. The choice of how to best represent 3D objects depends on the technological component, the capabilities of different platforms for publishing objects of a certain physical and digital sizes, among other factors.

At the stage of digitization, a key factor is the setting up the viewing capabilities of objects, particularly the Zoom-in and Zoom-out options. This is dependent on the quality of digitization, high resolution capture of images provides a clearer detailed view using the Zoom function.

3 Representation and authenticity in the digital space

Analysis of the possibilities of representing objects in a virtual environment is related to rethinking the opportunities of how objects will be used and how interacting with them will be carried out. However, the representation of objects online must be implemented by the ability to adapt the optics of viewing objects.

Interaction with digital objects is carried out through digital platforms where they are published. Objects can be viewed from different angles, zooming in or zooming out depending on the needs of the user and according to the capabilities and limitations inherent in the functionality of the platforms. That is, the ability to adjust the optics is determined, in addition to the quality and depth of digitization, also by the means that are used to represent objects in the digital environment.

The publication of 3D models is rarely carried out on project websites directly. More often they are getting connected with these websites through special exchange platforms. The use of third-party services instead of a direct publication on their own servers are on demand due to the fact that the significant volume of the required space to host 3D models can impede the operation of the website and unnecessarily overload the server. Exchange platforms remove many constraints, such as the number of published models. They also provide additional options for customizing the environment in which the models are going to be presented. Another advantage of such platforms is its multidisciplinarity, the publication of content from different fields, directions and topics attracts a variety of audiences and increases discoverability of the objects. Such a popular platform is SketchFab (SketchFab 2022).

There are several important features of the SketchFab platform that positively affect the ability to view the published objects and interact with them by users:

1) the publication of each 3D model is accompanied with the ability to add a description of the object and tags associated with the object, topic, time, material and select a set of categories to which the object belongs to increase discoverability and ensure interconnectedness with the digital environment;
2) implemented open data options for free download of the model by users;
3) an environment has been developed for setting the display mode of an object, adjusting the location of an object along the X / Y / Z coordinate axes, selecting lighting, background, tools for additional texture editing and other post-production options;
4) tools have been developed to customize the viewing of an object in virtual reality (VR) and augmented reality (AR).

The SketchFab environment hosts 3D models of the wooden sculpture (Center for Digital Humanities 2022). The hotspots with annotations will be created soon to highlight the specifics of the objects and other options, including VR and AR.

The SketchFab platform has advantages over other similar platforms, but is focused mainly on placing individual small to medium sized 3D objects. At the same time, setting up the display of an object also requires basic knowledge in graphics and optics, since it is necessary to select the relevant demonstration modes, including depth of field to minimize distortion and exhibit the digital object as similarly as possible to the real object.

Architectural constructures, large sculptures and sculptural compositions can also be published on the SketchFab platform, but their representation will not be optimal for viewing and user interaction with them. Zoom-in mode implemented on the SketchFab for observation of the object is optimal for medium and relatively small objects. For large objects, the platform limits the ability to zoom in, as the viewpoint in the maximum Zoom-in mode penetrates the mesh of the object into the void of the interior space, which is not simulated. That is why publication of the iconostasis' 3D model requires a different approach. The dimensions of this masterpiece are such that placement on the platform mentioned above is not appropriate due to the object being too small in size on the user screen, plus limited navigation options. Zooming-in and viewing fragments in good resolution are impossible on this platform.

The dense point cloud of the iconostasis has been published for public access on the PointBox platform (3D model of the iconostasis 2022). It is possible to zoom-in and zoom-out to observe the object. However, the platform limits the resolution and the size of the point cloud which makes it almost impossible to observe the details of the iconostasis closely.

The ArtStation platform (ArtStation 2022) will be used to place the 3D model of the iconostasis, since it makes it possible to create entire studios dedicated to the object or their combination. This platform implements a different approach, which embodies the possibility of using content of different formats, creating a united environment for representing a specific topic. In addition, the undoubted advantage of the platform is the ability to display content in high resolution, which is important for the representation of digital cultural heritage.

Undoubtedly, both platforms make it possible to make cultural heritage more accessible, more interactive and allows users to create new information products (for example, virtual galleries and exhibitions) connecting their environment and the projects websites.

At the same time, the digitization and publication of objects in a virtual environment raises questions related to the authenticity of the object (Fickers 2021). The authenticity of digital facsimiles is influenced by a large number of factors such as the digitization technologies used and the selected equipment, software that is used for the processing and visualization of models, etc. The content creator can influence the listed factors, as well as verify the resulting digital copy, check it out for compliance with the original object (including using a color palette) and designate the physical dimensions of the object. That is why there is a need to discuss digital facsimiles, framing them as critical facsimiles (Dahlström 2019).

However, there are many issues that are beyond the control of the professionals who create the digital product. First of all, such an issue is the equipment and software that is used by users of the digital content. The digital environment interaction with the object is carried out through a computer or another gadget. Therefore, the quality of the reproduced object, seen by the viewer, is affected. The creator of the resource is not able to influence the displays, as well as to track the difference of a digital object when it is played on different monitors. This circumstance is true for screens of various devices, as well as individual settings for brightness, contrast and flicker. The factors that are between the observer and the digital object in a virtual environment affect the authenticity of the object, but they are out of the control by the developers of the digital content. In addition, the individual perception of images on a computer or mobile device screen also has an impact on the ability to observe the content (Bimber and Hainich 2016).

The aforementioned circumstances influence not only the quality of the objects' representation or their perception in the virtual environment, but also bring to the materiality of the digital objects spirit of a "weak surrogate" (*Ireland, Bell, 2021*).

4 Adapting optics, scales, and zoom modes for comprehensive study

The ability to configure optics to interact with digital objects and use them in different directions depends significantly on scaling. In the analog world scale can be represented in the following main perspectives (Goodchild 2001):
1) implication of level of spatial detail;
2) representative fraction;
3) spatial extent;
4) process scale.

In reference to wooden religious sculptures and the possibilities of studying them, these scales are applicable and determine the opportunities for using Zooming modes. A sculpture can be measured in its physical dimensions and defined in terms of space (length, width and volume). It can be represented on a time scale (from creation to the present moment). The sculpture has a variety of contexts of existence and surroundings (inside the church, in the museum and between them). It is represented in a different physical condition, which is especially important for restorers. Sculptures also have a geographic scale for representation, since they have different origins and can be positioned according to this parameter on geographic maps. An analysis of the origin and localization together with other features makes it possible to classify sculptures and conduct comparative studies.

Digitization and virtual representation of cultural heritage helps to select the scale and fine-tune the distance between the viewer and the object defining the optics, switching from the detailed views to the general patterns and vice versa. The scaling in digital environment can be implemented in the Zoom-in, Zoom-out and Zoom-Zero modes. In a certain sense, combining the modes in this project is consistent with multiscale approach to digital heritage (Pepe et al. 2020).

5 Zoom-out mode

The analysis of the spatial representation of the sculpture at the maximum distance from the researcher is mediated by the map and carried out in Zoom-out mode. At this distance, it doesn't imply the object as it is, rather the data about it. The study of the origin and localization of the sculptures is based on metadata, description of origin and geographic locations. Understanding of data requires digital tools to collect, organize and process data. Geoinformation technologies make it possible to study the localization and distribution of sculptures to identify common and specific features of the objects for localities. Adjusting the optics and involving Zoom-in mode helps to analyze the origin in conjunction with the features of the sculpture such as its types, the appearance of the saints, distribution by topics and symbolism of objects and their elements. In this case, the image of the object becomes an important source of research development and its complication. Some sculptures of saints and especially Christ expressed visible similarity with the local nationalities (Vlasova 2006). For example, the faces of the religious sculptures from the territory of the Komi-Zyryans have wide prominent cheekbones, which were characteristic of the local population. A potential study on the correlation of the specificity of sculptures, their localization on provenance and anthropological characteristics of the local population inevitably requires Zooming-out for a generalized view of metadata and Zooming-in for comparative analysis of the facial features.

In the digital space, the most common mode for representing large and medium-sized objects is in the Zoom-out mode. In virtual space, viewing opportunities are limited by the size of the screen. To see the entire object on the screen, the Zoom-out mode is used, which significantly distances the object visually from the viewer. The size and quality of a display of a mobile device or a personal computer monitor shape a limited framework for interaction with an object. The real size of the object observed in virtual space becomes unobvious because the human eye sees an object reduced in size compared to its real physical size. So, as the user gets closer to the object scrolling in, it is difficult to determine where the Zoom-out mode switches to Zoom-zero and Zoom-in modes.

The Zoom-out mode has obvious advantages because it allows users to observe the shape of an object in general, to see some of its general features. With regard to architecture, for example, only in the Zoom-out mode can one track the features of the structure of an object, classify it according to the specifics of the shape and organization of elements. This circumstance is essential for the analysis of the iconostasis in our case study.

The iconostasis of the Transfiguration Cathedral in Perm has impressive dimensions – 22 meters in height (with a cross on the top of the iconostasis, the height is 25 meters), about 15 meters in width. The iconostasis has three tiers and contains 21 designated places for icons. Along with the icons there are paintings on biblical subjects. Only 19 images out of 21 have survived, two pictures were lost over time. They are the icons of the Mother of God and the Evangelists Matthew and Mark. The general idea and structure of the iconostasis can be seen in the Zoom-out mode. The dense point cloud of the 3D model of the iconostasis has been published online (3D model of the iconostasis 2022). Viewers can assess the scale of the masterpiece of wooden architecture, see and understand the general logic of space organization, analyze the hierarchy of plots depending on the canon and their location in the iconostasis.

Also, in the Zoom-out mode, it is possible to assess in a general way the internal space of the cathedral in combination with interior items, primarily in relation to the iconostasis, the central object in the cathedral.

In the physical space of the cathedral, the view of the iconostasis is difficult due to the narrowness of the space and the closeness of the walls to it, as previously mentioned. It is impossible not only to see the iconostasis as a whole, but also to appreciate the harmony of the space of the cathedral and the masterpiece of architecture. In a virtual environment, new perspectives are opened up for the implementation of such visualization and representation of contexts. It becomes possible to model the space of the cathedral in the condition before the installation of the walls, to open an overview of the entire iconostasis and the space in front of it. According to the preserved visual historical sources such as photographs, plans and sketches, it will be possible to recreate the space of the cathedral for the period before the reconstruction via digital means.

6 Zoom-zero mode

The Zoom-zero mode is useful for a deeper immersion of the viewer (researcher) into the contexts. The religious sculptures were often carved to human height, were realistic in terms of anatomy and proportions. A context for the sculptures was created within the church, which could be changed depending on religious holidays. Sculptures were an important part of the rituals and activities in the church. The sculpture and sculptural compositions had effect on parishioners of the church and make them feel like witnesses to biblical events. On various religious holidays in churches, sculptures could be draped in clothes. The surroundings of the sculptures could be changed by lighting candles and placing them in a certain order around the sculptures, creating a play of light and shadow.

Recreating the environment of existence of objects via digital means will allow users to interact with objects on a qualitatively new level, and the Zoom-zero mode will provide an opportunity to see the object as an eyewitness to events.

Reconstruction of the space in the digital environment where the sculptures and the iconostasis existed requires a whole complex of historical sources. In this regard, it is critically important to know the dimensions and proportions of the space of churches and parishes, where wooden sculptures were brought from, their interior to restore a realistic image of the environment that surrounded the sculpture and what context existed in its natural existence. Unfortunately, only in relation to a small part of the sculptures, visual sources have been preserved in photographs depicting the places where they were located in the natural environment, located in churches. According to these photographs, preserved descriptions, with memories of collectors, it is possible to partially reconstruct the space in digital format to expand the possibilities of analysis of the objects in the digital space.

The reconstruction of the natural environment of these objects is needed to recreate the authentic experience of the visitor at the churches. In doing that, it is necessary to use special virtual environments where the problem of scale can be addressed. Such virtual environments can be shaped on the basis of digital platforms for publishing well-documented and annotated 3D models online and complex environments such as virtual reality (VR).

The Zoom-zero mode can only be achieved as a presence effect, when a person can correlate the object and himself, noticing the size of both. In a sense, this can be achieved with the help of VR technologies. Modern platforms for representing 3D objects and VR allow the users to set up the optics and switch between modes according to the user's tasks. It enables them to set the optimal scale adapted to specific objectives. In the SketchFab environment, you can set up both the display of an isolated object in a digital environment and scale its representation in VR and AR. Where the physical characteristics of the size will make sense, there will be something to compare it with and the user will see the real size of the object, authentic to the original. Moreover, the height of the viewer can be easily taken into account by changing settings in the software or hardware. For example, most of the VR-glasses include a set of settings with various height characteristics to adapt the VR content to the physical size (height) of the viewer (player) to make the experience more realistic.

In some sense, implementation of the Zoom-zero mode in creation of VR-content echoes the film-making process where producers tend to avoid using zoom. The "Dolly Zoom" (Vertigo Effect or Hitchcock Zoom) was popularized by Alfred Hitchcock and then applied for quite specific scenes in filmmaking (Hitchcock's Re-released Films 1991). As an artistic effect it is used for achieving the particular psychological effect, attracting attention of the viewer to certain details, visualizing implicit processes, etc. However, this effect causes significant distortion and flattening the image (Vermeulen 2018). That is why the modern film industry prefers video-capturing with no zoom, thus achieving the needed effect with a camera position selecting distance to the object. In virtual reality, using zoom may cause discomfort to the viewers due to the unrealistic camera movement or specific optical effects which distort perspective and disorientate observants.

Additionally, when using VR in Zoom-zero mode, it becomes possible to see the space of churches and wooden sculptures through the eyes of parishioners of the past. It is important to note that the sculptures occupied different places in the church, placed at different heights. For example, they could be put on pedestals, in wall niches, placed on the floor of the church near the altar or in other spaces. The position of the sculptures is significant not only in terms of the hierarchy of saints, for example, but also in the fact that certain features of the sculpture can only be seen in their authentic location. Consciously or unconsciously, the sculptures of saints had visual characteristics that made them similar to the local population. For some of the sculptures, this resemblance to representatives of the Komi population is visible with the unaided eye. Other sculptures require the recreation of an environment, a certain angle of view, natural to its position in the church, in order to see this similarity.

To look with more depth, the time of year and the time of day for such a reconstruction is also important. Recreation of natural lighting such as light breaking through the glass of windows, the light of oil lamps and candles is also a necessary condition for the reconstruction of the authentic environment in which the object existed.

However, for most sculptures, placement in a natural context can be quite limited and a visual reconstruction of the authentic environment is problematic due to the lack of historical sources. Many sculptures were brought from distant churches and there is no mention of where the sculptures were located, what significance they had for the decoration of the church, whether they were constantly in the space of the church or were brought on holidays for decoration. It is known that in some cases the sculptures were removed from churches to hide them for varied purposes. The sculptures were not always created according to the canon, they were often worshiped as deities, which is in tune with pagan religions.

7 Zoom-in

The Zoom-in mode is necessary to view the object in detail, going closer to it and observing features and attributes of the items more meticulously. The Zoom-in mode in relation to the iconostasis provides an opportunity to see the images in the frames which represent biblical scenes, analyze in detail the iconography and combinations of colors used, which is especially important for comprehensive research of the iconostasis as a piece of art (*Vlasova, 2006*). Therefore, it opens up new perspectives for studying the object moving from general observation in Zoom-out mode closer and closer to the elements of the whole iconostasis.

With regard to manufacturing techniques and threaded parts of the iconostasis, digital technology creates additional opportunities for studying it. Figure 3 shows a fragment of a dense cloud of points extracted from the array of iconosta-

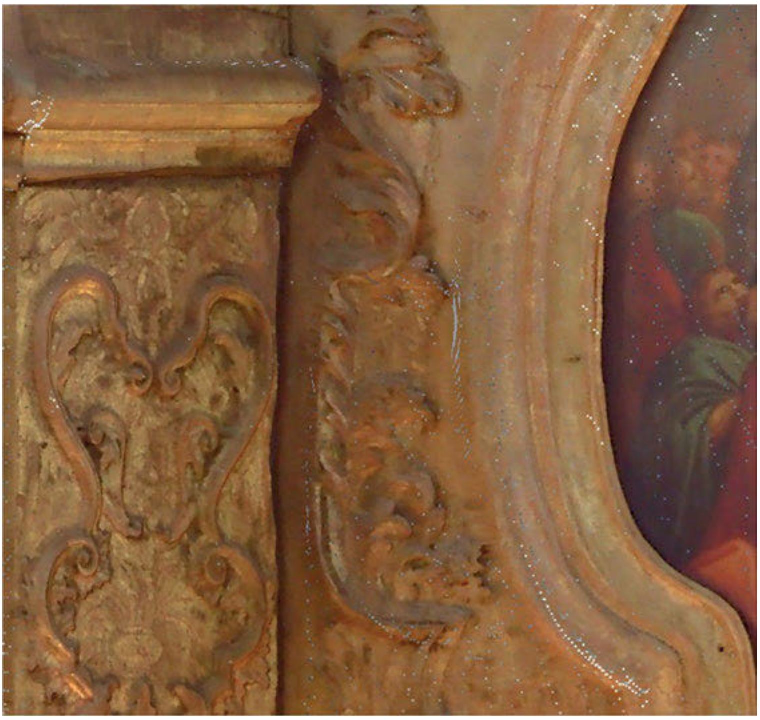

Figure 3: Fragment of a dense cloud of points created on the basis of laser scanning of the iconostasis. Screenshot of the point cloud was made by Nadezhda Povroznik.

sis scans. The dense point cloud is a set of pixels captured in 3D modeling, each of the points has a number of certain coordinates that helps to orientate the object in space. In the picture we can see fragments of carvings, some of which are of a repeating nature on other parts of the iconostasis. Analysis of the dense point cloud and its parts will help to classify fragments, identifying regularities and predict possible repetitions of the lost parts of the ornamental carving (Tari 2016).

In addition, digital means can be used to complement the main body of the iconostasis with the separated parts. Some fragments of the carving have fallen away from the iconostasis and became independent items of storage in the gallery such as Cherub in an ornamental frame, for example (Cherub in an ornamental frame 2022). Other elements were lost, their partial restoration is possible on the basis of studying the repeatability of decorative elements as it was mentioned earlier referring to the relevant study (Tari 2016). The connection of the separated and restored fragments with the body of the iconostasis is getting achievable with help of digital technologies and subsequent representation in the virtual environment.

Zoom-in and Zoom-zero modes allow users to see novelty in sculptures and open up perspectives for an interdisciplinary approach to analysis. Research at the intersection of medicine, art and the humanities expands the possibilities of artistic interpretation of sculpture. Interpretations can be made of certain features of the sculptures from a medical point of view, which will deepen the context and understanding of the sculpture by the viewer. Felipe C. Cabello's research on the Isenheim altarpiece provides a definite direction in the medical interpretation of religious painting and sculpture (Cabello 2018).

Since some of the sculptures are made in a high degree of realism, in the Zoom-in mode, it is possible to analyze in detail the ways in which the context of events is represented in the sculpture. According to the author, the character incarnated in the sculpture was an important person of the plot. For example, the sculpture of Christ in the dungeon (Seated Savior 2022) is part of the plot of the Passion cycle, which was widespread in plasticity of wooden sculptures in the eighteenth-nineteenth centuries. The gospel story associated with the sculpture describes the finding of Christ in prison before ascending Golgotha. According to the plot, Christ was beaten in the face with sticks. When looking closely at the sculpture, you can see what artistic techniques were used, what colors and palette the author chose to depict injuries and bruises.

Applying medical interpretations, contextualization can be significantly deepened and we can address the sculptures through the plot and events that happened to Christ. One of these details for interpretation may be the bulging belly depicted by the author. The artist expressed the emaciated body of Christ, the pale color of the skin, which has deathly hues and greenish and yellowish shades indicating extreme exhaustion, and blood under the crown of thorns, etc. Analysis and medical interpretation of these details will significantly complement cultural interpretations, explain and verbalize the sensations conveyed by the sculpture.

Information technology and Zoom-in modes make it possible to visualize details that are hidden to the unaided eye and to deepen the interpretation of the sculpture. Having a full-fledged 3D model of an object, it is possible to extract the mesh to analyze the shape of the sculpture. Mesh is a structural layer of a 3D model which represents the geometry of the model and consists of polygons. Separating mesh from the coverage textural layer helps to consider the shape of the object separately from painted surface. The pigments hide the bottom layers and in that way some important details that also require attention remain invisible.

Laser scanning is a very precise technology to capture and measure the shape of the object. It helps to build the geometry of the object (mesh) very precisely for the subsequent visual representation. Analysis of the extracted mesh is able to disclose details that convey the realism of the sculpture, physiology, naturalness and the carving techniques.

By separating the geometrical and textural layers of the sculpture using digital means and analyzing mesh and color individually, it becomes possible to learn more about the technique used by the sculptor. In the photograph of the sculpture of the Seated Savior (Figure 4) we can see the colors of the surface, but the curving technique itself is not so obvious. Figure 5 shows the mesh of the sculpture in high amount of polygons. 3D laser scanning shows excellent results in spite of the imperfect coverage of the scanned surface (the missed spots are indicated in green on the Figures 4 and 5). Artificial illumination of the mesh highlights the curves of the body, the relief of the muscles, emphasizing the strength of the emaciated body. Also, it is feasible to conduct comprehensive research to

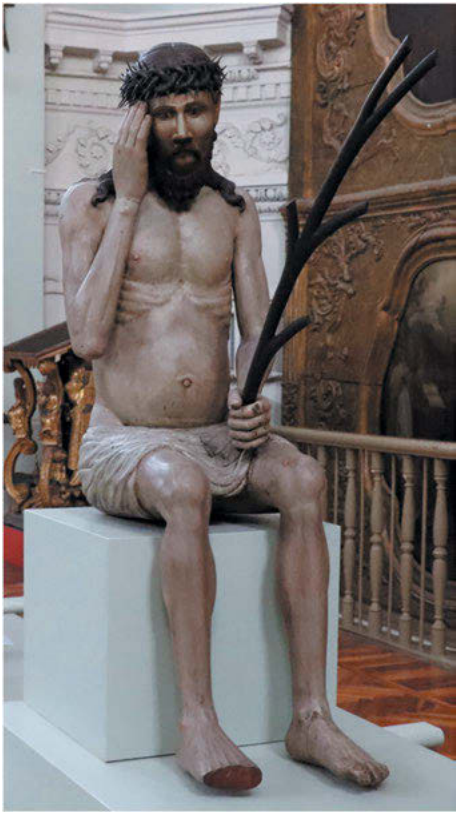

Figure 4: Photograph of the sculpture of Christ in the dungeon (Seated Savior). Photo by Nadezhda Povroznik.

Figure 5: Mesh of the sculpture of Christ in the dungeon (Seated Savior) created using laser scanning. Screenshot of the mesh was made by Nadezhda Povroznik.

understand effects that were achieved by the creator through wood carving and what was emphasized with paints.

Zoom-in mode helps to dive deeper which can be implemented on the basis of additional technologies, including tomography and X-rays. On the basis of these technologies, it is possible to penetrate inside the sculpture and reveal structural features hidden from the human eye. An X-ray study of the sculpture was already carried out in the 1980s. In the 1980s, wooden sculptures were analyzed using X-rays to study the technology of creating a sculpture, the internal system of fastenings and the internal state. These technologies were involved to analyze the physical state of wooden sculptures, to detect the presence of cavities, to trace changes in physical condition and to determine on the basis of the results of analysis the required restoration and preservation measures. Each sculpture is a complex construction that may consist of dozens of parts. The system of the connections of these parts from the outside view is also not distinguishable (e.g. nails and cotter pins remain invisible for the unaided observers, see Figure 6). In addition, the problem of preservation is associated not only with the state of the paint layer but also with internal lesions and defects. The radiographs obtained as a result of the study can be considered as pieces of art. Special attention is needed towards the conclusions made by radiologists regarding the interpretation of images. Despite the fact that the objects under study had inventory numbers, Christian terminology was used by the radiologists in the conclusions such as “X-ray of the hand of the Savior” or “X-ray of the thigh of the Virgin”. Subsequently, the images from the X-ray procedures were exhibited in the gallery as independent objects of art as part of the “Towards the Light” program (The Perm Gallery will show . . . 2015).

Figure 6: X-ray of the sculpture. Saint Nicholas of Mozhaisky. 19th century. 1980. The study was conducted by Dr. Professor A.I. Novikov.

8 In conclusion

The digitization of cultural heritage should be carried out on the basis of preconceived possibilities for scaling the project and laying the foundation for a diverse representation of objects. We should address the formation of a special digital environment, an infrastructure in which it is possible to adjust the optics and switch from mode to mode, from Zoom-out to Zoom-in through Zoom-zero modes and back according to the particular goals. That is, such a property as the adaptability of a digital resource for specific purposes should be implemented. This approach will ensure switching research optics from the analysis of details to local and even global generalizations. On the basis of adapting optics, the possibility of tuning in, it becomes possible to deepen the interpretation of sculptures and their contexts. Scalability of the elements in such a digital environment enables the opportunity to combine the Zoom modes to understand the same topic from different distances.

Furthermore, the adjustment of optics is essential for audiences whether researchers or virtual visitors of the gallery that will interact with digital cultural heritage. It is important for the cultural institution to create and tell stories and expose them to viewers, to different audiences. This is also essential for researchers to discover something new, previously unexplored, to ask new questions, to dig into the contexts deeply, to offer an interpretation of the details and the way to put together a holistic picture.

The invention of such a digital environment that comfortably switches between Zoom modes inevitably faces numerous challenges. Many of them are directly related to the digital realm, including the authenticity of sources in the digital medium, computer-mediated experience, screen-mediated interaction and others that shape the limits of our understanding of heritage.

Digitization of the objects and reconstruction of the environment alone is not enough to understand all the cultural layers and contexts of existence of the sculpture. It is necessary to know the traditions, local customs, which often differed from canonical events due to the late Christian colonization of the region and the rooting of pre-Christian customs, mixing and symbiosis of Christian and pagan cultures. Also, there is an important topic for the further discussion which relates to religious ethics in the digital environment.

The next step after the digital reconstruction of the iconostasis is planned to restore the interior of the Transfiguration Cathedral, to show how it looked like at the beginning of the 20th century prior to the installation of additional floors and walls for the gallery's exhibitions. Also, it is planned to retrieve the space behind the Holy Gates. In Orthodoxy, there is a religious ban on visiting the space behind the iconostasis by women. In relation to this prohibition, the issue of the religious ethics in the digital world arises as an important topic for subsequent discussions.

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Johan Malmstedt

Scale Exercises: Listening to the Sonic Diversity in 5000 hours of Swedish Radio with Computers and Ears

Abstract: This article explores the significance of scale within the field of audio analysis. The introduction of digital signal processing methods is today enabling large-scale processing of recorded sound, which in turn provides access to vast amounts of unexplored audiovisual data. It is now possible to zoom the sounds of our past. In order to highlight both affordances and limitations of these new methods, this article studies 5000 hours of Swedish radio from the 1980s. By adopting computational tools from bioacoustics, linguistics and musicology it becomes possible to study trends and developments in the acoustic style of broadcasting. This provides insight into the changing characteristics of public service media in the era of de-monopolization. However, to achieve these insights, the historian needs to practice the sonic scales.

Keywords: radio history, audio analysis, sound studies, signal processing, media studies

1 Introduction

> However, based on this material, it is not possible to say anything about the general character of the individual radio channels, nor about any specific aspect of content (Åberg 1996: 17).

This rather pessimistic note concludes a methodological summary written by the Swedish media scholar Carin Åberg 1996. Her ideas, though radical, have remained on the periphery of media studies ever since. She was running up against a problem of scale. Inspired by the work of German radio scholar Detlef Schröter, Åberg wanted to approach the medium, not like an information channel, but as a matter of design. Radio was simply the total sum of sounds that people wanted to hear. This meant that radio had to be studied beyond the textual and discursive realm, as "sound in time" (Åberg 1999). However, studying the actual flow of radio sounds quickly revealed itself to be a very laborious and difficult task. Manual coding was not only time-consuming, it also posed issues of precision. This led Åberg to conclude that "there just aren't any tools available for sound analysis this date. Visual and textual media rules not only science, but society at large –

https://doi.org/10.1515/9783111317779-009

and the methods, and theories for understanding sound are simply lacking" (Åberg 1996: 18–19).

The following article seeks to return to Åbergs discouraging conclusion. Her battle with the problem of scale predicts our contemporary position. Recent humanities scholarship related to sound has again addressed the problem of scaling audio data (Bull and Cobussen 2021). Yet today, it is possible to engage the issue through different means. By transposing these questions into the realm of signal processing, my work aims to redeem some of the methodological ideas of Åberg, whilst at the same time situating audio data within the debates of digital scholarship. My argument is that digital audio renders zooming not only a possibility, but as a necessity, in a way that re-actualizes Åberg's ambition. Upon tapping into the vast information aggregate of digital sound archives, the scholar unavoidably shifts through a variety of points of perspective, calling for a self-reflexive approach to "digital hermeneutics" (Clavert and Fickers 2021). In contrast to textual and visual information, the media we use to scale sound-related data constantly involves multiple, interlocking modalities. In order to not remain unreflective around this epistemological eclecticism, it is necessary to return to the question of scale in regard to audio data. The following chapter analyzes a set of audio data by means of variation computational methods, zooming in and out on a dataset of 5000 hours of Swedish broadcasting from 1980 to 1989. By means of signal processing, the analysis explores trends and variations in the data on four different scale levels. The overarching research question concerns the status of sonic diversity within the data and how it develops over time. Diversity was a guiding principle for Swedish Broadcasting throughout the last decades of the twentieth century. Prior research studied the results on an organizational level, but the actual sonic content remains unexplored. My analysis maps several aspects of diversity within the audio and tracks the development over time. In doing this, the purpose is both to demonstrate the affordances and limitations of digital audio, as well as to contribute to the understanding of the sonic development of broadcasting media. The process is intended to demonstrate the capacities of digital audio, and is, in this sense, a sort of media archeological experiment on the level of signal content (Fickers and van den Oever 2019).

2 The scales of audio data

Sound has regularly been diagnosed as a peripheral modality in humanities research (Thompson 2002, Smith 2004, Sterne 2011). Nonetheless, there have been significant changes in the way sounds are processed, stored and analyzed since the turn of the millennium. For almost two centuries, digital formats harbor larger amounts of the total human sonic cultural heritage than all analogue media combined. This is driven both by the escalating output of new digital content, as well as by extensive digitization projects across sound archives all over the globe. This radically changes the conditions under which culturally produced sound can be studied. No longer are we dealing with material objects and feeble radio transmission. Instead, the radio scholar and anyone else with an interest in sounds are confronted with a vast repository of preformatted information. These strings of acoustically interpretable data are condensed as digital audio files, allowing the researcher to ask entirely new questions about the history of sound. Simultaneously these very files pose new questions back to the researcher.

This media theoretical feedback loop begs the question of what audio data really is, and to what degree it is different from other types of data. As Wolfgang Ernst has pointed out, in terms of digital storage, there is only data. The computer makes no fundamental distinction between textual and sonic content (Ernst 2013). Nevertheless, audio data pertains specifically to a certain modality of human perception, posing a set of more or less unique difficulties. This article suggests that audio data, as information captured about, and intended to render acoustic phenomena, ought to be distinguished empirically in at least three significant ways. All three aspects pertaining to the matter of scale, and thus, the article aims to provide an introduction to the multi-scalar problems and prospects of audio analysis. Whilst the subsequent analysis in this paper demonstrates these aspects, this first section provides a more general overview of the argument.

There is no unmediated approach to the study of recorded sound, just different scales of mediation. This might at first glance appear as an oxymoronic statement. However, there is a firm tradition of distinguishing between machinic and human analysis, the same way there is a strong emphasis on the difference between qualitative and quantitative approaches. Both these distinctions indicate a methodological dis-entanglement which digital media does not allow. There is no access to digital audio which is not fundamentally quantitative and machine-aided. There might be elements of what we associate with human hermeneutics, but the very access to the sound file is an instance of complex calculation. It is not only a case of time-axis manipulation, allowing for playback and reversal – digital sonic mediation always takes place under the regime of signal processing (Kittler 2017). Information becomes manipulable and self-generating. The order of bits can be reorganized however fits the question. Instead of a recorded sentence of speech, we can listen back to all the consonants in alphabetical order, or only the breaths in between. This means that the supposed sound object under study decomposes into a tangible, zoomable meshwork of information (Ernst 2016). It remains the responsibility of the researcher to consider the stages of mediation with a certain amount of “self-reflexivity” (Clavert and Fickers 2021).

There also is no absolute ‘close’ or ‘distant’ approach to audio data, only the interaction of several related scale steps. This is not a problem exclusive to audio data. In text-oriented research, “scale” has been considered the “single most important issue” of digital transformation (Hayles 2012: 27). The conclusion, according to N. Katherine Hayles, is the task of finding “bridges” between distant analysis and close reading (Hayles 2012). Despite attempts to translate this vocabulary into the sonic realm, the media condition under which sound is processed in computers does not support such a distinction (Clement 2019, Mustazza 2018). Whilst the basic element of a text can be reduced to a symbol or a letter, proper ‘close listening’ would entail listening to phonons, the absolute quant level of sonic vibration (Arrangoiz-Arriola et al. 2019). The contemporary standard of pulse-code modulation, which informs most digitally stored sound, sets a limit by sampling the sound wave 4000 times per second. Staying properly close to the digital sound would thus result in many thousand observations for every second of speech. The same can be said regarding the frequency register of sound. Much of the vibrational forces we refer to as acoustical phenomena take place both above and below the perceptual spectrum of human listening. When sonic artifacts are the subject of study in the humanities, it is seldomly considered beyond the spectrum of the audible and perceptible. This means that digitally stored information about sound waves does not allow for the tropes of distance and closeness, which have pervaded digital scholarship. Rather, the sound scholar engages with a medium that represents sound through several, relatively anthropocentric, interrelated scale steps.

Finally, there is no purely monomodal approach to audio data. Zooming on sound takes place through different scales, in visual and auditory realms interconnectedly. The audio data being subject to analysis is the result of physical sound waves entering a digital information processing system, but “unlike tabular data and image data, it does not follow a very clear and organized structure” (Smallcombe 2022). Whilst images and text are well-developed and deeply integrated into today’s machine-learning technologies, the messy waves of sound remain somewhat elusive. This further motivates a careful distinction between audio data and other modalities of storage. Whilst there are experimental efforts in the field of data sonification, researchers rarely find the analytic necessity to transform images or text into sound. In contrast, sound constantly and repeatedly passes the threshold to the image. This can be regarded in a long tradition of acoustic analysis. Already in 1927, philologist Alois Brandl could suggest that the human ear was inferior to the eye in the study of speech (Ernst 2016: 115). Sonic material is not only an object for our listening. It constitutes a multimodal experience. This complicates things even further, because in the process of scaling sounds, the visual domain must be considered simultaneously.

To summarize, all audio analysis takes place on a scale involving both human and machinic participation. Through the interdependence on signal processing, several scale levels in the data are engaged simultaneously. Audio data furthermore engages the multi-scalar dimension of visual and sonic representation. With this in mind, sound-oriented research must develop further sensibility towards its epistemic object, advancing a specific type of "digital hermeneutics" (Clavert and Fickers 2021). This requires both technical know-how, as well as the capacity to reflect on, and represent the methods of inquiry. Though partly overlapping, the matter of audio scalability departs from the standards of visual and textual analysis. As the remainder of this article aims to demonstrate, understanding the interrelated scales of audio analysis requires concrete practical experience. Initially, the analysis shifts between several levels of frequency-based analysis, studying both harmonic shifts in the entire audio data and specific noises from a more granular perspective. The final section of the analysis shows how frequency scale levels can be complemented with rhythmic pattern recognition, focusing on the time domain, rather than the frequency domain in the recordings. Such an endeavor requires scale exercises.

3 5000 hours of radio

The Swedish media database constitutes the exemplary model of a digital sound archive, ripe for multi-scalar exploration. Sweden was one of the first countries to apply a rule for legal deposit designated for broadcasting content. In the late 60s, plans for a new archival institution were under discussion in the Swedish library sector (Snickars 2015). This was supposed to be a radically modern archive. The impulse to capture the development of mass media was not unique, but the Swedes displayed a level of ambition that was rare at the time. At the annual IASA (International Association for Sound Archives) conference in 1975, the subsequent head of the broadcasting archive Claes Cnattingius proudly declared this radical stance; modern media [. . .] like radio [. . .] contain important information, which should be preserved to the same extent as written material" (Cnattingius 1975: 27). According to the official register at IASA, Sweden was amongst the first countries in the world to take on this daunting task and the result is one of the most extensive broadcasting archives in Europe. Since 1979, all radio broadcasted by the Swedish public service is recorded and preserved at the National Library.

Today, the majority of the collection is digitized, constituting a vast repository of digital information. This analysis samples roughly 5000 hours distributed over the decade between 1980 and 1989. The material consists of 15 randomized complete week-days of broadcasting from each channel, every year, each one consisting of roughly 18 hours of sounds. This amounts to about 500 hours of sampled data every year. This is of course a small sample, in comparison to the totality of the broadcasting material, yet it multiplies the sample size used in Åberg's study by 50, which should prove sufficient for experimental results.

The sample is collected evenly from two separate channels within the Swedish public service monopoly, P1 and P3. The two channels were at the time competing over the major audience base. P1 is the 'flagship' and the first channel in Swedish broadcasting history. P3 was introduced in 1964 and was supposed to offer a more youthful appeal. The introduction of P3 was partly an attempt at creating variation and competition within the radio monopoly. At this point, there were diverging views on public service broadcasting and the risk of a monotone output drove organizational reconfiguration. Where many other countries resolved this situation by the gradual introduction of commercial alternatives, Sweden would sustain the radio monopoly until 1993. Up to that point, however, the matter of variation was in focus on the public service agenda. This is also the context within which Carin Åberg was writing. Her research reacted against what she perceived as a reductive embrace of media diversity, or as her contemporaries sometimes referred to it; "relative entropy" (Åberg 1996). Picking up Åbergs critical approach to radio diversity, this analysis pertains to diversity in the signal content itself. Whether the last decade of measures for increased variation within the monopoly was successful or not has been up for debate. Prior research has studied this late-stage radio monopoly through organizational and audience-based perspectives, but far less attention has been paid to the actual sonic content. By deploying questions related to sonic design and the expression of radio, as proposed by Åberg, it is possible to investigate how the last decade of the public service monopoly sounded.

The analysis follows in four stages, each employing a new set of algorithmic methods in order to extract and represent different aspects of the audio data. There is no overall method, but the employed techniques are all discussed and explained subsequently in each chapter. The methodological approach consciously borrows methods from other fields of research in an experimental manner. Though there is great virtue in developing methods from scratch within digital humanities research, there is also a need for sustainability and reuse. Therefore, it is important to consider how digital scholarship can build on previously established work. The ambition of the following analysis is to maintain critical reflection around the methods of algorithmic processing, whilst simultaneously expanding on the historical results.

4 Sonic diversity in the total data set over time

On this initial scale step, the data presents itself as thousands of hours of unsegmented signal values. The task is to consider how the question of diversity can be considered on an abstract level. One answer comes from the field of computational bioacoustics. This area of research is focused on machine-aided analysis of acoustic communication amongst animals. It is an endeavor that entails working with large sets of data. Bioacoustics was thus also quick to adopt digital processing techniques into its toolbox. Today, there is a rich repository of methods within the field, from which humanities research surely can learn. In fact, in the specific interest of measuring species, there have been specific tools developed to explore sonic diversity in large data sets. A common method is the "audio diversity index" (ADI). A computational approach to ADI was suggested by Farina Pieretti in 2016 (Pieretti et al. 2016). This method of measurement is featured in the approved computational bioacoustics library Scikit-maad (Ulloa et al. 2021). By processing visualizations of the audio content, the algorithms are trained on finding acoustic events. These events are collected and compared in accordance with Simpson's diversity index. The applied form is that of 'Simpson's reciprocal index', where the outcome value simply indicates the total amount of different sonic events which the algorithm can detect within the file. The translation of this method to human-produced cultural data is essentially experimental, yet the results merit attention. Figure 1 displays the average values from each year in the sample data, distributed between the two channels.

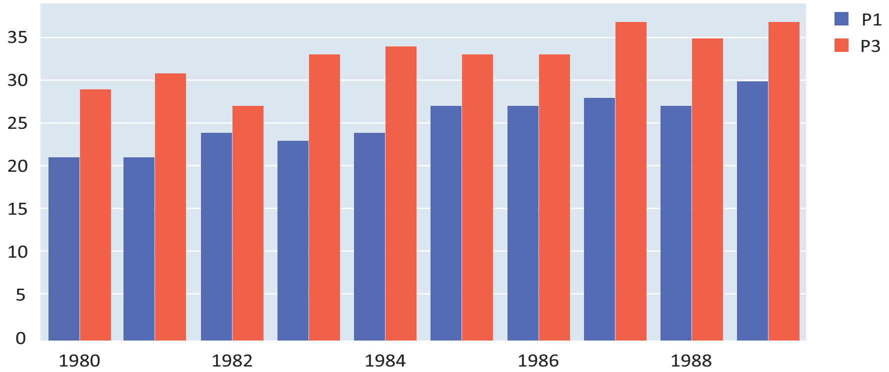

Figure 1: The average Acoustic Diversity Index from the total data of each year in the sample set, plotted chronologically. The ADI groups sonic events into species, and measures the level of variety. Both channels display a gradual increase in ADI, with P1 demonstrating a higher level of change. The X-axis display the year in the data set and the Y-axis is the average Acoustic Diversity value in the data.

Taken at face value, these results indicate a clear increase in diversity within both channels. The algorithm manages to detect 21 different types of sounds within the average P1 broadcasting day in 1980. Over the decade this appears to increase gradually until the end of the decade which renders a total average of 30 different sounds. Parallelly, the development on P3 appears similar, if slightly more moderate. P3 starts out with a comparatively high average of 29 different sounds, but ends the decade with a slightly lesser increase, amounting to a value of 37. As it appears from the sample data, both channels thus increase their repertoire of sonic types. However, P3 begins at a level of diversity that is only achieved by P1 towards the end of the decade. The result can thus be understood as a testimony of a clear difference in variation between the two channels. Yet, such an interpretation remains speculative, and the precise number of estimated sounds ought to be considered with caution. It is rather the estimation of the algorithms based on one specific manner of segmenting and comparing spectrogram visualizations. However, since the same method has been applied throughout the data set, the relative values are arguably still comparatively valuable. Thus, the rather clear trend towards a higher number of different sounds is not entirely speculative in nature, but could provide an indication of the general development of the sonic content.

This is however not the only way to measure the overall character of the data. A more signal-oriented approach, which has been applied in bioacoustics and computational musicology alike, is the measurement of 'Audio Complexity Index' (ACI). In contrast to the diversity index, this analysis does not pertain to sonic events but instead measures the variation between short-time segments. Complex-

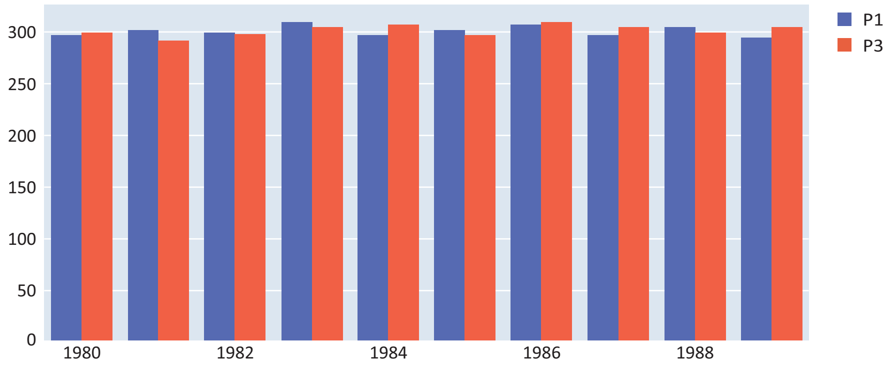

Figure 2: The average Acoustic Complexity Index from the total data of each year in the sample set, plotted chronologically. ACI is a measurement of amplitude diversion in segmented parts of the frequency spectrum. The results demonstrate no significant variation over time, or between the respective channels. The X-axis displays the year in the data set and the Y-axis is the average Acoustic Complexity value in the data.

ity is in this sense refereeing to the amplitude variation within certain parts of the frequency spectrum. The results pertain to the degree of variation over time in separate parts of the frequency register. It is thus a type of measurement less oriented around specific events and instead tuned towards the dynamic contrast over time. Figure 2 plots ACI values, in the same manner as the previous plot.

There isn't a direct relationship between the diversity index and the complexity value in the data files. On the contrary, the complexity levels do not display any clear tendency at all. In the sample data from both channels, the average values vary irregularly from year to year. The highest scores in the analysis are found in P1 in the year 1983. It is however not so simple that one method provides a more reliable answer, instead, they supplement each other. The complexity measurement might appear more brute, but has for example been successfully applied within musicological scholarship, in ways that have granted new knowledge about the variation and unpredictability in popular music (Pease 2018). Prior research has also suggested that comparison between two or more indices produces more balanced results (Lopes and Machado 2019). Where the diversity index provides an indication of the total heterogeneity in the sonic data, the complexity value gives insight into the amount of variation over time. In the case of Swedish broadcasting, there appears to be a certain increase in the diversity of sonic events, which nevertheless are not reflected in the dynamic over time. It is thus clear that the matter of sonic diversity can be far from exhausted on this level of scale. Instead, the results compel us to study the audio data at a different level of granularity. Up until this point, it remains undisclosed what kind of sounds actually featured in the analysis. In order to better understand the tendencies demonstrated in these figures, it is crucial to consider the characteristics of the broadcasted content. Thus, the following section will change the perspective to the level of acoustic object recognition.

5 Audio content as a historical indicator of radio style

In the vast ocean of signal values constituting a sound file, there reside the ingredients for what human, cultural listening understands as certain culturally definable phenomena or objects. The machine-aided identification of such objects is often referred to as 'acoustic object recognition'. This is a form of processing that relies heavily on pre-trained models, moving the analysis one scale step closer into the granularity of the data. Sound, transformed into spectrogram image, is scanned for visual cues associated with certain sounds. There are today several such models available, all with different purposes and capacities. None of them constitute a "one-size-fits-all" solution, instead, the tool has to be tuned to the purpose (Tsalera et al. 2021). The following part of the analysis will employ the 'inaSpeechSegmenter' toolkit. It was developed as part of the European Union's "Horizon 2020 research and innovation" program and is intended to be specifically applied to mass media content (Doukhan et al. 2018). In comparison to other models available, it has a rather limited categorization variety but compensates with high accuracy. The limitation is in this case also quite well adjusted to the goal. InaSpeechSegmenter classifies audio according to merely four categories; female speech, male speech, music and noise. The approach might appear restricted, but in fact, it ties in with a long tradition in radio studies. Since the work of Rudolf Arnheim, there has been a long

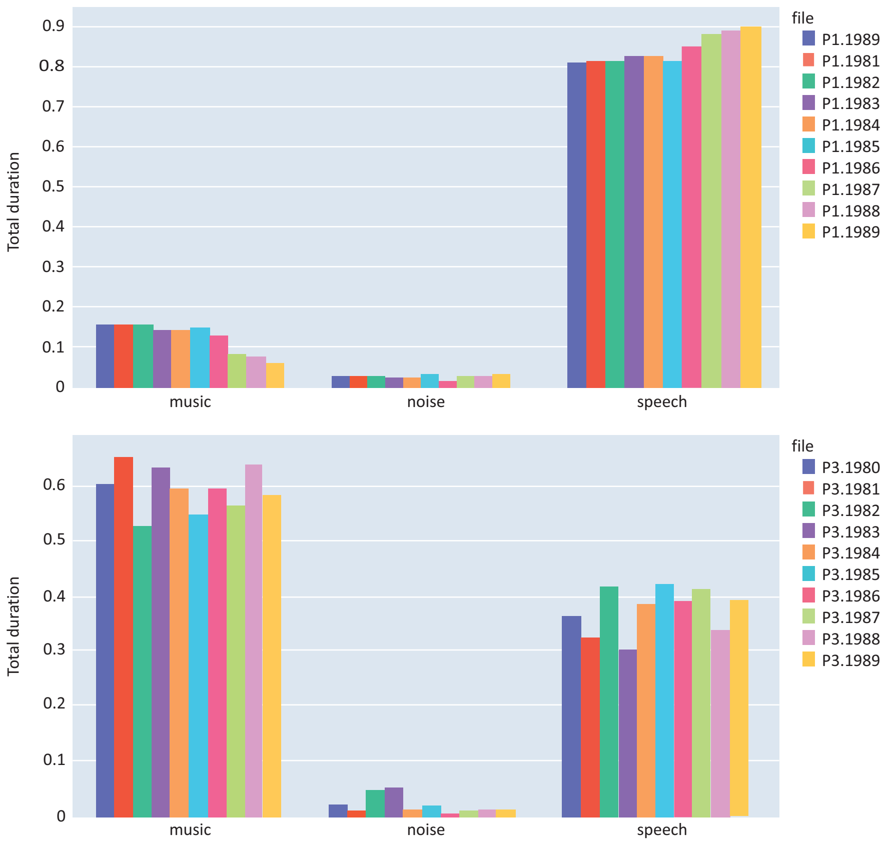

Figure 3: The total distribution between "Music", "Speech", and "Noise" in the content, displayed as percentage. The upper graph displays the results from P1 from each year in the sample set and exhibits a gradual reduction of music. The lower graph contains data from P3 and, though demonstrating overall higher levels of music, does not indicate any clear change over the decade.

line of media theory that considers the semiotic fundamentals of radio to be reducible to precisely music, speech and noise (Arnheim 1933). Åberg herself applied this taxonomy in her analysis of radio structure (Åberg 1999). Thus, in Figure 3, the percentual distribution of these three categories is plotted for each year respectively throughout the decade.

The most striking difference between the two channels appears to reside in the distribution of music and speech. Already at the beginning of the decade, P3 contains almost four times the amount of music compared to the sibling channel P1. That P3, was, and still is, more music-oriented in its content is generally accepted and known. Yet by this type of analysis, it is possible to get a grasp of to what degree the two channels incorporated music and how it changed over the decade. Where the data from P3 ends at almost the same level as it started, P1 demonstrates a clearer development. The initial 16 percent of music gradually gives way to even more speech content. The result confirms prior media historical research which has proposed that music was effectively reduced in P1 broadcasting throughout the decade (Forsman 2014 and Weibull 2018). Despite not being a novel discovery, the accordance arguably lends credence to the methodological approach. Nevertheless, these results can provide nuance to previous media historical depictions. The redistribution of content between the channels has in prior research been considered as a “migration” of music, from P1 to P3 (Weibull 2018). ‘Migration’ implies a direct relationship and communal economy of content within the monopoly, resulting in an increase of music in P3 relative to the reduction on P1.

This appears however not to be the case in the data analyzed in my study, which indicates a more independent process. The distribution between music and speech seems to display a different tendency on P3, with declining values of both throughout the middle of the decade. Towards the end of the decade, the values return to the previous levels. There is, in fact, an explanation for this curious tendency. In further attempts to diversify the radio monopoly, local broadcasting channels were established all over Sweden throughout the 80s. In 1987, a new, entirely separate channel was added to the list, hosting the local content corresponding with each region. However, up until then, local broadcasting was given airtime on P3, which meant that throughout parts of the day, the content of P3 was controlled by several local stations. Since every region had its own output during these hours, the archive registers this as an absence of content in P3. This brings to mind the archival factors at stake in this pursuit. The very way in which the material has been archived will always be hardcoded into the results. Nevertheless, it is still possible to determine that the spoken and musical content appear to diminish to an equal degree throughout the period, thus indicating an unvaried distribution. The two channels seem to have influenced each other sonically, but not necessarily in the direct sense of content migration.

By combining these values with the results from the previous part of the analysis, it is possible to further nuance the issue of sonic diversity. As concluded in the previous section of the analysis, P3 exhibited significantly higher variation in sonic content. It would be tempting to connect the distribution between music and speech to the level of sonic diversity. Yet, the results seem to refute this explanation. By comparing the chronological development of music in P1 broadcasting against the index values in the prior part of the analysis, the assumed correlation between musical content and sonic diversity is thrown into question. Only considering the P1 data, music seems to have a negative effect on diversity value, yet combined with unchanging results of P3, the conclusion is rather an absence of any necessary relation between the category of music and sonic diversity.

This reveals less about the general nature of music and more about the nature of computational audio analysis. For the computer, at least, the musical content played on Swedish radio at the time, does not display any significant difference in sonic expression. The matter of sonic diversity remains elusive on this scale level. It begs the question of what resides within these encompassing categories. This is a good opportunity to direct attention to the third content category; noise. Due to the statistical underrepresentation of the noises in the material, it would be easy to overlook, yet the category posits an interesting challenge to the matter of sonic diversity. Less conceptually transparent than the categories of speech and music, 'noise' contains most sonic events which fall outside the scope. In order to better understand the diversity values and the overall sonic profile of Swedish radio, the following segment will explore the granular level of this category.

6 Granular analysis of radio noise

Figure 4 represents the diversity in a sample of noises from the P1 throughout the decade. The visualization is produced with the human-in-the-loop tool 'edyson', developed at the Swedish Royal Institute of Technology (Fallgren 2014). The tool has certain methodological similarities with the diversity index employed in the initial part of the analysis, yet allows for more flexibility. The audio stream is segmented into bins, which are then processed visually. The plot is generated by mapping the similarity of each bin according to the technique of principal component analysis (PCA). It can thus be considered as a representation of the sonic breadth within the category of noise. Furthermore, the 'edyson' tool is for an interactive environment, allowing for aural exploration of the results. By zooming in on the noise and listening back to each group of bins, it is possible to identify certain key features within the cluster. I was able to manually detect four general

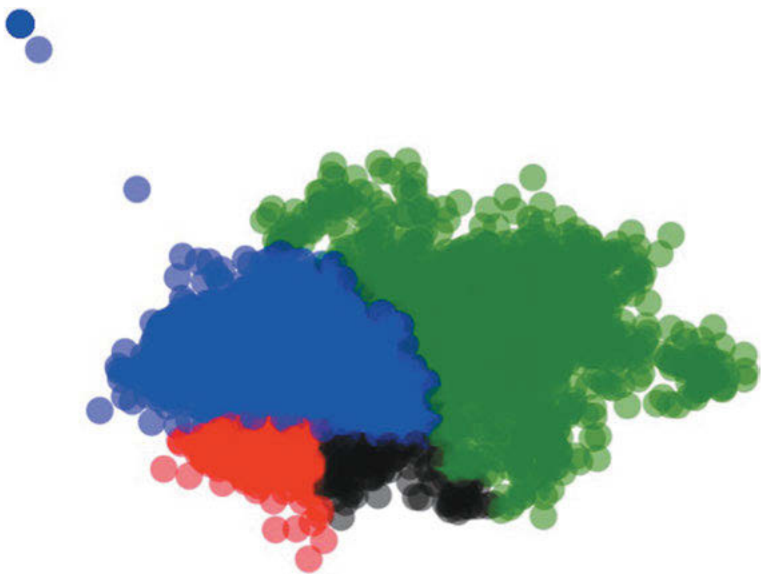

Figure 4: Visualization of the audio content in the category “noise”, by means of the ‘edyson’ module. A sample of noises in the P1 1980, 1983, 1986, and 1989 data sets have been disassembled into two-second segments and arranged according to similarity. The outcome can be interpreted as a map of the sonic features in the data where a more condensed cluster indicates more homogenous acoustic content. Color-coding has been done by manual listening and designate four categories of sound. Blue nodes are segments that contain sound effects and jingles, not determinable as music. Red nodes are crowd sounds and other human, non-speech noises. Green nodes correspond to environmental sounds and dark nodes are technical noises.

types of noises, which are represented by the color-coding. The green area corresponds to sounds with plausible animal origin, or associable with a natural ambiance like leaves in the wind or waves. The red area contains different human sounds, hands clapping or the intermingled voices of a larger crowd. The dark area is composed of noises that are mainly media-related, like hisses and loud electronic noise. The larger blue area is composed of sound effects, mostly consisting of one particular bell sound, announcing the start of the news. A comparison with the noises of P3 broadcasting, presented in Figure 5 reveals a structural difference.

Though only composed from a small sample, we can still speculate on the relationships between the difference in cluster shape and the character of the content. The P3 data posits less uniformity, with a broader area of distribution. However, in contrast to the case of P1, manual coding revealed that most noises in this data were made up by jingles and other sound effects of musical nature. In

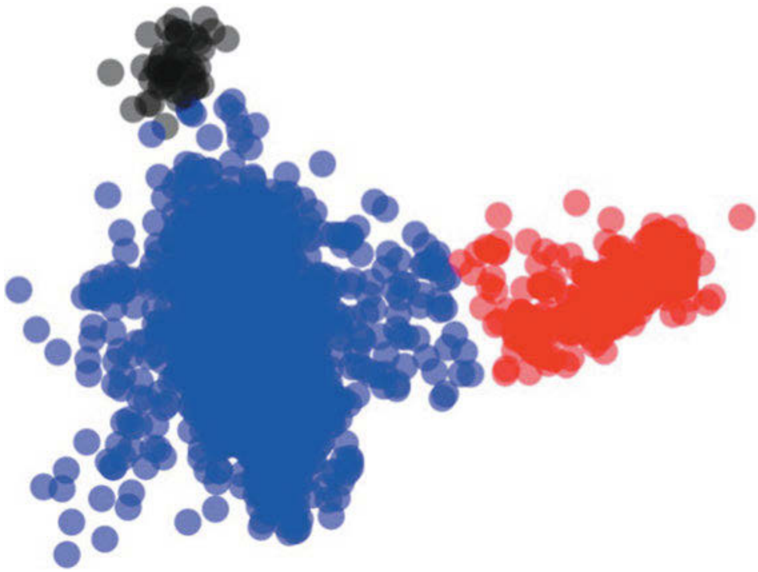

Figure 5: Visualization of the audio content in sample from the category “noise” in the P3 sample sets,1980, 1983, 1986, and 1989. Color-coding has been done by manual listening and designate three categories of sound. Blue nodes are segments that contain sound effects and jingles, not determinable as music. Red nodes are crowd sounds and other human, non-speech noises. Dark nodes are technical noises.

comparison to the environmental noises of P1 which have finer variations, these sound effects utilize much larger areas of the frequency spectrum. The result is a wide distribution, with noticeable outliers in P3 noises. The identification of sound effects and jingles has historical significance. Prior research has located how the regional alternatives appearing throughout the 1980s incorporated these techniques from American and British commercial broadcasting (Forsman 2000). My results seem to indicate that this sonic style also had an impact on P3 broadcasting. In order to further grasp this tendency, Figure 6 measures the acoustic diversity index in the noises of P1 and P3 throughout the decade.

The results from this measurement indicate that levels of diversity depend heavily on the noise category. In P3, noise can be interpreted to compose more than 90 % of the total diversity. There appears to be a positive relationship between the distribution of sounds within the noise category and the average acoustic diversity. P3 exhibits a high variety of sounds that are not identifiable as speech or music, thus increasing the diversity of sonic events. In contrast, P1 develops a more nuanced noise register, yet without the general distribution of P3. Furthermore, it is important to note that this source of diversity, the noise category, actually only

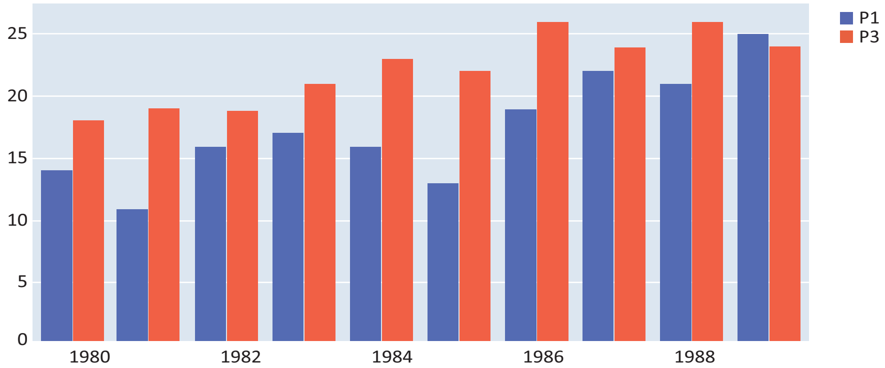

Figure 6: The ADI of the extracted 'noise' from each year in the data set. P1 measurements are coded in blue, and P3 in red. The noise ADI indicates a similar increase over the decade as witnessed in the total data, if only vaguer. More importantly, the score remains similar to the total ADI, indicating that the noises compose a significant part of the overall acoustic diversity. X-axis display the year in the data set and the Y-axis is the average Acoustic Diversity value in the data.

corresponds to 8 % percent of the total content over time on P1 and 6 % on P3. This clearly highlights the limitations of the frequency spectrum. Even if it has been possible to propose tendencies in the overall distribution of sounds of Swedish radio throughout the decade, zooming in on the frequency spectrum only reveals certain aspects of the sonic. To comprehend the diversity of recorded sound demands further study of the time-axis. Therefore, the final section of this analysis will pertain to the order of content on a higher, time-bound scale of broadcasting.

7 Scaling the time-axis

To grasp the rhythmic variations of Swedish broadcasting requires zooming out from the details in the noise. Considering how speech and music still constitute the majority of the radio content, these two categories can be employed for rhythmic analysis. The aim is to consider the predictability of content on the time-axis. In the following graph, the similarity in the order in which speech and music occur throughout the day is represented along the axis of PCA. This method calculates two alternative averages, which serve as the X and Y-axis. Figure 7 maps the correspondence between separate broadcasting days, where closer clustering implies a higher degree of internal similarity within the yearly sample. To study the homogeneity of this rhythm over time, the plots are composed of all 20 broadcasting days from each sample year. Figure 7 plots the P1 data from 1980, 1983, 1986 and 1989.

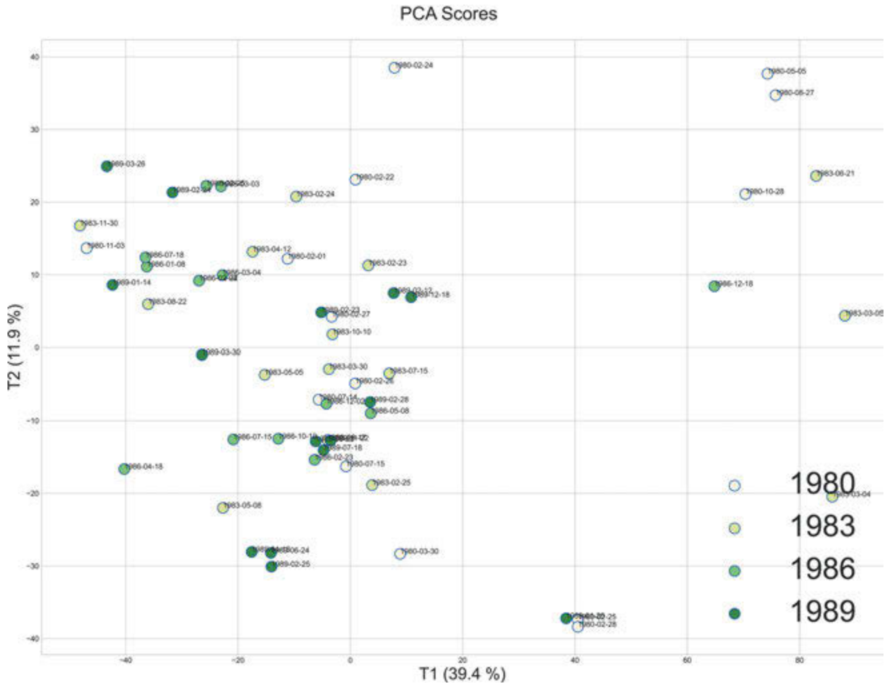

Figure 7: Principal components analysis (PCA) of the order of content in P1 data from 1980, 1983, 1986, and 1989. Each data point corresponds to a sampled day and the principal components have been computed from the distribution of speech and music in each 10-minute window as variables. X and Y-axes are two variant approximations of the trends in the total data. Darker color-coding indicates a later date. Components clustering closer to each other are more similar and those that cluster closer to the origin have less deviation from the overall mean.

The sample sets from P1 display a discernable tendency towards higher degrees of relative homogeneity. The transparent nodes, corresponding to earlier dates, contain more outliers and expand both X- and Y-axis. This broad distribution can be contrasted with later dates, indicated by the opaquer nodes, which tend to center in a narrow cluster with certain dates almost overlapping. It is possible to interpret these results as evidence that the distribution between music and speech becomes more ordered over the decade. In this sense, P1 becomes more predictable in regard to sonic content, and predictability is in turn also a valid measurement of diversity. This is foreboded by Åberg's contemporaries when they praised "relative entropy" (Åberg 1996). The concept of entropy, though disputed, is generally conceived as a measurement of the total amount of predictable states within a system (Letzler 2015). If we consider the distribution of music and speech as a set of states along the broadcasting day, the collected sample from 1989 in fact exhibits a higher degree of entropy. It is a result that nuances the previous findings, in which Swedish radio appeared to become more diverse. It recalls the results in the first part of this analysis, where the distribution of acoustic diverse events appeared to increase, whilst the complexity of time displayed more ambivalent results. The rhythmic content analysis pertains to a more granular dimension of the audio data, yet both results testify to the difference between zooming on the time-axis, and zooming in the frequency spectrum. In order to compare the historical development, the following figure plots the same aspect in the P3 data.

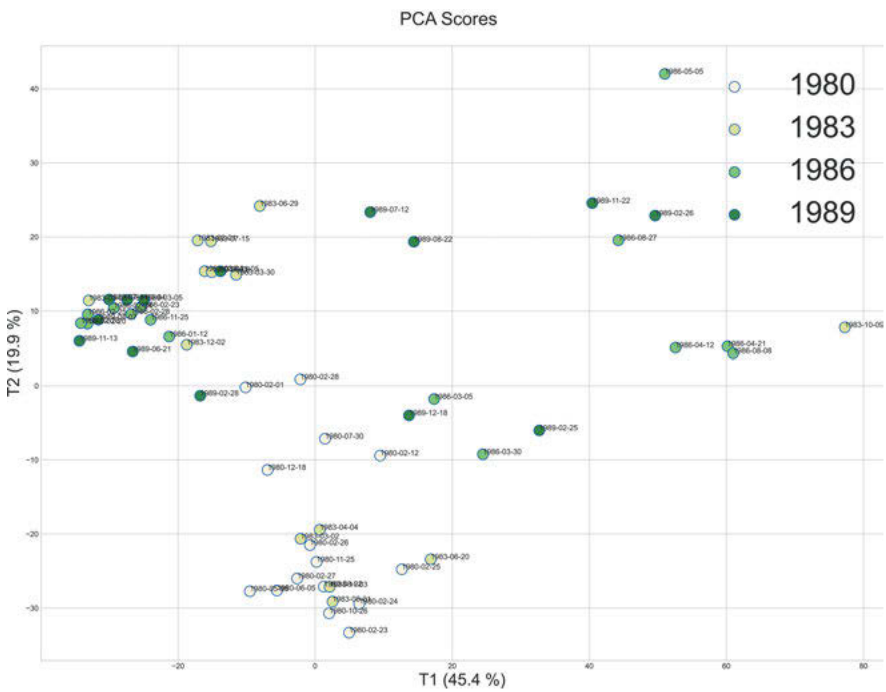

Figure 8: PCA plot of the speech and music distribution throughout the day in P3 broadcasting from 1980, 1983, 1986, and 1989. Notice how most outliers consist of dates from 1983 and 1986.

This cluster exhibits significant differences from the P1 sample data. P3 displays a higher level of similarity towards the end of the decade, but the early, transparent nodes are also comparatively closely aligned. The outliers are instead composed of dates in the middle of the decade. Besides the tendency toward higher homogeneity by the end of the decade, there is thus a curious indication of greater variation in the sample set from the middle of the decade. One plausible explanation for this irregularity can be sought in archival circumstances. As mentioned above, between 1983 and 1986, P3 hosted regional content in short segments throughout the day. National broadcasting would come to a halt and each listener would subsequently receive content from the respective regional sender. However, as this content was place-variant, the archive only registers gaps in the content. These daily gaps are a likely explanation for the noticeable increase in heterogeneity. How to regard it from a historical perspective remains open for discussion. One interpretation would be that the P3 content, at least as it was received by each individual listener, became more varied, integrating the sounds of an entirely different radio station. Nevertheless, what becomes diversified is not the sounds produced by P3. Instead, the data from 1989 seem to suggest that the status towards the end of the decade is, just like in P1 broadcasting, less variated.

This observation has media theoretical resonance. In contrast to concerns about the organizational diversity of radio, there is a small, but a long tradition of thinking about structural homogeneity in broadcasting. Back in 1977, sound ecologist Murray R Schafer speculated on the development of broadcasting media:

> Each radio station has its own style of punctuation and its own methods of gathering the material of its programs into larger units, just as the phrases of language are shaped into sentences and paragraphs. Different events are repeated periodically in daily or weekly schedules, and within each day certain items may be repeated several times at fixed intervals. (Schafer 1977)

Writing in the middle of the 1980s, radio scholar Andrew Crisell made a similar observation, proposing that internal competition between channels pushed broadcasting towards ever more predictable content (Crisell 1986). The rhythmic distribution of speech and music on Swedish radio appears to verify these predictions. Yet, as the analysis aims to display, sonic phenomena are complex and the historical development is not without ambiguity. Instead, the very concept of diversity becomes subject to multiple interpretations. Certain aspects of the sonic content do appear to become more diverse throughout the decade, while other aspects relating to rhythm exhibit the opposite tendency.

8 Final notes

Åberg concludes her critical reflections on radio diversity by stating that the "operationalization of content diversity has rendered it an irrelevant category for the everyday understanding of radio" (Åberg 1996: 7). She perceived contemporary media research to conflate the complex concept of diversity into either organizational structure or checklists of political opinions. Yet, as Åberg argued, there is no direct causal relationship between different aspects of diversity, and by focusing on too narrow and operational definitions, media research risks missing out on the more nuanced scales of radio. The results from my analysis underscore this point. It is only by remaining dynamic to the subject of study whereby the manifold aspects of sonic diversity are revealed. Entropy, as Åberg noted, needs to be relative to something. The analysis has revealed oppositional lines of development on separate scale levels, both within respective channels, as well as in the relationship between the two channels. Starting from a zoomed-out perspective, treating the entire audio data as an unsegmented mass, it was possible to detect contradictory tendencies in the sonic content. Within the frequency spectrum, both channels indicated an increasing breadth of content. It was furthermore possible to determine that the highest cause of acoustic diversity stems from neither spoken, nor musical content, but the few occasions of other sounds or noises. However, bearing the time-axis in mind, it is possible to detect an increasingly repetitive distribution of content throughout the broadcasting day on both channels. In this regard, the two channels also grew increasingly differentiated from each other. Thus, considered as a system of multiple channels, differences are gradually more distinguished, whilst each channel develops a more predictable rhythm of content. The two channels appear to become more ambiguated from each other, rendering a more heterogenic broadcasting selection. This happens simultaneously as the internal homogeneity of each respective channel increases. The results thus contribute to our understanding of how broadcasting content develops over time within a closed environment.

I will use the final paragraphs of this essay to reflect on the larger significance of these results. Beyond the historical significance, these results are also a testament to the character of recorded sound. The way in which the subject of sonic diversity has shifted through different perspectives is not unique to Swedish Radio. Rather, it reflects how scaling is a necessary instance when working with audio data. As the analysis demonstrated, the sonic material was only possible to explore by engaging several different scale steps subsequently. Yet, the order and choice of scale allow for different nuances in the data. As the analysis demonstrated, whether we choose to zoom within the frequency register, or along the time-axis, different results are rendered. Visual representation, automatic analysis, and careful listening need to be applied consequently. The manner in which we arrange the possible stages of mediatization affects the object of study in ways that are not arbitrary, but require precision. At this point, a new theory of scale in sound studies must neither resort to naïve positivism nor become ensnared in the debates of relativism. Though it is possible to learn from previous debates around textual data, recorded sound calls for new perspectives on scalable research.

My suggestion is that a future theory of scale in the study of audio data might find inspiration, neither in tabular data nor in text analysis, but within a neighboring field of research concerning the same modality. Within the realm of sonically-oriented knowledge, music theory already offers a highly developed concept of scale which diverges from other applications in the sciences. Music, and especially harmony, has been thoroughly scrutinized for its historical ties to positivistic conceptions of data (James 2019). Nevertheless, as music theorists Daniel Chua and Alexander Rehding recently reminded us, music and its associated theorizations allow for much more nuanced and complex thinking (Chua and Rehding 2021). The musical scale does not designate a singular corrective but provides multiple solutions for the movement between orders of magnitude. Certain solutions unveil the capacity of the material in a more striking manner than others, yet the decision always takes place at the intersection between aesthetics and truth, and the choices are up to the researcher. As is the case of this analysis, the more abstract order of magnitude might render similar results as what is detectable on a small scale. Yet, frequency and temporality can be segmented in many ways in between, adding nuances and dynamism to the results. Thus, sonically invested scholarship must further explore and experiment with the possible combination of scales, and scale steps available within the scope of audio analysis. Therefore, this article is a call for scale exercises. 'Zoom' is no longer a mere onomatopoetic description for a visual operation. Sounds are always already being zoomed.

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Hermeneutics

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Complexity and Analytical-creative Approaches at Scale: Iconicity, Monstrosity, and *#GraphPoem*

Abstract: By revisiting concepts such as monstrosity and iconicity, this chapter reconsiders digital writing from a complex system perspective involving multi-scale architecture, performativity and intermedia. The case in point is the *Graph Poem* project—applying graph theory and natural language processing in poetry—particularly with its analytical-creative approaches informing certain computationally assembled anthologies coming out of the project. The algorithms deployed in those anthologies operate at different scales, expanding networked text corpora by adding poem-nodes based on both small-scale, poetry diction related, and large-scale, network-topology-relevant criteria. Such methodology illustrates a politically updated data-focused relevance of monstrosity beyond the recent post-disciplinary theory, as well as a concept of iconicity drawing mainly on writing theory and performance studies. A complexity-informed notion of digital writing thus emerges foregrounding scale, monstrosity and iconicity as conjoined features of digital space and the digital in general.

Keywords: digital writing, complex dynamic systems, monstrosity, iconicity, network analysis

1 Introduction: Digital writing from a complex systemic and analytical-creative perspective

This chapter contends that monstrosity and iconicity are fundamental features of computational approaches to text corpora and networks in digital space and that the interconnectedness of the elements involved in digital writing and their behaviour make this type of writing strikingly similar to complex system. Complex systems have been successfully used to model and explain the heterogeneity and interrelatedness of real-world phenomena. Santa Fe complexity experts John H. Miller and Scott E. Page explain that "[a]t the most basic level, the field [. . .] challenges the notion that by perfectly understanding the behavior of each component part of a system we will then understand the system as a whole" (2007: 3).

https://doi.org/10.1515/9783111317779-010

They also emphasize the fact that complexity is interested in a state between stasis and chaos, control and anarchy, particularity and universality.

A complex systemic approach to digital texts is thus two-pronged: on the one hand, it posits that any change in one of the elements of a corpus (a text, in our case) has both direct and indirect effects on all the other interconnected elements, as well as on the place and significance of a text within the larger collection; second, it acknowledges the emergent nature of digital writing, whose evolution cannot be foreseen by simply referring to the sum of properties of the texts that is made of; rather, computational emergence makes digital writing a radically novel macro-level entity with respect to a micro-level substrate, a structure in which low-level elements are in tension with the higher level ones. Nevertheless, the organized complexity of computational approaches and the inevitable reductionism in the modelling of such writing occasion a reflection on the notion of control which, we argue, could be used to enhance the emergence of digital textuality and its openness to otherness, to 'foreign' traditions and modes of writing. The emergent digital textualities rely on traceable and quantifiable properties of existing corpora, but they turn the analysis of such a controlled medium into a creative catalyst for further multimodal expansions.

In the second section "Texts as (photo)graph and performative relays", we draw on performance theory to propound a more nuanced notion of (poetic) texts as computationally inter-related "performative relays" (Wildrich 2014a and 2014b)—documents acting as continued transfers of the performances they document, so much more amenable in our context given the inherent performative nature of poetry—and build on this to foreground a generalized and inclusive concept of writing ranging from natural-language-based to coding to interface and platform programming. The notion of performative relay also conveys well, we believe, the emergent nature of digital writing—understood as closely determined by the occurrence of "complex large-scale behaviours from the aggregate interactions of less complex parts" (Holland 1995: 11)—and the ways in which its evolution is informed by the history, medium and mediation of the texts involved. As such, the expanded concept of digital writing advanced by this contribution refers to complex systemic environments activated by intermedial and performative—and, therefore, iconic—presence as "presentification" potentially turning out creative (in several data-relevant senses, and thus monstrous) in drawing on contemporary culture's pervasive analytical modes of mediation.

In order to elucidate that concept, in the third section "Iconic digital writing for/as #GraphPoem complex systemic & analytical-creative approaches", we critically engage with Sybille Krämer's notion of iconicity (2003) and with John Cayley's metaphor of the icon (2006) and revisit the notions from a complexity thinking point of view, treating digital writing as an open communication system engaged in continued feedback loops with the medium and the computational model. The interoperability informing the digital, we argue, is what opens texts to new modes of writing, giving them an organicist dimension: writing in digital networked environments is alive and everchanging. It is embedded in the medium, intermedial and part of the mediation, that is, it is performative and spatial, while also making the beyond and the inherent present through continued interaction.

Such distinctions pave the way for emphasizing in the fourth section "Text and/as network; control and rock 'n' roll: systemic monsters' ubiquity and monstrous resistance" the dynamic nature of the relationship between the elements of digital writing and its multi-scale architecture, specifically in a complex mathematics and analytical-creative framework. We argue in favour of natural language processing (NLP) combined with network analysis as a most effective way to computationally chart text corpora in general and thus better understand digital writing. The appropriate mathematical model for such corpora and investigations is the (multilayer) network, whose complexity and dimensionality raise challenging issues related to processing, operability and comprehensibility. We posit that the most suitable theoretical framework is represented by complexity and graph theory applications with an emphasis on representative concepts like monstrosity and iconicity that involve aspects of both all-engulfing magnitude and detailed specificity. These concepts are particularly useful as they straddle the apparent conflict and actual symmetry between the ubiquitous control informing the digital and digital writing as potentially working—mainly by means of its complexity and analytical creativity—against such control. We consequently examine digital writing by means of complex network (graph) theory and we use the *Graph Poem* project and its developments as a case in point. The *Graph Poem* involves poetry corpus assemblage and expansion—a specific form of data-related complex-mathematics-driven creativity—as well as computational-analysis-informed creative writing/generation and intermedia (e.g., *#GraphPoem @ DHSI* in Section 5).

Following up on the digital-writing-relevant tie-in between complex mathematics and analytical-creative (humanities) computing, on the one hand, and monstrosity and iconicity, on the other, in the last section "Demo(nster)s of networked textualities and computational (analysis-based) writing", the discussion will review these two latter concepts considering the recent literature. Monstrosity will be analysed from a literary studies, digital humanities, and remix studies perspective, and iconicity will be situated in a writing, performance and remix-studies-relevant framework. While monstrosity is generally seen as a Frankenstein of the humanities embodying DH and, thus, referring mainly to issues of disciplinary 'tresspassing' and embracing the humanistic 'Gothic' dark side, but also to (paradoxical) political/cultural complacency or un-criticalness, we will argue that it is a feature of both innovative, transgressive or complex approaches as well as of the insidiousness of ubiquitous systemic control in digital space and cultures informed by magnitude and scalability. Iconicity will then be revisited in relation to digital writing's intermediality, the significant role played by the visual and visualization in digital cultures, and complex surfaces in electronic literature (and beyond), while arguing that it is inextricably intertwined with monstrosity in simultaneously large-scale and detail-intensive contexts.

The conclusion will reinforce the literary, philosophical and historical relevance of the highlighted project from a complexity angle grounded in NLP and graph theory and employing the cultural lenses of monstrosity and iconicity in a way that advances specialized research on control at the graphic, linguistic and algorithmic level in digital writing. We conclude that the multi-scale architecture of specific procedures within projects such as the *Graph Poem* sets the ground for an analytical-creative approach to textuality, one that uses the medium-informed apparent fixity of existing corpora to create further scalable instantiations of digital writing.

2 Texts as (photo)graph and performative relays

Text remains a volatile concept and reality at the crossroads of an impressive number of subjects, approaches and media. This volatility—perhaps more apparent than ever in the age of connectivity—is still interestingly contemporaneous with very diverse and even conflicting acceptances of text, and one should perhaps not be surprised if terms like "block" cohabit with more dynamic and interactive ones sometimes within the same approach. Interestingly enough, from a dynamic systems point of view, "blocks" are five behaviour patterns that confer *movement* to the structure, either through linear and exponential growth, or through decay, collapse or oscillation (Deaton and Winebrake 1999). They are never static. If we examine digital writing through the lens of complex systems though, texts will be conceived as large dynamic multi-mode, multi-link networks with various degrees of uncertainty, which arise from the inflows and outflows of information that animate the system.

In literary history, for instance, Copeland and Ferguson (2014) speak of a number of "building blocks" of literary studies [that have occasioned a series of conferences and special issues of *English Literary History* from Johns Hopkins University Press], including text, that "may persist as references in dynamic theoretical environments, remaining central to our thinking as literary scholars; but as our discipline expands, their conceptual fixity is not assured" (2014: 417). Text finds itself in these new dynamic contexts at a confluence of disciplines and approaches among which the above-mentioned editors, who otherwise provide a generous enumeration and pertinent brief review of main relevant concepts in the humanities (only), do not include digital humanities or any relevant computational subject or approach such as text analysis, NLP (natural language processing), machine learning, etc. That is why, perhaps, the main focus remains—as in the quotation above—on the "theoretical environments" and the "conceptual fixity", whereas a perspective grounded in computationality and digital space would rather focus on interactive media-related environments and on the instantiating, iterative and operational dynamism of text in digital media.

It is such environments and dynamism that we want to focus on in our considerations, while also aiming to shed light on the theoretical aspects of text arising from practice-driven and media(tion)-informed contexts. Yet, our approach is far from meant to engender any fresh new binaries to replace the old ones; it aims instead to go beyond stiff oppositions such as 'traditional'/analogue vs digital/computational and rather see them as coexisting and influencing each other. We propose to depict digital writing as a dynamic system, an expansion in which stability and instability, analogue and computational coexist at the edge of chaos or, a state that allows any system to survive and proliferate. Since ('traditional') text in digital contexts[1] is at stake in our research—mostly 'page poems' in networked mediating environments for #GraphPoem—it becomes in fact imperative to straddle such divides. As we will see in what follows, an effective way to do that is to translate the text question into one on writing. Before getting there, we need to explore the intermedia and performative qualities of text in digital (networked) environments.

Writing never happens in isolation or in one single medium. This is so much the more so when we refer to writing in the digital realm. Literature on the effect of the digital on born-analogue media has been proliferating over the past years. In a book on the literary invention of digital image, for instance, Monjour (2018) explores the evolution of photography as shaped by literature and as metamorphosing into post-photography in the digital age. The ontology of post-photography speaks to photography's transitioning from the representational to the performative whereby it gets to condition the real instead of simply recording it. In this new ontology and ecology, (post)photography is unmoored from the past and plunges into virtually possible futures or alternative temporalities.

We find Monjour's concept of image ecology sensibly consonant to our own notion of (digitally) performed commonalities between poems and corpora within

1 Not necessarily the same thing as "digital text" which can present features such as hyperlinks, (embedded) video or audio, interactive images (photo galleries, maps, diagrams, simulations), interactive questions, etc., cf. Loss Pequeño Glazier, *Digital Poetics. The Making of E-Poetry* (Tuscaloosa: The University of Alabama Press, 2002).

the *Graph Poem,* while speaking conveniently to the intermediality of texts in digital contexts and digital writing. We will provide more background on the *Graph Poem* in what follows, but for now suffice it to say that it is a project representing poetry corpora as network graphs in which the nodes are the poems and the edges correlate those poems based on quantified poetic features. Analysing the latter for graph-theory-relevant features will reflect on the poems and corpora involved as both individual and interrelational conglomerates. In Monjour's terms, those graphs perform (and "presentify,")[2] rather than represent poems and corpora. The text of the poem (as graph poem, as network/'photo' . . . graph) thus becomes a multifaceted, dynamic and interactive reality that shapes and is shaped in its turn by the various and multilayered con-texts it is located—and performed—in.

Texts in digital media are indeed performed by the 'simple' fact of being accessed, opened, read and downloaded (cf. Kirschenbaum's and Vauthier's ".txtual condition,"[3] as well as Lori Emerson's reading-writing interfaces[4]), and this is so much the more the case with poems and/as documents in particular. Poems are traditionally perceived as documents of an 'original' performance involving the staging of certain states of facts expressing, shaping, deconstructing or demystifying (if not altogether denying) a sense of self as negotiated in lingual inscription. In simpler terms, the poem is ('traditionally') the recording or documentation of a hypothetical (performative) 'writing' event. Yet, documentation is already part of an event or performance the moment the latter is under way (while there is also performativity to documentation, as we will argue next). This is literally the case when a literary text is seen as a social occasion (Carruthers 2014) or when a poet's (Donne's) 'manuscripts' (Kastan 2014) prove to be the result of multiple 'non-authorial' interventions and social negotiations.

In more complex frameworks, though, the documentation can be part of the performance in ways that enrich both with multiple temporalities and spatialities. The concept of "performative relays" proposed by Mechtild Wildrich, for instance (Wildrich 2014a), refers to various documents of a performance that by

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2 "La photo renvoie à ce qui « sera » ou ce qui « pourra être », s'attribuant ainsi une performativité où le geste de présentation/présentification prend le pas sur la fonction de représentation" (Monjour 2018: 44).

3 Matthew Kirschenbaum, "The .txtual Condition: Digital Humanities, Born-Digital Archives, and the Future Literary." *Digital Humanities Quarterly* 7.1 (2013), accessed May 1, 2022, https://bit.ly/1mCbo2G; Bénédicte Vauthier, "The .txtual Condition, .txtual Criticism and .txtual Scholarly Editing in Spanish Philology," *International Journal of Digital Humanities* 1 (2019): 29–46.

4 Lori Emerson, *Reading Writing Interfaces. From the Digital to the Bookbound* (Minneapolis: University of Minnesota Press, 2014).

means of giving a new place, time, and medium to the latter actually continue it and thus, in fact, make it possible, [re]enact it (Wildrich 2014b) on certain 'new' levels and 'novel' contexts. In borrowing and transferring this concept to poetry, we bound it to refer to the text of the poem 'solely,' thus highlighting and redefining text as the document *predating*, shaping, and, at the same time, recording any performance of the poem (cf., for instance, Tanasescu 2022). Text—as document of poem—is itself always shaped, dismantled, and again reshaped in its turn—rewritten and revised, re-inscribed and re-performed—in various networked contexts (Nicolau 2022,[5] Tanasescu 2022, Tanasescu and Tanasescu 2022). From the angle of digital writing seen as intermedia and performative activity, writing a graph poem involves (re)writing any poem-node in the graph as the corpus is itself (re)written, and thus also writing in digital space the moving (photo)graph of the network that "presentifies" the corpus.

The paradoxical status of text in the context is that of document predating the performance of the poem in digital space. At the same time, since text can be, as we argue, redefined in digital (writing) contexts as performative relay(s), it emerges after the writing/performance at hand as its recording(s). If, for instance, in the example in Section 4, an expanding corpus of poems is (re)present(ifi)ed as a network in which the edges are correlations between the vectors representing each poem-node, the text of each poem written computationally will evolve alongside the corpus *per se*. The interrelational reticular architecture of the corpus as digitally written/performed will be reflected by the evolving digital inscription, i.e., document, of each poem involved, its corpus-dependent vector.

3 Iconic digital writing for/as #GraphPoem complex systemic & analytical-creative approaches

Sybille Krämer (2003) offered an articulate systematic reformulation of writing truly pertinent to our subject and the example above. Since it does not equal language use but rather provides philosophical—and computational—models for the analogue flow of language, she argues, writing is not solely discursive, but "iconic" as well. In as much as "cultural activity," writing is in fact not dependent on either

5 Felix Nicolau (2022) revisits the #GraphPoem poetics and particularly *Various Wanted* (MARGENTO *et al.* 2021) from a linguistic angle, drawing on Coseriu's integral linguistics and linguistics of context.

(natural) language or semantics. Moreover, in its "operative" version (the one based on calculus and informing higher mathematics and other formal symbolic systems), writing is profoundly and effectively desemanticizing and anti-hermeneutic (Krämer 2003: 531) while nevertheless (or so much the more so) preserving and developing specific cognizing (and cultural) functions. Krämer thus manages to bridge a series of established divides, such as the one between text and image—since text is now proved to have a definitory iconic and "inter-spatial" (523 et infra) component—and the one between texts in natural language and other kinds of writing. Among the latter, of special relevance to us is obviously the writing done in programming languages, but logical notations and even "numeric systems" are of course also of interest (518).

Conceptual and concrete poets have tried to make this point decades earlier though their practice, but their impact has been generally confined to literature and aesthetics. The overlapping or even congruity of techniques and strategies involved in both programming and 'plain' writing was advanced by John Cayley (2002) in an article that appeared one year before the publication of Krämer's contribution in English translation. While indeed not discussing concrete writing, Krämer's argument goes nevertheless beyond the scope of poetry or the arts and makes a strong point about the iconic and (inter-)spatial nature of writing in general. Likewise, her elucidations related to writing as operative and even algorithmic technique (Krämer 2003: 534) are equally general and far–reaching, particularly given that digital writing is approached only towards the end of the paper in a succinct fashion that still manages to cover some crucial aspects discussed below. Compared to that, Cayley's considerations regarding programming as already present in traditional/page writing, although universally applicable, are not employed to foreground a general concept of writing but on the contrary, to distinguish between the code involved in, and the resulting text of, electronic literature computational generation. Yet, in describing how 3D immersive virtual electronic literature works, Cayley uses icons as a metaphor for the unique experience involved, drawing on recent theological contributions as well as canonical Eastern Orthodox authors like John of Damascus. Just as for a believer or a religious painter the icon is not a representation, but a threshold beyond (and by means of) which experiencing the deity is literally possible, dynamic inscriptions on "complex surfaces" can "mysteriously" congeal into meaning for the reader/user (Cayley 2018: 10 and 222).

We want to combine particularly these two perspectives, Krämer's and Cayley's, into the notion of the iconic relevant to our argument. Krämer's "operative writing" is best epitomized by calculus and higher mathematics, but being quintessentially a "cultural technique"—i.e., "dealing with symbolic worlds" while involving "desemantification" as a "crucial aspect" (Krämer 2003: 531)—it pervades so many other kinds of writing, potentially all of them and, therefore, literary writing as well. It also bridges literary writing quite conveniently with coding and the kind of (inter)operability informing the digital, while also covering with its iconicity the intermediality typical of the latter. As a medium embedded in another medium (the digital one), argues Krämer, drawing on Niklas Luhmann's general systems theory (Krämer 2003: 529–530),[6] writing becomes the only form of that new medium.

It is in this capacity, therefore, of sole form of the digital medium, that writing can occasion interconnections across apparently widely disparate genres, such as computer code and 'page' poetry, and thus allow us to explore the anatomy and functionality of the relevant complex networks. Nothing is pure, simple or un-miscegenated about either the connectivity of such networks: the links between poems and the topology of their graph-structured corpus—and, indeed, the versions of the poems themselves as read and processed by the machine—are inevitably informed by the "operative writing" involved in the algorithms and the specific coding scripts deployed for the task or within the various interfaces and platforms in use. The reverse is also true. The interactions and links between the coding blocks, applications, and interfaces involved, the way they perform in the shared context and their specific outputs are coloured by the sets and models imported and by the specific contents and features of the poems and corpora under scrutiny.

As we intend to illustrate the relevance of the iconicity of digital writing to the complex-system-based approach informing the *Graph Poem* (and, thus, potentially contemporary DH more generally), we will provide here a brief background and description of the scope of the project. While various other aspects and applications of the *Graph Poem* will still continue to inevitably emerge in

6 A note needs to be made on how we depart from Luhmann in our understanding of digital writing as a complex system. For the German sociologist, the definition of a system is based on the concept of autopoiesis (1995, 408), or self-creation, which radicalizes otherness: his notion of "soft" complexity is articulated around the concept of "complexity of operations," that is, the number of possible relations between the constituents of a certain system exceeds the number of actual relationships that will happen in the said system. Luhmann's view of complexity is thus largely reductionist, because the complexity of operations entails selection and because systems are separated from the environment by a boundary: he only acknowledges the differences that arise between systems (what makes one system different from another) and the difference between a system and the environment, but he does not fully address the problem of the differences arising between units in the same system—that is, the problem of heterogeneity. Luhmann's difference is contained within the system and is a condition of the system's self-referentiality and closure, whereas the present contribution sees digital environments in general and digital writing in particular as essentially open to external interactions and ultimately internalizing such interactions.

our argument as we go along, here we will refer to its main tenets and milestones. Initially started at San Diego State University in 2010, continued on a Social Sciences and Humanities Research Council grant at the University of Ottawa starting in 2014 and then also at UCLouvain since 2019, *Graph Poem* involves deploying NLP and graph theory applications in computational poetry analysis. The project's objectives are to digitally define, compute, represent, expand, and evaluate graphs—networks of nodes and edges, where the nodes are the poems and the edges, links between the poems defined according to genre-based criteria—as computational tools to (re)organize North American (and then progressively other) poetries and to discover new relevant commonalities and paradigms among various poems (and, therefore, poetries and poets). More specifically, the edges quantify similarities between these poems in genre-relevant respects, such as diction, meter, sonic devices, figures of speech, etc. Since advanced by a poet, the project had from the very beginning a strong creative component: the graphs were initially used in writing poems presenting certain stylistic features and/or (thus) fitting into or enriching specific corpora and collections, as well as in teaching poetry and creative writing (Tanasescu 2011).

As the project advanced, this trait developed into a computational analytical-creative approach. As detailed below, the computationally assembled anthology *"US" Poets Foreign Poets* (MARGENTO 2018) foregrounded such an approach as relevant to locating and integrating relevant data. An initial corpus of contemporary (North) American poems was algorithmically expanded to include poems (from any other literature, region and period) that proved to have particular NLP-based features resulting in their positioning and ranking within desired ranges in the overall evolving network (Section 4 for further specific details). The complex coupling of NLP and network analysis resulted in the creation of a one-of-a-kind evolving dataset making up the ongoing project of the collection, of which the published anthology was only a momentary stage.

The latter represents an instance of iconic digital writing as it intermedially inscribes a developing corpus and its mathematical modelling alongside the texts it consists of, or it keeps absorbing, in their evolutionary interrelation. In this context, analytical creativity refers to the creation of data not from scratch, but based on the computational analysis of existing datasets, and as (dis)located data now 'made new' by processually being integrated into, interacting with, and reshaping, those initial datasets. While the process also involves the creation/generation of new texts and/or algorithms (cf. Section 4), the main emphasis is laid on corpus complex-mathematics-based (dataset) assemblage and automated expansion, as a form of digital writing.

In a more recent iteration of the project (Margento et al. 2022), the creative part of the analytical-creative paradigm[7] is somewhat closer to a more habitual acceptance. Initial text datasets (poetry collections) were hybridized with others (poetry collections or anthology contributions as well, but also academic articles and social media content) and then fed to topic modelling algorithms that provided alternative readings/rewritings of those initial data (consequently also hybridized). The resulting 'translations', from English into English, Romanian, and/through Python, progressively featured words, lines of verse and finally stanzas branching out into "various" multiple inter- and intra-language renditions and (concrete-poetry-style) rearrangements. The iconicity of such writing bridged text and/as visuals as well as natural language and code, alongside traditional (print and electronic) book formats and platform content (specifically GitHub repos).[8]

From the above-outlined perspectives, digital writing is performative and the project under discussion has a literal performance component too. With respect to the latter, Cayley's in-passing appropriation of the mystical iconic can prove quite useful in that it accounts for the complexity, diversity and manifoldness of inscriptions in digital space while alluding to a relevant kind of mediating transcendence. As argued in the previous section, digital writing is fundamentally performative and when an initiative like #GraphPoem involves performance *per se*, the interface becomes an "interfacing livestream" as the spectacle consists of performing an apparently usual Graphical User Interface as event venue (Tanasescu 2022). The venue becomes on these occasions a screen of manipulated and manipulatable screens, an interface of interfaces, multitudinous and connective. As such, the performed interface goes beyond the established distinction between "looking at" and "looking through" windows as a digital-space-based theatrical hypermedium that performs the interface and presents it as *the* performance, while also opening it up to various other platforms and participants or users impacting it from beyond. This interplay of the within and the beyond and the mediating transcendence of the related binary speaks quite relevantly to the iconic described above.

The type of modelling involved by projects such as the *Graph Poem* involves network representation and analysis; therefore, the outputs provided and insights inspired by network analysis reflect on an actual immanence of the data at hand.

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7 While, to the best of our knowledge, "analytical-creative" is our own term in the field of literary computing (and DH more generally), other projects and stances can be described as such as they also deploy and harness computational analysis for creative (literary) purposes (Drucker 2021 and Johnston 2018).

8 For a more detailed description of the process, see the note on the poetics in the collection proper (Margento et al. 2022: 114–120); for a translation-studies and digital-humanities-focused analysis, see Nicolau 2022.

However, the beyond is also in the guise of ongoing propulsion, that is, the above-mentioned computational corpus assemblage and expansion. There is, of course, humanistic immanence in all modelling in digital humanities (Sperberg-McQueen 2019: 285) and there is oftentimes complexity and obviously further relevance or applicability as well (McCarty 2019). What interests us primarily, though, and what is characteristically illustrated by the project under discussion is its iconicity involving digital writing in its intermediality and complex reticularity setting in motion a dialectics of immanence and transcendence imperiously engaging systemic control. It is these aspects that tie in iconicity with control and monstrosity in ways relevant to our discussion.

4 Text and/as network; control and rock 'n' roll: Systemic monsters' ubiquity and monstrous resistance

Projects like #GraphPoem are representative of a more general condition of digital writing. On the one hand, all the data, given its inherent performativity and interrelationality, is in continuous transition, in a characteristic state of flow and flux. On the other, the ubiquity of the digital and the imbrication—if not complete overlapping of space and digital space (Vitali-Rosati and Monjour 2017)—makes control arguably ubiquitous and inescapable. "That a monster should be such a natural!" as Trinculo puts it.[9]

Within network-based digital humanities projects as well as on the Web in general, nodes and layers in flux mutually instantiate and perform each other. Such dynamic of both inter-related and dissonant ontologies demand matching adaptive polyvalent models accompanied by a versatile uncompromisingly transgressive critique: a critique that needs to track down and scrutinize the numerous, if not countless points of entry for political and economic control. To the extent to which no data is raw or unbiased (Gitelman 2013) and no algorithm, coding block or computational application can be developed or run in any haven or heaven of immunity to system domination or corporate infiltration, control is virtually ubiquitous, located at "the level of the medium itself," and "must be defined via the actual technologies of control that are contained within networks".[10]

9 William Shakespeare, *The Tempest* (New York: Simon & Schuster, 2013), 3.2. E-book.
10 Alexander R. Galloway and Eugene Thacker. "The Limits of Networking." *Nettime*, March 24, 2004, accessed April 9, 2022. https://bit.ly/2RYGhAj.

The simple act of (digital) writing in itself, by itself, and in its entirety attracts and, moreover, ensures control; writing (in) the network is not only network-controlled, but also constitutes the very act of network control. The latter has actually been synonymous to communication (and therefore network writing) from the very inception of all operational packet-switching webs: what TCP (the transmission control protocol) has been for the internet, was, before the advent of the latter, NCP (the network control protocol) (Baldwin 2015). Just like control, networks are also always there, even when apparently not (Franklin 2012).[11] The monstrosity of control thus resides in its habitation in the very factuality of digital writing proper and what unites the two is their shared technologically networked nature.

The paradox of any disruptive, subversive or even liberating digital writing endeavour—or, in our inclusive iconic acceptance, digital humanities initiative—thus emerges to be attempting to fight control by means of or from within control, using emerging network(s) against *the* network, and leveraging in-house complexities to escape systemic complexity. Heidegger's *The Question Concerning Technology* (1977) states a seemingly related paradox: it is particularly in the dangerous orientation humanity has towards technology, an orientation that "[en]frames" humans themselves as standing-reserve (Heidegger 1977), that humanity could find the potential to be rescued. The Heideggerian "rescue" by means of technology—when the latter means digital technology—will yet have, as it follows logically, to work with control against control. Even if, for instance, linked open data (LOD) represents a utopian attempt at democratizing the digital, those articulating them into searchable databases will still have to navigate the challenges of power and gatekeeping informing authority records (as established by major libraries and archives) (Mattock and Thapa 2021).

In the case of the *Graph Poem*, this kind of navigation posits complexity theory as the scaffolding for developing data-driven computational 'monsters' analytically-creatively attempting to elude monstrous control. Monsters are hybrids *par excellence* (see the next section) and our practice involves hybrids indeed that behave conveniently monstrously due to the complexity informing them.

The computationally assembled poetry anthology *"US" Poets Foreign Poets* (Margento 2018), for instance, involved monstrous hybridisation on a number of levels. Developed as a transnational and translational project, the anthology involved or featured people in Canada, Romania, the U.S., Mexico, "Babylon," and

11 Franklin intriguingly concludes that even the cloud is a network, even if in its hidden inexplicit layers.

beyond, and deployed notions and methods of algorithmic translation[12] that shaped the data in unprecedented ways. For the translation of digital poetry pieces, we translated the involved algorithms, that is, developed versions of them or put in place completely new ones generating intra- and inter-lingual equivalents (in English and Romanian, the main two languages in the anthology, but also in French, Spanish, and . . . Python). Going back and forth between such algorithms as well as between natural languages—mainly English and Romanian—in the process obviously put a subversive spin on the data and the ways in which they were assembled.

Moreover, and speaking of computational assemblage, we and our co-editors deployed several Python in-built algorithms for computing certain features of the corpus of poems represented as a graph. Yet, for the algorithmic expansion of the corpus, we used our own diction classifier, described alongside our rhyme classifier in Kesarwani et al. 2021, to track down potential candidates for inclusion in the collection that would preserve and further develop the above-mentioned features. This took the initial dataset down a path of centrifugal—and potentially self-dissolving—distortion and estrangement (plus literal foreignization, as the initial US slowly slipped into "us," poets both within and beyond the imperial walls of the USA). The in-house algorithms instrumental in this corpus expansion computed and multiplied consistencies that translated into what the Python modules could only read as paradoxical and singular. In Figure 1, we have the graph of the initial corpus (of 40 poems) and in Figure 2, the same, only a few stages later, already expanded with 13 poems.

Here is what was noticed to be special about certain nodes in the initial corpus: poems like Harryette Mullen's "[marry at a hotel, annul 'em]", Jerome Rothenberg's "The Holy Words of Tristan Tzara", Alan Sondheim's "zz" and Ilya Kaminsky's "We Lived Happily During the War" (nodes 21, 25, 31, and 12, respectively, in Graph0 [Figure 1]) proved to rank really low in terms of closeness centrality and incredibly high for betweenness centrality. Vertex 21 (Mullen), the last on the closeness centrality list, ended up second on the betweenness centrality one, while 25 (Rothenberg), on the 26th position in closeness, turned out to be none other but the very first in betweenness (see the lists below). Similarly, 31 (Sondheim) ranked 30th in closeness yet 3rd in betweenness, while 12 (Kaminsky) got the 35th position in closeness and still went as far up as the 5th one in betweenness (MARGENTO 2018: 260).

12 "Transcreation" in Funkhouser's terms (MARGENTO et al. 2019).

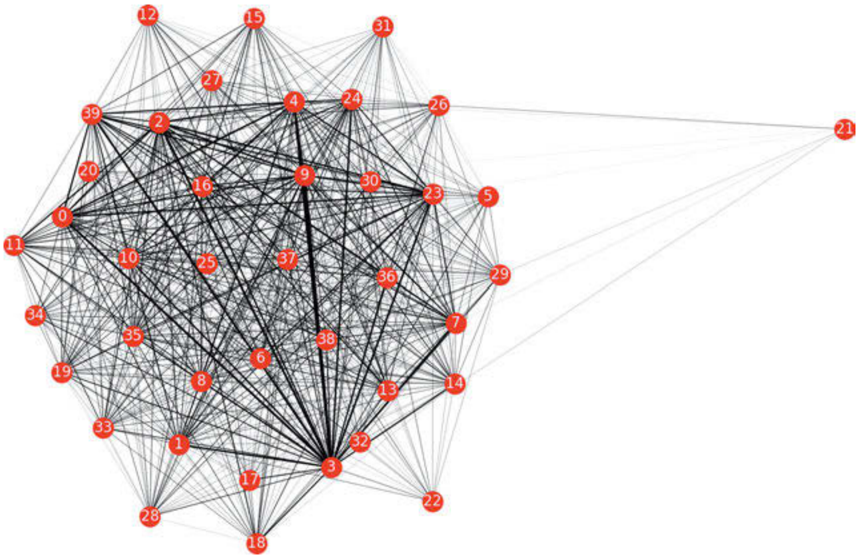

Figure 1: The graph of the initial corpus of poems for the anthology *"US" Poets Foreign Poets* (Margento 2018).[13]

13 **Initial Corpus:**
0: 'baker-scavanger-loop.txt', 1: 'baldwin_internet_unconscious.txt', 2: 'bond-in.txt', 3: 'carpenter_issue1.txt', 4: 'drucker_unnatural_selection.txt', 5: 'galvin_headlines.txt', 6: 'galvin_in_my_sights.txt', 7: 'hejinian-i-laugh-as-if-my-pots-were-clean.txt', 8: 'hejinian-preliminaries-life-after-1990.txt', 9: 'jhave_one.txt', 10: 'joudah_pulse.txt', 11: 'joudah_way_back.txt', 12: 'kaminsky_during_war.txt', 13: 'kaminsky_map_of_-bone.txt', 14: 'levin_five_skull_diadem.txt', 15: 'levine_second_going.txt', 16: 'levine_smoke.txt', 17: 'margento_&_erica_t_carter_jam_session.txt', 18: 'mcclatchy_mercury.txt', 19: 'mencia_poem_crossed_atlantic.txt', 20: 'mullen-if-in-virginia.txt', 21: 'mullen-marry-at-hotel.txt', 22: 'mullen-massa-had-a-yeller.txt', 23: 'notley_at_night_states.txt', 24: 'rothenberg_pound_project.txt', 25: 'rothenberg_tzara.txt', 26: 'sappho.txt', 27: 'scappettone_underture.txt', 28: 'snyder_home_from_siera.txt', 29: 'snyder_what_you_should_know.txt', 30: 'sondheim-please-read.txt', 31: 'sondheim_zz.txt', 32: 'stacy-doris-poem.txt', 33: 'starzinger-collectio.txt', 34: 'stefans_walkabout.txt', 35: 'taylor_apocalypse_tapestries.txt', 36: 'vincenz_bicycle.txt', 37: 'waldrep_fragment1.txt', 38: 'waldrep_fragment3.txt', 39: 'wright_apologia_pro_vita.txt'}.

Closeness centrality for G0:
OrderedDict([(1, 1.0), (3, 1.0), (4, 1.0), (7, 1.0), (9, 1.0), (23, 1.0), (24, 1.0), (0, 0.975), (2, 0.975), (10, 0.975), (19, 0.975), (33, 0.975), (39, 0.975), (14, 0.951), (29, 0.951), (35, 0.951), (36, 0.951), (6, 0.928), (8, 0.928), (11, 0.928), (13, 0.928), (16, 0.928), (34, 0.928), (38, 0.928), (5, 0.906), (25, 0.906), (30, 0.906), (37, 0.906), (27, 0.886), (31, 0.886), (17, 0.866), (26, 0.829), (18, 0.812), (15, 0.795), (12, 0.78), (20, 0.78), (28, 0.78), (22, 0.75), (32, 0.709), (21, 0.582)]).

Betweenness centrality for G0:
OrderedDict([(25, 0.681), (21, 0.145), (31, 0.109), (1, 0.107), (12, 0.068), (5, 0.064), (20, 0.049), (19, 0.048), (30, 0.048), (38, 0.037), (32, 0.032), (24, 0.028), (18, 0.022), (39, 0.018), (22, 0.016), (17, 0.012), (28, 0.009), (33, 0.006), (14, 0.005), (35, 0.005), (6, 0.004), (27, 0.001), (34, 0.001), all the other nodes = 0]).

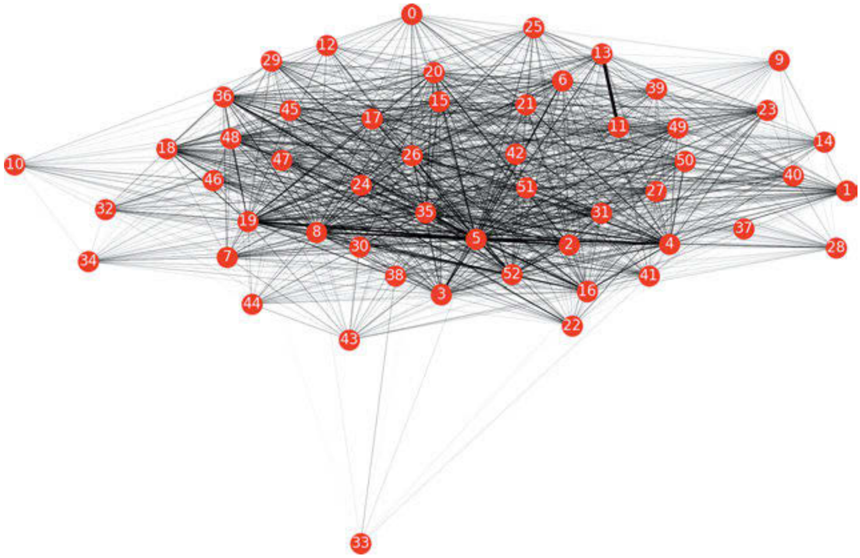

Figure 2: The graph of the *"US" Poets Foreign Poets* (Margento 2018) corpus after algorithmic expansion.[14]

14 Expanded corpus:
{0: 'babylonians_high_priest_prayer.txt', 1: 'babylonians_womanumission.txt', 2: 'baker-scavanger-loop.txt', 3: 'baldwin_internet_unconscious.txt', 4: 'bond-in.txt', 5: 'carpenter_issue1.txt', 6: 'cayley_&_howe_readers.txt', 7: 'dove_tafelmusik.txt', 8: 'drucker_unnatural_selection.txt', 9: 'foarta_butterflycion.txt', 10: 'funkhouser_from_hello_allocation.txt', 11: 'funkhouser_frontal_renewal.txt', 12: 'funkhouser_margento_pyprose.txt', 13: 'funkhouser_margento_runes.txt', 14: 'galvin_headlines.txt', 15: 'galvin_in_my_sights.txt', 16: 'hejinian-i-laugh-as-if-my-pots-were-clean.txt', 17: 'hejinian-preliminaries-life-after-1990.txt', 18: 'huerta_ayotzinapa.txt', 19: 'jhave_one.txt', 20: 'joudah_pulse.txt', 21: 'joudah_way_back.txt', 22: 'kaminsky_during_war.txt', 23: 'kaminsky_map_of_bone.txt', 24: 'levin_five_skull_diadem.txt', 25: 'levine_second_going.txt', 26: 'levine_smoke.txt', 27: 'malaparte_entire_history_of humankind_margento.txt', 28: 'margento_&_erica_t_carter_jam_session.txt', 29: 'mcclatchy_mercury.txt', 30: 'mencia_poem_crossed_atlantic.txt', 31: 'montfort_code.txt', 32: 'mullen-if-in-virginia.txt', 33: 'mullen-marry-at-hotel.txt', 34: 'mullen-massa-had-a-yeller.txt', 35: 'notley_at_night_states.txt', 36: 'rothenberg_pound_project.txt', 37: 'rothenberg_tzara.txt', 38: 'sappho.txt', 39: 'scappettone_underture.txt', 40: 'snyder_home_from_siera.txt', 41: 'snyder_what_you_should_know.txt', 42: 'sondheim-please-read.txt', 43: 'sondheim_zz.txt', 44: 'stacy-doris-poem.txt', 45: 'starzinger-collectio.txt', 46: 'stefans_walkabout.txt', 47: 'strickland_house_of_trust_w_hatcher.txt', 48: 'taylor_apocalypse_tapestries.txt', 49: 'vincenz_bicycle.txt', 50: 'waldrep_fragment1.txt', 51: 'waldrep_fragment3.txt', 52: 'wright_apologia_pro_vita.txt'}.

Closeness centrality for G6:
OrderedDict([(3, 1.0), (5, 1.0), (8, 1.0), (16, 1.0), (19, 1.0), (35, 1.0), (36, 1.0), (4, 0.981), (30, 0.981), (52, 0.981), (2, 0.962), (6, 0.962), (49, 0.962), (17, 0.945), (18, 0.945), (20, 0.945), (24, 0.945), (26, 0.945), (27, 0.945), (31, 0.945), (45, 0.945), (47, 0.945), (48, 0.945), (46, 0.928), (21, 0.912), (51, 0.912), (15, 0.896), (23,

Figure 2 also shows how a comparable unusual status can be seen in some of the poems our in-house algorithms have meanwhile thrown in: node 9, for instance, "Butterflyçion" by Șerban Foarță,[15] is the fourth lowest in closeness centrality and third highest in betweenness centrality, while node 47, "House of Trust" by Stephanie Strickland and Ian Hatcher, is the 22nd for closeness and second for betweenness. With more and more poems more and more marginal—in terms of distance to most of the other poem-nodes—but central in terms of helping others connect (betweenness centrality), the corpus will be alternately torn between disintegrative expansion (systemic entropy, disorder) and black hole amassing (systemic negentropy, order), but with an always insatiable avidity for foreignness.

This latter aspect, which ensures the disparity between the two centrality scores a new poem-node gets, is the arguable proof of the subversiveness of such a poetry-based computational approach. The continuous turning of the in-built modules of the Python library on their head can potentially be read as the butterfly (or . . . "butterflyçion") effect of the at least apparently common-sensical or 'harmless' insertion of an in-house (or even 'garage-band' kind of) procedure between the recurrences of some ready-made algorithm or application. If control is monstrously ubiquitous in the digital medium, resistance can be monstrously insidious in its mathematically chaotic effects.

Most importantly for our argument, these monstrous effects are generated by a complexity-informed approach: the behaviour of our two-pronged system is richer, harder to predict and therefore more . . . *complex*[16] than the two tiers—ready-made network analysis libraries and in-house NLP algorithms—taken separately. The fact that the components do not scale linearly onto the resulting aggregate speaks to the complexity of the resulting system (the processual performative anthology), but also to the multi-scale architecture of such an instance of digital writing. While the cor-

0.896), (39, 0.896), (41, 0.896), (42, 0.896551724137931), (7, 0.881), (14, 0.881), (50, 0.881), (43, 0.866), (12, 0.852), (13, 0.852), (37, 0.852), (28, 0.838), (0, 0.825), (38, 0.8), (25, 0.787), (29, 0.787), (22, 0.776), (32, 0.776), (40, 0.776), (34, 0.753), (10, 0.732), (9, 0.722), (11, 0.712), (1, 0.702), (44, 0.675), (33, 0.565)]).

Betweenness centrality for G6:

OrderedDict([(37, 0.546), (47, 0.187), (9, 0.168), (22, 0.098), (3, 0.067), (44, 0.067), (33, 0.062), (10, 0.060), (45, 0.046), (14, 0.045), (43, 0.036), (32, 0.030), (27, 0.026), (30, 0.024), (51, 0.020), (15, 0.012), (34, 0.008), (28, 0.007), (48, 0.005), (36, 0.004), (1, 0.003), (23, 0.003), (42, 0.003), (7, 0.002), (38, 0.001), (52, 0.001), (11, 0.0007), (12, 0.0007), (13, 0.0007), (17, 0.0007), (24, 0.0007), (29, 0.0007), (39, 0.0007), (46, 0.0007), all the other nodes = 0]).

15 Șerban Foarță, "Buttérflyçion." Translated by MARGENTO. *Asymptote* July 2016. Accessed April 2, 2022, https://www.asymptotejournal.com/jul–2016/.

16 In more recent iterations of the project, complexity refers literally to the networks involved, see Margento. "Google Page Rank Poems" (2022), accessed May 29, 2022, https://github.com/Margento/GooglePageRankPoems and Margento 2024.

pus as a whole expands and the representing network grows in nodes and links, at the micro level the nodes evolve in their own idiosyncratic ways: the atypical, marginal and eccentric, the 'mavericks' draw in more and more like them. If one zooms in on the inner workings of such coopting of new nodes and the features used in it, they will find no large-scale-small-scale fractal-like correspondence. On the contrary, the newcomers will turn out to be primarily related to just a minority of already existing nodes (for diction-related quantifications) and only in an a-posteriori way to the network as a whole (once their ranking in terms of centralities is confirmed).

Yet, the monstrosity of such a procedure—of analytical-creative data generation and expansion—only emerges fully as its inherent complexity comes into play. It is hard, if at all possible, to predict the ways in which, generally speaking, such complex systems can develop. It is quite likely that in certain scenarios, the nodes may evolve in ways that could spectacularly impact the development of the entire network. While the centrifugal trend caused by the ever more marginal incoming nodes is indeed also imprinted by the requirement for these nodes to be good connectors within the overall growing network, it is also conceivable for certain nodes or node subsets, as centralities are being continuously reshuffled, to get completely cut off, particularly since their main affiliations lie with a remarkable yet rather isolated minority. Even as a hypothetical possibility, this is indication of deep-running discrepancy between various dynamics and scales in such complex environments and their disruptive or even disintegrating potential.

5 Demo(nster)s of networked textualities and computational (analysis–based) writing

Montrer le monstre montré . . . (Salomon 2018: 37–38) It is not just the monster, but this sentence and its implicit processual drive that can describe quite accurately the networked textual performativity and intermediality informing digital writing. Monsters have had a spectacular comeback in recent years in digital and cultural studies. Megen de Bruin-Molé's "Monster Theory 2.0" (2021) has thrived at the intersection of remix studies and mashup, digital humanities and Gothic literary and/or pop culture studies. While the initial focus mostly looked at monsters as widely if not archetypal-elusive cultural constructs seen mainly from poststructuralist deconstructive angles (Cohen 1996), this revival speaks mainly to digital and networked cultures and social practices. Typically hybrid *le mixte* for

Foucault,[17] the monster is currently further hybridized (Neill 2022) as character of popular remixes, mashup and "Frankenfictions" (de Bruin-Molé 2019). More relevant for our discussion though are the most recent reassessments of monsters and monster theory/ies within the framework of remix studies and/as digital humanities (Navas et al. 2021, de Bruin-Molé 2021) and that of remix in intermedia networked performance (Tanasescu 2022).

In these two latter contexts, the monster resurfaces as a metaphor that, while retaining and recycling definitory traits foregrounded in early monster theory, transplants the monstruous from the Gothic character *per se* to critical transdisciplinary reformulations and practices. If Gothic mashups exposed "dark undercurrents" in the appropriated narratives (Neill 2022, xvi), revisiting the disciplinary and cultural status and prospects of digital humanities from a monster-theory-relevant stance occasions now both arguments in favor of monstrously decolonizing/ed digital humanities as well as a more aware assessment of instances of remix uncritically perpetuating political biases and hegemony (de Bruin-Molé 2021). When present in performance, monstrosity—referring to community-based and collective data-driven subversiveness—can expose not only the undercurrents in a certain narrative, but those in the medium and space at large (Tanasescu and Tanasescu 2022) and reconceptualize remix in the process (Tanasescu 2022). As part of the *#GraphPoem @ DHSI* performance series, a poetics of network walks is instrumental in enacting a potentially new type of remix applied to a "hypersonnet" and involving the relevant code and "human-computer-*intra*-action" poems, on the one hand, and the coding and/or social-media platforms and ongoing sub-performances, on the other (Tanasescu 2022). Remix thus becomes a way of rewriting and reperformance within performance done by a hybrid sensibly different from the (Gothic) literary monster: a data-AI-human communal and ontologically intermedial monster (Tanasescu et al. 2020, Tanasescu 2022).

Such binary-straddling three-headed monsters can act as potential "glyphs" (Cohen 1996: 4)—i.e., icons or instances of iconicity in our terms—for the (post)digital and digital space[18] and, consequently, also for digital writing. Digital writing emerges from this poetics as fundamentally performative and intermedial, while text (as networked "glyph," or again, iconic writing) proves itself as ever-evolving document or "performative relay[s]" (see above). This performativity is what ties in writing, and thus iconicity with monstrosity most deeply. *Demonstrate*—and therefore our ubiquitous and still much-in-demand *demo*—is etymologically related to

17 Michel Foucault, *Les Anormaux, Cours au Collège de France, 1974–1975, Hautes Études* (Paris: Seuil / Galimard, 1999), 1.

18 Stephen Kennedy, *Chaos Media: A Sonic Economy of the Digital Space* (New York: Bloomsbury Academic, 2015), 87–88.

monster: they can only be grasped when showed, when performed, when proved [to be there and working, i.e., 'performing']. In order to be proven to be effective and (highly) performing, it needs to be performed. Performing its performance is showing what is shown, *montrer le . . . montré* in all its monstrosity.

There is, therefore, a certain recursiveness in digital writing's *demo*nstrosity and the ways in which it not only continuously and indomitably traverses and generates (layers of) networks, but also—since the "monster always escapes" (Cohen 1996: 5)—simultaneously eludes and incorporates them. Franklin, as part of his critique of digital humanities practice, especially as understood and carried out by authors like Franco Moretti[19] and his following, cautions that while diagrams and graphs can be useful in processing and analysing texts, they may very well oversimplify the diverse nature of writing and textuality; what if, posits the critic, the graphs are themselves part of the text's surface and not only its underlying anatomy (Franklin 2017: 158). Yet, what Franklin formulated as a counter-argument is not always hypothetical and, in fact, it can refer not only to the 'monstrous' inclusion of networks in the text proper, but to their simultaneous de*monst(e)r*ative involvement in the composition of the text as well (MARGENTO 2018), a text thus explicitly demonstrated as iconic.

As illustrative of an analytical-creative poetics (Stefans [in Sondheim et al. 2019], Tanasescu 2023, Tanasescu and Tanasescu 2022), the networks presented in the anthology and representing the growing corpus also enact that very growth since instrumental in the corpus expansion and thus in the progressive selection of poems that are sequentially included in the collection. Being both in and behind—or iconically beyond—the collection, and operating at various scales simultaneously, accounts for their monstrous elusiveness and intermedia versatility, as well as for the resulting performativity and processuality[20] of the anthology *per se*. The latter thus turns out to be a collection of graph (poems) networks, while the graphs (or, again, the "glyphs," in Cohen's terms cited above, and, in our terms, instances and agents of iconicity) enact, and actually are, the writing of the collection, and an instance of digital writing more generally speaking. As such, the "algorithmic, linguistic, and graphical expansion" that Funkhouser speaks about (MARGENTO et al. 2019, web) can work as an enumeration of three different facets of such writing but also as a performative (con)fusion of the three to the point of monstrous indistinguishability, interoperability and unrestrainability. Most relevantly, these three characteristic features speak to the above-mentioned multi-scale #GraphPoem

19 Franco Moretti, *Graphs, Maps, Trees: Abstract Models for Literary History* (London; New York: Verso Books, 2007).

20 The "unprecedented propulsiveness" in Christopher Funkhouser's words, MARGENTO et al. 2019.

architecture. While linguistic expansion mainly plays out at small-scale—subset or individual (zoom-in)—node levels in this particular case, the graphic one is prevailingly manifest at the large-scale—(zoom-out), gradually larger and most often overall comprehensive—level. Monstrosity and iconicity are inevitably intertwined across such levels and the processes thereof, but as hinted above, through its segregational, disruptive and potentially even disintegrative drive, the sectional and nuclear levels of a graph poem are markedly monstrous, whereas, as argued in this section, the large or largest-scale ones are ostensively iconic.

6 Conclusion

Digital writing can be best understood by deploying complexity theory and an analytical-creative paradigm that can befit its intermedial and performative multimodalities, its iconicity and monstrosity. #GraphPoem is in all these respects a useful illustrative example of digital writing: the iconic and monstrous poem-network escapes and integrates, eludes and includes, evades and invades. As text, it gets submerged by the various levels of digital writing inscribing it in digital space and blowing it up in multiple directions through the commonalities with other texts instantiated by the networked corpus and the software and hardware dependencies. As multilayer performance, it re-emerges through its consistently branching out performative relays that (re)generate and analyse, document and *demo*nstrate the poem and/as its mediating environments. As seen above, in either of these frameworks, the poem makes manifest a multi-scale architecture of digital writing reflecting the complex and paradoxical inner workings of digital space.

We argued in this paper that monstrosity is actually foregrounded as embedded in the (post)digital *per se* and therefore, just as the systemic control informing the latter, ubiquitous. But if control is the omnipresent and inescapable monster, the only way to fight it is by monstrosity as well, and this is particularly apparent in projects such as the *Graph Poem* (#GraphPoem), whose analytical-creative and complex approach consistently attempts to disrupt and subvert hegemonic politics of data and algorithms. The mix of network science applications, NLP (natural language processing) and intermedia remix in computationally assembling poetry anthologies and livestreaming performances involve networked performative textualities outputted by a complex multimodal type of writing we termed iconic. Writing in general and digital writing in particular are fundamentally if inapparently that way; the *Graph Poem* specifically de*monst(e)r*ates that through the propulsiveness of its graphic, linguistic and algorithmic human-computer-*intra*-action monstrosity. As argued above, these aspects are instrumental in *Graph Poem*'s multi-scale architecture particularly as made apparent in one of the project's computationally assembled anthology (MARGENTO 2018) whereby the small-scale levels proved mainly monstrous and the large-scale ones discrepantly and predominantly iconic.

The iconicity of graph poem multimodal writing is complemented by its iconization of digital space, in its turn based on complexity-theory-informed modelling. In the dynamics of this analytically-creative ~~inter-translatable~~ dualism resides and performatively thrives the poetic monstrosity of the digital.

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Benjamin Krautter

The Scales of (Computational) Literary Studies: Martin Mueller's Concept of Scalable Reading in Theory and Practice

Abstract: Starting from a detailed reconstruction of Martin Mueller's theoretical conceptualization of scalable reading, my article focuses on the practical implications that scalable reading has on (computational) literary studies. Based on an extensive analysis where I structure the concept in four different dimensions that are important to understand the idea of scaling, I will examine the practical consequences that scalable reading can have when analyzing literature. For this, I will examine different forms of literary network analysis of German plays and analyze them in light of the various dimensions of scaling. Doing so, I illustrate how qualitative and quantitative methods in literary studies can be brought together in a fruitful way.

Keywords: mixed methods, scalable reading, (computational) literary studies, literary theory, network analysis

1 Outline

Mixed methods approaches in digital humanities have lately been described as a way to "move beyond the dichotomies of 'close vs. distant', 'qualitative vs. quantitative', [and] 'explanatory vs. exploratory'" (Herrmann 2017: § 6), as a possibility to "create a space for quantitatively minded digital scholarship that goes beyond the trend of 'big data,' allowing [. . .] to craft digital hermeneutic strategies" (Sá Pereira 2019: 407), and even as a shaping element of "the epistemic cultures of the Digital Humanities" (Kleymann 2022). Martin Mueller, a renowned Shakespeare scholar and classical philologist, has been one of the strongest proponents of such integrative approaches for the analysis and interpretation of literature over the last ten years. In reaction to Franco Moretti's controversially discussed idea of *distant reading*, Mueller coined the term

Acknowledgments: The research in this article has been conducted in the project Quantitative Drama Analytics: Tracking Character Knowledge (Q:TRACK) and was funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) – project number 424244162.

https://doi.org/10.1515/9783111317779-011

scalable reading.[1] For Mueller, scalable reading is meant to be a "happy synthesis" of qualitative and quantitative methods and does not aim to overcome reading "by bigger or better things" (Mueller 2012). Instead, he focuses on the notion of how digital tools and methods might create new ways to mediate between text and context. As Thomas Weitin has repeatedly pointed out, scalable reading represents a conceptual attempt to practically overcome the gap between single-text readings and the analysis of larger quantities of literary texts (cf. Weitin 2017: 1–2; Weitin 2015: 9–14). In Mueller's case then, scaling is not predominantly a question of choice between big or small data, i.e., corpus analyses or single text readings. The operation of scaling is rather presented as a methodological challenge: how can literary scholars analyze texts, text segments or text corpora from different points of view? How can they incorporate both quantitative and qualitative methods? How can they, rather than only compare them, fruitfully combine the results deriving from these differently scaled operations?

In this article, I will reconstruct Mueller's theoretical conceptualization of scalable reading and discuss the practical implications it can have on computational literary studies. In a first step, I will contextualize the origin of Mueller's concept, for scalable reading emerged in response to a methodological debate on the challenges of literary history. (2) I will then focus on the metaphor of zooming that led Mueller to the term scalable reading. Why has he used the metaphors of zooming and, subsequently, scaling? What do they bring to the table? (3) This will be followed by a deeper analysis of scalable reading where I structure the concept in four different dimensions that are important to understand Mueller's idea of scaling. (4) Finally, I will examine the practical consequences that scalable reading can have when analyzing literature. For this, I will concentrate on different forms of literary network analysis of German plays. (5, 6) Thereby, I want to illustrate how qualitative and quantitative methods in literary studies can be combined in a productive way.

2 The challenges of literary history

In his essay "Patterns and Interpretation" (2017), Franco Moretti claims that digitization has completely altered the literary archive, as it has made it possible to simul-

1 Complementary to Mueller's term, Johannes Pause and Niels-Oliver Walkowski propose the term scalable viewing for an examination of media products that have an aesthetic dimension. Cf. Pause and Walkowski (2019).

taneously study large numbers of literary texts. According to Moretti, digitization not only enables but also calls for new scales of analysis, as it alters the way in which we should deal with the objects of study: "when we work on 200,000 novels instead of 200, we are not doing the same thing, 1,000 times bigger; we are doing a different thing. The new scale changes our relationship to our object and, in fact *it changes the object itself*" (Moretti 2017: 1). In light of text collections containing tens or even hundreds of thousands of literary texts, for Moretti, "[r]eading 'more' seems hardly to be the solution" (Moretti 2000b: 55). In the realm of these massive collections, close reading approaches, on the contrary, appear to be "totally inappropriate as a method of studying literary history", as Matthew Jockers has argued in his book *Macroanalysis* (2013: 7).[2] Instead, Jockers proposed to adopt a position that he calls macroanalysis and is "primarily quantitative, primarily empirical, and almost entirely dependent upon computation" (Jockers 2013: 32).[3]

Approaches such as those outlined by Moretti and Jockers have recently reignited a methodological debate on how to appropriately investigate literary history.[4] Scholars regularly account for three fundamental reasons for this circumstance: The debate is, firstly, sparked by a theoretical discussion on canon, canonicity and its implications for our understanding of theoretical concepts and literary history alike, which dates back to the 1970s (cf. Jannidis 2015: 659; Bode 2012: 8–9; Moretti 2020a). Robert Darnton described the canon of literary history as "an artifice, pieced together over many generations [that] bears little relation to the actual experience of literature in a given time" (Darnton 1989: 17).[5] Secondly, it is based on the promise of empirical rigor in text analysis (cf. Jannidis 2015: 659; Heuser and Le-Khac 2011: 80; Willand 2017: 80). Advocates of quantitative methods argue that they bring a more scientific approach to literary studies, as they question or validate findings based on a larger number of texts (cf. Jockers 2013: 5–8) This has oftentimes been described as a bird's-eye view (cf. Mueller 2014: § 31; Willand 2017: 93; Jockers 2013: 19) Thirdly, this assumption seems to rest on the continuously increasing computing power, and on the ongoing digitization of literary texts. As Fotis Jan-

2 For more on Jocker's idea to do macroanalysis and how it compares to Moretti's approach see Krautter and Willand 2020: 83–87.

3 Contrarily to this, Jockers (2013: 26) also repeatedly calls for a "blended approach" that combines the benefits of both, small- and large-scale studies: "It is exactly this sort of unification, of the macro and micro scales, that promises a new, enhanced, and better understanding of the literary record. The two scales of analysis work in tandem and inform each other".

4 There is, though, a long-standing tradition using quantitative methods in literary studies. Cf. Bernhart 2018.

5 The idea of empirical rigor in text analysis, however, has also led to strong objections, as it encourages "the idea that computer-aided approaches to texts reduce literary works to formalistically describable and objectively countable objects". Gius and Jacke 2022: 2.

nidis (2013: 34) puts it, the computer as a "*number cruncher*" is destined for quantitative techniques of text analysis.

Much of the ongoing debate dates back or relates to Franco Moretti's controversially discussed concept of distant reading, which he first proposed in his essay "Conjectures on world literature" (Moretti 2000b: 56–58). In his paper, Moretti famously – and polemically – described distant reading as a "little pact with the devil" (Morretti 2000b: 57). By referring to what Margaret Cohen coined the "great unread" (Cohen 1999: 23; Cohen 2009: 59; cf. Moretti 2000a: 225–227), i.e., virtually forgotten literature that can only be traced in archives, Moretti argues that literary history is not limited to its canonical fracture and should not be extrapolated from a few exemplary texts (cf. Moretti 2000a: 207–209). He postulates, for instance, that the canon of nineteenth-century British novels consists "of less than one per cent of the novels that were actually published" (Moretti 2003: 67). His own ambitious endeavor, namely doing world literature, rests on his materialistic view on literary history (cf. Moretti 2006: 84; Moretti 2013: 121). To answer his research question, he therefore pursues to incorporate the largest possible corpus. Aiming to overcome the limitations of and flaws in literary history that he himself perceives, Moretti wants to shift the "focus from exceptional texts to 'the large mass of [literary] facts'" (Moretti 2003: 67).

To cope with this enormous amount of literature, Moretti proposes to do "'second-hand' criticism" (Moretti 2000b: 61, FN 18). In his opinion, literary history needs to become "a patchwork of other people's research" (Moretti 2000b: 57) that does no longer rely on close reading literature:

> [T]he trouble with close reading (in all of its incarnations, from the new criticism to deconstruction) is that it necessarily depends on an extremely small canon. This may have become an unconscious and invisible premiss by now, but it is an iron one nonetheless: you invest so much in individual texts *only* if you think that very few of them really matter. Otherwise, it doesn't make sense. And if you want to look beyond the canon [. . .] close reading will not do it. It's not designed to do it, it's designed to do the opposite. (Moretti 2000b: 57)

Initially, he based his suggestion of distant reading, which he later claimed to have been a "fatal formula" that was partly "meant as a joke" (Moretti 2013: 44), on two methodological ideas: firstly, reading secondary literature instead of primary literature, i.e., analyzing other researcher's analyses and blanking out primary sources; and, secondly, activating research networks with experts on different languages, epochs and genres (cf. Moretti 2000b: 58–60). In the end, his idea of world literature depends on bringing together as much knowledge on as many literary works as possible. His focus deliberately shifts from understanding and interpreting a single literary text – in Moretti's view this is a task where close reading excels – to detecting patterns in large literary corpora. For Moretti, these patterns have the power to explain literary conventions and their historical development: “conventions matter for us much more than any individual text: they matter *as such*” (Moretti 2017: 7). Doing distant reading, “the reality of the text undergoes a process of deliberate reduction and abstraction”, where a bigger picture emerges, states Moretti (2005: 1). In this sense, distant reading “allows you to focus on units that are much smaller or much larger than the text: devices, themes, tropes – or genres and systems” (Moretti 2000b: 57).

When Moretti introduced the term distant reading in 2000, he neither referred to computational approaches, nor specifically mentioned quantitative methods to analyze literature. A first connection to quantitative methods was drawn by Moretti three years later, in an essay called “Graphs, Maps, Trees” (2003). There, he suggests incorporating abstract models imported from theories by other disciplines, namely quantitative history, geography and evolutionary theory (cf. Moretti 2003: 67). Since then, the connection from distant reading to computational methods has been deepened – mainly from 2010 onwards, when the Stanford Literary Lab was formed (cf. Underwood 2017: § 29–35).[6] Nowadays, distant reading has become a dictum for quantitative corpus analyses (cf. Underwood 2017: § 7–11; Weitin et al. 2016: 104). In the last 20 years, however, Moretti’s polemical term, his trenchant provocations (cf. English 2010: xiv), and his preference for abstract models have called many critical voices. His critics – and critics of quantitative approaches in general – either object to the principle of analyzing art by computation (cf. Lamping 2016), the lack of innovative and new insights compared with the massive efforts one must put in (cf. Schulz 2011), or they object the exploratory value of computational methods, by judging them to be nothing but “mere play” (Fish 2012).

Meanwhile, the debate has shifted its direction, at least partly. Instead of choosing sides between close and distant reading, a discussion on how to meaningfully combine small- and large-scale research in literary studies has emerged (e.g., Weitin 2017: 1–2). This has been accompanied by a discussion on how to interweave qualitative and quantitative methods of text analysis and, subsequently, how to combine interpretative readings with statistical evaluations (e.g., Willand 2017: 77–93). For this purpose, the term mixed methods has been partly adopted from social sciences (e.g., Herrmann 2017). Moacir de Sá Pereira (2019: 405), for instance, states that “a conscious use of mixed methods would push aside the binarism and let literary study be a counting discipline at the same time as a reading

6 Peer Trilcke and Frank Fischer (2016: 13) point out that in his recent publications Moretti no longer uses the term distant reading. Instead, he refers to computational criticism or simply digital humanities.

one". Mueller (2012) argued similarly when he criticized distant reading for not "express[ing] adequately the powers that new technologies bring to the old business of reading". In Mueller's view, the term "implicitly set[s] 'the digital' into an unwelcome opposition to some other".

In the following, I will elaborate on Mueller's own conceptualization of mixing methods that goes by the term scalable reading.[7]

3 From Google Earth to scalable reading

"The charms of Google Earth led me to the term Scalable Reading as a happy synthesis of 'close' and 'distant' reading", said Martin Mueller (2012) in one of his programmatic blog posts entitled *Scalable Reading*. Mueller's enthusiasm for Google Earth is tied to one specific operation: zooming. In his opinion, zooming facilitates exploration. Just a few clicks on the digital map enable a change of perspective from small details of individual streets to a global view of the world and *vice versa*. By zooming out, streets can be seen in context of the entire city, and the city, in turn, in context of the state or the country. By zooming in, instances like mountains or rivers can lose their structuring significance, while finer details emerge. Changing scale and thus changing perspectives becomes a matter of a few clicks: "you can zoom in and out of things and discover that different properties of phenomena are revealed by looking at them from different distances" (Mueller 2012).

In contrast to Google Earth, where zooming in and out is easy to operate, the corresponding operation comes with much greater intellectual demands when applied to literary texts: for instance, a literary analysis that is based on a single text passage (zooming in) cannot be hermeneutically interpreted in the context of the author's oeuvre (zooming out) without considering co-texts and contexts (cf. Krautter and Willand 2020: 78–79). Hence, the attempt to metaphorically zoom out of a literary analysis means that scholars need to read (many) other texts by the author and her or his contemporaries. Only then, it seems possible for compositional principles and patterns to emerge, i.e., to reach a higher level of abstraction. By integrating and scaling different text analytical methods, Mueller, however, identifies an opportunity to transfer the motion of zooming from Google Earth to literary texts in a direct manner. In his case, scaling is neither a question of corpus selection, nor is it a simple choice between big and small data or some sort of an in-between level. Mueller rather presents the operation of scaling as a methodological

7 Chapters 3 and 4 of this article are an adaptation of a more detailed study that is part of my forthcoming dissertation.

challenge: how can literary scholars analyze texts, text segments or text corpora from different points of view, i.e., with quantitative and qualitative methods alike?

Mueller illustrates these efforts by using the example of medieval Bible concordances. For him, the concordances act as textual equivalent to Google Earth. By compiling alphabetical word lists and identifying the corresponding text passages the monks facilitated zooming, according to Mueller. With the help of the now accessible parallel texts, it had become possible to systematically analyze and understand individual passages in the context of a bigger picture, i.e., other analogous passages. The monks assumed that the reorganization of the Bible into word lists would help them with the exegesis of God's word and, in consequence, to better understand the order of God's world. Thus, the text-internal understanding of the Bible can be transferred to the text-external world. Mueller recognized this analogy in Google Earth. As a user of Google Earth, one expects that the scalable map has an orientation function for the reality represented. When Google guides the user to the next train station by means of its digital map, the user does expect to arrive at this train station in reality.

Why is this methodical association of Google Earth and Bible concordances relevant for Mueller's idea of scalable reading? For Mueller, the concordances can be understood as a hinge that connects the idea of zooming in Google Earth with scaling in computational literary analysis: "Strip a fancy text retrieval system to its basic operations, and you find a concordance on steroids, a complex machine for transforming sequential texts into inventories of their parts that can be retrieved and manipulated very fast" (Mueller 2012). He argues that the basic functional principle of modern tools for computational text retrieval are still comparable with concordances. They support you in finding specific text elements and by doing so, they help to accelerate "forms of non-contiguous reading" (Mueller 2014: § 9). Even the difficulties that arise from using these tools seem similar to those the monks experienced nearly 800 years ago. Algorithms can identify statistical patterns in a data set, but they cannot attribute meaning to it. Just as the monks had to compare *and* interpret the parallel texts listed in the concordance, the identified patterns in a computational analysis must be contextualized and understood.[8] Concordances and digital tools alike, thus, change the way in which we deal with the objects of study incrementally, i.e., in small steps.[9] As an example for this stepwise transformation, Mueller reflects on the usage of surrogates in literary studies. "Our typical encounter with a text is through a surrogate – set-

8 Mueller (2012) has called this the "'last mile problem' of human understanding."

9 Here, Mueller (2013) refers to a report, which Douglas Engelbart prepared for the Air Force Office of Scientific Research.

ting aside whether there is an original in the first place," writes Mueller (2013). Surrogates, then, represent the textual basis for reading, analyzing and interpreting literature. However, they are not congruent to their original form of publication. Mueller argues, for instance, that the script of a play, most of the times, is "meant to be seen and heard in a live theatre rather than read. But however paltry a surrogate the printed text may be, for some purposes it is superior to the 'original' that it replaces" (Mueller 2005).

Mueller (2014, passim) illustrates that every surrogate has its own "query potential," which explains the coexistence of different surrogates referring to the same *original* literary work.[10] In consequence, reading Shakespeare's plays in Bevington, Riverside or Norton editions already classifies the reader as "*distant reader*" (Weitin 2015: 9; cf. Weitin et al. 2016: 115). For the reader no longer works on the original, but with a representation of the original. For Mueller, digital machine-readable texts are just one step further into "the allographic journey of text[]" representations (Mueller 2014: § 10). He argues that they possess a "second-order query potential" comparable to Bible concordances (Mueller 2008: 288). Thus, they can be transformed, analyzed, or evaluated in ways, which would either require an enormous effort or do not seem possible for printed texts at all.[11] An obvious example that comes to mind are calculations based on bag-of-words[12] representations, as amongst others John Burrows (2002) has used for his stylometric studies on authorship attribution.

4 The different dimensions of scaling in literary analyses

It is already clear that scales in Mueller's metaphorical conception of scalable reading extend along several dimensions. In the following section, I argue that

10 It is not always clear what should be considered the *original* work (cf. Grubmüller and Weimar 2017: 415–416). This does not, however, compromise Mueller's argument with respect to digital analyses.

11 Stephen Ramsay (2013: 490) argues similarly: "It is one thing to notice patterns of vocabulary, variations in line length, or images of darkness and light; it is another thing to employ a machine that can unerringly discover every instance of such features across a massive corpus of literary texts and then present those features in a visual format entirely foreign to the original organization in which these features appear. Or rather, it is the same thing at a different scale and with expanded powers of observation".

12 In a bag-of-words model, a given text or a corpus of texts are represented as the multiset of their word frequency. A bag-of-words model disregards word order and syntax.

four different dimensions are important to practitioners reflecting on their own approaches when integrating qualitative and quantitative methods to analyze literature.

As indicated, the textual basis of literature is, firstly, available in a broad scale of surrogates, which oftentimes coexist (cf. Weitin et al. 2016: 115). There are oral texts, manuscripts, contemporary publications, complete works, historical-critical editions, digitized texts, specifically encoded text corpora, born digitals and a lot more. Furthermore, one can manipulate these surrogates, whether they come in analogue or in digital form. One can focus on specific segments, prepare concordances and word frequency lists or concentrate on linguistic features such as parts of speech. Remodeling surrogates in such ways, however, changes the epistemic object (cf. Trilcke and Fischer 2018). We are then no longer analyzing the literary text as a whole, but an abstract representation of it, which might solely persist of relations between literary characters, as in the case of character configurations and the resulting networks.[13]

The most obvious scale, secondly, is probably the question of scope, i.e., the size of the object of study. Is the goal of a study to examine a single literary text, perhaps even an extract of a single text? Or is it to investigate a larger number of texts? How extensive does this corpus then turn out to be? The quantitative scope is additionally related to the heterogeneity of the chosen literary texts (cf. Gius 2019: 8–9). In which languages are the texts written? Do they belong to the same genre? Which literary period do they originate from?

The scope of investigation, thirdly, impacts the units of analysis. As stated by Moretti, investigations that focus on a large corpus of texts allow us to analyze units that are smaller or bigger than the text. By doing distant reading or macroanalysis the units thus deviate from the typical meso-scale of literary studies, as Carlos Spoerhase (2020: 6–7) has pointed out. The goal is no longer to understand a single literary text. Instead, large-scale corpus analyses emphazise infratextual or supratextual units, such as the distribution of individual word forms or the diachronic development of genres. For Matthew Jockers (2013: 22), "the results of macroscopic text-mining" are able to "aggregate[] a number of relatively small details into a more global perspective". Unlike close reading, which is more or less bound to the meso-scale, Jockers (2015) argues that macroanalysis empowers "[s] cale hopping". In contrast to close reading, macroanalysis would "allow for both

13 Of course, literary network analysis is not limited to the analysis of character relations. Maciej Eder (2017: 50–64), for instance, has used networks to visualize stylometric differences of different authors.

zooming in and zooming out" (Jockers 2013: 23). For Spoerhase, however, it is obvious that in the humanities, when scaling the research corpus and thus the research question, scholars implicitly preselect the units they observe, interpret and evaluate (cf. Spoerhase 2020: 8). Accordingly, a large corpus of literary texts not only enables the scholar to look at supra- and infratextual units, it rather becomes a necessity.

Just like Moretti and Jockers, Mueller emphasizes that quantitative analyses allow for both zooming out and zooming in: "Digital tools and methods certainly let you zoom out, but they also let you zoom in, and their most distinctive power resides precisely in the ease with which you can change your perspective from a bird's eye view to close-up analysis" (Mueller 2014: § 31). Mueller, though, does not tie the metaphor of zooming to the size of the corpus, i.e., the number of literary texts to be investigated. For him, zooming neither excludes the meso-scale, nor is it a one-off operation, where scholars once set a specific scale that determines the perspective of their study. His conception, fourthly, rather considers analytical methods themselves to be scalable. As Thomas Weitin has pointed out, Mueller's idea of scalable reading includes all acts of reading and analysis. Thus, depending on the research question, various qualitative and quantitative methods can coexist equally and can be brought together in a combinatorial way. Unlike the binary terms close and distant reading or micro- and macroanalysis imply Mueller's concept highlights that the purposes of either qualitative or quantitative methods are not determined *a priori*. To know which method works best is not (only) a question of corpus size. As I have shown, Mueller's concept of scalable reading challenges this simplistic assumption and advocates for a position that takes into account all scales of analysis.

5 A practice of scalable reading?

In practice, however, scholars have used scalable reading rather as a catchphrase to oppose Moretti's polemical dichotomy than as a methodological approach (cf. Weitin 2017: 1–6; Weitin 2015: 9–14).[14] In the following section, I try to highlight the intricacies attached to a practice of scalable reading within the digital humanities in regard to the four dimensions I have laid out. For illustration purposes, I have chosen to focus on one of the most prominent methods in digital humanities, namely network analysis (cf. Jannidis 2017b: 147). The idea of employing network

14 There are of course some exceptions, e.g., Horstmann and Kleymann 2019.

analysis on literary texts has been imported from the empirical social sciences, where networks are used to model social relations (cf. Trilcke 2013: 201). In computational literary studies, network analysis is used for different purposes: to analyze character networks in a corpus of plays,[15] short stories (cf. Jannidis 2017a), or novels (cf. Rochat 2015), to differentiate between literary genres (cf. Evalyn et al. 2018; Hettinger et al. 2016), or to identify main characters (cf. Fischer et al. 2018; Jannidis et al. 2016). Graph theory supplies the mathematical basis of network analysis. It operates with two constitutive components, so-called nodes (or vertices) and edges. In its simplest shape, a network can be described as "a collection of points joined together in pairs by lines" (Newman 2010: 1), wherein the points are called nodes and the lines are called edges. Nodes that are connected by edges relate to each other. The type of relationship depends on the entities that are represented by the nodes and on the form of interaction the edges describe. One might think of characters talking to each other or, going beyond literary texts, of authors corresponding with each other. I will focus on two different kinds of interactions of characters in German plays that result in different kinds of networks: co-presence networks and coreference networks. Doing so, the networks become an abstract representation of a very specific trait of the plays, depending on how the interaction between characters, i.e., the edges connecting the nodes, is precisely defined.

Figure 1 shows a character network of Friedrich Schiller's play *Die Räuber* (1781). In this network, each node depicts one of the play's characters. The edges connecting the nodes display that "two characters are listed as speakers within a given segment of a text (usually a 'scene')" (Trilcke et al. 2015: 1). Networks like this are called co-presence networks (cf. Trilcke 2013, passim) and account for a large part of literary network analysis of plays. They owe their popularity to mostly two reasons. Firstly, they build upon structuralist precursors and drama analytical insights of the 1960s and 1970s. Solomon Marcus' concept of dramatic configuration, which soon became handbook knowledge (cf. Pfister 1988, 171–176; Asmuth 2016: 44–47), is particularly important for the theoretical justification of co-presence networks. Configuration, in this case, means "the section of the dramatis personae that is present on stage at any particular point in the course of the play" (Pfister 1988: 171), and can be used for segmentation purposes. Marcus' studies on dramatic configuration have not only been praised as proto-network analytical approaches to character relations in plays (cf. Trilcke 2013: 221), they also exemplify that quantifying the segmentation of a play with regard to changes in configuration has long been established. In this respect, Manfred Pfister has em-

15 For one of the pioneering studies see Stiller et al. 2003.

phasized that “[e]very entrance or exit of one or more” characters is “a significant development on this level of segmentation” (Pfister 1988: 234). Secondly, co-presence networks can be automatically created if the plays are encoded accordingly. This allows the scholar to straightforwardly compute a large number of networks from different plays and compare them not only visually, but also with regard to different mathematical network measures.

For my analyses, I use a corpus of plays stemming from the Drama Corpora Project, which currently consists of 16 different text collections (cf. Fischer et al. 2019). As of now (September 19, 2023), the biggest collections are the French Drama Corpus (1560 plays), the German Drama Corpus (644 plays) and the Russian Drama Corpus (212 plays). All plays collected in the Drama Corpora Project are encoded according to the same Text Encoding Initiative (TEI) format. Important structural information, such as the distinction between main and secondary text or the marking of act and scene boundaries, is therefore machine-readable. The following excerpt of Schiller’s *Die Räuber* gives insight into the arrangement of a TEI encoded play. The play is structured by different *tags*. <div type=“scene”>, for instance, marks a new scene, <sp who=“#[. . .]”> assigns the subsequent character speech to an identifier. This information is essential for ensuing analyses, as it is possible to extract it deterministically from the encoded plays.

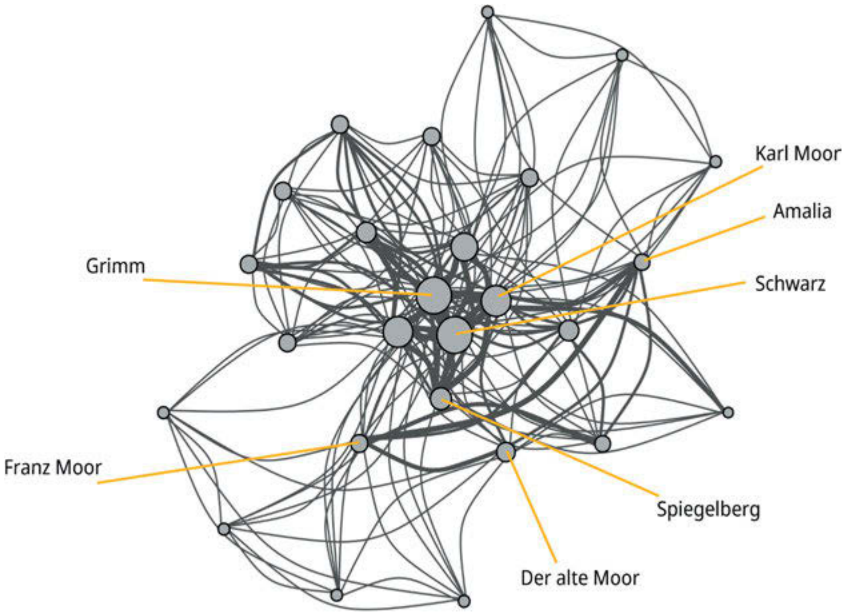

Figure 1: Co-presence network of Schiller’s *Die Räuber*.

Text excerpt from Schiller's *Die Räuber* encoded in TEI taken from the Drama Corpora Project.

```
[. . .]
<div type=“act”>
<head>Erster Akt</head>
<div type=“scene”>
<head>Erste Szene</head>
<stage>Franken. Saal im Moorischen Schloß.</stage>
<stage>Franz. Der alte Moor.</stage>
<sp who=“#franz_von_moor”>
<speaker>FRANZ.</speaker>
<p>Aber ist Euch auch wohl, Vater? Ihr seht so blaß.</p>
</sp>
<sp who=“#der_alte_moor”>
<speaker>DER ALTE MOOR.</speaker>
<p>Ganz wohl, mein Sohn – was hattest du mir zu sagen?</p>
</sp>
[. . .]
```

All the information necessary to compute a co-presence network as seen in Figure 1 is part of the TEI encoded plays. One can automatically extract the information required, and, subsequently, represent it in the form of a matrix. Table 1 illustrates an excerpt of such a matrix for *Die Räuber*. This matrix provides the basis for network visualization (Figure 1), and all subsequent calculations of network measures.

However, the prospect of automating network creation causes some limitations in formalizing the interactions of characters. As I have outlined above, the interactions represented in Table 1 and Figure 1 refer to characters speaking in a particular segment of text. Here, these segments are specified as scenes. They are denoted as such by the play's secondary text. This operationalization of interaction, then, is similar to but not congruent with Marcus' understanding of configuration. A play's configuration changes whenever a character enters or exits the stage, i.e., whenever the dramatis personae on stage changes (cf. Marcus 1973: 315–319). In plays that follow the principles of French Classicism, entrances and exits of characters designate a new scene – at least in theory. Configuration and scene then coincide. Plays that are influenced by Shakespeare follow a different principle. In Shakespearian theatre, scenes are bound to a change of location (cf. Ranke 2010: 710). Therefore, several characters can enter or exit the stage without designating a new scene. As entrances and exits of characters are not (yet) encoded in the Drama Corpora Project, the automatic creation of co-presence networks relies on scenes as a segmentation. This can lead to negative side effects. Schiller's *Die Räuber* is a good example to outline the problem. Solomon Marcus has already pointed towards the significant discrepancy between the number of configurations and the number of scenes in *Die Räuber*, as he counted 78 configurations in the course of the 15 scenes (cf. Marcus 1973: 326–333). The matrix in Table 1 depicts whether a character speaks in a certain scene of the play. Looking at the matrix, it can easily be identified which characters speak in the same scene. Daniel and Kosinsky, for instance, both speak in Scene 11 (IV, 3). According to the above-mentioned operationalization, this is sufficient to create an edge between the two characters in the network (see Figure 1). Kosinsky, however, only enters the stage after Daniel has already left it. Hence, Daniel and Kosinsky never actually meet on stage both of them talk to Karl Moor, but in separate instances. While in the first three acts the sphere of the family and the sphere of the robbers have been occupied by disjunctive groups of characters, Karl manages to cross this boundary in the fourth act. A network analysis that rests on scenes as segmentation shows Kosinsky to also cross this boundary. This error would mitigate the special role Karl occupies (cf. Krautter and Willand 2021: 117–118).

Table 1: Excerpt of the configuration matrix of Schiller's *Die Räuber*. A value of '1' indicates that a character speaks at least once in the corresponding scene.

	Franz Moor	**Der alte Moor**	**Karl Moor**	**Amalia**	**Spiegelberg**	**Daniel**	**Kosinsky**	**. . .**
Scene 1	1	1						. . .
Scene 2			1		1			. . .
Scene 3	1			1				. . .
Scene 4	1							. . .
Scene 5	1	1		1		1		. . .
. . .	. . .	. . .	. . .	. . .	. . .	. . .		. . .
Scene 11			1			1	1	. . .
. . .	. . .	. . .	. . .	. . .	. . .	. . .		. . .
Scene 15		1	1	1				. . .

Looking at Figure 1, one can see that the nodes and edges of the network carry some additional information stemming from the matrix. On the one hand, the edges are weighted, i.e., they do not only represent that the connected characters do speak in the same segment, but their strength also indicates the number of segments in which both characters speak. A stronger edge signifies more segments. On the other hand, the size of the nodes corresponds to the so-called degree, i.e., a simple measure for centrality in a network. Centrality measures try to determine the importance of a node for certain constellations within the network structure. The degree of a node simply corresponds with the number of other nodes that share an edge with the node in question (cf. Newman 2020: 133–135). The bigger the node is pictured, the higher is its corresponding degree.

5.1 Analyzing individual co-presence networks

Now that I have outlined the essential premises of literary network analysis in general and co-presence networks in particular, I would like to raise the question: How can they meaningfully be embedded in drama analysis? And how do networks relate to the four dimensions of scalable reading? Franco Moretti's essay "Network Theory, Plot Analysis" (2011) has shown promising signs of integrating network visualizations into the hermeneutic process of understanding literature. Moretti's discussion of Shakespeare's *Hamlet* (1609) rests upon his manually created network visualization, wherein he identifies Horatio as an important character for the network's structure. Horatio "inhabits a part of the network where clustering is so low that, without him, it disintegrates" (Moretti 2011: 6). Similar to close reading, Moretti dissects the network into different individual parts and merges his network-analytical observation with broad text-analytical findings. According to him, "Horatio has a function in the play, but not a motivation. [. . .] I can think of no other character that is so central to a Shakespeare play, and so flat in its style" (Moretti 2011: 7).

Critics have accused Moretti of betraying his own distant reading agenda. Analyzing *Hamlet*, Moretti's intuition seems to be more important for the interpretation of the network than statistical evaluations. His vision to provide explanatory models based on large corpora that extend beyond understanding and interpreting individual canonical texts seems to fall flat (cf. Trilcke and Fischer 2016: 12; Prendergast 2005: 45). On the one hand, Moretti's writings oftentimes rest upon tentative thoughts and ideas, which intend to provide ample food for thought rather than presenting thoroughly tested and validated results. He himself admits that it was "less concepts than *visualization*" which he "took from network theory," as a large-scale analysis was not yet feasible for him due to data-gathering reasons (Moretti 2011: 11). On the other hand, his understanding of the term distant reading constantly changes. In the first few pages of his book *Graphs, Maps, Trees* (2005) Moretti, for instance, argues that distant reading is mainly a process "in which the reality of the text undergoes a process of deliberate reduction and abstraction" (Moretti 2005: 1); which is exactly what he did with his network analysis of *Hamlet*.

How does Moretti's study now fit to Mueller's concept of scalable reading? Looking at the four dimensions, the most striking change compared to a traditional approach of reading and interpreting Shakespeare's *Hamlet* is the radical change of surrogate. Moretti no longer interprets the play's text, but its abstract representation as a network with nodes and edges. While the scope of his study is limited to just one play – the typical meso-scale of literary studies, the text representation, in turn, changes the units of analysis. His sole focus lies on the characters' co-presence.[16] In his own words, the analysis rests upon "the possibility of extracting characters and interactions from a dramatic structure, and turning them into a set of signs" (Moretti 2011: 11). In other words, he combined quantitative and qualitative methods, firstly, in order to create, and secondly, to interpret the networks. Is this, then, equivalent to what Mueller has referenced as scalable reading?

Regarding that, it is the conclusion Moretti has drawn from his network analysis that is striking. The network itself and, subsequently, the characters' degree as well as their average distance (also called average path length) in the network[17] in his opinion demand for "a radical reconceptualization of characters and their hierarchy" (Moretti 2011: 5). For Moretti, established concepts in literary studies such as the protagonist of a play and the network analysis' findings can hardly be fruitfully combined. Abstract models serve an explanatory power that, according to him, does not blend in with "concepts of 'consciousness' and 'interiority'" (Moretti 2011: 4), which are common for literary studies. Mueller has criticized positions like these when he mentioned the 'unwelcome opposition' created by the term distant reading. While Moretti's insights mostly rest on intuitive interpretations of the network, he has no intention to integrate them into an interpretation of the play's text; the play's text and the play's network have become different objects.[18] For Moretti, then, it does not seem desirable to combine network analysis with the meso-scale of literary studies.

Looking at Figure 1 it becomes obvious that not all co-presence networks profit in the same way from the "'intermediate' epistemological status of visualization" that Moretti praises in his essay (Moretti 2011: 11). The network of Schiller's *Die Räuber* suffers from a lack of readability, which can be attributed to both the absence of the play's temporal level and the big group of robbers in the centre of the network.[19] In consequence, the disjunct social spheres of robbers and family, which on a structural level are defining for the first three acts of the play, are not perceptible in the network visualization. On the contrary, it seems that the robber band with Schwarz, Grimm and Karl Moor is at the centre of the play, while the family, i.e., Franz, Der alte Moor and Amalia, have only a peripheral role. Not even Moretti, though, would

16 Moretti's operationalization of co-presence differs a bit from the above mentioned as he created the networks manually. Therefore, he could choose to only connect two nodes when the characters in question talk to each other.

17 Average distance (or average path length) is defined as the average number of steps needed from one node to travel along the shortest paths to all other nodes of the network.

18 For a comparable position, see Trilcke and Fischer (2018: chap. 3).

19 The network's density (0.52), however, is pretty similar to the average (0.48) and median (0.46) density of 201 plays with a comparable network size (between 15 and 35 characters) taken from the German Drama Corpus. A network's density is defined as the proportion of possible edges that are actually realised. Cf. Wassermann and Faust 1994: 101.

suggest that Schwarz and Grimm, the characters with the highest degree in the network, should be regarded as the protagonists of the play because of their centrality.

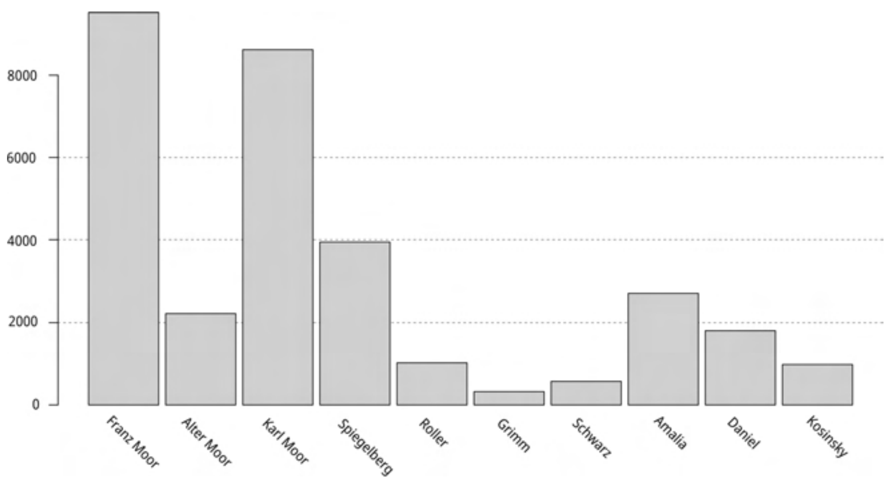

Figure 2: Selected characters from *Die Räuber* and the number of words they utter throughout the play.

Looking at the number of words Schwarz (572) and Grimm (322) utter in the course of the play (see Figure 2), it becomes clear that their high degree values do not correlate with their impact on the play's action. Based on the numbers in Figure 2, one would rather classify them as minor characters. Networks and their visualization should therefore always be contextualized and treated with caution in interpretation.

5.2 Analyzing a bigger corpus of co-presence networks

The real benefit of literary networks, however, has never been understood to be the analysis of single plays, but rather the investigation of a bigger corpus of plays (cf. Trilcke and Fischer 2018: chap. 3). In terms of the four dimensions of scalable reading, this corresponds to an upscaling of the object of study. The idea is to compare different plays that are modelled as networks based on data values, i.e., network measures such as the degree of a node. Then, it should be possible to detect patterns that reveal new insights into literary history and allow to test existing hypotheses quantitatively – at least this is the expectation. Figure 3[20] shows an example for a diachronic analysis based on 590 German plays (1730–1930) taken from the German Drama Corpus. I have taken the plays' average degree in order to compute the mean values for every decade from 1730 until 1930 (black line). From a descriptive point of view, one can see that the average degree slowly rises from the later 18th century onwards. From around 1830 to 1880 only minor fluctuations are visible. Then, the average degree starts to increase. This is followed by a fairly pronounced drop and an equally noticeable rise. Peer Trilcke and Frank Fischer have interpreted these average degree values as an indicator for the fact that playwrights and their plays have started to react to social modernization and differentiation starting from the second half of the 18th century onwards. They do, however, point out that this hypothesis is already well established in literary history (cf. Trilcke and Fischer 2018: chap. 4.1).

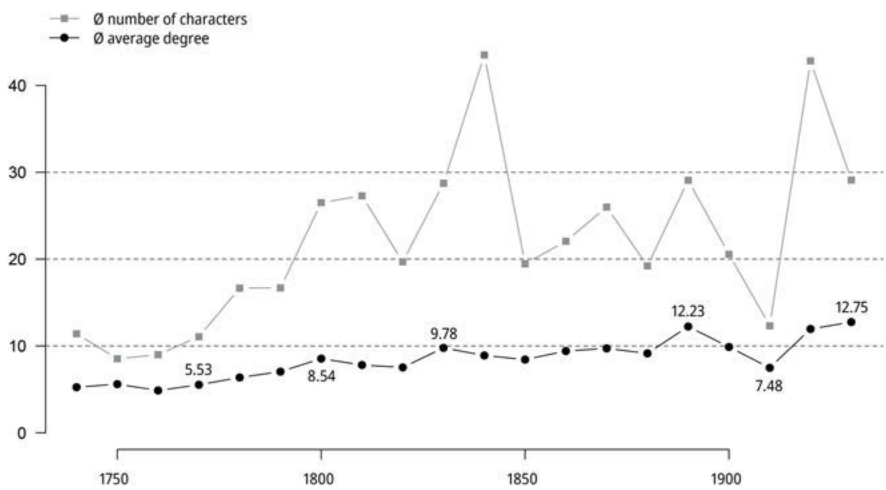

Figure 3: Number of characters (grey) and average degree (black) of 590 German plays. The figure shows mean values per decade.

But how convincing are these numbers? Do the values really support the hypothesis? When looking at Figure 3, there seem to be some striking dependencies with regard to the plays' average degree and their number of characters. This becomes particularly clear in the decades between 1890 and 1930. To check

20 Figure 3 reproduces an investigation of Trilcke and Fischer 2018, figure 6. See also Trilcke et al. 2015.

on this visual impression further, I have calculated the Spearman correlation ρ and the Pearson correlation r of several network metrics and the plays' number of characters. The values of Table 2 do indeed confirm the visual perception. Across the computed network metrics, a relatively stable relation between the number of characters and the metrics themselves emerge. From a conceptual point of view, this makes sense: the more characters a drama has in total, the higher is the potential degree of each character.[21] *Vice versa*, as the number of characters in a play increases, the probability that they will speak to all other characters decreases. Hence, there is a negative correlation with the networks' density. These observations seem to rest upon a poetological decision of the playwrights. Oftentimes, extending a play's cast list goes hand in hand with a larger number of depicted locations, where only a limited number of characters have access to. In principle, the network metrics as well as the examination by Trilcke and Fischer mostly rest upon the changing numbers of the individual play's characters. There is nothing wrong with this observation. To showcase these diachronic alterations in drama history, however, you hardly rely on network analysis.[22]

Table 2: Correlation between the number of characters and several network metrics in 590 plays.

	Ø Degree	**Max degree[23]**	**Density[24]**	**Ø Path length**
Spearman's ρ	0.77	0.97	−0.75	0.72
Pearson's r	0.41	0.76	−0.39	0.42

As my previous remarks and analyses have shown, it is not only difficult to productively make use of co-presence networks for the typical meso-scale of literary studies. When zooming out, one also must contextualize the network metrics and critically reflect their values. Consequently, a scalable reading approach that allows for the scaling of all four dimensions and not only focuses on either "units

21 When normalizing the degree according to a play's number of characters, the effect is reversed.

22 Boris Yarkho (2019), for instance, has distinguished between classicist and romantic plays by counting the number of characters that are speaking in the various scenes of a play. He then compared the distribution of speech acts in around 200 plays.

23 Max degree only considers the play's character with the highest degree value.

24 The density of a network is equivalent to normalizing the network's degree according to its number of characters. This is said to ensure better comparability, as the values of the metric range from 0 to 1. Cf. Jannidis 2017b: 153.

that are much smaller" than the text or units that are "much larger" seems hard to achieve when focusing on co-presence networks. Instead, co-presence networks seem to be better suited for a reading at scale approach.[25] As Weitin postulates, reading at scale leaves aside the idea of adjusting scales. Alternatively, it takes into consideration the "trade-off" that different scales of analysis entail (Weitin 2021: 116). In his view, doing a quantitative corpus analysis means to decide for a certain scope and a specific surrogate. Different text representations and methods have different advantages and disadvantage, e.g., their comparability or their context sensitivity (cf. Weitin 2021: 116). Therefore, they lead to different research questions and answers. The four scales of scalable reading are each set to a specific value: (1) choosing a specific surrogate; (2) selecting a fixed number of objects to study; (3) settling for a specific unit of analysis; and (4) focusing on a single text analytical method. In the case I have outlined above this corresponds to: the co-presence of literary characters (1); 590 German plays (2); the dramatic structure as an indicator of social modernization (3); and network analysis (4).

6 Outlook: Coreference networks as an alternative?

From the perspective of network analysis, Mueller's concept of scalability seems to fall flat – at least when looking at co-presence networks. Can we conclude, then, that network analysis in general does not allow for a scalable reading in Mueller's sense? What will happen if we look beyond co-presence networks? As I have indicated earlier, there are other possibilities to model the interaction of two literary characters. One possibility, for instance, is to look at coreference chains.[26] The linguistic concept of coreference refers to two or more expressions that have the same reference, i.e., the expressions point to the same character or object (cf. Crystal 2008: 116–117). Lately, the automatic resolution of coreference chains has received a great amount of attention within natural language processing (cf. Pagel and Reiter 2020: 56). For the analysis of (German) literary texts, however, the performance of automatic

25 For the idea to differentiate scalable reading to reading at scale, see Weitin 2021, 116–145. Weitin exemplifies his idea by applying Topic Modeling to a corpus of novels.

26 There are other, equally promising ideas, to map forms of interaction onto the edges. Michael Vauth (2019), for instance, directs his attention to narrative elements in Kleist's plays. Andresen et al. (2022) make use of knowledge dissemination in plays to create character networks.

coreference resolution requires further improvements.[27] For my indicative analysis and the creation of coreference based character networks, I will therefore make use of a manually annotated version of Schiller's *Die Räuber*.[28]

Figure 4 visualizes two networks based on these coreference annotations. The networks focus on the four main characters of *Die Räuber*, namely the brothers Karl and Franz Moor, their father (Der alte Moor) and Amalia. In these two networks, the annotated coreferences are used to model the interaction of the characters. Doing so, the perspective changes from who is talking with whom to who is talking about whom. Each time one of the characters is mentioned in a speech act, a new edge between the two characters will be added. Unlike the co-presence networks, the edges of the coreference networks have a direction to display who is talking and who she or he is referring to. Figure 4 depicts two networks whereof one network concentrates on the play's fifth act (left), while the other network displays the whole play (right). When looking at the coreferences in the character speech of Franz Moor one can identify some instructive patterns. Compared to the other three characters in the network, Franz's utterances in the course of the play feature lots of references, especially targeting his father (276 references) and his brother Karl (314 references). This is not surprising as his father and his brother are omnipresent in his monologues and dialogues. When comparing the fifth act to the whole play, the references, however, diminish. Only three references are targeting Karl, only four his father. His utterances, then, become much more self-centered. His thought process no longer revolves around the perceived injustice of nature he had previously projected onto other characters. Dreaming of judgment day, his own horrible intrigues collapse and Franz commits suicide.[29]

I will not go into further detail on how to fully interpret the coreference networks of *Die Räuber*. Instead, I will give an outlook on how a more tailored and reflected modeling of literary networks might prove fruitful not only for Mueller's vision of scalability, but also for a greater relevance of quantitative methods to literary studies. As I have indicated, the coreference networks of *Die Räuber* yield a promising perspective for various scales of observation. Although the units of analysis, i.e., the coreference chains, are infratextual, certain patterns emerge from them that allow for inferences on a bigger scale. The coreference

27 Fynn Schröder, Hans Ole Hatzel, and Chris Biemann (2021) report an F-score of about 0.65 for the coreference resolution in German novels.

28 Pagel and Reiter have published a corpus of plays with manually annotated coreferences, including Schillers *Die Räuber*. For more details on the annotation process and the annotated data, cf. Pagel and Reiter 2020: 56–60.

29 For a more detailed analysis and interpretation of this, see Krautter and Willand 2021: 128–131.

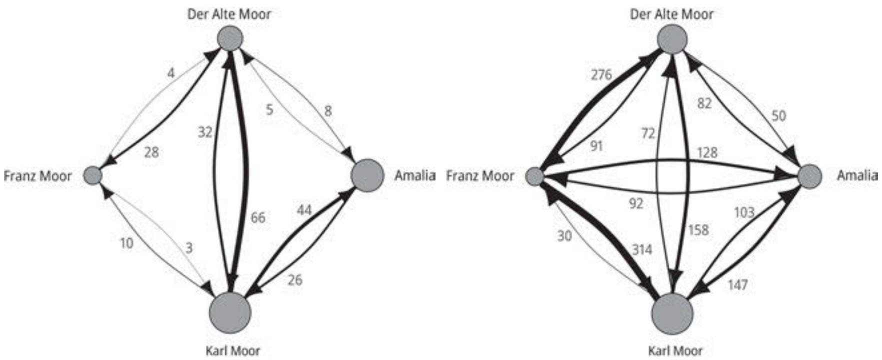

Figure 4: Coreference networks of Schiller's *Die Räuber* for the fifth act (left) and the whole play (right).

values, for instance, can be used to further characterize the relationship between Karl and Franz.[30] As it is possible to contextualize and interpret the values in light of the play's plot, they also seem to support the typical meso-scale of literary studies – at least in principle. Moreover, the two coreference networks that I have compared provide a clear change of state that warrants follow-up research. One can easily change both the text representation and the method of analysis to supplement the networks, e.g., by re-reading the relevant passages, or by comparing the corresponding segments stylometrically or with the help of topic modeling. More challenging, however, is the investigation of bigger corpora. Manually annotating every single play of a large text collection is not feasible. Once the automatic resolution of coreferences is further improved, this form of network analysis could function as a prime example of what Martin Mueller had in mind when he was trying to advocate a rethinking of the scalable dimensions of (computational) literary studies.

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30 A similar approach can also be utilized to create character networks of narrative texts. In this case, however, the coreference chains are mostly used to identify co-occurrences of character references. Cf. Jannidis 2017a: 18.

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Florentina Armaselu

Text, Fractal Dust and Informational Granularity: A Study of Scale

Abstract: This chapter proposes a method of text analysis that combines conceptual aspects from the model of scalable or zoomable text (z-text), topic modelling and fractal geometry. It argues that this type of methodology may assist in detecting different levels of generality and specificity in texts and reveal some characteristics of the assemblage of blocks of text, above the word level, at different scales of representation. Applications of such an approach can range from hermeneutics and discourse analysis to text (and possibly z-text) generation and summarization.

Keywords: scalable text, topic modelling, fractal geometry, informational granularity, digital hermeneutics

1 Introduction

Scale in text analysis has often been considered in relation to big collections of data and the possibility offered by digital methods and tools to provide insights into patterns, trends, outliers and linguistic phenomena that are hard to detect and cover by human reading alone. Several terms, such as *distant reading*, sometimes opposed or compared to *close reading* (Moretti 2013; Underwood 2019), *scalable reading* (Mueller 2014), *macroscope* (Hitchcock 2014) and *long zoom* (Johnson 2007), have been coined to define this type of approach that allows for shifts from a bird's eye view to individual details. However, what seems to have been less studied so far is the significance of the concept of scale and its possible applications as an inherent feature of text itself. Under the magnifying glass, a text is far from being a flat conceptual structure; it may reveal a stratified organization with different layers of general and specific, abstract and concrete, simple and complex units of meaning.

This chapter will focus on scale in textual forms, starting from the assumption that a text can be conceived as a scalable construct containing different levels of detail and can be explored by zooming in and zooming out (Armaselu 2010;

Acknowledgements: The author would like to thank the C²DH and Andreas Fickers for the thinkering grant that made this project possible, Dario Rodighiero, from the University of Groningen, for his review and suggestions of improvement, and Sarah Cooper, from the Language Centre of the University of Luxembourg, for English proofreading.

https://doi.org/10.1515/9783111317779-012

Armaselu and Van den Heuvel 2017). It will investigate the possibility of computer-based detection and analysis of scale-related structures in text, as well as the potential meaning attached to these scales and forms of interpretation.

The analysis will combine topic modelling (Blei 2011), for the preparation of the data, with the theory of fractals that is known for its applications in various domains, from mathematics and physics to statistical economics and linguistics. In his book *The Fractal Geometry of Nature*, Mandelbrot (1983) describes the concept of *fractal*, derived from the Latin *fractus, frangere* (to break), and its use in modelling highly irregular and complex forms from nature such as coastlines, clouds, mountains and trees, whose study goes beyond standard Euclidean geometry and dimensions. One of the fractal forms utilized as a model of a coastline at various scales is the Koch curve (Figure 1). The process of generating such forms starts with a straight interval called the *initiator*. A second approximation replaces the straight line with a broken line formed of "four intervals of equal length", called the *generator.* New details such as promontories and subpromontories appear through the iterative replacement of the generator's four intervals by a reduced generator. Although its irregularity is too systematic, the Koch curve is considered to be a "suggestive approximation" of a coastline (Mandelbrot 1983: 34–35, 42–45).

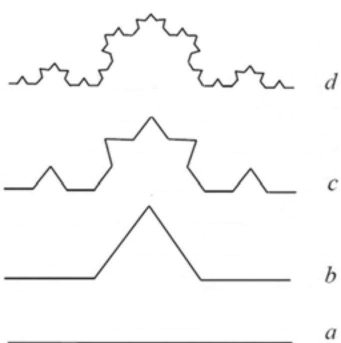

Figure 1: The first four iterations in building a Koch curve (adaptation of Sapoval 1989, 19): a – first iteration, *initiator*; b – second iteration, *generator*; c, d – third and fourth iteration.

Applications of fractal theory in text analysis have exploited various aspects of the concept of *scaling* and *self-similarity*. In scaling systems, a part is in "some way a reduced-scale version of the whole", and when "each piece of a shape is geometrically similar to a whole, both the shape and the cascade that generate it are called *self-similar*" (Mandelbrot 1983: 345, 34). Elaborating on Zipf's law (Zipf 2012: 23–27), stating the relationship between word frequencies and their ranks as evidence of vocabulary balance in a text, Mandelbrot illustrated how constructs such as "scaling lexicographical trees" provide generalized proofs of the Zipf law while exhibiting scaling properties and fractal, non-integer dimensions (Mandelbrot 1983: 346). Other studies have applied fractal-based methodologies to automatic keyword extraction by assessing the "degree of fractality" of words as a measure of their relevance and non-uniform versus uniform distribution in texts (Najafi and Darooneh 2015). Fractal indicators, computed by considering the sequence of words and the number of letters in these words, have been used to compare the style of different types of texts, such as scientific, journalistic, conversational, epistolary and poetic (Kaminskiy et al. 2021). Fractal analysis has also been employed to determine the optimal number of topics based on the detection of "self-similar fractal regions" using a "density-of-states function" for texts in different languages (Ignatenko et al. 2019). More theoretical approaches have conceptualized language as a system that displays fractal features, such as "structural autosimilarity", "fractal dimension" and "iterative order" in generating linguistic structures (Pareyon 2007) or "self-similar patterns" of discourse through the "process of identifying recursive semantic components" (Tacenko 2016).

Although a variety of methods for the fractal-based processing or conceptualization of language have been proposed, mainly taking into account the composition of texts as compounds including letters, syllables, words and sentences, the scalable nature of text and its stratified structure from a conceptual perspective has been less studied so far. In this chapter, I propose an approach that combines topic modelling techniques and fractal theory-related measures to detect different layers of generality and specificity and analyze a text at different scales. For this purpose, I use a corpus of texts from historiography, literature and philosophy. Section 2 will describe the initial assumptions about text scalability and the data used to test and assess the methods illustrated in Sections 3 and 4. Section 5 will present the results and possible interpretations of the approach, while Section 6 will summarize the findings and propose hypotheses for future work.

2 Datasets

A particular area of research in digital history and humanities, that of global microhistory (Trivellato 2011), has presented interest for the study. The dataset used in the experiments contains books considered representative for the objective of this type of research: *1688. A Global History* (Wills 2001); *Plumes* (Stein 2008); *The Inner Life of Empires* (Rothschild 2011); *The Two Princes of Calabar* (Sparks 2004); and *Vermeer's Hat* (Brook 2009). These books combine methods of analysis spanning various conceptual levels, from micro to macro perspectives on the investigated historical phenomena, by connecting, for example: a series of paintings and art objects with the growth of trade and exploration in the seventeenth century (Brook 2009); micro- and macro-histories through the history of a family's own connections (Rothschild 2011); micro-historical accounts with the history of enslaved Africans in the early modern Atlantic world (Sparks 2004); or the perspective of particular actors (people, commodities, one year in time) with the history of specific groups and cultures (Stein 2008; Wills 2001). For comparison purposes, one literary and one philosophical text were included in the dataset, *Gulliver's Travels* (Swift 2009) and *Beyond Good and Evil* (Nietzsche 2009), available via Project Gutenberg (Hart 2004). The size of the corpus was relatively small to allow for closer analysis of the methodology as a proof of concept. The main question to address was to what extent the applied digital methods were able to detect various conceptual levels in the studied texts. The historiography group of books was presumed to already possess such a variety given their analytical coverage ranging from broad overviews to detailed examination in their unfolding of arguments related to world history and microhistory. It was expected that the two other books, from literature and philosophy, would contain a certain type of stratification as well, as an inherent structure of text itself that would be revealed by the analysis.

The books were divided into separate text files corresponding to chapters or parts (when chapters were too short), deemed as meaningful units of analysis for the exploration of scale in text. It was assumed that chapters and parts preserve a certain coherence and similarity in terms of varying degrees of generality and specificity in disclosing the content of the book. Figure 2 illustrates the structure of a book containing topics grouped on levels: from more general, representing a larger number of units, to more particular, mostly characterizing a single unit.

Preliminary experiments consisted in reorganizing excerpts from the books as *zoomable* texts or *z-texts*[1] using a dedicated interface, *z-editor*[2] (Armaselu 2010). The z-editor allows the user to start with a sequence of *z-lexias*[3] on the surface level and to expand or explore them by zooming in and out along the Z-axis and adding or revealing details that belong to deeper levels. I referred to the corresponding processes of expansion and exploration of z-lexias by zooming in and out as *z-writing* and *z-reading*. Each level of the structure corresponds to an XML-TEI file that stores the content and relations of parent and children z-lexias. For the author or reader of a z-text, the inner XML mechanism of the interface is transparent.

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1 Accessed July 23, 2023. http://www.zoomimagine.com/AboutProject.html.

2 Accessed July 27, 2023. http://www.zoomimagine.com/ZEditor.html.

3 Fragments of texts as units in the writing or reading process, inspired by Barthes's (1974: 13) *lexias*, "units of reading".

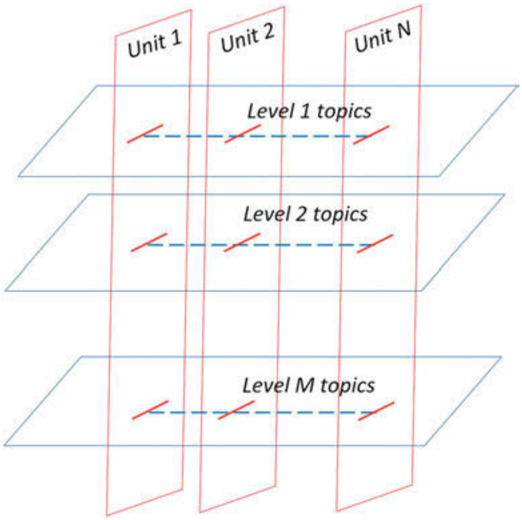


Figure 2: Structure of a book organized horizontally (left to right) by units (e.g. chapters, parts) and vertically (top-down) by conceptual level (e.g. from general to specific).

Figure 3 (left) shows a z-text constructed with fragments from the first chapter of Brook's (2009) book and the result of successive zoom-ins on a fragment from a historical standpoint. The exercise implied a preliminary interpretation of the book as a stratified representation of meaning. For instance, the top level in the *View from Delft* chapter contains fragments that describe events from a world history perspective, such as global cooling, plague and maritime trade in the sixteenth and seventeenth century. Details are added on the following levels: the focus gradually moves to more localized depictions of China's heavy frosts and the Little Ice Age in Northern Europe to the winter landscapes by Pieter Bruegel the Elder in the Low Countries and Vermeer's painting *View from Delft*. The painting is explained in more detail as containing several "doors" into the world of the seventeenth century. One door is the herring boats captured in the picture, as evidence of the herring fishery moving south under the control of Dutch fishermen due to climate change. Another door is the home of the Dutch East India Company, the VOC, also visible in the picture, which points to the network of trade that linked the Netherlands to Asia from the late sixteenth to the late eighteenth century.

Figure 3 (right) illustrates another hypothesis following the storyline more closely. More precisely, the text can be restructured starting from the other direction, i.e. the "doors" which are the paintings themselves corresponding to each chapter, then zoom in to open those doors and gradually expand the text. For instance, the chapter one z-text unfolds from the artwork and its description through

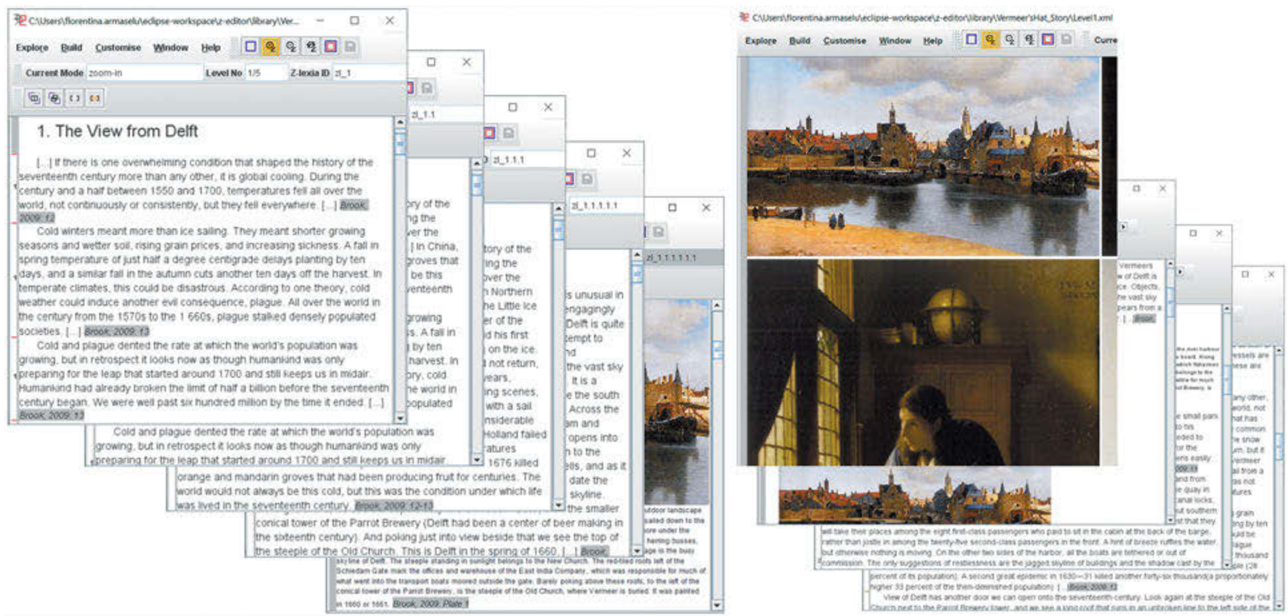


Figure 3: Brook (2009)[4] z-text: history layout (left); story layout (right).

4 Text fragments reproduced with permission (©Timothy Brook, 2009, *Vermeer's Hat: The Seventeenth Century and the Dawn of the Global World*, Profile Books and Bloomsbury Publishing Inc.). Image credits: Johannes Vermeer, *View of Delft* (Mauritshuis, The Hague); Johannes Vermeer, *The Geographer* (Städel Museum, Frankfurt am Main).

events of local history to the large-scale view on global cooling and world trade development. The labels marked in grey in the figures indicate bibliographical notes that contain pages in the book from where the fragments were extracted, such as pages 11, 12, 13 and Plate 1 (for the painting). The restructuring of the original text as a z-text presupposes that various clusters of meaning, belonging to different levels of detail, are scattered throughout the chapters of the book, not necessarily in contiguous areas. My assumption is that grouping them together by level on the same plane and stratifying the representation on several levels would provide new insights into the text and its complex multi-layered structure. This implies various conceptual scales dispersed through fragments that link to each other horizontally and vertically over shorter and longer distances. The methodology applied to detect this type of structure has followed this intuition.

3 Topic modelling

For the preparation and first phase of analysis of the corpus, I used MALLET (McCallum 2002), a software package applying latent Dirichlet allocation (LDA) for topic modelling (Blei 2011), combined with Microsoft Excel functions and Visual Basic for Applications (VBA) procedures that I created for the project.[5] The choice of MALLET and Excel was driven by their accessibility and the possibility of creating output and diagnosis files for further analysis and processing. However, the methodology should be applicable to other types of software as well (for instance, to an integrated Java package that may implement the proof of concept described in this chapter in a second phase of the project).

3.1 Entropy

Each book from the dataset was analyzed with MALLET.[6] Each folder, corresponding to a book organized into files for chapters or parts, was imported via *import-dir* with the options *keep-sequence* and *remove-stopwords* (strings were converted to lower case by default). The topic models were built with *train-topics*

5 Experiments with hierarchical LDA (hLDA) (Blei et al. 2009) were ongoing at the time of writing and are not described in this paper.

6 For more details about the options used for analysis, see Graham et al. (2012) and the online MALLET documentation at https://mimno.github.io/Mallet/topics and https://mallet.cs.umass.edu/diagnostics.php, accessed July 27, 2023.

including the options *output-state*, *output-topic-keys* and *diagnostics-file* to produce a series of XML and tab/space delimited files. The resulting data were imported into Microsoft Excel for processing through built-in functions and VBA procedures that I wrote for this purpose. After a set of tests with various numbers of topics (8, 10, 15, 20, 25) and analysis of topic quality, the number of topics was empirically set at 20, with an *optimize-interval* value of 20 and the default value of 20 for *num-top-words*. The decision was based on the observation that the number of 20 topics produced a topic distribution that included at least two dominant topics appearing in almost all the chapters/parts of the books from the collection considered in the study. This observation was considered as a first indicator of a structure layered from general to specific.

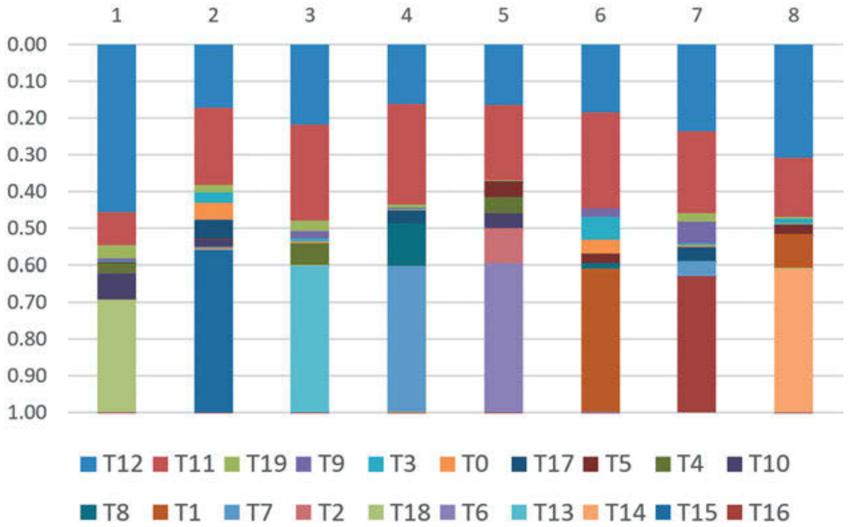


Figure 4: Topics sorted by *document_entropy* in Brook (2009), with topic probabilities (vertical axis) and their distribution by chapter (1–8, horizontal axis).

The goal of post-processing the MALLET files was to devise a methodology for detecting the levels of generality and specificity that characterize each book. For this purpose, I used the topic distribution per document (chapter or part) from the composition file, combined with the *document_entropy* measure from the diagnostics file. Topics with low entropy values are concentrated in a few documents, while topics with higher entropy values are spread evenly over many documents (MALLET documentation – *Topic model diagnostics*). This metric was considered as an indicator of generality versus specificity within the chapters/parts of the books included for analysis.

Figure 4 shows the topic distribution per chapter for Brook (2009), with topics sorted in descending order of their *document_entropy*. One can observe that topics T12 and T11 (top of the bars), and to a lesser degree T19 and T9, are the ones spread throughout the chapters, while topics such as T18, T15 and T13, at the other end of the spectrum (bottom of the bars), are mostly concentrated in a single chapter (chapters 1, 2 and 3 respectively). Intermediate topics are represented by thinner strips in the middle area of the bars.

Figure 5 presents the topic distribution by chapter (Brook 2009) for each of the 20 topics, arranged from more general to more specific (left to right and top-down). Table 1 shows excerpts of top words for the most generic and most specific topics and the chapters where these topics are prominent.

The first two topics (T12, T11) are almost evenly distributed throughout the chapters of the book. They are part of Brook's recurrent argumentation that outlines the emergence of global trade in the seventeenth century, connecting Europe with the world. Narrower descriptions of particular events, developed in relation with the eight paintings by Vermeer and other artworks, stand for articulation points chosen by the author as "doors" or "passageways" to the seventeenth-century world for each chapter (e.g. T18, T15, T13). Intermediary topics (e.g. T17) that cover fewer chapters (but more than one) appear to be less coherent[7] and are probably referring in the texts to fragments that make the transition between more general and more specific themes.

3.2 Levels

To detect the number of levels of generality and specificity inherent to a text and assign topics to such levels, I used the *document_entropy* metric and the computation of the *slope* (Excel built-in function) as a measure of the generality/specificity variation from one topic to another in the graph (Figure 6).

I considered that two adjacent topics T_i, T_j belong to the same level if the absolute value of the slope computed using their corresponding *document_entropy* is less than the value of the average interval computed as $(\max - \min)_{document\_entropy}$ divided by the number of topics.[8] The resulting mapping of topics to levels is shown in Table 2. One can observe that same level topics tend to appear together on plateau, while a change of level is marked by steeper or longer slope lines in the

7 Also according to the MALLET *coherence* indicator computed for the topics.

8 Except for the two most general topics that were considered by default as belonging to two separate levels, 1 and 2.

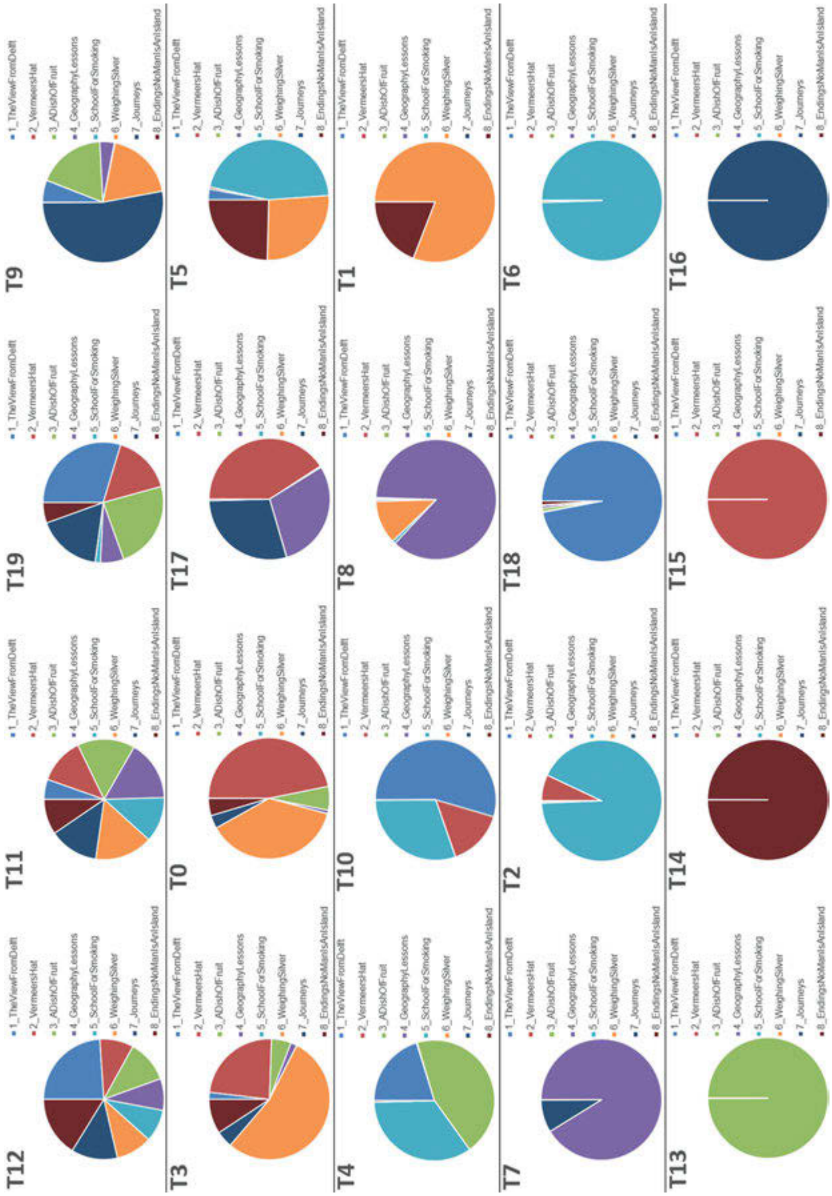


Figure 5: Topic (T0–T19) distribution by chapter (1–8)[9] in Brook (2009).

9 1_TheViewFromDelft, 2_VermeersHat, 3_ADishOfFruit, 4_GeographyLessons, 5_SchoolForSmoking, 6_WeighingSilver, 7_Journeys, 8_EndingsNoManIsAnIsland.

Table 1: Most generic and most specific topics. Excerpts from Brook (2009).

Topic	Top 20 words	Distribution by chapter
T12	century world dutch time vermeer seventeenth painting years people delft place trade life voc men things long great sea side	Even
T11	chinese china back made european trade europe europeans south coast end make called ship people spanish found needed portuguese japan	Even
. . .	. . .	. . .
T17	gunpowder fashion bound kill feet boundaries fishing passage role hung dutchmen rebel lack supplies semedo scattered correctly infiltrating reaching europe's	Mostly in 2_VermeersHat, 4_GeographyLessons and 7_Journeys
. . .	. . .	. . .
T18	delft paintings shanghai view canal pearl rotterdam built schouten chamber schiedam web buildings oude surface cold herring kolk contacts dong	Mostly in 1_TheViewFromDelft
T15	champlain french lake beaver native arquebus champlain's huron mohawks hurons allies felt hat montagnais lawrence hats dream iroquois chiefs map	Mostly in 2_VermeersHat
T13	porcelain white objects ships dishes lion dutch wen potters pieces amsterdam taste voc cargo dish portuguese produced ceramic lam blue	Mostly in 3_ADishOfFruit

diagram. The topic levels also seem to be correlated with the degree of generality/specificity or distribution by chapter shown in Figure 5.

Once the topics were assigned to levels, these levels were propagated to all the words in the text belonging to the topics. For this purpose, I used Excel to further process the MALLET output obtained via *output-state*, which is a file containing the words of the corpus (book), after stopword removal, with their topic assignments, index and position within each document (chapter or part of the book). In this way, each word was assigned to the level of the corresponding topic. Since the analysis of text as a scalable structure was intended for units of text larger than words, I created a set of procedures in Excel VBA to propagate levels from words to segments of a given length in number of MALLET words.[10]

10 That is, the number of word tokens after stopword removal by MALLET (this is how *words* are also referred to for the rest of the chapter).

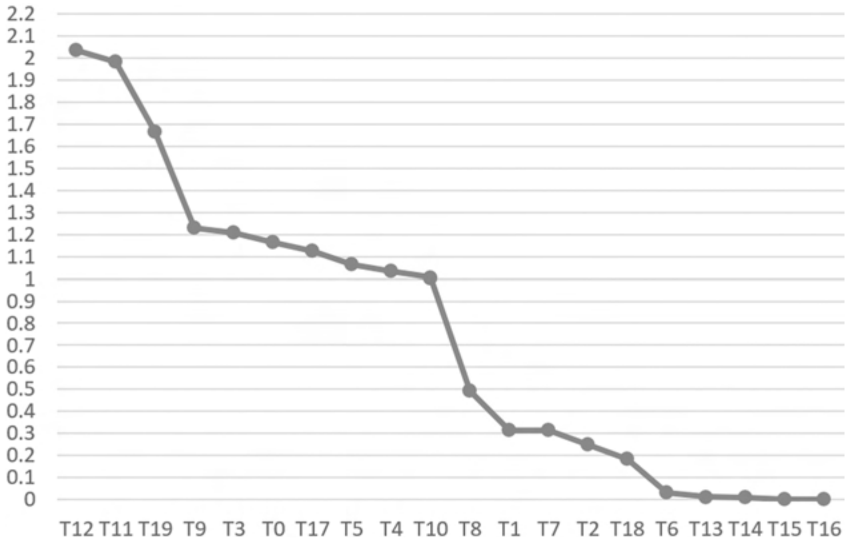


Figure 6: Topics (T0–T19) in decreasing order of their *document_entropy* (vertical axis) in Brook (2009).

Table 2: Topic to level mapping, from generic to specific (top-down), in Brook (2009).

Topic	Level
T12	1
T11	2
T19	3
T9, T3, T0, T17, T5, T4, T10	4
T8	5
T1, T7, T2, T18	6
T6, T13, T14, T15, T16	7

First, the probability of each word to belong to a topic was computed by counting the number of times a word *w* was assigned to topic *t* and dividing this value by the total number of words assigned to that topic. Then, given the length of a segment *s* defined as a number of words inside a document, a score was computed for each level according to the following formula:

$$score(s, l) = \frac{\text{count\_lvl}_{\text{l in s}}}{\text{seg\_size}_{\text{s}}} \times \frac{\text{avg\_prob\_word\_topic}_{\text{l in s}}}{\text{avg\_word\_distance}_{\text{l in s}}} \tag{1}$$

where: $\text{count\_lvl}_{\text{l in s}}$ is the number of times level *l* appears in segment *s* (i.e. the number of words assigned to level *l* in segment *s*); $\text{seg\_size}_{\text{s}}$ is the size in number of words of segment *s*; $\text{avg\_prob\_word\_topic}_{\text{l in s}}$ is the average word-topic probability for words belonging to *l* in *s*; $\text{avg\_word\_distance}_{\text{l in s}}$ is the average distance between words belonging to *l* in *s*.

A segment containing words from different levels is therefore assigned to the level that has the highest score according to (1). This is the level that appears many times in the segment and has many words assigned to it, whose average probability of words belonging to that level is higher, and which involves words that appear grouped together at smaller distances (presumed to form more compact clusters of meaning). In the case of Brook (2009), seven levels were detected (Table 2) and propagated to segments by applying this method.

Tests were run for different segment sizes, from one segment of the size of each book, then sizes iteratively divided by 4 up to 1,024 (six iterations),[11] in a process similar to the generation of the Koch curve that divides the segments by 4 at every iteration. Segment counting was reset at the beginning of each unit (chapter or part), except for the first iteration when a single segment of the length of the book was considered. Thus, segments of different sizes could result from an iteration (either for values larger than a unit size, when the actual size of the segment was the unit size, or for segments placed at the end of the unit containing the remaining words after the division corresponding to the iteration). The process was intended to simulate, by iterative reductions of the segment size, the representation of text at various scales, revealing a stratification by levels and a fragmented rather than flat structure where all the components are placed on a single line. The segment-level diagrams in Figure 7 were computed in Excel following the method for step charts without risers (Peltier 2008).[12] It was observed that for large segment size values (large scale), when one segment covers a full unit (chapter or part), the assigned level can differ from unit to unit, and it is not always a level corresponding to the most general topics, as would have been expected. Sometimes it may be a specific level or, less often, an intermediate level. Figure 8 displays the detail of the word distribution by level for the first 11 words and the first segment of size 35, 140 and 560 words in Brook's book, chapter 1. We can compare it with the three bottom diagrams from Figure 7 (read from right to left). According to the score computed by formula (1), segment 1 is assigned to level 6 when considered at a small scale (segment size: 35 words) and to

11 With the ratio of $2^{2(k-1)}$, where k = 1, 2, . . . , 6 represents the number of the iteration.

12 For simplification, all the segments are represented equally. Segment i spans i to i+1 (starting with 1), where i stands for the numerical labels on the horizontal axis of segments. For visibility and analogy purposes, the segments were represented as 15pt-wide bars (instead of points) in the Excel diagrams. The vertical axis represents the levels, from 1 to 7 for Brook's book.

level 1 when the scale increases further (140, 560 words). For larger scales (Figure 7, top, right to left), the first segment remains at level 1 for the next two iterations, but is assigned to level 7 when a single segment of the size of the whole book is considered. This way of looking at the text as made of building blocks of increasing size as the observation scale increases can provide insights into the mechanisms of meaning production which involve assembling words with different degrees of generality and specificity to form more complex units. The specificity or generality of these higher order units, such as sentences, groups of sentences or paragraphs, chapters, parts and whole book, could therefore be detected and mapped on different levels, revealing a stratified conceptual structure rather than a linear layout.

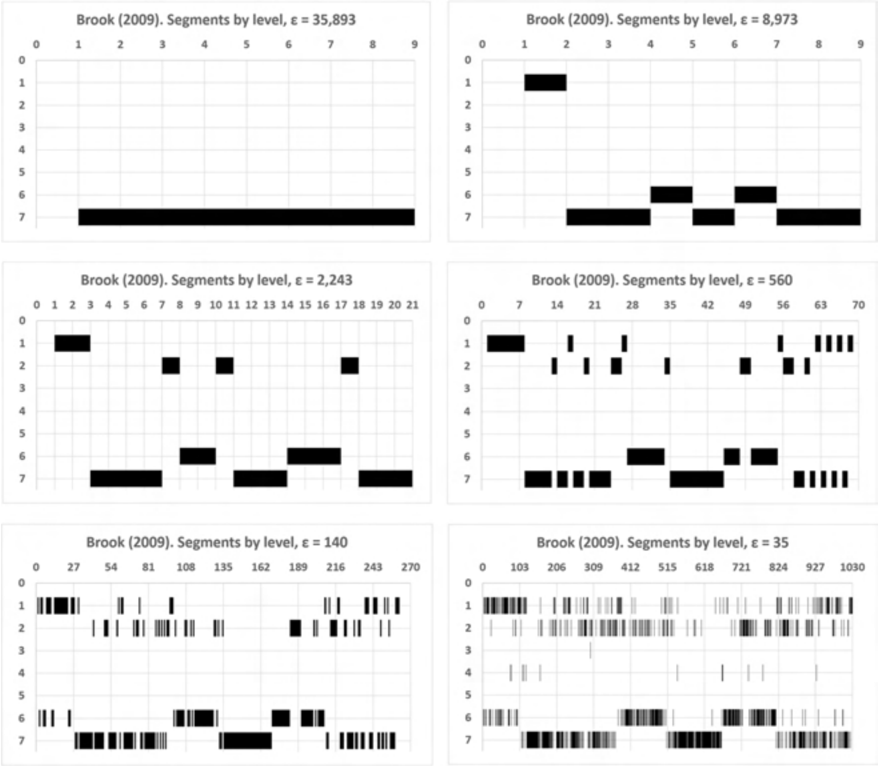


Figure 7: Segment distribution (horizontal axis) by level (vertical axis) at different scales, with ε the size of the segment in number of words (Brook 2009).

If we read Figure 7 in reverse order, we can interpret the progression left to right and top-down by analogy with a process in physics. First, the whole text-bar is assigned by the algorithm to the most specific level 7. By exposure to external fac-

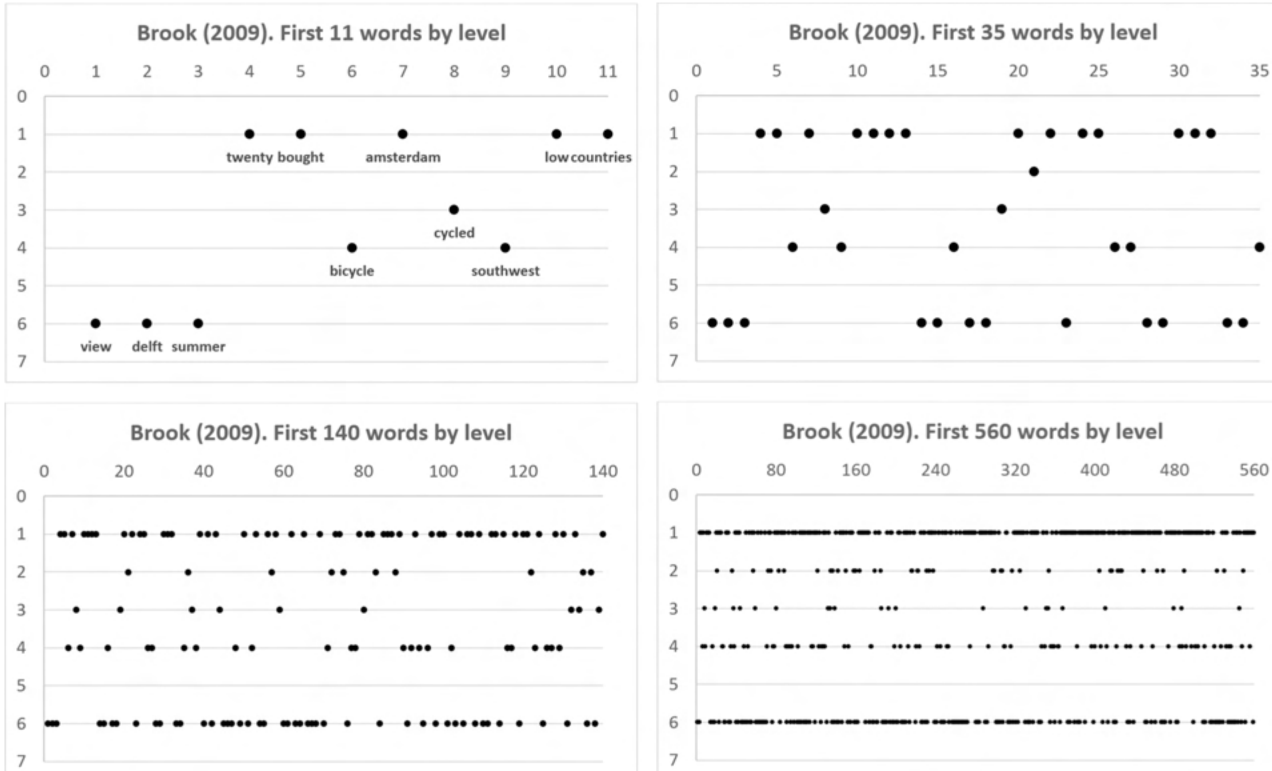


Figure 8: Word distribution by level, first 11 to 560 words from segment 1, chapter 1, at different scales (Brook 2009).

tors (in our case the analysis at different scales)[13] the text is broken into smaller and smaller units of analysis, which seems to increase the mobility of the resulting segments and their migration to more generic levels.

From a conceptual point of view, it therefore appears that the focus of Brook's book gradually moves from specific to generic (or from analysis to synthesis) with the decrease in size of the investigation unit. Following this line of thought, which seems to align with the storyline z-text layout depicted in Figure 3 (right),[14] we may infer that the strategy of argument unfolding of the book is primarily articulated, when considered at a large scale, around the concept of "doors", symbolized by the eight artworks corresponding to each chapter. This conceptual framework, corresponding to the microhistory level, is gradually enriched and contextualized within a global-history perspective that depicts the "dawn of the global world in the seventeenth century" through storytelling and synthesis inserts that become more "visible" or prominent at intermediary and smaller scales of analysis. In his study of semantic similarity in a taxonomy, Resnik (1995) proposes a measure to quantify the "information content" of a concept according to its position in a taxonomy (e.g. the top concepts being more abstract). Starting from this idea but applying it to textual fragments, I will use the term *informational granularity map* for the diagram depicted in Figure 7 that graphically describes the degrees of generality and specificity characterizing the units of analysis at different scales of representation. Granularity is understood both as a measure of the scale of observation, represented through the segment size, and as an expression of the degrees of generality and specificity of the content itself. Section 5 will provide a comparison with the informational granularity maps built for the other books in the collection (Figure 15).

4 Fractal geometry

This stratification by levels suggested that texts might possibly be interpreted as fractals; that is, as irregular, non-linear forms characterized by a certain degree of self-similarity. In this view, a text, first considered in its entirety as a single segment of words and a single conceptual unit, becomes scattered along several conceptual lines when iteratively broken into smaller segments and analyzed at decreasing scales. The question was whether this type of structure can be more

13 In physics this may correspond to exposure to radiation or higher temperatures that produces segment fragmentation.

14 It should be noted, however, that the z-text model operates with segments of the order of several sentences or one or two paragraphs.

formally portrayed as a fractal and if it is possible to determine its degree of irregularity as measured through a fractal dimension. This measure may then be used to compare the fragmentation of different texts by level and as a possible indicator of their complexity in terms of multi-layered rather than linear structures. To do this I applied a method called *box counting* that is used in mathematics, physics and other natural sciences to detect the fractal dimension of irregular shapes (Falconer 2014; Gouyet 1996).

4.1 Fragmentation

I considered text representations for the corpus like the one shown in Figure 7. A grid of squares of side ε can be imagined as covering the image at every scale, where ε takes iteratively different values for each of the analyzed books.[15] The algorithm consists in counting the number N(ε) of squares (or boxes) of side ε that intersect the text shape, for grids of different granularity.

Figure 9 shows an example of box counting for Brook's book and a box of side ε = 8,973 words. The number of boxes N(ε) in this case is six, that is the number of squares in the grid that contain segments of text. At this coarser granularity, only three of the seven levels detected for the book are occupied with segments, the most general level (L1) and two of the most specific ones (L6, L7). The segments and boxes were modelled in Excel as integer intervals taking account of the number of words in the segments and their succession, and the (i, j) pairs, where i represented the column and j the row corresponding to a box. The total number of boxes in a grid at a certain scale was defined based on the scale factor $s = 2^{2(k-1)}$ plus 1, where k was the number of the iteration. For instance, at the iteration k = 2, the total number of words for Brook's book (35,893) was divided by the scale factor $s = 2^2 = 4$, resulting in segments of ε = 8,973 words.[16] Since the division might not always be exact, the scale factor was increased by 1 to include the remaining words of the last unit. Thus, a grid of (s+1)*(s+1) = 5*5 = 25 boxes was devised. The position of the levels and the level interval ω on the vertical axis were determined by dividing the maximum value of the squared grid by the number of levels N_l. For the Brook example in Figure 9, the level interval $\omega = [(s+1)*\varepsilon]/N_l = (5*8,973)/7 = 44,865/7 = 6,409$.

15 E.g. 35,893; 8,973; 2,243; 560 . . . words for Brook's book corresponding to the six iterations, Section 3.2.

16 At this scale, ε exceeded the size of each unit (chapter) and the actual segment sizes corresponded to the sizes of the eight chapters of the book, labelled $S_1 – S_8$ in the figure.

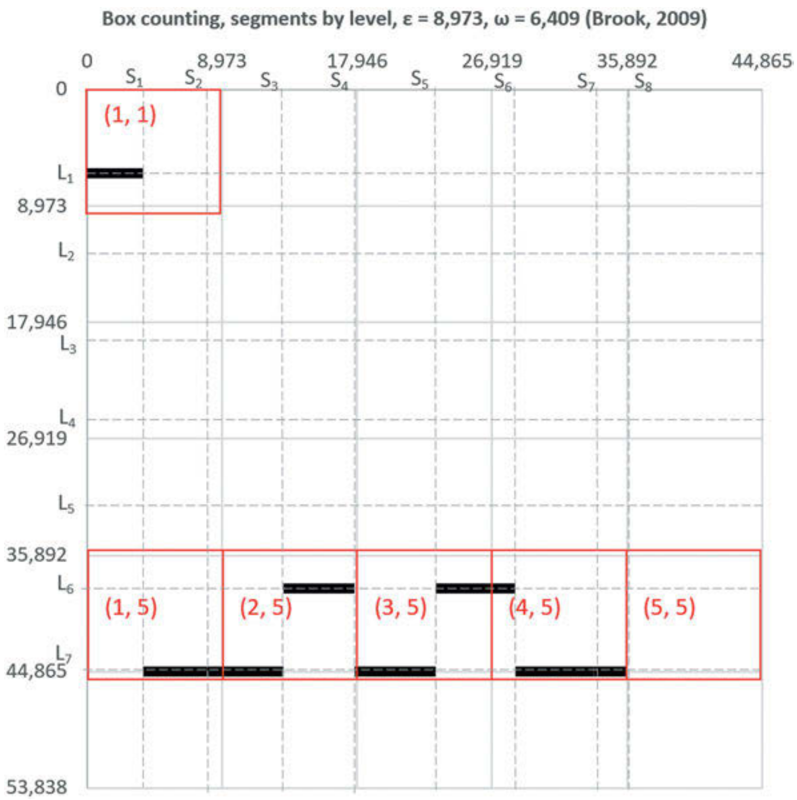


Figure 9: Example of box counting, second iteration, k = 2 (Brook, 2009).

The process was repeated and the number of boxes intersecting the text shape was calculated for six iterations (k = 1–6). I then built the diagram for log(1/ε) and log(N(ε)) (Figure 10). Usually, the fractal literature considers that if this curve exhibits an approximately linear behavior (at least for a certain subset of the plane), then N(ε) obeys a power law of the form: $N(\varepsilon) \approx c^{*}\varepsilon^{-D}$, where c is a constant. Therefore, the studied object may be assumed to possess fractal properties in the linear region, and D represents its fractal dimension.[17] Intuitively, D reflects how the number of counted boxes grows with the decrease in box side, the way in which the analyzed object fills the space, the ratio of change in detail to change in scale, or the inherent complexity of an irregular form (Falconer 2014: 27–28; Karperien and

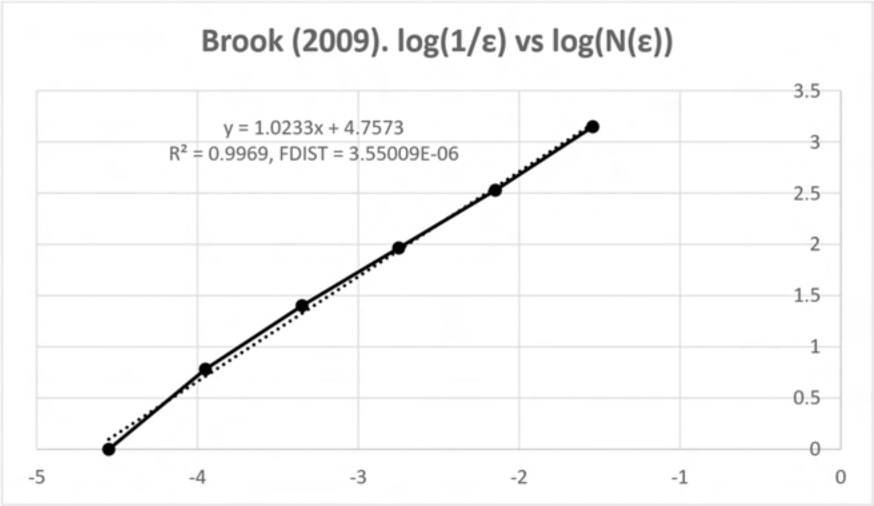
17 Or box-counting dimension. There are different types of fractal dimension. See Mandelbrot (1983) and Falconer (2014) for a survey of these types and their degree of equivalence.

Jelinek 2016: 20). Various applications of the box-counting method to images either considered a grid of iteratively reduced size overlaid on the same image (Ostwald and Vaughan 2016) or used mathematical functions instead of pixel pictures to eliminate the distortions due to zoom-in (Wu et al. 2020). Unlike the image-based approach, I considered that the representation of text at each scale also changes with the side of the grid cell ε (according to the algorithm described in 3.2) and I worked with an interval-based modelling of the boxes and segments in Excel. This type of representation was intended to capture the disposition of segments on levels at various scales by simulating the effect of a zoom-in that makes more and more details visible as the scale decreases, and to test the application of the power law for fractal behavior on these different scale-driven configurations.

In practice, D is calculated as the slope of the linear region of the graph (Figure 10) for a certain number of iterations. Studies in a variety of research fields have shown that despite its relative simplicity, the box-counting method presents a series of drawbacks. For instance, the value of D varies with the range of box sides, the number of iterations[18] and certain characteristics of the grid or image to be analyzed (positioning, resolution) (Datseris et al. 2021; Ostwald and Vaughan 2016; Harrar and Hamami 2007; Klinkenberg 1994). In their analysis of fractal patterns of words in a text, Najafi and Darooneh (2015) observe that detecting the fitting range in the log-log plot of the number of filled boxes against box side, and the fractal dimension as the slope of the line of best fit is quite challenging to do automatically. Other studies have pointed to the need to provide other statistical measures, such as the correlation coefficient, mean and standard deviation over multiple samples used to compute the fractal dimension, to assess the accuracy and limitations of the model (Karperien and Jelinek 2016: 23–26).

To estimate the fractal dimension, I applied the method of the least squares to compute the slope of the log(1/ε) vs log(N(ε)) graph (Harrar and Hamami 2007) and computed related statistical measures as first accuracy estimators. Figure 10 displays a 1.0233 slope and 4.7572 intercept (left) and the variation of the number of filled boxes with box side (right). The R^2 statistic shows a proportion of 0.9969 of variability in Y = log(N(ε)) that can be explained using X = log(1/ε) and a measure of their linear relationship and correlation in the sample. A value close to 1 indicates that a large proportion of the response has been explained by the regression, while a number near 0 suggests the opposite (James et al. 2017: 69–71). The FDIST statistic estimates the probability that the observed relationship between the two variables

18 For instance, Ostwald and Vaughan (2016: 40) recommend “at least eight and preferably ten or more comparisons” for better accuracy, to reduce the error rate to “around ±1 % or less”, in their study of the fractal dimension in architecture.



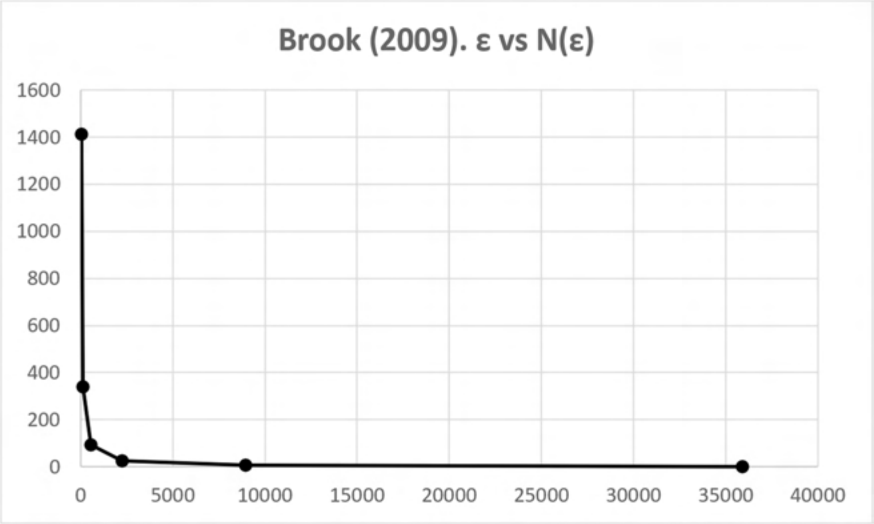


Figure 10: Fractal dimension as the slope of the double-log plot, log (1/ε) (horizontal) vs log(N(ε)) (vertical) (top); box side (horizontal) vs number of filled boxes (vertical) (bottom) for iterations k = 1 to 6 (Brook 2009).

occurs by chance, which is very low (3.55009E-06) in this case.[19] Although the influence of some factors on the box-counting dimension, such as the side of the box and the number of iterations, requires further analysis, I considered the values obtained through this approach as a rough approximation of the fractal dimension and basis of comparison for the texts included in the study (see also Table 4, Section 5.2).

Once the dimension value had been computed, another question needed to be addressed, i.e. how this dimension could be interpreted within the fractal theory framework. Mandelbrot (1983) generically called *dust* the fractals with dimensions in the interval 0 to 1. A classic example from this category is *Cantor dust*, whose generation is illustrated in Figure 11. Its construction starts with a straight line as an initiator, followed by a generator obtained by removing the middle third from the initiator. The process is repeated at smaller and smaller scales, by continuing to delete the middle third.

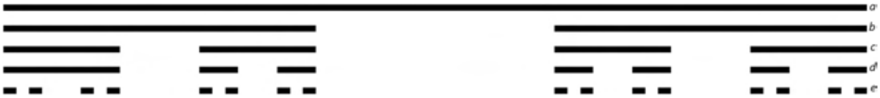


Figure 11: Cantor dust (adaptation of Mandelbrot 1983, 80): a – first iteration, *initiator*; b – second iteration, *generator*; c, d, e – third, fourth and fifth iteration.

While the Koch curve (Figure 1) is a fractal with an approximate dimension of 1.2618, Cantor dust has a fractal dimension of 0.6309 (Mandelbrot 1983: 36, 80). Two- or three- dimensional Cantor dusts or sets can also be generated, with fractal dimensions above 1, such as 1.2619 and 1.8928 respectively (Sławomirski 2013; Tolle et al. 2003). One can observe a certain similarity between Cantor dust (Figure 11) and the segments of Brook's book represented at smaller and smaller scales (Figure 7). Some differences may be noted as well. First, the appearance of the latter is not as regular as that of the former since the textual segments and their distribution were generated through a score-driven procedure with variable results rather than the application of an invariant pattern of iteration. Second, Cantor dust corresponds to a linear structure with the matter from the gaps being gradually incorporated into the dark areas of increasing density through the process of "curdling", according to Mandelbrot's terminology. In contrast, Figure 7 depicts a multilinear, two-dimensional arrangement derived from the dispersion of the textual matter on the plane over several levels of generality and specificity with the decrease in scale.

19 See also "LINEST function", *Excel for Microsoft 365*, https://support.microsoft.com/en-us/office/linest-function-84d7d0d9-6e50-4101-977a-fa7abf772b6d, accessed July 27, 2023.

I would therefore argue that texts may exhibit fractal geometry, which reveals a stratified conceptual structure on layers of generality and specificity at various scales. We can recall the procedure described in Section 3.2 and formula (1) that assigns a segment to the level with the highest score. This score considers the word count and the probability of words belonging to that level, as well as their average distance. If we imagine the segments as a form of dust, they seem to be attracted, at different scales, to levels that correspond to various degrees of generality and specificity. This "force of attraction" may be determined by the existence of more compact and coherent clusters of meaning in the text, which are more likely to belong to a certain level as compared with the other levels.

Following this interpretation, a closer look at Figure 7 suggests that at the largest scale, when the segment size coincides with the length of the whole book in number of words, this segment is "attracted" to the most specific level 7. It therefore seems that clusters containing words that are more specific are prevalent in conceptually depicting Brook's book at a global scale. However, for smaller and smaller scales, the dust segments are gradually scattered and attracted towards more generic, surface levels, as shown by the following iterations in the figure. This raises the question of whether this attraction and the movement of "dust" fragments from one level to another as the scale changes may indicate the existence of a certain type of pattern, correlation or persistence over a longer range, or whether it is completely random.

4.2 Memory

To determine whether such a "memory" of the text exists, I performed an analysis of fluctuation and long-range correlation for the selected corpus. The method was proposed by Peng et al. (1992) to uncover the correlation between basic structural units of nucleic acids over long distances by mapping nucleotide sequences onto a so-called "DNA-walk". In this random walk model, a function $u(i)$ describes a walker's move through two values, $u(i) = +1$ and $u(i) = -1$, if the walker moves either up or down for each step i of the walk. Based on the "net displacement", the sum of the unit steps $u(i)$ after l steps, Peng et al. (1992: 168) compute a measure called "root mean square fluctuation", $F(l)$, that characterizes the average of the displacement. A power law function of the form $F(l) \sim l^{\alpha}$ where $\alpha \neq \frac{1}{2}$ may indicate a long-range correlation in the considered walk, while a value of $\alpha = \frac{1}{2}$ can be the indicator of a random walk. A straight line on the plot $\log(l)$ vs $\log(F(l))$ would confirm a power law between the two measures, with α representing the slope calculated through the method of the least squares. Studies in linguistics, such as those by Pavlov et al. (2001), have applied the method to investigate long-range correlations between letters and combinations of symbols in English novels. In her analysis of children's language, Tanaka-Ishii (2018: 8, 5) observed that "long-range correlation is due to the arrangement of frequent words and rare words" and that "rare words tend to cluster".

The aim of my analysis was to determine whether any long-range correlation can be observed in the "walk" of the word segments from one level to another at different scales of representation. I considered the iterations k = 2 to 6. The function u(i) modelled the walk through the values: +1, if a segment j was followed in the text by a segment j+1 placed on an upper level (move up); −1 for a move down to a lower level; and 0 for a segment j+1 remaining on the same level as segment j. The number of steps was l = Ns–1, where Ns represented the number of segments detected for each iteration k. The fluctuation F(l) was computed in Excel using the formula proposed by Peng et al. (1992: 168). Figure 12 shows the plots for log(l) vs log (F(l)) for the iterations 4–6 (left to right) and Brook's book.

For larger scales (k = 2 to 3), the linear regions of the curves log(l) vs log(F(l)) covered shorter portions of the graph. As illustrated in Figure 12, for decreasing scales (k = 4 to 6), the diagram started to exhibit more visible linear regions, especially in the first part of the curves (left). A selection of the linear portions (right) allowed the values of α to be computed as the slope of the plots for these zones. As ε (the size of the segment) decreased, α took values from 0.1917 to 0.4218 (Appendix, Table 6, Brook). What can therefore be inferred about the segment "walk" through levels and the degree of correlation over longer distances corresponding to this walk? The values of α below 0.5 seem to suggest an "anti-persistent" behavior or "mean reversion" (Ijasan et al. 2017; Saha et al. 2020; Hu et al. 2021) when a move in one direction is followed by a move in the opposite direction. This behavior refers to the linear regions of the graphs (Figure 12, right), i.e. to a number of steps l = 9, 30 and 509 and segment size ε = 560, 140 and 35. In the case of Brook (2009), these segment sizes roughly correspond to blocks of 7–8 paragraphs, 2-2½ paragraphs and 2 and ½–3 sentences respectively. As the segment size decreases, the range in number of steps with walk correlation apparently increases. Shorter blocks at smaller scales would therefore exhibit longer memory. Table 6 (Appendix) summarizes the results of the experiments calculating the long-range correlation in the walk for the original and shuffled data.[20] One can observe that for this book, the segments of 140 words (~ 2–2½ paragraphs) display a smaller value of α than the segments of 560 and 35 words, which seems to be related to their relative immobility (a higher per-

20 The levels assigned to segments at each scale were randomly shuffled. The procedure was then applied in the same way as for the original data to model the walk and to compute the fluctuation and the value of slope α in the linear region.

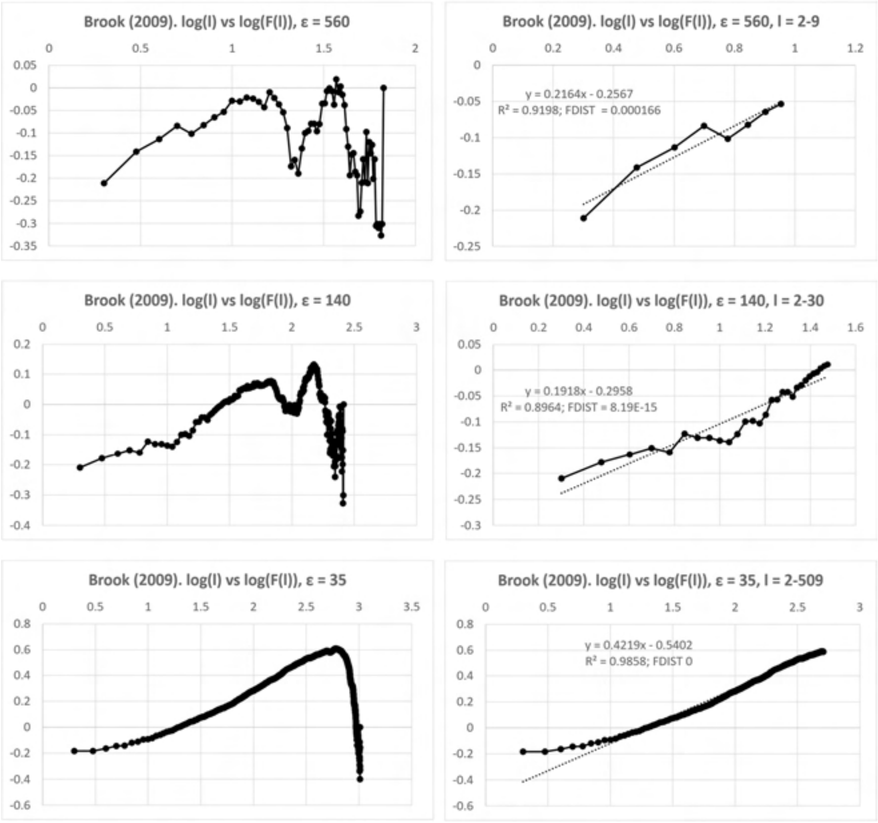


Figure 12: Fluctuation in the "walk" of word segments through levels for iterations k = 4 to 6 (Brook 2009).

centage of no moves, when the segments remain on the same level for longer periods) as compared with the other two block types. It is not yet clear why this happens, but a possible explanation may be related to the inner configuration of meaning of the book and the way this configuration is modelled by the algorithm defined by formula (1). In other words, 140-word blocks may be more dependent on the surrounding segments and thus less susceptible to independent movement across levels than the two other block types. Although there are significant differences between the values of α for initial and shuffled data, the latter still displayed values of α < 0.5, thus indicating an anti-persistent behavior, while a more random walk would have been expected. More shuffling rounds would be needed to draw a conclusion, but it is possible that the relatively high proportion of no moves (60%–68%) that characterized the walk at various scales had an impact on the results of the shuffling process. Therefore, the segments seem to fluctuate or remain still around or on some dominant levels at any examined scale. Mainly similar behavior was observed for the other books in the collection. Section 5 will provide a discussion of this aspect and its possible connections with Zipf's (2012) notion of specific-generic balance in texts.

4.3 Lacunarity

Another concept that presented interest for this study was that of lacunarity, as a "measure of the 'gappiness' or 'hole-iness' of a geometric structure" (Plotnick 1993: 202). In the domain of fractal geometry, this may be applied, for example, to distinguish objects with close or identical fractal dimensions, which display differences in the distribution and size of the gaps. The "gliding box algorithm" is one of the methods often applied to measure lacunarity (Allain and Cloitre 1991; Plotnick et al. 1993; Da Silva 2008). The method involves firstly representing an object against a grid of squares like the one shown in Figure 9. Then a box of variable side length (e.g. ε, 2*ε, 4*ε, 8*ε, etc.) is placed on the upper left corner of the grid and the number of occupied squares of side ε within the box is counted. After moving the box one column to the right, the filled squares in the box are counted again. The process is repeated over all the rows and columns of the grid, and for different sizes of the gliding box. The lacunarity is defined as a function of the side of the gliding box and the number of squares occupied by the object at different scales.

While the fractal dimension measures "*how much* the object (or data) fills the space", the "amount of space-filled, or the mass in some sense", lacunarity measures "*how* the data fill the space", the "spatial size of gaps and their structure within a set" or the "mass distribution" (Di Ieva 2016: 10; Tolle et al. 2003: 131). Lacunarity may thus indicate the "level of contagion between occupied sites at a particular scale" or the "degree of spatial clumping or aggregation" of certain populations (Plotnick 1993: 208). I considered that such a measure may be useful for a closer analysis of the distribution of gaps and the movement of segments to one level or another with the change in scale.

Figure 13 and Table 7 (Appendix) present the values and shapes obtained for the measure of lacunarity in the books in the collection. To compute this measure, I used the "gliding box algorithm" (Plotnick et al. 1993). For each scale and iteration (k = 1–6) corresponding to a certain segment and grid cell side (ε), the lacunarity was calculated using different values for the side of the gliding box, i.e. 2^0, 2^1, 2^2, . . ., as multiples of ε until a certain threshold for each iteration was

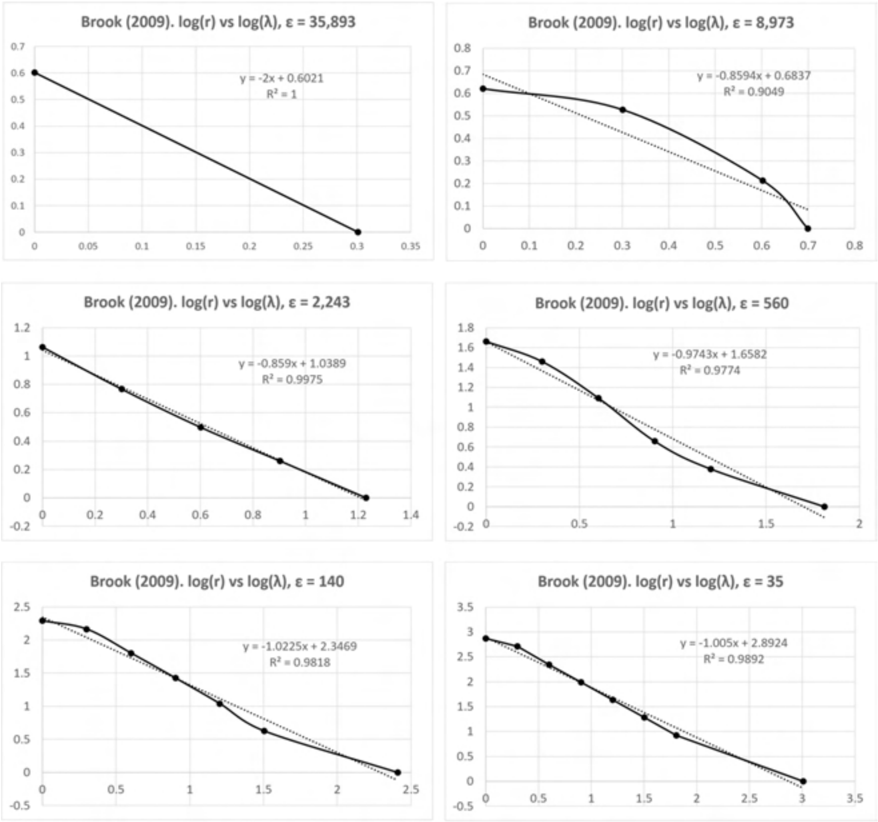


Figure 13: Log lacunarity (λ) by log side of the gliding box (r), iterations 1–6 (Brook 2009).

attained. The calculations also included the case of r corresponding to the side of the grid, M, as the maximum value ($r = 2^{i-1}, 1 \leq i < k+2$; $r = M, i \geq k+2$).[21]

As noted by Plotnick et al. (1993), the highest values of lacunarity were recorded at each scale (k = 1–6) for values of r = 1 when the gliding box was equal in size with the cell of the grid of side ε, while lower lacunarities were obtained as the box side increased. At different scales, the curves exhibited a certain degree of linearity (Figure 13), which according to Allain and Cloitre (1991) is a feature of self-similar fractals. In general, configurations with low variation in gap sizes display lower lacunarity, while objects with a wide range of gap sizes or larger areas of clumped sequences show higher values of lacunarity. For Brook

21 Table 7 shows the specific values of r applied for each iteration.

(2009) the average lacunarity (λ) increased with the decrease in scale and segment size (ε) and in the fraction represented by the occupied cells in the grid (P) (Table 7, Figures 7 and 9). This suggests that the variability of gap sizes increased with the decrease in segment size corresponding to the increase in segment movability from one level to the other. A comparison of the lacunarity measure of all the books selected for the study will be presented in the following section.

5 Discussion

The experiments performed so far with the corpus of seven books, five from historiography, one from literature and one from philosophy, indicate that an analysis at various scales of the texts may reveal fractal properties and a stratified structure.[22] To detect these levels, I combined the concept of zoomable text (z-text), as a starting point, with topic modelling and elements from fractal theory and applications. Although some limitations were identified and further analysis is needed, it can be argued that the initial assumption of the text as a multi-layered conceptual construct seems to be confirmed.

5.1 Attractors

Various types of layers can characterize the internal organization of a text on levels, e.g. from simple to complex, abstract to concrete, global to local, etc. In the present study I modelled this type of layered pattern through the generic to specific spectrum. To this end, I considered that topics spread over several documents are more general than topics distributed mostly over a smaller number of documents or just one document. The existence of a specific-generic balance in semantic systems was formulated by Zipf (2012: 185) through the metaphor of the artisan involved in the task of classification by a number of *n* criteria and correlations, and the Principle of Least Effort. Specific correlations describe a small set of particular classes of events more completely, while generic correlations depict

22 It should be noted that although theoretical fractals can go down indefinitely to smaller and smaller scales and we can imagine the scaling down of text to segments of size below 1 (word level), such as morphemes, letters, letter fragments, etc., for the present study I considered cut-offs in segment size above word level, as defined by the six iterations. See also Mandelbrot's (1983: 38) discussion on the Koch curve cascade of smaller and smaller promontories and the cut-off scales applied to real coastlines.

a larger set of classes but less completely. The balance between specific and generic correlations would therefore be maintained by the artisan in his attempt to generalize upon the basis of specific correlations, and particularize upon the basis of generic correlations, with the aim of minimizing *n* and the classification effort. Approaching the same question but from a different perspective, Lafon (1981) proposed a probabilistic model to discern between basic (non-specific) and specific forms in a corpus divided into parts.

My hypothesis was that this type of inference involves several degrees of generality and specificity that can be examined through longitudinal and transversal cuts of texts into units (e.g. chapters, parts) and levels (Figure 2), and different scales of observation. I assumed that a gradual unfolding of generic and specific arguments can be observed in the global-micro history texts built upon thematic aspects that varied from broad worldviews to minute examination of distinctive historical events, people, objects or points in time. Texts from other domains such as literature and philosophy were also presumed to exhibit a gradual relationship between generic and specific elements, from words defining the general theme and basis of communication to localized forms characteristic of certain units only. The topic modelling approach used in level detection offered a first glimpse into this type of conceptual structure. Table 3 lists the number of levels detected for each text in the collection against the number of words and units for each book. The influence of these two factors considered in isolation is not clear. A closer look at the percentage of intermediary levels and topics and the distribution of topics by level may suggest a possible explanation.

Table 3: Number of detected levels, book length (MALLET words), analysis units (chapter or parts), and intermediary levels and topics (sorted by length).

Book	Length	Units	Detected levels	Intermediary levels (%)	Intermediary topics (%)
1688. A Global History (Wills 2001)	51,846	8	8	62.50	35.00
Gulliver's Travels (Swift 2009)	37,892	5	9	66.66	75.00
The Inner Life of Empires (Rothschild 2011)	37,112	9	10	70.00	85.00
Vermeer's Hat (Brook 2009)	35,893	8	7	57.14	65.00
Plumes (Stein 2008)	29,023	7	9	66.66	65.00
Beyond Good and Evil (Nietzsche 2009)	24,196	10	7	57.14	45.00
The Two Princes of Calabar (Sparks 2004)	16,504	7	6	50.00	40.00

If we exclude the most generic (the first two) and the most specific (the lowest plateau) topics in the diagrams (Figure 14), we can infer which books exhibit a larger proportion of their topics and levels in the intermediary area. Thus, the books with a higher number of levels (≥ 8) in Table 3 are also those with a higher number of intermediary levels, such as Wills (2001), Swift (2009), Rothschild (2011) and Stein (2008). The number of detected levels may therefore be influenced by the length of the texts and the number of units, the way in which the authors shape their discourse through generic and specific classes of words and topics, and also classes of words and topics that belong to the area in between.

Studying the texts at various scales revealed that some levels act as "attractors" of segments (considered as "fractal dust"). The movement of segments from one level to another does not appear to be random. As shown in Section 4.2, this movement seems to be characterized by a particular type of "memory" of the segments and values of α situated below 0.5, which would correspond to an "anti-persistent" behavior. Table 6 presents a summary of this type of memory. One can observe a certain symmetry in moves up and down and a relatively high percentage of no moves or stationary behavior of the segments for all the books in the collection, which may indicate segment fluctuation around a dominant level at the smaller scales. Why this happens is not yet completely clear. As shown in Figures 7 and 15, the books as whole aggregates start on a more generic or specific level, and then, with the decrease in scale, a certain equilibrium between generic and specific tends to be established by the migration of segments from one level to another. The tension between generic and specific alluded to by Zipf (2012) therefore seems to operate at the smaller scales (and possibly word level) characterized by higher segment "mobility". It should be noted, however, that the generic-specific dichotomy is not binary, but multi-value and involves different degrees, or levels.

Table 6 provides insights into segment mobility at smaller scales. The lowest values of α are displayed for Stein (2008) and Wills (2001), the former with a generic level, the latter with a specific dominant level (Figure 15), and segment sizes of 453, 113 and 810 words.[23] These types of block therefore seem less mobile for these books, given the high percentage of no moves that characterizes them, or may follow a movement logic that is only feebly anti-persistent. For all the books, the memory interval (in number of steps) increases with the decrease in scale (segment size), and for more than half of the books (Rothschild, Stein, Wills and

23 Corresponding to $5\frac{1}{2} \div 6\frac{1}{2}$, $1 \div 1\frac{1}{2}$, and respectively $9 \div 11$ paragraphs.

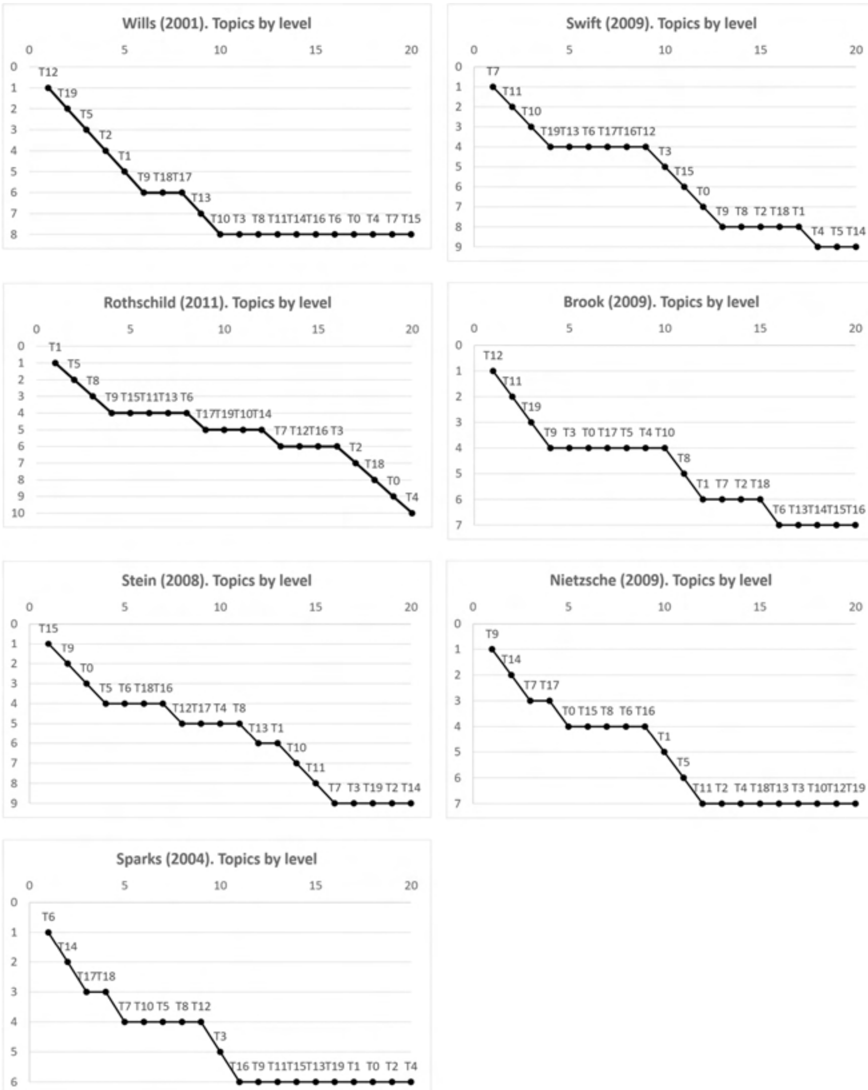


Figure 14: Topic distribution by level and book in the collection (sorted by length, left-right, top-down).

Swift), α increases with the decrease in scale.[24] These books, as can be observed in Figure 15, present a dominant level, with the highest density of segments, at all

24 It would be interesting to investigate the value of α in the case of segments of 1 word in size, to see if it approaches 0.5, representing a random walk, or if it remains below this value, and

scales. In this case, anti-persistent behavior would consist in a tendency of most segments to remain on the dominant levels, except for those that have enough mobility (or energy) to escape their attraction. The increase in α seems to capture this phenomenon, since this form of energy appears to increase with the decrease in scale. Thus, Zipf's property would manifest itself not as a generic-specific balance, but as a tendency to maintain stability around a certain level of generality or specificity. Two books (Brook and Sparks) exhibit a different pattern through a slightly lower value of α for the middle sizes (k = 5). In the case of Brook (2009), this may be related to a higher value for the number of no moves, as explained in Section 4.2. It should also be noted that this book contains the longest memory interval and the highest value of α for the smallest scale studied (k = 6). This may be due to a certain equilibrium between the occupation of generic, specific and intermediary levels (Figure 7, bottom, right) and the strategy, discernible at this scale, of an unfolding of detail vs global view, constructed around the eight artworks chosen "not just for what they show, but for the hints of broader historical forces that lurk in their details" (Brook 2009: 7). For Sparks (2004), the lower value of α (k = 5) may be related to the nature of the units themselves,[25] whose fluctuation suggests a slightly lower tendency to return to the dominant level at every move than the units corresponding to the previous iteration (k = 4).[26] The case of Nietzsche (2009) is more intriguing, since it shows a decrease of α with the decrease in scale. This behavior could be caused by the sensitivity of smaller scales to the style of this philosophical text that alternates very long assertive sentences with very short questions, which may impose a logic of segment assignment to levels that is perhaps less anti-persistent in nature than when articulated at a larger scale.

5.2 Dispersion

The study of the books at different scales and their fractal geometry seem to offer a new standpoint on text as a conceptual object. This may reveal a certain type of dynamics in the stratification of levels and the way in which these levels attract word segments with changes in scale. Such behavior may be related to the aggre-

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thus continues to show an anti-persistent behaviour. The time allocated to the writing of this chapter allowed only for partial experiments of this type, meaning that it is not possible to draw a conclusion at this stage.

25 $\frac{1}{2} \div 1$ paragraph.

26 $2\frac{1}{2} \div 3$ paragraphs.

gation of clusters of meaning, correlation over long distances and the modes in which conceptual building blocks of variable sizes are formed in language.

Table 4: Fractal dimensions and generated statistics by book (sorted by dimension).

Book	Fractal dimension (D)	R^2	FDIST
Gulliver's Travels (Swift 2009)	1.032885269	0.997971565	1.544E-06
Vermeer's Hat (Brook 2009)	1.023331752	0.996924745	3.55009E-06
The Two Princes of Calabar (Sparks 2004)	1.0148522	0.992653067	2.02913E-05
Plumes (Stein 2008)	1.01428358	0.997639195	2.09167E-06
1688. A Global History (Wills 2001)	1.00456998	0.997032804	3.30487E-06
The Inner Life of Empires (Rothschild 2011)	0.99646761	0.988888016	4.64762E-05
Beyond Good and Evil (Nietzsche 2009)	0.994695321	0.991815719	2.51873E-05

All the books in the collection showed a fractal dimension (D) slightly below and above 1 (Table 4) and a resemblance with the category of dusts (Mandelbrot 1983). Fractal dimension is considered an indicator of the degree of "change in detail" or complexity that becomes apparent with the "change in scale" (Karperien and Jelinek 2016: 20) or a way to describe, together with lacunarity, the "visual look" of a dataset (Tolle et al. 2003: 129). The books with the highest values of D are Swift (2009), Brook (2009) and Sparks (2004), which show a higher degree of dispersion of segments with the decrease in scale as compared with the others (Figures 7 and 15). While the books by Swift and Sparks exhibit lower values of average lacunarity (λ) (Table 7), Brook's displays a higher value that may be interpreted as a marker of higher variability in the size and structure of the gaps, and therefore a more complex pattern of detail unfolding with the decrease in scale. Sparks' and Stein's are very close in terms of fractal dimension but the texture of their segment distribution differs by a higher average occupation fraction (P) and a lower average lacunarity for the former and the reverse for the latter, which is also characterized by a simpler detail pattern with a concentration of mass on the second level and larger gaps. A simpler pattern, similar to Stein's, can also be observed for Wills', which has the highest value of average lacunarity discernible through large areas of empty space and a high density of segments on the last level at every scale. The values of D, λ and P of the last two books in Table 4 are somewhat harder to interpret: first, because both exhibit a value of D that is less than 1 (although by a very small amount), which brings them closer to the category of one-dimensional dusts, despite a relatively higher average occupation fraction of the grid (P) as compared with the others. What distinguishes the two books is a higher average lacunarity for Nietzsche, and thus a higher variability of gap configurations, while for Rothschild the average λ is the lowest of the whole collection, possibly due to a more homogeneous size and structure of the gaps. With these observations summarized, the question that arises is how these measures relate to the initial assumption of generality and specificity levels characterizing these texts from a conceptual point of view.

Differences were observed in the level of generality or specificity to which the segments corresponding to the largest scale were assigned in the first iteration (Table 5). This level may be interpreted as the *initiator* by analogy with the construction of theoretical fractals such as the Koch curve and Cantor dust (Figures 1 and 11). It is from this initial level that the dispersion of segments towards other levels begins when the reduction in scale is applied through the 6 iterations. This may suggest that from a global perspective, the words belonging to the initiator tend to group together in more compact or coherent clusters than those at other levels. An additional hypothesis may consider these levels as potential starting points in the writing process by the real or a hypothetical author, or by an automatic process of text generation.

As also illustrated in Figure 15 (read top-down), there are four books with an initiator corresponding to the more generic levels 1 and 2 (Rothschild, Swift, Stein and Nietzsche). The second row in the figure shows the distribution by level of segments with a size usually comparable to that of a unit (chapter or part). Recall that generic and specific levels are based on topics with respectively larger and smaller values of document entropy, which means broader or narrower unit coverage. Rothschild's initiator, placed on level 2, was assigned to a topic with large coverage and top words that refer to members of the Johnstone family (*john william james george betty alexander*) or to specific conditions, places and entities (*slaves scotland grenada east india company*). A closer look at the contexts of these words in the book revealed biographical details and fragments of letters and documents from various archives (via citations of primary and secondary sources), which can be associated with a microhistory perspective. For subsequent iterations, segments of smaller size spread either up, to level 1, corresponding to a topic with broad coverage (*johnstones empire information history slavery ideas*) and thus a view apparently closer to a macro-history perspective; or down, to deeper levels (i.e. 4–7) that cumulated more localized topics in terms of unit coverage but were variable in terms of micro- vs macro-historical standpoints (*henrietta illness anxious litigation; individuals historians enlightenment microhistory*). Rothschild's book therefore seems to be articulated around micro-historical characters and events, a conceptual unifying stratum discernible from a bird's-eye view and more localized macro-historical arguments that become visible in the layered representation only with a decrease in the scale of analysis. Stein's initiator was also placed on level 2, corresponding to a dominant topic (*ostrich feathers trade industry plumes jewish*). The decrease in scale resulted in the migration of segments either to the upper level

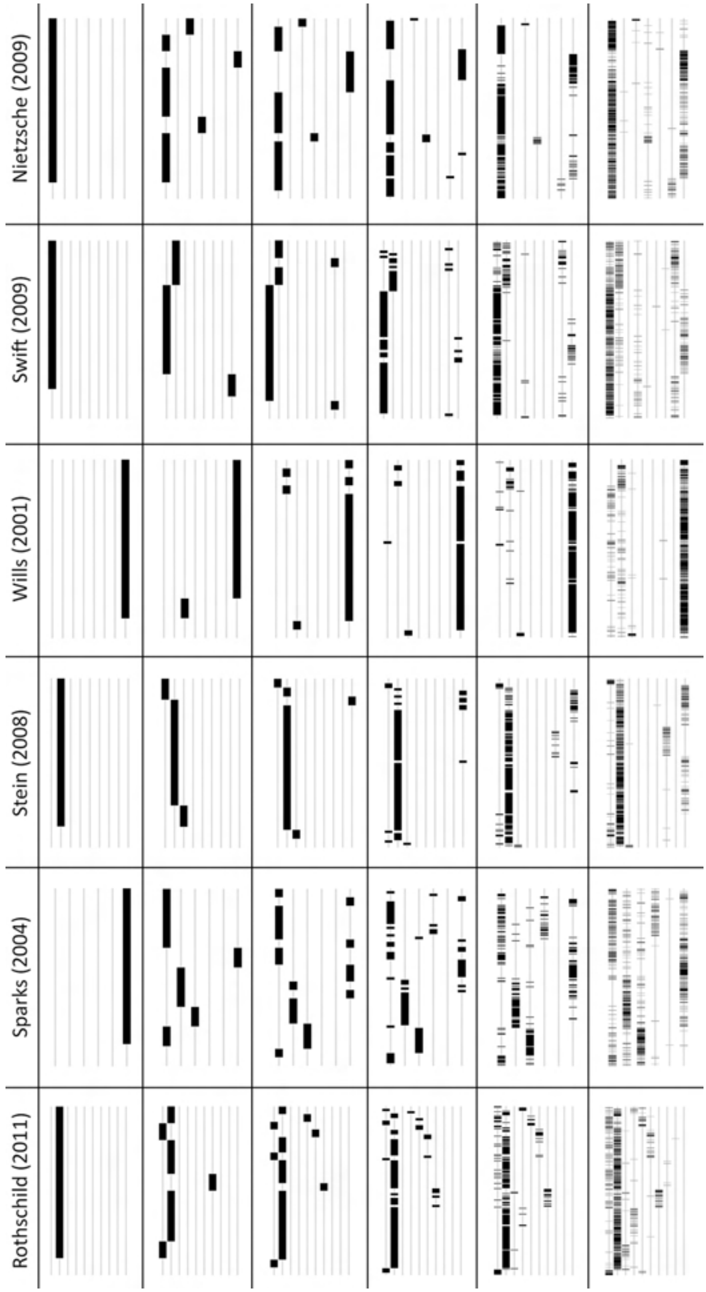

Figure 15: Segment distribution by level at different scales for six books.

Table 5: Initial level by book corresponding to the largest scale, iteration k = 1 (sorted by number of levels).

Book	Initial level	Total levels
The Inner Life of Empires (Rothschild 2011)	2	10
Gulliver's Travels (Swift 2009)	1	9
Plumes (Stein 2008)	2	9
1688. A Global History (Wills 2001)	8	8
Beyond Good and Evil (Nietzsche 2009)	1	7
Vermeer's Hat (Brook 2009)	7	7
The Two Princes of Calabar (Sparks 2004)	6	6

based on a general topic (*jews modern global commerce history commodity*) or to deeper levels (7, 9) corresponding to topics pertaining to manufacturers and the ostrich feather trade in different regions of the world, in Africa, America and Europe. Unlike Rothschild, Stein predominantly seemed to adopt a global history perspective with synthesis explanations that accompanied the microhistory accounts, noticeable at smaller scales of the visual representation (which I will call *map* from now on). The initiators in the case of Swift and Nietzsche occupied level 1, with a very generic topic (*great made time people good found hundred court*) for the first and a similarly generic one for the second (*man men good time great soul life taste world people love morality*). With the decrease in scale, the fluctuations of segments revealed some of the intermediary and deepest levels of the maps. For Swift, the dispersed segments were placed mostly on levels 2, 4, 8 and 9, attached to topics that went from more general (*country master reason nature honour*), through medium generality referring to objects, situations or institutions common to different places visited by the protagonist (*majesty majesty's left palace royal; yellow settled tolerable disposition*), to more localized aspects specific to a certain country or event (*yahoos houyhnhnms yahoo; emperor blefuscu imperial; island king luggnagg*). For smaller scale iterations in Nietzsche's text, the intermediary level 4 and the specific levels 6 and 7 were more prevalent. These levels referred to topics with medium coverage in the book (*recognized process psychological; unconditionally utility experienced; love woman vanity*) and to more localized, philosophical themes *(judgments sensation faculty impulses*; *skepticism germany greatness scientific; morals morality herd gregarious).*

The other three books (Brook, Sparks, Wills) exhibited a different pattern containing an initiator on the deepest level and segment dispersion gradually involving the upper levels with the decrease in scale (Figures 7 and 15). For Brook, also discussed in Sections 3 and 4, the second iteration produced a movement up of the segments corresponding to chapters 1, 4 and 6, i.e. from level 7 to level 1 for the first and level 6 for the two others. These chapters were the first to move since they were probably less stable with their most specific topics (T18, T7, T1) belonging to level 6 (Figures 4, 5, 14). The next iterations produced fluctuations of segments from these chapters between levels 6, 1 and 2, while the segments from the other chapters mainly fluctuated between levels 7, 1 and 2. Excerpts of top words from the most generic and specific topics of this book (Table 1) and the movements of segments (Figure 7) suggest a prevalence of the micro-historical perspective at larger scales, gradually balanced by global history arguments that become more discernible on the map with the decrease in segment size. Sparks' case was more intriguing since it displayed an initiator placed on level 6, and in the second iteration, a movement up to levels 1, 2 and 3 of most of the chapter segments, except for chapter 3 (Figure 15). A possible explanation of the relative stability of chapter 3 on the last level resides in its higher percentage of specific topics (T11, T19) (see also Figure 14). Although globally attached to the most specific level, the book exhibited a variable pattern at smaller scales. Thus, for subsequent iterations, the first third fluctuated around the top levels 1, 2 and 3 with topics mainly related to the slave trade (*robin johns slave trade; traders slaves trade calabar; town king english captains; atlantic africa numbers individuals*). The two other thirds showed an increasing density of segments on levels 4 (end) and 6 (middle), corresponding to intermediary or narrower themes and events (*wesley charles africans god christianity; roseau mortality shore believed night*). This threefold pattern suggests a certain similarity with Swift's distribution, also displaying a higher concentration of segments on the last level in the middle of the book; this may correlate with Sparks' argument unfolding style, which seems closest to that of a storyteller of all the five history books analyzed. Wills' map showed the simplest configuration, with an initiator on level 8 and fluctuations involving levels 1 and 2 with the decrease in scale (Figure 15). What is surprising about Wills' text is the higher segment density on the deepest level in contrast with sparser inserts at the upper levels at every scale, as compared with the other books. This pattern can be explained by the "baroque" composition of the book (as also suggested by its "Baroque Prelude"), intended to create the "portrait" of one year, 1688, from discrete depictions of people, places and events around the world at that particular time. The global perspective is therefore constructed by general topics from the upper levels 1, 2 and 3 (*time world year good long work; great people power made years trade; world voices voice sense human baroque*), while the bottom level 8 cumulates topics with more precise but narrower scope (*jews thy children jerusalem; spanish slaves coast portuguese; william king england james; muslim mughal ottoman hindu*). The relative sparsity of segments on the upper levels and the abundance of mass on the lowest level can therefore be attributed to Wills' method itself, based on "[s]erendipity, surprise, and letting one thing lead you to another" (2001: XI), which involves the author less and the reader more in making connections and fitting together the pieces of the global history puzzle of 1688.

5.3 Informational granularity maps

The combined approach of topic modelling and fractal geometry led me to scalable representations of the analyzed texts (Figures 7 and 15) and their generic-specific dynamics, representations that I will call *informational granularity maps*. The term *map* was inspired by Bjornson's (1981) "cognitive mapping" and its role in the "comprehension of literary texts". Bjornson distinguishes two modes of thought in the elaboration of a textual image. The first refers to the construction by readers of a "general idea" or "image" about what they are reading, i.e. "a poem, a play, a novel" and "how it can be expected to operate as they read". This general idea is then made more specific with the progression of the reading process, in the same way as "archeologists confronted by a heap of potsherds, start with a general idea about the nature of pottery and gradually refine that idea as they reconstruct a particular pot" (1981: 58). The second mode of thought is related to the hypotheses readers make about the world and the confirmation, alteration or denial of these hypotheses as they continue to read, operations through which "information is added to the textual image by assimilation and accommodation". These two modes of thought would therefore produce a flexible cognitive construct, a "schematized map of the text and its imaginary territory – a map that facilitates remembering what has been read". Bjornson also assumes that although these constructions will differ from person to person, there are invariant features that "tend to recur in different readers' mapping of the same text" (1981: 59). Ryan used Bjornson's concept of cognitive maps in a narrower sense, referring to a "mental model of spatial relations" (2003: 215). She conducted a series of experiments with high school students, who were asked to draw maps of the story world of the *Chronicle of a Death Foretold* by Gabriel García Márquez, to investigate the readers' mental construction of the narrative space. Ryan notes that text processing, in the process of reading, operates at different levels, "words, sentences, paragraphs, passages", to which one may add the level of the "global meaning or narrative macro-structure" (2003: 234). She also discerns two types of memory involved in the reading process, the "long-term memory", where the global representation of a text is stored, and the "sketchpad of short-term, or episodic, memory" affected by "smaller textual units", where the readers form their "most detailed visualizations" or "picture-like representations" (2003: 234). Based on the results of her experiments, Ryan concludes that early in the reading process readers create a global but schematic representation of the spatial configuration of the textual world, and that they then concentrate on the plot, characters and visualization of the current scene, without the need to reorganize the whole map, which remains relatively resistant to new input. According to Ryan, this would explain the differences but also the common elements in the students' sketches that, although not completely identifiable to cognitive maps, may document the selective work of long-term memory.

My visual representations (Figures 7 and 15) did not involve experiments with readers and their cognitive constructs of the textual world or the spatial configurations expressed within it; instead they were built through automatic analysis, namely, from the perspective of the texts themselves and a particular type of *information* carried by them, independently of the readers. Thus, the term *informational* was chosen, also inspired by studies in information and communication theory (Shannon 1948; Dretske 1999; Resnik 1995). These visual representations were intended to illustrate the *informational granularity* of the analyzed texts. That is, how texts, cut into smaller and smaller units of analysis, may change their geometry according to the reconfiguration at different scales of the spectrum of generic to specific themes characteristic to each text. I considered these barcode-like representations as *maps*[27] that depicted how the initiators, and their positioning on a generic or specific level, encompassed at global scale a sort of "long-term memory" of the texts considered in their entirety. Shorter segments also exhibited a certain type of memory, identified as mainly anti-persistent, possibly indicating a tendency of the segments to fluctuate around dominant levels (or attractors) at different scales. It would be interesting to compare via dedicated experiments, e.g. inspired by cognitive map studies (Bjornson 1981; Ryan 2003), the levels assigned by the algorithm (formula 1) with the levels of generality or specificity assigned by human readers of the texts, for each of the six iterations considered in the project. The fractal particularities of these maps (dimension, lacunarity) need further analysis. However, they seem to suggest some correlations between the visual characteristics of segment dispersion and the strategy of argument or story unfolding of the books. This drew attention, for instance, to certain words and topics that synthesized and linked together the conceptual threads of the texts, as entities evenly distributed throughout the units of analysis (chapters or parts), or on the contrary, to elements that narrowed down the scope of the narrative through localized descriptions or focused analyses of detailed content. The topic modelling approach used in level detection offered a first glimpse into this type of layered conceptual structure, despite its inherent limitations related

27 Some similarities with "genetic maps" were also observed (see for instance Fang et al. 2020: 4).

to topic instability and dependence on the choice of the number of topics. More general techniques should be investigated as potential alternatives, for instance those derived from information, entropy and energy theory (Shannon 1948; 1951; Marcus 1970; Onicescu 1966), the study of lexical cohesion and lexical chains (Morris and Hirst 1991; Barzilay and Elhadad 1997) and the analysis of rare word clustering (Tanaka-Ishii and Bunde 2016). The potential connections between thermodynamics, entropy, energy, the so-called "temperature of discourse" and the fractal dimension (Mandelbrot 1983: 347), and the stratified representations of texts and the dynamics of segment attraction to levels at various scales proposed in this study should also be further examined.

6 Conclusion and future work

The study proposed a method of text analysis that combined conceptual aspects from the model of zoomable text, topic modelling and fractal geometry. It was assumed that this type of methodology may assist in detecting different levels of generality and specificity in texts and reveal some characteristics of the assemblage of blocks of text, above the word level, at different scales of representation. Applications of such an approach can range from hermeneutics and discourse analysis to text (and possibly z-text) generation and summarization.

Further work will consist in deepening the analysis of measures such as lacunarity, fluctuation and long-range correlation in conjunction with that of fractal dimension. A closer examination of the limitations of the applied techniques (e.g. impact on the results of certain factors in box counting and topic modelling) and the applicability of alternative methods from other fields of research such as information theory, physics or genetics may also be envisaged.

Appendix

Table 6: Long-range correlation by iteration (k), number of steps in the linear region (l interval)$_{lin}$ and value of the slope (α), and corresponding R^2 and FDIST measures, for original (lin) and shuffled (lin-sh) data, and segment sizes ε with approximate number of corresponding sentences (s) or paragraphs (p).[28]

k	Measures Book	Brook (2009)	Rothschild (2011)	Sparks (2004)	Stein (2008)	Wills (2001)	Swift 2009)	Nietzsche (2009)
4	ε	560 ($7\frac{1}{2} \div 8$p)	579 ($7\frac{1}{2} \div 8$p)	257 ($2\frac{1}{2} \div 3p$)	453 ($5\frac{1}{2} \div 6\frac{1}{2}p$)	810 ($9 \div 11$p)	592 ($5 \div 6\frac{1}{2}p$)	378 ($4 \div 4\frac{1}{2}p$)
	(l interval)$_{lin}$	2–9	2–28	2–28	2–9	2–21	2–11	2–12
	Moves$_{all}$ (%)	no (60.29)	no (74.28)	no (67.64)	no (80.59)	no (89.55)	no (75.75)	no (86.95)
		up (20.58)	up (12.85)	up (17.64)	up (10.44)	up (4.47)	up (12.12)	up (5.79)
		down (19.11)	down (12.85)	down (14.70)	down (8.95)	down (5.97)	down (12.12)	down (7.24)
	α_{lin}	0.216384333	0.185040878	0.261332118	0.046823725	0.006867853	0.181172257	0.291666169
	R^2_{lin}	0.919798726	0.88342838	0.875057937	0.243531002	0.00451974	0.830157976	0.9693114
	FDIST	0.000166306	3.59628E-13	8.59407E-13	0.213958273	0.778237534	0.000244858	4.07101E-08
	$\alpha_{lin\text{-}sh}$	0.149986078	0.016463879	0.084144612	0.041551025	−0.050632471	0.113057825	0.170276019
	$R^2_{lin\text{-}sh}$	0.602186505	0.029770492	0.241980519	0.131817593	0.174296436	0.616295395	0.840515564
	FDIST$_{lin\text{-}sh}$	0.023587474	0.389453858	0.009155519	0.376707047	0.06702235	0.00714031	7.16962E−05
5	ε	140 ($2 \div 2\frac{1}{2}$p)	144 ($2 \div 2\frac{1}{2}$p)	64 ($\frac{1}{2} \div 1p$)	113 ($1 \div 1\frac{1}{2}$p)	202 ($2 \div 3$p)	148 ($\frac{1}{2} \div 1\frac{1}{2}p$)	94 ($\frac{1}{2} \div 1\frac{1}{2}$p)
	(l interval)$_{lin}$	2–30	2–50	2–97	2–36	2–31	2–20	2–40
	Moves$_{all}$ (%)	no (68.19)	no (72.24)	no (64.36)	no (77.39)	no (87.35)	no (67.82)	no (80.00)
		up (16.47)	up (13.30)	up (18.39)	up (11.49)	up (6.51)	up (15.50)	up (9.61)
		down (15.32)	down (14.44)	down (17.24)	down (11.11)	down (6.13)	down (16.66)	down (10.38)

28 The number of sentences and paragraphs are indicative and represent rough estimations based on manual counting and the observation of one or two chapters from the beginning of the books. They are not systematic counts or average values representative of the entirety of the books.

	α_{lin}	0.191770271	0.234109443	0.250216607	0.068862996	0.138374811	0.201002756	0.222016254
	R^2_{lin}	0.89637017	0.972306688	0.921194349	0.725516927	0.893800989	0.983533176	0.954688903
	FDIST	8.19074E-15	2.91902E-38	1.17451E-53	8.70955E-11	3.65465E-15	1.33272E-16	1.83752E-26
	$\alpha_{lin\text{-}sh}$	0.234708099	0.216825884	0.133893403	0.179243835	0.055466597	0.156645701	0.07041099
	$R^2_{lin\text{-}sh}$	0.946291969	0.969363938	0.552195165	0.950569927	0.544944655	0.90812337	0.730288518
	$\mathbf{FDIST}_{lin\text{-}sh}$	1.1192E-18	3.13713E-37	4.37272E-18	3.98671E-23	3.21971E-06	3.0635E-10	4.47479E–12
6	**ε (s or p)**	35 ($2\frac{1}{2} \div 3$s)	36 ($2\frac{1}{2} \div 3$s)	16 ($\frac{1}{2} \div 1$s)	28 ($1 \div 1\frac{1}{2}$s)	50 ($2\frac{1}{2} \div 3$s)	37 ($2 \div 2\frac{1}{2}$s)	23 ($2 \div 4\frac{1}{2}$s)
	(l interval)$_{lin}$	2–509	2–344	2–197	2–221	2–201	2–153	2–240
	Moves$_{all}$ (%)	no (62.58)	no (58.55)	no (49.27)	no (68.58)	no (72.30)	no (51.11)	no (66.82)
		up (18.95)	up (20.38)	up (25.41)	up (15.65)	up (14.03)	up (24.24)	up (16.68)
		down (18.46)	down (21.06)	down (25.31)	down (15.75)	down (13.65)	down (24.63)	down (16.49)
	α_{lin}	0.421862798	0.29979272	0.331368534	0.321025	0.386141823	0.264320874	0.150407153
	R^2_{lin}	0.985846869	0.97521342	0.979490072	0.91998802	0.965578685	0.986571656	0.9892173
	FDIST	0	7.1547E-276	1.0531E-165	1.5633E-121	8.0632E-147	2.6167E-142	3.9323E-235
	$\alpha_{lin\text{-}sh}$	0.224735648	0.189948059	0.252615074	0.23359415	0.287609244	0.374482602	0.279634208
	$R^2_{lin\text{-}sh}$	0.877148638	0.96534973	0.922715812	0.920340097	0.939106299	0.97994726	0.973250293
	$\mathbf{FDIST}_{lin\text{-}sh}$	1.5528E-232	4.6008E-251	8.3091E-110	9.6651E-122	2.7493E-122	3.0237E-129	2.2764E-188

Table 7: Average lacunarity (λ) by iteration (k), side of the gliding box (r) and occupation fraction (P).

k	Measures Book	Brook (2009)	Rothschild (2011)	Sparks (2004)	Stein (2008)	Wills (2001)	Swift (2009)	Nietzsche (2009)
1	**avg_λ** (r=1, 2)	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	P (occupied fraction)	0.25	0.25	0.25	0.25	0.25	0.25	0.25
2	**avg_λ** (r=1, 2, 4, 5)	2.538580247	1.5521262	1.789035467	2.090974625	9.726666667	2.179421769	1.588036704
	P (occupied fraction)	0.24	0.36	0.32	0.24	0.24	0.24	0.32
3	**avg_λ** (r=1, 2, 4, 8, 17)	4.671352876	3.978259635	4.460605475	5.402852824	11.95368659	5.711927248	5.190134757
	P (occupied fraction)	0.08650519	0.093425606	0.089965398	0.07266436	0.07266436	0.07266436	0.076124567
4	**avg_λ** (r=1, 2, 4, 8, 16, 65)	15.83437841	15.10998148	15.5291666	17.6682462	29.01423336	16.95334049	17.30767549
	P (occupied fraction)	0.021775148	0.020118343	0.020591716	0.018461538	0.01704142	0.019171598	0.017514793
5	**avg_λ** (r=1, 2, 4, 8, 16, 32, 257)	63.83729508	50.52015076	52.41730563	55.70682809	93.71280392	53.09860446	62.7550491
	P (occupied fraction)	0.005132553	0.005026571	0.005314236	0.004769187	0.00439068	0.005147693	0.004693485

6	**avg_λ** (r=1, 2, 4, 8, 16, 32, 64, 1025)	205.8479551	165.1325696	163.611997	193.8029156	243.8531417	161.2342388	196.8867079
	P (occupied fraction)	0.00134301	0.001390601	0.001481975	0.001298275	0.001261154	0.001453421	0.001334444
1–6	**avg_λ**	49.20492696	39.79884795	40.05135169	46.1953029	65.12675538	40.27958879	47.70460066
	avg_P (occupied fraction)	0.10079265	0.121660187	0.114558888	0.09786556	0.097559602	0.098072845	0.111611215

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Stephen Robertson

Scale and Narrative: Conceiving a Long-form Digital Argument for Data-driven Microhistory

Abstract: The framework for historical argument derived from the print monograph is increasingly untenable for digital historians. Digital argument is inclusive rather than selective in both its evidence and its form. The data required by digital methods produces multiple intertwined threads of interpretation and argument, resulting in arguments that are more expansive, larger in scale, than fit in a book. The alternative is obviously to present digital argument in its 'native' medium. This chapter analyzes how I conceive a form for one such argument, *Harlem in Disorder: A Spatial History of How Racial Violence Changed in 1935*; a multi-layered hyperlinked narrative that connects different scales of analysis: individual events, aggregated patterns and a chronological narrative. In three sections I lay out my understanding of the nature of digital argument, the options I consider for presenting it and the details of the form that I decide to employ.

Keywords: digital history, microhistory, narrative, argument, data

The framework for historical argument derived from the print monograph is increasingly untenable for digital historians. Digital argument is inclusive rather than selective in both its evidence and its form. Using digital methods to analyze data results in arguments that are more expansive, larger in scale, than fit a book. The data required by digital methods produces multiple intertwined threads of interpretation and argument, beginning with the process of creating data from sources, extending to aggregations and analysis of that data at shifting scales and in various relations and contexts, and including data that does not fit a given argument. To fit a book, or even an article, digital argument must be reduced in scale and complexity. For the short-form argument of a journal article, those compromises are manageable. There are increasing examples of such articles that provide models for digital historians of how to shape digital history for print journals (Robertson and Mullen 2021). For a longform argument, the compromises are more fundamental and examples have until very recently been rare (with several scholars opting to instead recast digital research into a print monograph, so none of its origins were visible) (Ayers 2003; Brown 2020; Thomas 2020).

The alternative is obviously to present digital argument in its 'native' medium. The first digital historians of the internet age were quick to recognize that

https://doi.org/10.1515/9783111317779-013

the properties of the digital medium offered new forms for scholarly argument, initially focusing on those possibilities rather digital methods for analysis (Smith 1998; Ayers 1999; Rosenzweig 1999; Bass 1999; Ayers 2001; Thomas 2001; Robertson 2004; Thomas 2004).[1] Experimental online digital history journal articles were published by *American Quarterly* in 1999, the *American Historical Review* in 2000, 2003 and 2005, and the *Journal of Multi-Media History* in 1998, 1999 and 2000, alongside experiments in other disciplines such as the journals *Kairos* and *Vectors*.[2] Robert Darnton sought to promote similar experiments in long-form digital argument, but the higher professional stakes attached to books resulted in the Gutenberg-e project he led being focused on transposing the monograph into an e-book.[3] Then those experiments with forms of argument ended, at least in digital history.[4] On the one hand, historians showed little interest in developing the new approach to reading that the new forms required. On the other hand, digital historians' attention turned toward other possibilities. The development of the open-source Omeka platform encouraged adoption of the exhibit as a form for history in the digital medium, primarily directed at non-scholarly audiences. Other digital historians focused on the affordances of the computer to process and visualize

1 For a fuller elaboration of the narrative of the development of digital history in this paragraph, see my "The Properties of Digital History," *History and Theory* 61, 4 (2022), 86–106.

2 "Hypertext Scholarship in American Studies," 1999, https://web.archive.org/web/20201114000152/http://chnm.gmu.edu/aq/; Ethington 2001; Thomas and Ayers 2003; Censer and Hunt 2005; "Journal for MultiMedia History – Volume 3 (2000) Contents Page," accessed May 15, 2022, https://www.albany.edu/jmmh/; "Vectors Journal: Mobile Figures," accessed May 2, 2022, http://vectors.usc.edu/projects/index.php?project=54; "Kairos: A Journal of Rhetoric, Technology, and Pedagogy," Text (Kairos: A Journal of Rhetoric, Technology, and Pedagogy), accessed May 21, 2022, https://kairos.technorhetoric.net/.

3 "Gutenberg-e Home," accessed May 21, 2022, http://www.gutenberg-e.org/; "What Is the Gutenberg-e Program? | AHA," accessed May 21, 2022, https://www.historians.org/about-aha-and-membership/aha-history-and-archives/historical-archives/gutenberg-e-program-(1999–2008)/what-is-the-gutenberg-e-program; Manning 2004; Seaman and Graham 2012. While none of these projects used digital methods, three authors did initially produce projects that used the digital medium to create layered or non-linear arguments: Pohlandt-McCormick 2005; Lowengard 2006; Gengenbach 2005.

4 Until 2021, when the *Journal of Digital History* launched. The *Journal of Multimedia History* published only three issues, in 1998–2000. *Vectors* ceased publication in 2013, having published seven issues, in 2005–2007, and 2012–2013. *Kairos* continues to publish. *William and Mary Quarterly* did publish a "born-digital article" in 2018, but it did not involve digital analysis and is better described as a multimedia article. The article, which retained the form of a print article, featured sound, images and animations without making use of the immersive and interactive properties of digital media. See Newman 2018; Piker 2018; Ayers 2019.

data. The results of that work were typically presented in the digital medium as visualizations. As a form that users explore through browsing, searching and interaction, data visualizations have an implicit argument rather than the explicit argument expected by scholarly audiences. This is the situation William Thomas highlighted in 2015, when he presented the next phase of digital history as one in which "scholars may be called upon to play a more purposeful role in making interpretive arguments, to establish genres of digital scholarship, to engage in meaningful critical review of digital scholarship, and to deal more forcefully and deliberately with the digital divides in our disciplines" (Thomas 2015: 534).

Opportunities to take up Thomas' call have been limited and risky for digital historians. Academic journals remain print publications, if anything with less scope for online experiments because of a reliance on the platforms of commercial publishers and the challenges of sustaining the increasingly diverse and complex components of digital history projects. Academic publishers, even as they adopt e-book platforms, have lacked the infrastructure to publish digital arguments on a scale akin to monographs. It has been a professional risk for digital historians to commit to a digital format for a project that takes the time to complete of a long-form argument and which generally has significant professional stakes, in terms of being the basis for award of a PhD, hiring, tenure and promotion, especially as the sustainability of digital publications remain uncertain. However, just before Thomas' call was published, the Andrew W. Mellon Foundation embarked on its ambitious Monograph Initiative to secure a future for long-form scholarly argument in the digital age (Maxwell et al. 2016). One strand of the projects funded by that initiative focused on publishing in a digital medium, including the establishment of Stanford University Press Digital Projects to publish scholarship that did not take the form of a book.[5] In addition, beginning in 2018, the Mellon Foundation partnered with the National Endowment for the Humanities to offer fellowships to "support individual scholars pursuing interpretive research projects that require digital expression and digital publication".[6] As a result, in 2019, when I returned to work on a spatial analysis of the racial disorder in New York City's Harlem neighborhood on March 19, 1935, opportunities to pres-

5 "Stanford Digital Projects," accessed May 19, 2022, https://www.sup.org/digital/. The Press assumes responsibility for hosting and preserving the projects that it publishes; see Jasmine Mulliken, "Meanwhile, Behind the Server Scenes . . . ," SUP Digital Blog (July 13, 2022), accessed July 2, 2023. https://blog.supdigital.org/meanwhile-behind-the-server-scenes/. For a discussion of the Digital Projects published as of July 2022, see my "The Properties of Digital History."

6 "NEH-Mellon Fellowships for Digital Publication," The National Endowment for the Humanities, accessed May 21, 2022, https://www.neh.gov/grants/research/neh-mellon-fellowships-digital-publication.

ent the research in a long-form digital argument for publication online existed in a way they had not when I began my research in 2010. I am in the privileged position that pursuing those opportunities involved limited risk for me; as a tenured full professor, neither tenure nor promotion reviews are in my future. I successfully applied for an NEH-Mellon Fellowship for Digital Publication in 2020 and in 2021 I signed a contract with Stanford University Press to publish *Harlem in Disorder: A Spatial History of How Racial Violence Changed in 1935* as a Digital Project.

In *Harlem in Disorder* I use granular data about events created from a variety of types of sources, mapped and analyzed in multiple relationships and at different scales, to argue that the violence was a complex mix of "hoodlums" taking the opportunity to commit crimes, residents targeting white businesses that had been the subject of political protests, poor and desperate people seeking food and goods they had been unable to obtain by other means, young men acting out their frustration and boredom and bystanders passing their time on the street being drawn into violence. Interpretations of racial violence generally acknowledge its multifaceted nature but select one thread to emphasize, as required by the form of argument which fits a book. In the case of Harlem in 1935, it has been the attacks on white property, novel at that time, but central to racial violence in subsequent decades. That emphasis comes at the cost of isolating those incidents from contexts that shaped them and simplifying the character of racial violence and how it changed in the second half of the twentieth century. It also makes it possible to discount portrayals of Black participants in racial violence as pursuing political goals by pointing to incidents that did not fit that picture – the kind of distortion prevalent in the aftermath of the protests following the murder of George Floyd in 2020 (Howard 2022: 263–264). Retaining complexity, as digital argument allows, better captures the nature of racial violence and shows the balance and relationship between different forms of violence.[7] For Harlem in 1935, the resulting picture is of transition not simply change, with overlooked violent clashes between Black residents and white men and women that echoed earlier outbreaks of racial disorder occurring around the more prevalent and novel attacks on white property, producing a new mix rather than an entirely new form of racial violence.

This chapter analyzes how I conceived a form for that argument – a multi-layered, hyperlinked narrative that connects different scales of analysis: individual events, aggregated patterns and a chronological narrative. In elaborating this concept of a long-form digital argument, my aim is to add to the models for argument-driven

7 This approach is indebted to Seligman 2011.

digital history that my colleague Lincoln Mullen and I have identified.[8] Picking up Thomas' call, as well as that of Cameron Blevins, our focus was on forms of argument for projects of a scale of an academic journal article (Blevins 2016). As opportunities emerge for the publication of digital argument on a larger scale, in digital mediums, models are also needed to encourage and enable digital historians to publish their scholarship in that form. As of May 2022, Stanford University Press (SUP) has published seven Digital Projects and will soon publish Lincoln Mullen's *America's Public Bible: A Commentary* and several others.[9] *Harlem in Disorder* adds to those models one that should be accessible to a wide range of historians. As a microhistory that employs handcrafted data, the scale of my analysis employs a widely used framing and method that is not typically associated with digital history. My argument also departs further from the single linear narrative of a print monograph than most of the published projects. Finally, *Harlem in Disorder* is built on a freely available platform, Scalar, rather than as a custom site, offering another model for using a platform employed in two other SUP Digital Projects. In the following three sections I lay out my understanding of the nature of digital argument, the options I considered for presenting it and the details of the form that I decided to employ.[10]

1 The nature of digital argument

I understand digital history argument as a combination of data as evidence and multiple interlinked threads of narrative interpretation. Digital tools and methods analyze data created from historical sources. This approach is not a return to the quantitative, social science history based on statistical analysis of the 1960s and 1970s, but a different approach to data and its analysis. To mark that distinction, I label it "data-driven history" rather than quantitative history.[11] This approach uses

8 Arguing with Digital History working group, "Digital History and Argument," White paper (Fairfax, VA: Roy Rosenzweig Center for History and New Media, November 13, 2017). Accessed July 2, 2023. https://rrchnm.org/argument-white-paper/; Robertson and Mullen, "Arguing with Digital History"; "Models of Argument-Driven Digital History," 2021. Accessed July 2, 2023. https://model-articles.rrchnm.org/.

9 "Stanford Digital Projects."

10 In making sense of that process, I relied particularly on the work of Edward Ayers, William Thomas, Fred Gibbs and Trevor Owens, Johanna Drucker, Lisa Gitelman, Harmony Bench and Kate Elswit, and the Arguing with Digital History working group, especially my collaborator Lincoln Mullen.

11 Here I am giving meaning to a term used by several scholars without definition. Sharon Leon uses "data-driven history" without explanation in a forthcoming chapter; Sharon Leon, "The Peril and Promise of Historians as Data Creators: Perspective, Structure, and the Problem of Re-a greater range of data than quantitative history and uses it in a wider variety of ways. Digitization has made more data available in two senses, by making text machine-readable, and by making historical records accessible online.[12] The greater variety of uses of that data reflect new tools for analysis – text mining tools and languages for unstructured textual data, but also mapping and network graphing tools that encourage the creation of structured data about spatial locations and about relationships.[13] Digital history additionally uses data in exploratory ways, not only for hypothesis testing and creating knowledge using statistical methods: anomalies, trends or unusual coincidences can be identified with simple frequency counts or correlations (Gibbs and Owens 2013: 168). A close reading of sources is then used to explain the patterns identified in the data, rather than seeking explanations in statistical models as quantitative history does (Gibbs and Owens 2013: 162).

Representing sources as data is treated by digital historians as an act of historical interpretation. "*Data are capta*, taken not given, constructed as an interpretation of the phenomenal world, not inherent in it," in Johanna Drucker's

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presentation," *[Bracket]* (blog), 2019, Accessed July 2, 2023. http://www.6floors.org/bracket/2019/11/24/the-peril-and-promise-of-historians-as-data-creators-perspective-structure-and-the-problem-of-representation/. A variant, "data-driven scholarship," was used by Kathleen Fitzpatrick (2011: 104), who derived it from the title of a workshop organized by CHNM and MITH in 2008, with funding from IMLS, "Tools for Data-Driven Scholarship." None of the published material from that workshop explains the term, but its focus associates it with the digital tools that shape the approach to data in digital history. An alternative label, "computational history," tends to be applied to only some of the methods that rely on data, typically text analysis, and excluding mapping and network analysis; see Arguing with Digital History working group, "Digital History and Argument," White paper (Fairfax, VA: Roy Rosenzweig Center for History and New Media, November 13, 2017), Accessed July 2, 2023. https://rrchnm.org/argument-white-paper/. Alison Booth and Miriam Posner noted in 2020, "We can detect another shift in nomenclature: data is perhaps edging out digital." They link this to the rise of data science within universities, for which DH can offer a humanities perspective. In my use of the term, I'm suggesting that the shift does also reflect the central place of data in the practices of digital humanists, that it is internal as much as external. See Booth and Posner 2020.

12 Flanders and Munoz identify six "major types of research objects and collections that present distinctive forms of data" created by humanities disciplines," focused mainly on literary studies. Three are forms of textual data, scholarly editions; text corpora; text with markup; one a combination of textual data and digitized images, the thematic data collection; one a product of digital research methods, data with accompanying analysis or annotation (an image, a map, a virtual 3-D reconstruction); and one a digital extension of a longstanding form, the finding aid. Julia Flanders and Trevor Munoz, "An Introduction to Humanities Data Curation," *Digital Humanities Data Curation* (blog), accessed May 10, 2022, https://guide.dhcuration.org/contents/intro/. Flanders and Munoz.

13 Arguing with Digital History working group, "Digital History and Argument."

influential formulation (Drucker 2011). Whereas humanities scholars usually immerse themselves in sources, dive in, and understand them from within, to use Miriam Posner's metaphor, creating data involves extracting information and features from sources, requiring the decomposition of a subject or object into abstract attributes and variables.[14] Heterogeneous and ambiguous historical records do not fall straightforwardly into categories (Schoch 2013; Borgman 2015: 28; McPherson 2018: 130–131; Bench and Elswit 2022). In response, digital historians employ an iterative process to create data: as their research progresses they enrich and enlarge their datasets, making choices about classifications in response to explorations and interpretations of new information that change the data (Hoekstra and Koolen 2019: 80).[15] That process can also counter the dehumanization involved in the transformation of historical subjects into abstract categories: as Harmony Bench and Kate Elswit point out, "The process of manually curating data from archival materials draws us closely into the lived experiences they index, as we grapple with the multiple and conflicting stories behind each data point, and what each signifies" (Bench and Elswit 2022: 39). Black digital practice, as exemplified by Jessica Marie Johnson, emphasizes the need to carry that engagement forward, to "infuse the drive for data with a corresponding concern with and for the humanity and souls of the people involved" (Johnson 2018).

This process of creating digital data requires more documentation than the citation of sources used for analogue research (Hoekstra and Koolen 2019: 81). Gibbs and Owens advocated that explanation take two forms, "history writing that explicates the research process as much as the research conclusions," and "history writing that interfaces with, explains, and makes accessible the data that historians use." (Gibbs and Owens 2013: 163–164) In both cases, those explanations extend beyond what can be accommodated in footnotes. For computationally generated data, explicating the research process generally means a narrative discussion of the computer scripts, models or simulations executed to create data. That process is the same for all the data created by that computational tool from a single kind of source. The same is not true of data created from multiple sources, which is more often handcrafted than computationally generated. General statements about that process reveal little about the choices made about individual data points. In creating data about the career of African American choreographer Katherine Dunham, Bench and Elswit, "routinely cross-reference and reconcile in-

14 Miriam Posner, "Humanities Data: A Necessary Contradiction – Miriam Posner's Blog," June 25, 2015, Accessed July 2, 2023. http://miriamposner.com/blog/humanities-data-a-necessary-contradiction/.

15 For more detailed accounts of this process see Leon, "The Peril and Promise of Historians as Data Creators"; Croxall and Rawson 2019; Erickson 2013.

formation including from Dunham's personal and professional correspondence, contracts, company documents from receipt books and payroll to costume lists, personal logs, programs, scrapbooks, lighting plots, and newspaper clippings. To these we have added supplemental data sources, such as immigration records, local newspapers, and historical transportation maps and schedules" (Bench and Elswit 2020: 290). As that process is different for each data point, it cannot be fully captured by a narrative discussion of method. Instead Bench and Elswit leave traces of it including sources and annotations in their dataset (Bench and Elswit 2022: 291).

Sharing datasets with such documentation, a practice borrowed from the social sciences, is the most common form of the second type of explanation advocated by Gibbs and Owens. Humanities data, however, has unique features that require modifications to the practices used in the sciences. Outlining principles for curating humanities data, Flanders and Munoz note that "While data in non-humanities disciplines clearly carries an interpretive framework with it, in the humanities the interpretation is in some cases the primary object of interest, not just a perspective on the data that can be separated from it". This interpretation exists in layers, as "crucial decisions affecting the usability and meaning of humanities data are made at each stage of data creation and management".[16] However, even to the extent that scholars effectively record these multiple layers of interpretation of data in a dataset, they are located at a distance from a narrative argument, limiting the extent to which history writing actually interfaces with the data in the way Gibbs and Owens envision.

Although the gap created by the separate publication of datasets makes it difficult to see, data changes the relationship between evidence and argument by multiplying the connections between them. Data includes more than the evidence for an argument presented in a print narrative and its footnotes; it includes all the research material gathered for a project. Reflecting on the first decade of digital history, Edward Ayers highlighted this contrast between historians' conventional research practices and working with data. "In conventional practice, historians obscure choices and compromises as we winnow evidence through finer and finer grids of note-taking, narrative, and analysis, as the abstracted patterns take on a fixity of their own. A digital archive, on the other hand, reminds us of the connections we are not making, of the complications of the past, every time we look at it" (Ayers 2001: 6–7). "Databases tend toward inclusivity, narratives toward selectivity", as Katherine Hayles put it (Hayles 2012: 182).

16 Flanders and Munoz, "An Introduction to Humanities Data Curation."

In addition, creating data produces "individual, separate and separable" items that can be aggregated to allow their analysis in different relationships and at different scales.[17] Analysis of sources by immersing oneself in them, to use Posner's metaphor for conventional humanities approaches, does not lend itself to aggregation in the same way. In that case, data appears in context rather than being separate and separable and is analyzed through "an iterative process of reading, questioning, contextualizing, and comparing" from which relationships and patterns are intuited rather than established by aggregation. By contrast, when data is created from sources, it is divided and classified and can be grouped based on any of its properties. "The power within aggregation is relational, based on potential connections", as Lisa Gitelman and Virginia Jackson put it: "network, not hierarchy" (Gitelman and Jackson 2013: 8). Data can also be aggregated at different scales (Bench and Elswit 2022: 38). Data's capacity to be aggregated, together with its inclusivity, creates multiple connections between data and argument.

Given the nature of data as evidence, a data-driven argument takes the form of multiple threads of narrative and interpretations of data linked together. The print academic article and monograph have only a limited capacity to present complexity of that kind. Multiple arguments can be presented sequentially, but, as David Westbrook argued, that structure "pulls discursive strands apart" so that much of the "complex interplay" in which they "reinforce each other, highlight each other through conflict, and reveal things together that they never could apart" is "necessarily lost" (Westbrook 1999: 255). Footnotes, endnotes and appendices provide a means of adding additional complexity to a narrative through sources that support an argument, or relate it to the work of other scholars and to other topics. However, that material is limited in scale and is located on the page and within the text in a position that clearly subordinates it to the "main text" (Landow 2006; Ayers 2001: 7; Adema 2021: 29–30). A reader could potentially follow a reference in a note to another text, but for most that is not an option. While they might have access to an academic library that holds the secondary literature, only a small proportion of primary sources being excerpted or referred to likely would be available online. To view most, a reader would have to visit a particular archive (Chartier 2011: 11). So most readers likely quickly return to the "main text." Notwithstanding the presence of notes, then, the print narrative effectively remains largely closed to other threads of argument and interpretation. Hence, long-from digital history arguments presented in books, and to a lesser extent short-form arguments in articles, by necessity must omit elements of both argument and data.

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17 Leon, "The Peril and Promise of Historians as Data Creators."

In a digital medium, however, an argument can take the form of multiple threads linked together, “as layered or branching or interweaving narratives”, to convey more of the complexity of the past than is possible in print argument (Ayers 2001: 7). Such an argument is necessarily composed of modular elements; each thread is a pathway that uses hyperlinks to connect elements in a particular order. Those threads are presented simultaneously, so elements can be linked to more than one thread, a form which better represents the multiple relationships among arguments and the multiple interpretations of sources and data than the traditional model in which evidence is subordinated to argument and a single thesis (Bass 1999: 276). As David Lloyd put it, the effect of digital argument is “to liberate contradictory and refractory threads in the material from the demands of a historically based argument, where they were necessarily smoothed over in the interest of coherence” (Hayles 2012: 38).

While the links that create such a digital argument make it hypertextual, its form is not one in which the user creates meaning as imagined by early hypertext theorists.[18] The threads available to a reader are structured by the author (Ayers 2001: 8). Links to multiple, simultaneous threads do work to disrupt the linear flow of reading associated with the print book, but here that disruption is a feature not a bug (Hayles 2012: 63–68). Data-driven argument fits the case Hayles allowed for, a case in which, as Diana DeStefano and Jo-Anne LeFevre put it, the “complexity of the hypertext experience is more desirable than maximizing comprehension and ease of navigation”.[19] Links call attention the choices made by a historian in constructing an argument (Drucker 2014: 178–179).

Rather than hypertext, it is the database that has come to represent the character of the modular, structured form of digital argument. Although the content of digital media can be stored in databases, the term has been used more generally, almost metaphorically, by scholars such as Lev Manovich, Ed Folsom and Hayles to highlight the separation of content and an interface that provides access to that content as the key feature of digital media (Hayles 2007; McGann 2007; Folsom 2007a; Folsom 2007b; Price 2009). With that separation, “it is possible to create different interfaces to the same material”, which each embeds a particular organization” (Manovich 1999: 86). Narrative argument can be one form of interface, but it is not implicit in the logic of the database (Manovich 1999: 83). As a result, Manovich points out, the author has to do more than simply link database records to create a narrative, contrary to hypertext theory; they “also have to con-

18 Landow, *Hypertext 3.0*; Robertson 2004.

19 Diana DeStefano and Jo-Anne LeFevre, “Cognitive Load in Hypertext Reading: A Review,” *Computers in Human Behavior* 23.3 (2007), 1636, quoted in Hayles 2012: 68.

trol the semantics of the elements and the logic of their connection" (Manovich 1999: 87).

The idea of argument as an interface to a database also encompasses the other form in which data and argument are connected in digital history, in and through visualizations. As individual, separate and separable items, data lend themselves to spatial display, "are mobilized graphically," as Gitelman and Jackson (2013: 12; see Hayles 2007: 1606) put it. Such visualizations can present the complex, multivariate arguments of data-driven history not as pathways of linked modular elements, but in the form of "rich, browsable interfaces that reveal the scale and complexity of the data behind them, and provide a context that enriches the exploration and interpretation of that data".[20] They show patterns in data – numbers of frequently collocated or reused words in texts and connections in network graphs, and patterns of spatial proximity, movement and interaction with spaces in maps and 3D models. The designers of *Photogrammar*, for example, used maps to make "visual arguments about the breadth and eclecticism of FSA-OWI photography: "a choropleth county map of the U.S.A [. . .] for example", conveys one of *Photogrammar*'s key historiographical interventions and the basis of its claim for further attention: the FSA-OWI collection was national in scope, covering much more than the images of poverty in the Dust Bowl and American South that public history has tended to emphasize" (Cox and Tilton 2019: 134–145). However, the tools borrowed from the empirical sciences with which visualizations are created can work at cross-purposes with how digital historians work with data, serving as "a kind of intellectual Trojan Horse, a vehicle through which assumptions about what constitutes information swarm with potent force", in Drucker's metaphor. Those tools assume "assume transparency and equivalence, as if the phenomenal world were self-evident and the apprehension of it a mere mechanical task", so present data as certain. As a result, digital historians' visualizations need to be reoriented to present data as created and interpreted from a subjective point of view (Drucker 2014: 125–126, 130).

2 Presenting digital argument

While there are a growing number of examples of making short-form digital history arguments in print articles, there have not been examples of making long-form digital arguments in books. An exception appeared after I began work on *Harlem in Disorder*, Cameron Blevins' *Paper Trails: The US Post and the Making of*

20 Arguing with Digital History working group, "Digital History and Argument," 26.

the American West, a spatial history like my project. Blevins used digital history "to see the postal network in its entirety", "processing, analyzing and visualizing" a dataset of "every post office that ever existed in the United States" (Blevins 2021: 5). That digital project is connected to the book through the inclusion of a large number of maps and charts (accommodated by the unusual dimensions of the book) and the creation of an online supplement. Blevins stressed that the book presents a data-driven argument, that those maps "are foundational for its arguments, interpretations and larger narrative structure" (Blevins 2021: 7). The core data on the location of post offices is available online, accompanied by a detailed "data biography". An online supplement presents a chronological mapping of the post office data accompanied by a brief narrative which explores features and details of a beautifully designed map.[21] However, that macro analysis is only one of the threads of Blevin's argument: "Maps of the postal network provide a bird's eye view of the network as a whole, but most 19th-century Americans didn't interact with the US Post at thirty thousand feet. *Paper Trails* repeatedly descends to ground level in order to see the system through their eyes. Individuals make up the narrative heart of this book" (Blevins 2021: 14). They are, however, missing from the digital supplement; a user can only zoom in and click on individual points to obtain details of a particular post office. So while Blevins presents his argument as "ultimately [. . .] defined by the intersection between these two scales, the ways in which large forces shape individual lives and how human experience gives meaning to the structures that define our world", publishing that argument in print required the large scale visualizations be transformed from their native digital form into static images and published online apart from the individual scale (Blevins 2021: 15). Blevins managed that combination adroitly, reflecting his skill as a writer and his experience as a leading digital historian, but the resulting hybrid form inevitably imposed limits on the nature of the digital argument. (However, it brought other benefits: time to research and write rather than find a digital format; an audience that reads and reviews books; and a publication in a print format that still has more professional standing and is more sustainable).[22]

Digital maps represented an option for presenting *Harlem in Disorder*, which like *Paper Trails* is centered on mapping data. Since the early 2000s, digital historians have been experimenting with online platforms to reimagine mapping in hu-

21 Online supplements, many based around maps, appeared in the US in the 2010s, to provide resources related to scholarly monographs. Some of those projects used digital methods, but unlike *Paper Trails*, they did not make digital arguments. For examples of online supplements in Southern history publications, see Blevins and Hyman 2022: 89–90.

22 Cameron Blevins, email message to author, May 15, 2022.

manities terms as a means of combining scales and presenting multiple threads of argument. One result has been a series of edited collections theorizing deep maps and spatial narratives produced by groups of scholars convened by David Bodenhamer, John Corrigan and Trevor Harris (2010; 2015; 2021). In his most recent definition of deep maps, Bodenhamer argued that they "link time and space (chronotope), operate across multiple scales of time and space, embody multiple agents and multiple perspectives, recognize alternate schemes and emergent realities, foster a dynamic context that reveals movement and linkage, and (ideally) are emotional and experiential" (Bodenhamer 2021: 7). Deep maps thus fit the multiplicity central to digital history arguments in their "multiplicity of sources used, of perspectives represented, of experiences captured, of interfaces used", and "enable multiple meanings to be made by its users", as Lincoln Mullen and I put it (Robertson and Mullen 2021: 132). Moreover, deep maps provide the context for argument, with users navigating through a narrative created by the author. Even as such spatial narratives involve a selected pathway, elements not included in that pathway remain on the map and around the narrative – more visible than the contents of footnotes, appendices and indexes – so that users can see other possible paths even if those alternative narratives have not been constructed (Robertson and Mullen 2021: 136–137). In that way, spatial narratives differ from the strictly linear narratives that are the output of StoryMap tools tied to Geographic Information Systems and their 2D maps and social science methodologies (Robertson and Mullen 2021: 135).

While technologies exist to extend GIS to allow "dynamic representations and interactive systems that will prompt an experiential, as well as rational, knowledge base", as Bodenhamer pointed out, realizing the possibilities of deep maps requires a means of using those technologies in combination, a platform that is "an environment embedded with tools to bring data into an explicit and direct relationship within place and time", analyze that data and trace and present spatial narratives and arguments (Bodenhamer 2021: 4, 7). Such a platform does not yet exist. I did use Neatline to create a prototype during the preliminary stages of my project, an experiment in spatial narrative that was discussed in the chapter Lincoln Mullen and I contributed to *Making Deep Maps*. A set of tools for the digital collection software Omeka, Neatline combines maps, a timeline and text and visual annotations to the map that support the creation of manually created, interactive spatial arguments.[23] My prototype site used annotations to elaborate connections between points on the map and a modular narrative argument in waypoints, links located in a sidebar that open on the map and used the timeline

23 "Neatline," accessed May 19, 2022, https://neatline.org/; Nowviskie et al. 2013: 692–699.

as the means of navigating the spatial narrative. Waypoints can be associated with a zoom level centered on a specific location; clicking on them moved you around the map. Annotations in the form of polygons and lines also shifted some of the argument into a visual form, directing attention to movement, direction, proximity and connection. However, waypoints can accommodate only a limited amount of text, and the complexity of the narrative required the waypoints be broken into groups and appear on a series of maps, limiting the scope of the spatial narrative (Robertson and Mullen 2021: 142–145). Neatline also did not offer an effective way to integrate the legal process and official investigation that followed the events of the disorder.[24]

If a fully realized spatial narrative is not yet possible, the vision Robert Darnton offered in 1999 of an electronic book structured "in layers arranged like a pyramid" has become more readily realized and reimagined as a form for digital argument (Darnton 1999). Darnton conceived those layers as augmentations of a top narrative layer, providing thematic accounts, documentation, historiography, suggestions for classroom uses and commentary. As Ayers noted in 1999, "Darnton's vision, while exciting, is more archival than hypertextual. It elaborates upon the traditional book but does not change the central narrative" (Ayers 1999: 4). In other words, he was not conceiving a form for data-driven argument; to the contrary, Darnton explicitly stated that he was "not advocating the sheer accumulation of data, or arguing for links to databanks – so-called hyperlinks. These can amount to little more than an elaborate form of footnoting".

Darnton's multi-layered form of publication has recently been reimagined for data-driven arguments. Introducing the *Journal of Digital History*, Andreas Fickers and Frédéric Clavert open with Darnton's vision, and echoed him in describing their publication as "a multilayered publication platform in the field of history that will offer new opportunities for showcasing data-driven scholarship and transmedia storytelling in the historical sciences" (Fickers and Clavert 2021). Their focus was on connecting argument with the methods of analysis on which it relies. As a response to "the need for a stronger transparency of how digital infrastructures, tools and data shape historians' practices", articles include a narration layer, a hermeneutic layer and a data layer. The data layer contains both datasets and code thanks to an editorial system based on Jupyter notebooks. "The methodological implications of using digital tools and data" are elaborated in the Herme-

24 David McClure, a lead developer on Neatline, later developed a custom platform, Grapl, that builds out some of the features of Neatline to create "a unified, coherent threefold path linking long-form scholarly text, data-driven maps, and richly mapped data—a framework for the publication of both texts and datasets, held tightly together by the spatial logic of the map." McClure and Worthey 2019.

neutic layer. In the Narration layer the focus is on "transmedia storytelling," incorporating multiple media or platforms into the argument, which in practice means combining text with visualizations, to date, charts, maps and 3D objects.[25] As a model of digital argument, the *Journal of Digital History* goes some way toward what my project needs, but as a vehicle for short-form argument lacks the multiple threads of argument, aggregation of data at different scales and granular examination of data creation.

A more expansive multi-layered data-driven argument is used by Lincoln Mullen for *America's Public Bible: A Commentary*, a website to be published by Stanford University Press. In an explanation of "How to use this website," he also invoked Darnton to describe how "the different elements of the site form an interpretative pyramid, something like the e-books that Robert Darnton envisioned". In contrast to the *Journal of Digital History*, scale serves as the basis of Mullen's layers. Darnton did not explicitly address scale in describing his pyramid structure, but his layers did represent "ever-wider components", as Thomas put it in 2001 (418). So too does Mullen's structure, while also reflecting the form and process of his argument; namely, "identifying, visualizing, and studying quotations in American newspapers". At the base is a dataset of millions of biblical quotations that appeared in newspapers, a selection of which are aggregated into trend lines showing the appearance of a verse over time in another layer. (Mullen's data is computationally generated, so their creation is dealt with in an essay on method, but the pages which show aggregate trends include a measure of the certainty with which the prediction model identified text matching the biblical verse – and link to the newspaper pages on which they appear.) Two narrative layers offer interpretations of that data, verse histories for a selection of the data and essays on broader questions in the history of the Bible in the United States and the most popular verses and genres of verses.

Mullen's layers of data, aggregate and narrative fit the form of my argument, but the different nature of my data changes the nature and relation of the layers in my publication. Mullen was using big data to examine public life in a period of over a century, while I am using a small dataset to understand an event that lasted less than a day and its immediate aftermath. Rather than text generated by computational feature extraction and prediction from a single type of source, my event and prosecution data are handcrafted from multiple sources, including newspapers, legal records and a variety of information gathered in the official investigation of conditions in Harlem. As the combination of sources for each data point

25 "About the Journal of Digital History," *Journal of Digital History*, accessed May 19, 2022, https://journalofdigitalhistory.org.

varies, each needs a narrative description of the interpretive choices made to create it. Since the data model includes multiple categories, events appear in multiple groupings, producing a denser web of connections within this layer than in *America's Public Bible*, in which verses can be accessed only on the basis of how frequently they were quoted, in chronological order by the year of their peak rate of quotation and in biblical order. Mullen captured the different balance between data and narrative in the forms of our arguments when he labelled *America's Public Bible* an "interactive scholarly work", presumably evoking Thomas' definition. As "hybrids of archival materials and tool components", "Interactive scholarly works have a limited set of relatively homogeneous data, and they might include a textual component on the scale of a brief academic journal article". The emphasis on narrative of *Harlem in Disorder*, by contrast, fits Thomas' definition of a digital narrative: a "highly configured, deeply structured" "work of scholarly interpretation or argument embedded within layers of evidence and citation", with "explicit hypertext structures" that situate evidence and interpretation in ways that allow readers to unpack the scholarly work" (Thomas 2015: 531–532).

Unlike the case with spatial narrative, the combination of technology for a digital narrative does exist. Content management systems combine interfaces for publishing, creating and editing content (including various media) with databases for storing and managing that content. My initial experiments involved working with WordPress, the most widely used open-source CMS. However, it became clear it would be difficult to build from scratch a structure for the relationships between different elements of my argument in that platform. An alternative open-source digital authoring and publishing platform that offered features to construct those relationships existed in Scalar, developed by the Alliance for Networking Visual Culture at USC.[26] In the same spirit as the idea of deep maps, Scalar is based on reimagining the database in humanities terms: a "speculative remapping of rigidly logical structures toward more conceptual ones, creating possibilities for many-to-many relations of diverse and varied kinds", as Tara McPherson, part of the team that developed Scalar put it. As "a platform for imagining relation", Scalar aligns with the form of digital argument (McPherson 2018: 223). For my project, the key

26 The *Born-Digital Scholarly Publishing: Resources and Roadmaps Institute* organized by Brown University and funded by the NEH held in summer 2022 provided training in three platforms, WordPress, Scalar, and Manifold (a Mellon-funded e-book platform that supports digital media and iterative scholarship but is otherwise too closely modeled on the print book to be useful for my project). The other widely used open-source humanities CMS is Omeka. It fits an interactive scholarly work better than a digital narrative as its focus is on a digital collection, with metadata a central element of its design. Omeka's exhibit building features do not provide the structures for creating relationships available in Scalar.

feature is its flexible structure, which "allows you to model conceptual structures in a variety of ways, exploring the full capacity for various sequences and groupings" (McPherson 2018: 197). That flexibility is also crucial to the iterative nature of humanities analysis of data. As McPherson notes, Scalar "doesn't demand that scholars have mapped a rigid data structure in advance of authoring, which allows for flexibility in the relation between different components of a project" (McPherson 2018: 193). And equally important, Scalar supports arguments that move across scales, "as scholars are able to move from the microlevel of a project (perhaps a single image or video annotation) to the structure of the entire project and its integrated media. The researcher can create careful readings within a project of many components that can also be instantly represented as a whole collection" (McPherson 2018: 211).

The semantic elements of Scalar used to create relations are paths and tags. Paths are sets of sequential pages, which can contain subpaths, branching narratives. Tags create categorical groupings, which can also refer to other tags to create linked groupings (McPherson 2018: 197). The tag is the key to creating relationships that group the modular elements of a Scalar site into scales of analysis and link and interweave data, analysis and narrative. In other platforms, clicking on a tag takes a user to list of all of the pages that have that tag; in Scalar, clicking on a tag takes you to a page, which in additional to identifying all the pages that have that tag, can include text and media. As a page, a tag to be a site for analysis and interpretation not just connection and collection.

3 A multi-layered, hyperlinked microhistory that connects different scales of analysis

Harlem in Disorder uses Scalar's paths to create a linear narrative: a chronological description of the events of the night of March 19, 1935, with maps of their location, the prosecutions that spanned the following several months and the investigation that culminated in a report submitted to New York City's Mayor more than a year later. Additional layers of argument examine categories of events, stages and outcomes in the legal process and the forms and reporting of the investigation. Those groupings aggregate events at different scales, extending the spatial grouping of events provided by the map. The data on the events of the disorder and the subsequent prosecutions are a further layer, presented not as a dataset, but as a set of pages that describe the interpretive choices made in creating each data point from multiple sources. Included are data that cannot be fitted to arguments made in the narrative: events without information on timing, so not in the chronology; events that have no location, so are not on the map and events that appear only as prosecutions in court, neither in the chronology nor on the map. The final layer are the sources, each a page to which all the notes citing that source are linked. The sources themselves are not part of the site; they would fit naturally into the note pages, but the published sources are still under copyright and access to the legal records and other archival sources is restricted.

Links between those multiple layers take the form of tags. Employing the categories in the data model as tags for events makes them a visible part of the multiple narratives in the site, creating relationships that group events for analysis at different scales and linking data, analysis and chronological narrative. The data model itself is unremarkable; it involved none of the challenges of modeling events in the lives of the enslaved, for example. However, moved from a dataset to a narrative the categories of the data model become part of the structure of the argument and make visible how the argument is data-driven.

Tags for timing and location serve to construct a narrative that encompasses multiple events happening in different places at the same time, as happens in racial disorder. Tags for timing group individual events into sections of the chronological narrative each covering a thirty-minute period. The ambiguity and uncertainty of data on time precludes using shorter spans. Tags grouping events by location might seem redundant given the mapping of the data. However, they are a necessary concomitant, a means of addressing the uncertainty and ambiguity not visible in a point on the map. Grouping events by location also incorporates events for which there is no information on timing. The tags group events by the city block on which they occurred on (or as an occurring at an unknown location), creating narratives that branch off the chronological narrative.

Tags for events in the disorder classify them as one of nine types, with additional tags that group them based on different features of those types, who was involved, and whether an arrest or prosecution followed. The label for each tag includes the number of events in that group, to give a sense of context at a glance (eg "Assaults (54)"). The subtags for the five largest groups of events used in the project are listed in the column under the event type tag in Table 1. The Assault tag page, for example, includes links to the fifty-four events grouped as assaults. It also features fifteen related tags into which those events are grouped. Six tags are forms of assault, six tags are based on the identities of the alleged victim and two tags are based on the police response. There is also a tag for assaults by police, to highlight a gap in the data: the absence of specific incidents of violence by police notwithstanding widespread statements about police beating and shooting at people on the streets. Additional tags group those who were injured in alleged assaults and alleged assaults that resulted in arrests and those that resulted in prosecutions. In combination, these subtags create a dense web of relationships

Table 1: Subtags for the five largest types of events, listed in the column under each event type.

Assaults	Inciting Crowds	Injured	Looting	Windows broken
Hit by objects	Calls to break windows	Injured (not in assault)	Looting of food & drink	Windows broken in businesses selling food & drink
Assaults by groups	Calls to assault police	Injured in assault	Looting of clothing	Windows broken in businesses selling clothing
Assaults by individuals	Calls of information	Injured & arrested	Looting of miscellaneous consumer goods	Windows broken in businesses selling miscellaneous consumer goods
Shot & wounded			Looting of unknown businesses	Windows broken in vacant stores
Assault in unknown circumstances	Inciting crowds without arrest	Injury to face, nose, or eye	Looting of Black-owned businesses	Windows broken in unknown businesses
“Beaten”	Inciting crowds in the courts	Injury to head or ear	Businesses that did not survive	Windows not broken
		Injury to hand	Businesses that did survive	
Assaults on Black men		Injury to leg		Windows broken by crowds
Assaults on white men & women		Injury to arm/ shoulder	Looting by crowds	Windows broken by individuals

(continued)

Table 1 (continued)

Assaults	**Inciting Crowds**	**Injured**	**Looting**	**Windows broken**
Assaults on white men		Fainted	Looting by individuals	
Assaults on white women				Windows broken without arrest
Assaults on women		Injured women	Looting without arrest	Breaking windows in the courts
Assaults on police		Injured white men	Looting in the courts	
Assaults by police		Injured Black men	Looting in the civil courts	
Assaults without arrest				
Assault in the courts				

between the events grouped as assaults.[27] The page itself contains a discussion of how the category was defined, of the patterns in the types of assault and who was involved and how they departed from violence in Harlem in 1935, summarizing the more detailed discussions on the tag pages for those categories and contexts. An interactive map of the events of the disorder that can be located, with a layer consisting of the assaults highlighted, anchors a discussion of patterns in where this group of events occurred, followed by a discussion of patterns in when they occurred. Finally, there is a discussion of how other historians have interpreted this type of event as part of disorder in Harlem. This organization is replicated for each of the related tags, which analyze smaller subgroups and point to the relations between them.

Employed in that way, the tags bring patterns in the disorder into focus at multiple scales. Classifying data simplifies it, somewhat reducing its complexity. However, in this form of digital argument the more complex, disaggregated view of the events is still accessible in the maps and in the layer of pages discussing individual events that appear on each tag page.

Pages for individual events offer a different perspective on complexity. Most of those pages have multiple tags highlighting different facets of what happened during the disorder and who was involved and creating a point of connection to those arguments (Figure 1). Pages for individual arrests events also have tags reflecting the categories from the data model for prosecutions: they are grouped by the event from which they resulted, the identity of the defendant, the charge, in which courts prosecutions took place, the outcome and the sentence (Figure 2). Arrests are a separate category of event to counter the tendency to assume those arrested are guilty or at least involved in the related event. For Harlem in 1935 that is a particularly questionable assumption given the practices of the predominantly white police officers responsible for making those arrests.

The content of individual event pages provide the data's backstory, in greater detail than summary traces of the process of data creation of the kind that can be left in a dataset. Each of the sources in which information on the event appears are discussed, agreement and disagreement among them is identified and decisions about what information to use and why, and about how to categorize event,

27 As I created the project, the density of relationships exposed limits in the capacity of Scalar. The performance of the site slowed significantly, a result that discussions with Scalar's developers revealed was a result of pages that included more than 100 relationships. That limit was not mentioned in the software's documentation. As a result, the tags attached to upper-level category pages had to be replaced with manually created links, which do not impose the same load as tags. Tags identifying types of sources were also removed, replaced with manually created links in the notes pages that access analysis of different sources.

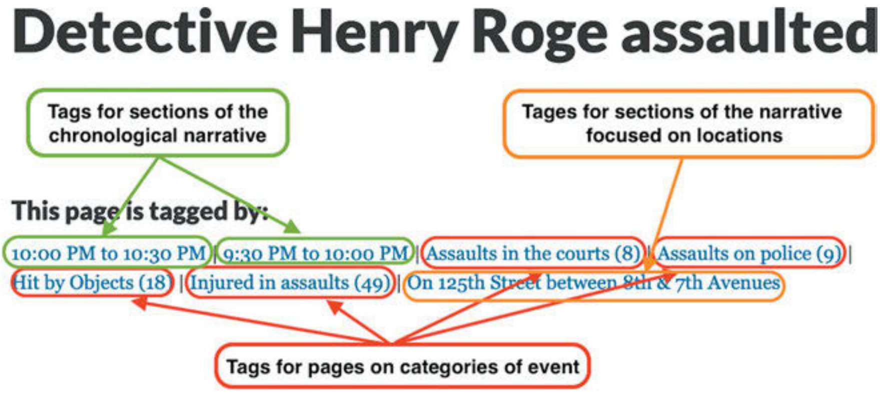

Figure 1: Tags on a page for an event in the disorder.

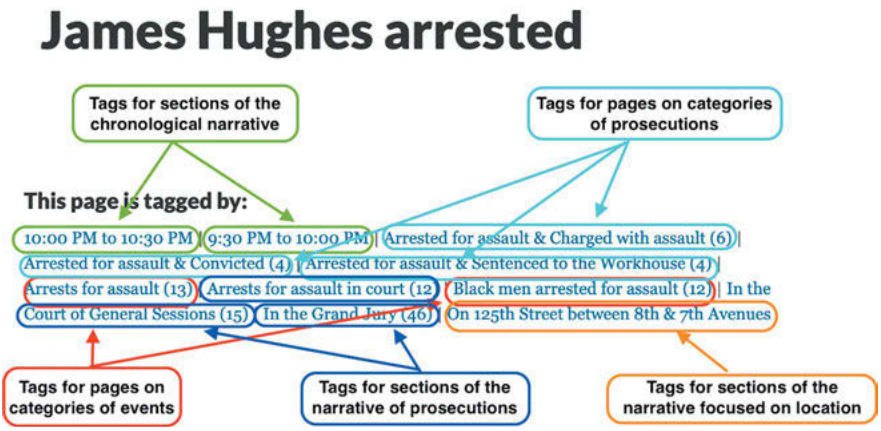

Figure 2: Tags on a page for an arrest in the disorder, including tags for sections of the narrative of prosecutions and categories of prosecutions.

are explained. This analysis also highlights gaps in the information, highlighting when the categorization, timing or location of an event are uncertain to counter the apparent certainty of its appearance in the chronological narrative and on the map. The label for an event, where possible, names the participants: the name of the owner or staff member of a looted or damaged store or the name of an individual killed, injured or arrested. In some cases, Probation Department files, and census and draft records provide details of individual lives. Although fragmentary, such information offers some counterbalance to the reliance on aggregate numbers to describe the disorder in the existing literature on Harlem in 1935 and the broader tendency of data to dehumanization.

If producing a page for every data point seems an unmanageable amount of work, it is worth remembering that the contents of these pages are necessarily part of data-driven historical research. They describe decisions that are required to create handcrafted (not computationally generated) data, information that is currently summarily recorded in some part of a dataset (or when evidence is not data, not systematically published at all). That displacement of the details of our analytic and interpretive processes fitted the scale of the print forms in which historians published. Absent those constraints, the importance of that information for understanding and assessing an argument warrant bringing into a closer relation with narrative.

4 Conclusion: Reading digital argument

The detailed granular data and dense web of relations that connect the multiple layers of *Harlem in Disorder* result in an argument that is larger in scale and more expansive than could be contained in a book. Given that unfamiliar structure, it is important that *Harlem in Disorder* is still legible as a 'book.' The Table of Contents that is part of the design of Scalar highlights the chronological narrative, so that it serves as a spine for the publication. Following that narrative are sections analyzing newspaper coverage, individual events and contexts for those events beyond the disorder – sections that could be understood as appendices. Strictly adhering to that linear path through the content would leave the narrative alone to convey the complexity of the disorder. Reading in that way, however, seems an unlikely response to *Harlem in Disorder*; it would require ignoring links and tags in those pages that connect to the individual events discussed in each section of the chronological narrative and to pathways to other layers of narrative. After almost twenty years of additional experience with hyperlinks than those who encountered the early experiments in digital argument, readers are likely to have a greater degree of comfort with them. At the same time, given the content of the layers linked to the narrative, readers interested in the process of historical research and interpretation are more likely to engage with those threads of the argument. In that regard, the project has been conceived as a primer of sorts on historical method of interest to an audience beyond those who work in the fields of African American history and digital history. By exposing layers of historical analysis and interpretation it fills a gap in teaching between the primary source and the secondary source.

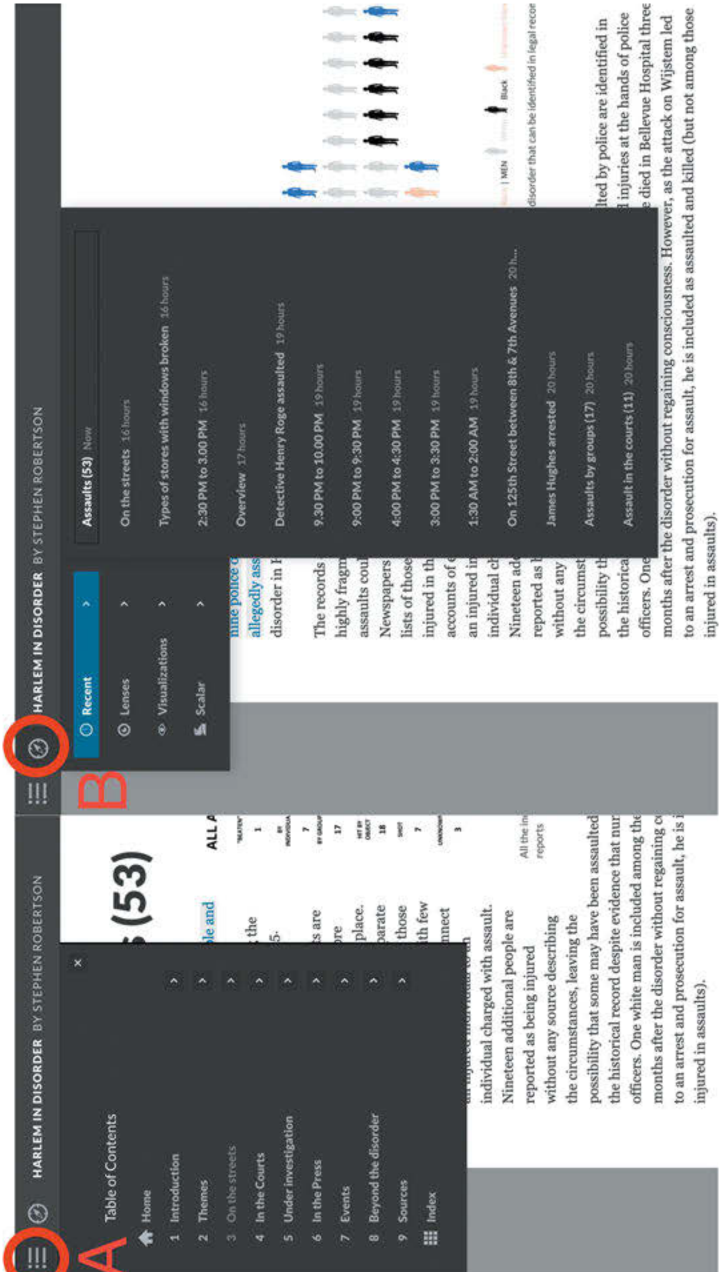

Figure 3: Two Scalar Menu options: Table of Contents (A) and Recent Pages (B).

For readers who do follow links, the chronological narrative will be a touchstone. After starting by following that narrative, a reader will depart from it at a point of interest to zoom in on a specific event and arrive at a page that contains tags that link to more information about events related to that event in some way and notes that link to sources. Clicking on a tag would take the reader to a different layer of argument, analyzing a category of events or a type of source. In moving across individual events and different groupings of events, that pathway would embody the complexity of the disorder while also highlighting how the shape of that argument is the product of choices about how to categorize events identified in the sources. Although they are navigating across as well as along narrative layers, readers should not become lost, as many felt in the early digital arguments. Whatever page they are on, Scalar's menu provides multiple options for finding their way: they can click on the compass icon (labelled B in Figure 3) to access a list of recent pages on which to retrace their path; or they can click on the list icon to the left of the compass (labelled A in Figure 3) to access a table of contents that provides a way to return to a section in the chronological narrative or category or event in the other layers of argument, or to the thematic introduction that lays out the overall argument. Read in this way, the argument does not unfold sequentially as it would in a book. Instead, the digital argument is woven from threads drawn out of the narrative and intertwined until they form a fabric whose pattern shows the complex mix that characterized racial violence in Harlem in 1935.

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Digital Landscapes

Natalie M. Houston

Meaningful Aesthetics: A Comparison of Open Source Network Analysis Tools

Abstract: As a contribution to a critical hermeneutics of data visualization, this chapter presents a critical examination of the default aesthetics used in three open-source network analysis software packages: Pajek, Cytoscape and Gephi. The aesthetics of network graphs are produced by the selection of the algorithm, algorithm-specific parameters, the visualization of statistical measures and the elements of line, shape and color that are applied. In this study, visualizations of the character interaction network from Victor Hugo's novel *Les Misérables* are generated using the default parameters available in each software package, in order to explore the assumptions embedded in the tool and contribute to a humanist analysis of network analysis software and its outputs. Because network visualizations assist in understanding data structures at a variety of scales, critical awareness of how network graphs are produced contributes to a more situated, self-reflective data visualization practice that recognizes how aesthetics are always creating meaning.

Keywords: network analysis, data visualization, aesthetics

1 Introduction

Today we live in a world marked by physical, technological, political and social networks that operate at a scale beyond human comprehension. The rapid growth of the internet as both the dominant popular concept of a network and an important material, infrastructural network is but one example, and as Fredric Jameson suggests, contemporary technology is "mesmerizing and fascinating not so much in its own right but because it seems to offer some privileged representational shorthand for grasping a network of power and control even more difficult for our minds and imaginations to grasp: the whole new decentered global network of the third stage of capital itself" (Jameson 1991: 37). Within this "multinational and decentered" complexity, human perception struggles, according to Jameson, "to locate itself, to organize its immediate surroundings perceptually, and cognitively to map its position" (Jameson 1991: 44). Drawing on theories of urban space and Althusser's definition of ideology, Jameson theorizes cognitive mapping as an attempt to locate the subject in the "vaster and properly unrepresentable totality" of postmodern society, which he

https://doi.org/10.1515/9783111317779-014

describes as marked by “spatial as well as [. . .] social confusion” (Jameson 1991: 51, 54). In the decades since Jameson first explored these ideas, their relevance has only become clearer. What he identified as the literature of “high tech paranoia” in spy novels and early cyberpunk fiction has become quite resonant with reality: “the circuits and networks of some putative global computer hookup are narratively mobilized by labyrinthine conspiracies of autonomous but deadly interlocking and competing information agencies” (Jameson 1991: 38). Ruth Ahnert et al suggest that competing information organizations became visible in popular culture with the investigation into global terrorist networks following 9/11 and the founding of Facebook in 2004, which brought once-obscure concepts and methods of network science into the popular vocabulary. They identify “the network turn” at the beginning of the twenty-first century as “a whole host of converging thoughts and practices around the turn of the new millennium — the zeitgeist of the networked age” (Ahnert et al. 2020: 3). Kieran Healy also points to the expansion of both material and symbolic networks during this period: “The rapid development of computing power, the infrastructure of the Internet, and the protocols of the World Wide Web, together transformed the capacity to construct, visualize, analyze and build networked systems in practice. They were also accompanied by a major shift in the cultural salience of network imagery” (Healy 2015: 186). Network theory has been extensively operationalized in recent decades so as to substantially modify the world we inhabit and our everyday experience of it (Healy 2015: 195–198). Thus, as Jameson suggests, “cognitive mapping cannot (at least in our time) involve anything so easy as a map [. . .] mapping has ceased to be achievable by means of maps themselves” (Jameson 1991: 409). Instead we turn to networks, and particularly to network graphs, to understand our position, whether at a subway stop in an unfamiliar city or within a professional discourse community on social media (Derrible and Kennedy 2009: 17–25; Grandjean 2016). Network visualizations enable the viewer to perceive relationships at a variety of scales at the same time: we can holistically perceive the overall structures that connect an enormous set of data points and we can also zoom in on certain nodes, either with the assistance of technological tools or simply by focusing our attention on a portion of the graph.

Not surprisingly, the visualization and analysis of network data have become an important method for research in the digital humanities during recent decades. Projects like Six Degrees of Francis Bacon, Kindred Britain, and The Viral Texts Project have demonstrated how network visualizations can help researchers and students understand the scale, scope, and spread of historical relationships among people and texts.[1] Since the early 2000s, the availability of large-scale cultural data has increased with the development of mass digitization libraries like the Internet Archive, Google Books, and the Hathi Trust Research Library. Data visualization of all kinds has become more widely used in humanities scholarship as well as in journalism. Digital humanities training courses and workshops often focus on the use of software tools for data visualization and analysis, including network analysis tools like Gephi and NodeXL. These developments have encouraged increasing numbers of humanities researchers to use network visualizations for exploratory analysis of many different kinds of large-scale data, such as contemporary or historical social networks; relationships among characters in books, television or film; and economic or political relationships among individuals, organizations and institutions. However, the implications of the aesthetic choices produced by network visualization tools are not yet widely understood.

Traditional scientific approaches to data visualization focus on accuracy and clarity, assuming that graphs and charts can represent a set of data and therefore the phenomena to which it refers (Tufte 1983). However, as Johanna Drucker suggests, both the data itself and the methods for its visualization need to be examined through "humanistic inquiry," which "acknowledges the situated, partial, and constitutive character of knowledge production, the recognition that knowledge is constructed, taken, not simply given as a natural representation of preexisting fact" (Drucker 2011: para. 3). There are no natural representations: the recognition, presentation, and shaping of knowledge into information is an ideological act that reflects many interpretive choices on the part of its creators that are too often hidden from view to end users. As Lev Manovich says, "data does not just exist — it has to be generated" (Manovich 2001: 224).

Interpretive choices are also embedded in the tools used to create visualizations. As Ahnert et al point out, "we do need to be aware of the assumptions encoded in the tools we use so that we can bend them to our own needs" (Ahnert et al 2020: 64). This is especially relevant for interdisciplinary researchers who often use methodologies and tools from other disciplines and apply them to humanities contexts. Data visualization tools are often designed for specific purposes and research communities and their affordances reflect the values and activities of those communities.

Current network analysis tools make it possible for researchers to visually explore, filter and manipulate data at a variety of scales. The results of those op-

1 "Six Degrees of Francis Bacon," accessed December 15, 2021, http://www.sixdegreesoffrancisbacon.com; "Kindred Britain," accessed December 15, 2021, https://kindred.stanford.edu/; and "The Viral Texts Project," accessed December 15, 2021, https://viraltexts.org/.

erations can be output in structured data tables as well as in graphical images. Because network visualization software provides for the creation and comparison of multiple views of the data, it can support humanistic research, which "consists not of converging toward a single interpretation that cannot be challenged but rather of examining the objects of study from as many reasonable and original perspectives as possible to develop convincing interpretations" (Sinclair et al. 2013: para. 1). However, the outputs from such software should be presented within a critical framework that also reflects on the creation of the data, the layout algorithm and specific choices made within the software. Ignoring these elements leads Alexander Galloway to claim that the visual similarities among "four different maps of the internet, produced by different methods and sources, selected from numerous examples available via a normal web search" mean that "only one visualization has ever been made of an information network, for there can be only one" (Galloway 2011: 89–90). By presenting these graphs at very small scale and without citation to their source, Galloway limits deeper inquiry into the techniques and technology of their creation. However, it appears as though at least three of the four were generated with the same layout algorithm and with community detection applied as colors to the nodes and edges. Galloway ignores these visualization choices and describes these networks as endlessly repetitive because he sees them as part of a "positivistic dominant of reductive, systemic efficiency and expediency" (Galloway 2011: 100). Yet as Drucker suggests, critically examining the methods that produce data visualization can help to dismantle its ideological mystification: "The apparently neutral declarative statements of interface and data display share an ideological agenda *to simply appear to be what is*. Taking apart the pseudo-transparency by showing the workings and apparatus of the interface and graphical display of data is a crucial act of hermeneutics applied to information displays and systems" (Drucker 2020: 132).

As a contribution to this critical hermeneutics of data visualization, this chapter presents a critical examination of the default aesthetics used in three open-source network analysis software packages: Pajek, Cytoscape and Gephi. Many different choices affect the aesthetics of network graphs, including the selection of the algorithm, algorithm-specific parameters, the visualization of statistical measures, and the elements of line, shape and color that are applied. In network analysis software tools, some of these choices are implemented by default and others are available for researchers to choose from. In this study, visualizations of the classic *Les Misérables* character interaction network are generated using the default parameters available in each software package, in order to explore the assumptions embedded in the tool and contribute to a humanist analysis of network analysis software and its outputs.

2 Contexts

2.1 Tool criticism

Along with Drucker and Ahnert, a number of scholars have called for the critical examination of digital tools. Karin van Es suggests that tool criticism "reflects on how the tool (e.g., its data source, working mechanisms, anticipated use, interface, and embedded assumptions) affects the user, the research process and output, and its reliance on the user's training" (van Es et al. 2021: 52). Tools must be understood in the context of how they are being used, especially as they are adapted by researchers in the humanities. The incredible capabilities of today's software bring network visualization of large-scale data within reach of many users, but as Bernhard Rieder and Theo Röhle suggest, this power can mean that users "happily produce network diagrams without having acquired robust understanding of the concepts and techniques the software mobilizes" (Rieder and Röhle 2017: 118). Scott Weingart offers a simple example: although a user can load a bimodal network (containing nodes that represent two different types of entities, like authors and books) in Gephi and run the centrality calculation on it, the implementation of node centrality that is built into the tool is designed only for unimodal networks. Thus "although the network loads into Gephi perfectly fine, and although the centrality algorithm runs smoothly, the resulting numbers *do not mean what they usually mean*" (Weingart 2011, emphasis in original). Understanding how a given tool works and thinking critically about it can assist in working with "humanistic data," which Weingart characterizes as "uncertain, open to interpretation, flexible, and not easily definable" (Weingart 2011). Marijn Koolen argues that even if researchers lack the mathematical knowledge to critically review the algorithms behind the tools they use, "tool criticism should analyze and discuss tools at the level of data transformations [. . .] how inputs and outputs differ and what this means for interpreting the transformed data" (Koolen 2019: 382). This is particularly relevant for network visualization, which transforms a mathematical matrix into a spatial representation.

2.2 Network visualization

Network analysis is predicated on the assumption that understanding the connections between entities leads to greater understanding of a dataset. Although the statistical analysis of networks originated with studies of physical systems, such as the roadways within a city or machines on a computer network, network analysis was soon also applied to figurative connections between people as seen in club memberships or correspondence networks (Wilson 1986; Zachary 1977). Visualizations of such networks represent entities as nodes, or vertices, and the connections between them as edges. Network graphs are thus a subset of the larger category of node-link diagrams, which use a common "set of abstractions [. . .] so close to ubiquitous that it can be called a visual grammar. Entities are almost always shown using outline boxes, circles or small symbols. The connecting lines generally represent different kinds of relationships, transitions or communication paths between nodes" (Ware 2013: 222). A variety of statistical measures are used to describe network graphs, including node degree, edge weight, modularity and measures of centrality. These measures help identify important nodes and communities within a network and the ways that information, power or prestige flow between them. However, the visualization of a network "can allow users to see relationships, such as patterns and outliers, that would not be apparent through a metrics-based analysis alone" (Gibson et al. 2012: 325). This is especially important in visualizations of large-scale datasets that are difficult to comprehend in numerical terms.

Since 1984, a number of different algorithms have been developed to generate force-directed network graphs, which are widely used today especially for very large datasets. Force-directed graphs visualize the nodes in a network as if they were powered by spring or electrical forces of attraction and repulsion (Kobourov 2013). Nodes that are more closely interconnected are displayed closer together, near the center of the graph and nodes that are less connected are dispersed outwards to its margins. It is important to recognize, however, that these spatial representations do not have a direct relationship to the data, as Ahnert et al point out: "Networks express an internal logic of relationships between entities that is inherently intuitive. They also lack an explicit external spatial referent, whether the latitude and longitude of cartography, the scale and sequence of a timeline, or the categories and measures that mark the x-y axis of a statistical graph" (Ahnert et al. 2020: 57). The meaning of a network's layout can only be understood within its own visual codes.

Because most force-directed layouts draw the layout iteratively, starting from randomly selected nodes, the resulting graph will look somewhat different each time a user runs a specific algorithm, even with the same parameters selected. Tommaso Venturini suggests that the term "spatialization" is more appropriate than "visualization", since "Force-directed layouts do not just project networks in space—they create a space that would not exist without them [. . .] In a force-spatialized visualization there are no axes and no coordinates, and yet the relative positioning of nodes is significant" (Venturini et al. 2021: 3). Within this space, looking for indications of polarization, density, and clustering help the researcher to develop interpretations of the data (Venturini et al 2021: 4; Gibson et al. 2012:

345). However, users are likely to interpret node position as having more significance than it does: in a layout of a network containing three clusters, sometimes clusters 1 and 2 will be closer together, and sometimes clusters 1 and 3 will be closer (Gibson et al. 2012: 324). To counteract this mistaken perception, a key practice of exploratory data visualization is to produce multiple drawings of a network in order to see which aspects of its structure persist; this process can be enhanced or constrained by the visualization's aesthetics.

2.3 Meaningful aesthetics

Within the context of data visualization, visual elements such as color, shape, symmetry and size contribute to the viewer's perception of both the graph's meaning and its overall beauty or aesthetic impact. Aesthetics are considered to be deeply related to the communication of meaning within graph drawing: "Creating aesthetically appealing graphs is more than a quest for the beautiful – it has the practical aim of revealing underlying meaning and structure. In general, researchers associate aesthetics with readability, and readability with understanding" (Bennet et al. 2007: 57). Although contemporary neurobiology has offered different explanations of the underlying mechanisms of perception, the Gestalt principles of pattern perception continue to be relevant for understanding how we perceive visual designs. These principles include proximity, similarity, relative size and continuity, which explain that viewers are likely to perceive objects that are similar and/or near each other as constituting a group; to correlate differences in size with differences in quantity or strength; and to perceive connection from continuous lines (Ware 2013: 181–186). Many guidelines and tools for data visualization incorporate these fundamental principles of perception. A recent investigation into viewers' subjective rating of the beauty and interest evoked by randomly generated network graphs suggests that curved shapes are more likely to be perceived as beautiful, which corresponds with prior research in consumer design focused on material objects. More complex structures were rated as more interesting as visual stimuli. The researchers suggest that the combination of both beauty and interest are important in designing network graphs, as interest is required to engage attention for longer periods of time (Carbon et al. 2018).

The aesthetics of network graphs are produced by the combination of the network layout algorithm and the visual design choices selected in the visualization software. Within computer science, "aesthetically pleasing" layouts have been an explicit goal of force-directed algorithms since at least 1984, when Peter Eades specified that edges should be the same length and that the graph layout should be symmetrical (Kobourov 2013: 385). Later algorithms would add other criteria, like the even distribution of nodes, minimizing edge crossings and node separation and non-overlap (Gibson et al 2012: 22). These aesthetic criteria are thought to "ensure that a graph is displayed more effectively and allow the user to easily perceive the topological structure of a graph", but as Helen Gibson points out, in practice these principles sometimes conflict with one another and with users' subjective perceptions of the graphs (Gibson et al. 2012: 326–330).[2] A variety of visual design choices are available in network visualization tools, including node and edge color; node size and shape; and line styles and widths. These choices can be used to represent different features of the nodes and edges, whether present in the original data or calculated through statistical analysis of the network. These meaningful aesthetics help users gain insight about the relationship between node attributes and the overall topology of the network (Gibson et al. 2012: 341).

Even before a user interprets these visual cues in relation to the underlying data, they are likely impacted by the overall aesthetic appearance of any graph, as Helen Kennedy and Martin Engebretsen suggest: "Our encounters with form, colour, and composition are informed by bodily experience as well as aesthetic judgement [. . .] Data visualizations thus create meanings through visual and other codes. But they also generate feelings, by which we mean the emotional responses that are connected to human encounters with data visualizations. Meanings and feelings are inseparable in our situated interactions with texts" (Kennedy and Engebretsen 2020: 23–24).[3] Recent art exhibits featuring network diagrams foreground these emotional responses to network aesthetics, but they should also be explored as part of humanist knowledge creation.[4]

3 Method

This paper presents a study of network visualization tools and their outputs.[5] Because understanding the design history of visualization tools and the creation of data used for analysis is integral to the humanist critique of the apparently objective appearance of traditional data visualization, this section describes the tools and data used in this study.

2 For examples of empirical user studies, see Purchase 2002 and Purchase et al. 2002.

3 See Kennedy and Hill 2018 for a user study focused on these emotional responses.

4 See, for example, *The Art of Networks III*, held at https://www.barabasilab.com/art/exhibitions.

5 A number of comparative studies exist, but most focus on technical, rather than aesthetic comparisons. See, for example Broasca et al. 2019; Combe et al. 2010; and Majeed et al. 2020.

3.1 Network analysis tools

Three network analysis tools (Pajek, Cytoscape, and Gephi) were selected because they are cross-platform, open-access tools capable of visualizing very large networks. These are all mature tools in continuous development, with active user communities and wide adoption by researchers. Additionally, these tools are considered more comparable with each other from the user perspective because each provides a graphical user interface (GUI) and thus do not require knowledge of a programming language like Python or R. All of these tools will help users seeking to understand the relationships among entities in a dataset, but they will each do that work somewhat differently.

3.1.1 Pajek

Pajek was first released in January 1997 and remains in continued development to the present time. Pajek provides for a large number of analytic operations on six distinct data objects: network matrices or graphs; and five data objects that contain information about the nodes: "partitions" of nominal or ordinal properties; "vectors" of numerical properties; "clusters," or subsets from a partition; "permutations" containing ranked properties; and "hierarchies" which represent nodes in a tree diagram. As its developers admit, "Pajek is not '*a one click program*', some users call it '*the network calculator*'. That means that for obtaining some result several basic operations must be executed in a sequence" (Mrvar and Batagelj 2016: 2). Although this design means that Pajek has a steeper learning curve than some other programs, it is very powerful: the main program can handle networks of up to one billion nodes, and there are two versions designed for enhanced memory optimization for processing even larger networks. Version 5.15a of Pajek64 (for 64-bit Windows systems) released in May 2022 was used in this study.

3.1.2 Cytoscape

First released in July 2002, Cytoscape was specifically designed for "integrating biomolecular interaction networks with high-throughput expression data and other molecular states into a unified conceptual framework" (Shannon et al. 2003: 2498). It provides for the integration of data from scientific databases of gene information and a number of analyses specific to biological research. Over time it has developed into "a general platform for complex network analysis and visualization" and the project website highlights uses of the software in the social sciences and general study of networks.[6] Many additional capabilities can be installed into the framework with apps developed by the Cytoscape team and the user community. Cytoscape is designed for optimal rendering of networks with up to 100,000 nodes. Cytoscape version 3.9.1 released in January 2022 was used in this study.

3.1.3 Gephi

First released in July 2008, Gephi was designed as a “flexible, scalable and user-friendly software” that would provide “better network visualization to both experts and [an] uninitiated audience” (Bastian et al. 2009: 361). According to the Gephi documentation site, “Gephi is a tool for people that have to explore and understand graphs. Like Photoshop but for graphs, the user interacts with the representation, [to] manipulate the structures, shapes and colors to reveal hidden properties”.[7] This design for user interactivity includes displaying the network while the layout algorithm is running, direct manipulation of the shape of the graph and options for changing its aesthetics. Although it includes statistical analysis components, Gephi is explicitly described as a “a software for Exploratory Data Analysis” that can help users to hypothesize and “intuitively discover patterns” in networks.[8] Along with continued developments to the primary software, a large number of optional plugins designed by the Gephi team and other users extend the capability of the platform. Gephi is capable of handling networks with up to 100,000 nodes and 1 million edges. Gephi version 0.9.5, released in May 2022, was used in this study.

3.2 *Les Misérables* character interaction dataset

Computer scientist Donald Knuth’s 1994 book *The Stanford GraphBase: A Platform for Combinatorial Computing* included a number of datasets Knuth created from literary works (Knuth 1994: 12–14, 45–46, 180–191). One of these datasets lists 80 characters from Victor Hugo’s 1862 novel *Les Misérables* and their interactions in each chapter (Knuth 1994: 14). Although his dataset encompassed 80 characters, he documented interactions among only 77 of them, creating a network containing 77 nodes and 254 edges.[9] This dataset was selected for this study in part be-

6 “What is Cytoscape?,” accessed May 1, 2022, https://cytoscape.org/what_is_cytoscape.html.
7 “Gephi documentation wiki,” accessed May 1, 2022, https://github.com/gephi/gephi/wiki.
8 Ibid.
9 The Stanford GraphBase data files are available from Skiena 2008. Knuth’s personal website notes that he realized later that he omitted an interaction between Fantine and Cosette, but

cause it has been widely used in network analysis scholarship, beginning with Newman and Girvan's community detection algorithm paper in 2004 and is freely available online in a number of network data repositories (Newman and Girvan 2004). A graph of this network is also included as an example within Gephi's installation files.

However, it is important to note that the collection of data, particularly from cultural works like Hugo's novel, involves a number of decisions that are unfortunately not well documented for Knuth's dataset: he says only that "the vertices of the graphs represent the characters that appear in well-known novels, and the edges represent encounters between those characters" (Knuth 1994: 12). For literary scholars, neither characters nor encounters are self-evident: key questions include how a fictional character is defined for the purposes of the research (i.e., do they have to be named within the novel to count) and how their interactions would be defined and documented (via direct and/or indirect speech, direct physical actions, or simply being described as present in the same scene of the novel) (Moretti 2011). For example, Michal P. Ginsburg's dataset of character interactions in *Les Misérables*, which includes inferred encounters and unnamed characters, is much larger than Knuth's, comprising 181 characters and 500 interactions.[10] However, since the purpose of this study is to evaluate network visualization tools, Knuth's dataset was selected because it has become a standard reference point in network analysis scholarship.

3.3 Approach

As discussed above, the appearance of a network graph depends upon both the layout algorithm and aesthetic choices applied. Each of the network visualization tools discussed here implements several different force-directed layout algorithms, as noted in Table 1. Each of these tools also allow users to apply many different aesthetics to a network graph, such as node color, size and shape; line color, width and style; label shape, size and font; overall image zoom; and background color. Within each of these aesthetics there are frequently at least ten different options, and Gephi and Cytoscape provide for user selection of colors using

notes that his original data files should be considered "forever-frozen examples of typical data that is more or less accurate." See Knuth, "The Stanford GraphBase," accessed May 7, 2022, https://www-cs-faculty.stanford.edu/~knuth/sgb.html.

10 Michal P. Ginsburg, "*Visualizing Les Misérables*," accessed May 7, 2022, http://lesmiserables.mla.hcommons.org/.

RGB or six-digit hexanumeric notation, which encompasses 16.7 million colors. (Pajek offers 96 defined colors.) Thus a comprehensive examination of all possible combinations is beyond the scope of this chapter. Instead, this chapter examines the assumptions and effects of the default settings provided in the tools, which are likely to influence many users, especially those with limited background knowledge or technical expertise in graph drawing. Beyond this direct influence, understanding the assumptions that are built into these tools contributes to the critical awareness of how software shapes interpretation. In this study, the *Les Misérables* dataset was imported into Pajek, Cytoscape and Gephi, and images were generated of the initial presentation of the data and the different force-directed layout options available in the tool, using the default display settings.

Table 1: Graph Layout Implementation in Network Visualization Tools.

Tool	Force-Directed Layouts	Other Layouts
Pajek 5.15a	Kamada-Kawai Fruchterman-Reingold	Circular Pivot MDS VOS Mapping EigenValues Tile Components
Cytoscape 3.9.1	Edge-Weighted Force Directed Layout (Biolayout) Edge-Weighted Spring-Embedded Layout (Kamada-Kawai) Prefuse Force-Directed Layout Compound Spring-Embedder Layout	Grid Layout Attribute Circle Layout Group Attributes Layout Circular Layout Hierarchical Layout
Gephi 0.9.5	Force Atlas Force Atlas 2 Fruchterman Reingold OpenOrd Yifan Hu Yifan Hu Proportional	Circular Layout Contraction Dual Circle Layout Expansion Label Adjust Noverlap Radial Axis Layout Random Layout Rotate

4 Results

As noted above, the *Les Misérables* character interaction network is of modest size, containing 77 nodes and 254 edges. As such, it is often used in studies of network layouts and is even included within Gephi as a sample file. It thus serves as a good example for examining how the three tools initially visualize the topography of the network. This is a unimodal network, in which all nodes represent the same kind of entity, in this case characters in the novel. Because force-directed algorithms display the more highly-connected nodes towards the center of the diagram, the distribution of node degree within a dataset strongly influences the visualization of the network. Within the Knuth dataset, the node degree, or the number of different nodes a given node is directly connected to, ranges from 1 to 36, with Jean Valjean, the novel's protagonist, interacting with the greatest number of other characters (36). Other high degree nodes include the urchin Gavroche (22), the student Marius (19), the police inspector Javert (17) and the innkeeper Thenardier (16). Figure 1 displays a histogram of node degree in the dataset. The majority (78%) of the novel's characters are connected to ten or fewer other characters, with 35% of the nodes in the dataset connected to only one or two others.

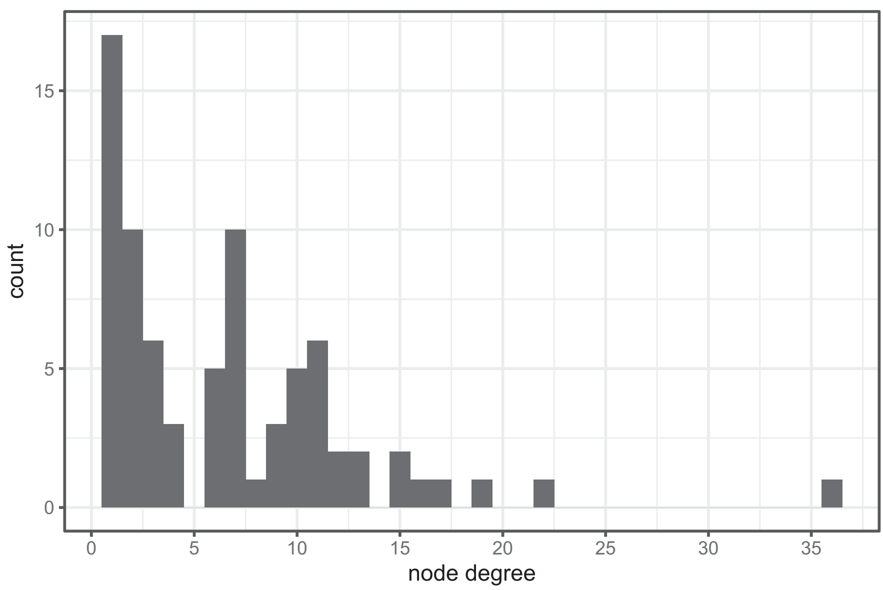

Figure 1: Node degree frequency in the *Les Misérables* dataset.

Another fundamental measure of a network's structure is edge weight, the count of how many times a specific connection is repeated; in this dataset, characters who repeatedly interact within the novel's chapters have edges with higher weights than those who only interact once or twice. Most (87%) of the character interactions recorded by Knuth occur five or fewer times and 97 of the 254 (38%) interactions recorded in Knuth's dataset occur only once. Notably, there are 14 characters with a node degree of one who interact with that other character only one time; six of these interact with Bishop Myriel and four with Valjean. With such low node degree, the Myriel cluster, which also includes a seventh character with node degree of only two, tends to be positioned near the edges of the graph in most visualizations. Within the novel, these upper-class characters exist in a very separate world than do the working- and middle-class characters.

There are four pairs of characters who interact repeatedly throughout the novel and thus have very high edge weights: the protagonist Valjean and his adoptive daughter Cosette (31); Cosette and her suitor Marius (21); Valjean and Marius (19); and Valjean and his enemy Javert (17). These four characters are central to the novel's plot and themes. As the novel's protagonist, Valjean has the highest node degree, meaning he is connected to the greatest number of other characters (36), and he also appears in the novel the greatest number of times (158, or 62% of the interactions in the dataset). However, an important character does not necessarily have to interact with a lot of different characters: Cosette's node degree is only 11, but she appears very frequently in the novel's pages: 68, or 27% of the interactions in the dataset. In network visualization, edge weight is conventionally visualized through line thickness, but other aesthetics such as color or line type (i.e., solid, dotted or dashed) can also enable the viewer to visually compare edges based on their weight, in order to understand the frequency of that interaction in the data. Node degree and edge weight are fundamental measurements that greatly impact the visualization of the network.

4.1 Pajek

In Pajek, a user's first encounter with a set of network data is through a shaped, defined form because the software automatically applies a circular network graph layout to the data in the Draw window. The low resolution Draw window generates the working view of the graph along with any aesthetics that have been applied, either as part of an analysis or as a manual selection. Figure 2 shows the initial visualization of the *Les Misérables* character interaction network in Pajek's Draw window, before any layout algorithm has been applied by the user. (This view can also be generated under Draw/Layout/Circular/Original.) Although this layout is labeled a circular layout within the software, the shape of the graph depends on the window used for the Draw view and on a typical computer screen it tends to be more elliptical in shape rather than an exact circle.

In this default working view of the network, all nodes in the graph are represented by equally-sized yellow circles which are evenly distributed in an elliptical layout against a tan background with dark red node labels. Even in a relatively

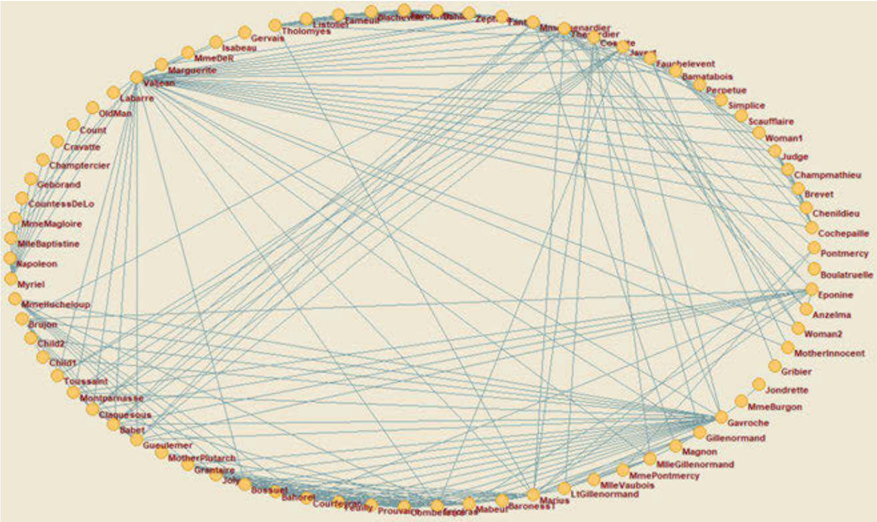

Figure 2: Pajek: initial view of the network in the low resolution Draw window.

small network such as this one, many of the node labels are illegible because they overlap with nodes and edges. The display of node labels supports exploratory understanding of network information, but they can interfere with the perception of the overall topology of the network. Although the display of node labels is a default feature of graph drawing in Pajek, labels have been removed in the remaining graph images so as to facilitate comparisons among the different layouts and tools.

The colors, shapes and line styles used by default in the low resolution Draw window emphasize the nodes more than the edges and the tan background minimizes contrast between the visual elements. Higher resolution Encapsulated PostScript (EPS) images can also be exported from Pajek, with the colors for nodes and edges set from a defined list of 96 named colors in the Export/Options screen. An exported EPS image thus uses different aesthetics than what is displayed in the working view of the graph. Figure 3 displays the initial view of the data with the default color settings used for EPS file export. Here the darker blue lines used for edges shift the visual balance a bit away from the nodes, which are displayed in a light salmon color. These EPS file settings are used in the remaining images generated from Pajek.

Although the Pajek reference manual simply states that nodes in this initial layout are positioned by default “in order determined by the network,” examination of the graph along with the node weights reveals that this layout is designed to reveal clusters of connected nodes (Mrvar and Batagelj 2022: 69). High degree

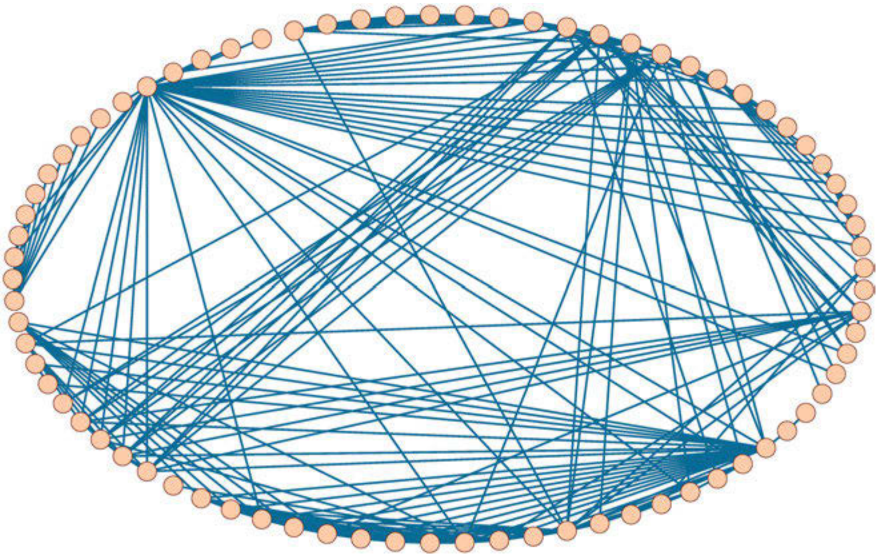

Figure 3: Pajek: initial view of the network with default color settings for EPS file export.

nodes (those with a lot of connections), such as the one representing the novel's protagonist Valjean, are positioned so that the edges connecting them to low degree nodes cross the diameter of the ellipse. By default in Pajek, all edges are displayed as equal width, drawn with thin blue lines, rather than visually indicating edge weight. These visual choices place more emphasis on node degree, or the number of edges connected to a given node, rather than on significant relationships between node pairs.

Because this layout is the first view presented of the data in Pajek, the software promotes the assumption that the connections to high degree nodes are the most meaningful. Although this is a standard approach to analyzing networks, examining the data in other visualizations can highlight other ways of seeing the nodes in the network. Figure 4 shows the same elliptical ("circular") layout with random positioning of the nodes. As discussed above, low-degree nodes are predominant in this dataset, which points to Hugo's representation of class, gender and professional distinctions within an urban setting. Viewing the network with random positioning of nodes shifts the focus from the plotting around the novel's central characters to the socio-historical view offered in the novel.

Pajek includes two classic force-directed algorithms in its layout options, which it calls "Energy" layouts: Kamada-Kawai (Kamada and Kawai 1989) and Fruchterman-Reingold (Fruchterman and Reingold 1991). The default setting for these layouts selects a random node as the starting point for drawing the graph, although a

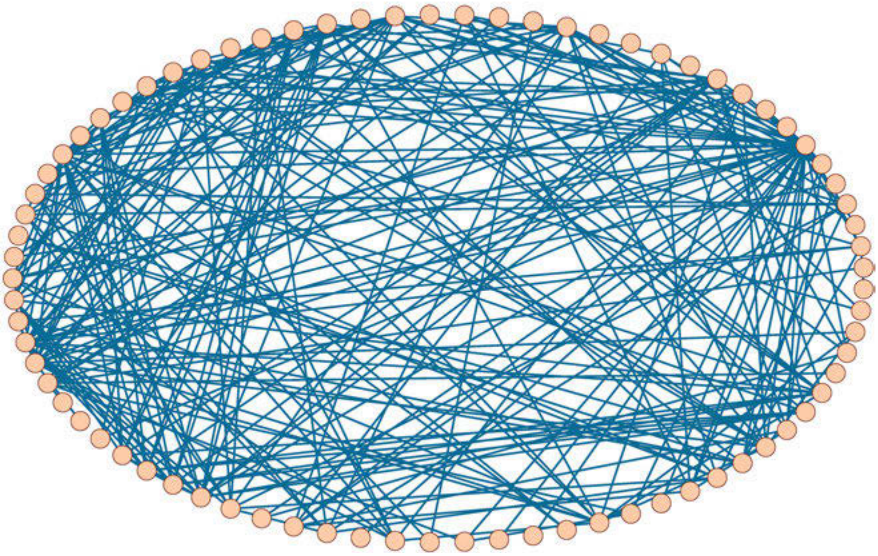

Figure 4: Pajek: elliptical (circular) graph layout with random node ordering.

specific starting point may be selected by the user. Pajek offers several layout parameters for the Kamada-Kawai algorithm, which is based on spring forces, including options to fix the position of specific nodes, to optimize subclusters or to optimize components (Mrvar and Bagatelj 2022: 69). This layout tends to emphasize symmetry and produces a boxy effect in the display of node clusters (Gibson et al. 2012: 330). Figure 5 shows the Kamada-Kawai layout with separated components, which reduces visual overlap of the nodes (Kobourov 2013: 383). This layout visually distinguishes four groups among the more connected nodes and the default aesthetics applied in Pajek represent higher edge weights with thicker lines. Because of the strong attractive force applied in the visualization, it is difficult to distinguish the individual nodes for Valjean, Marius, Javert and other key characters at the center of the graph. As in all force-directed layouts, this algorithm places highly-connected nodes towards the center of the graph and the very low degree nodes are clearly visible around the perimeter. Because these nodes are evenly arranged at some distance from the center of the graph, they are strongly distinguished from the more highly connected nodes, but it is difficult to perceive how they relate to the network as a whole. For example, the group of seven very low-degree nodes connected to Myriel are located in the upper right quadrant of the graph. Because they are spread out so far from each other and their edges cross others before connecting with the Myriel node, these nodes are not visually distinct as a group.

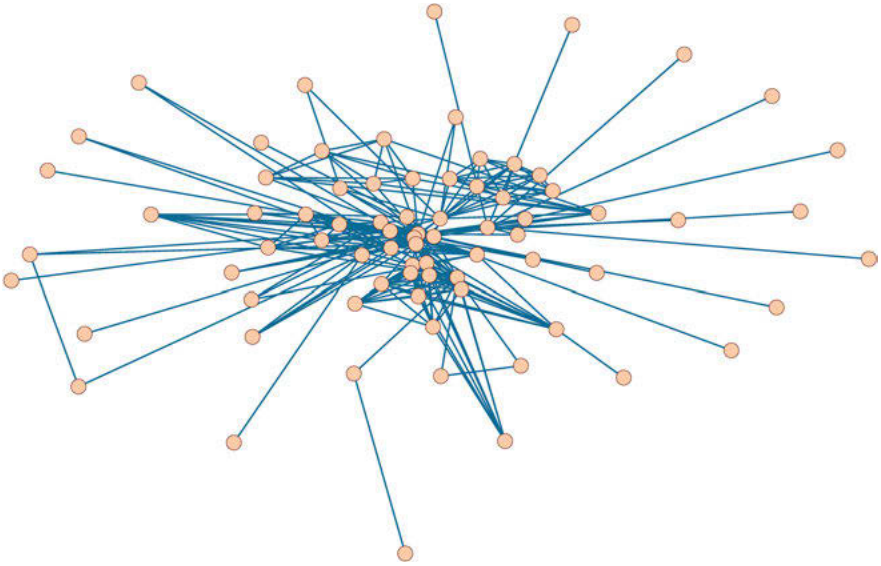

Figure 5: Pajek: Kamada-Kawai layout with separated components.

Figure 6 displays the *Les Misérables* character network in Pajek using Fruchterman and Reingold's algorithm, which is based on the attractive and repulsive forces exerted between "atomic particles or celestial bodies" combined with annealing or cooling processes (Kobourov 2013: 385). This layout spreads out both the highly weighted and less weighted nodes to form a rounded shape to the graph overall. Pajek's implementation of the algorithm tends to draw edges closely alongside each other, creating an elongated visual effect. The intricacy of connections is minimized in this layout in favor of displaying node groups, which is helpful for understanding the structures within Hugo's *Les Misérables*: the high degree nodes for the key characters Valjean, Javert, Marius and Cosette are located at the very center of the graph; the nodes for the political revolutionaries connected to Courfeyrac and Enjolas are arranged in an overlapping wedge in the upper left quadrant; and the cluster of upper-class characters connected to Bishop Myriel is clearly visible on the right side of the graph. In this layout even small differences in node degree are visually distinguished because of the way the algorithm calculates the attractive force at the graph's center. Although node placement does not have inherent meaning, the placement of the nodes relative to one another and to the center of the graph is meaningful.

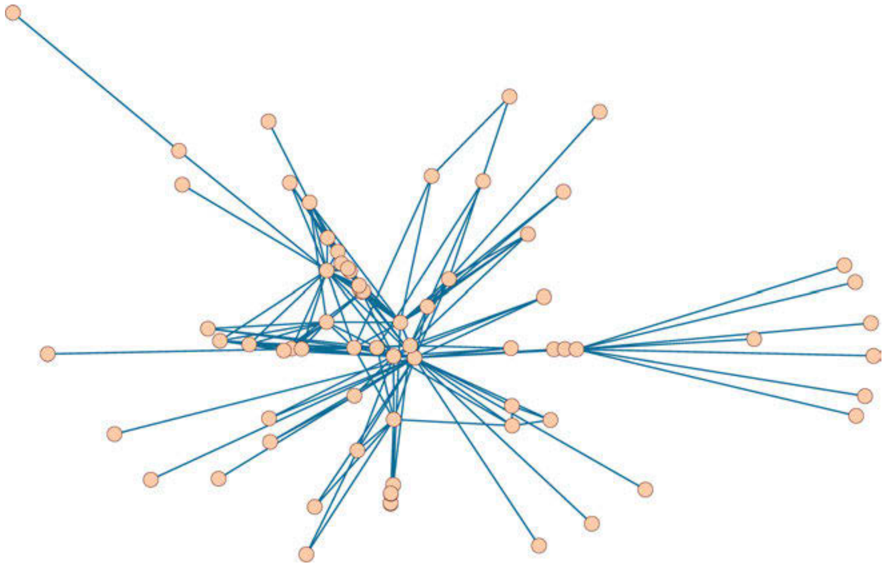

Figure 6: Pajek: Fruchterman-Reingold layout.

4.2 Cytoscape

Cytoscape provides four force-directed layouts in the main program: the Prefuse Force-Directed Layout; the Edge-Weighted Force Directed Layout based on the Biolayout algorithm, which is specifically designed for similarity analysis in biological research and does not work well for other kinds of network data; the Edge-Weighted Spring-Embedded Layout, which is an implementation of the Kamada-Kawai algorithm; and the Compound Spring-Embedder Layout, which is optimized for use with compound graphs as well as other networks (Heer et al. 2005; Enright and Ouzounis 2001; Kamada and Kawai 1989; Dogrusoz et al. 2009). Cytoscape manages aesthetics for edge and node style, color, shape and size, along with the data features that these aesthetics represent, through a palette of 18 predefined “styles.” Users can also modify these existing styles or create their own.

The current version of Cytoscape initially displays network data using the Prefuse force-directed layout, although the software documentation states that the Grid Layout is the default view of the data. As shown in Figure 7, this view of the data is initially displayed in the “default” palette style, which represents nodes with light blue rectangles containing the node label in black and edges as thin grey lines on a white background. As with the default aesthetics applied in Pajek, the emphasis here is on the nodes, more than the edges: the large rectangular nodes provide information but also obscure some of the edge intersections, making it difficult to perceive the relationships between the nodes.

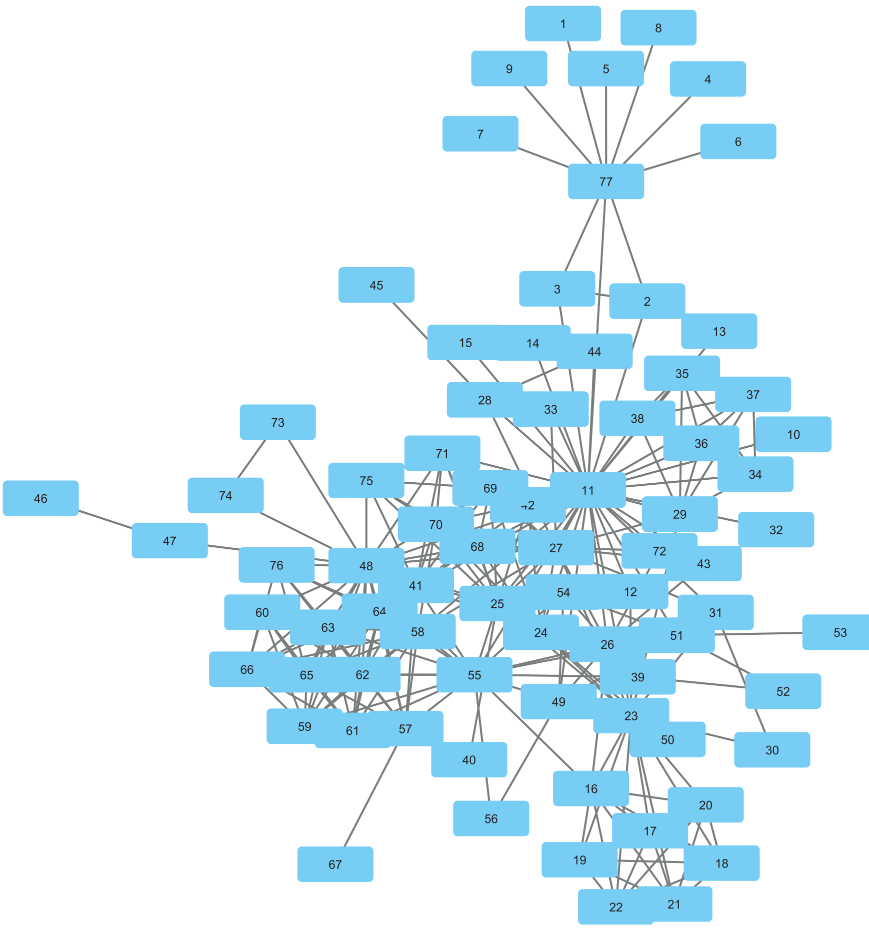

Figure 7: Cytoscape: initial view of the network (Prefuse layout with default style).

Figure 8 shows the same Prefuse layout with the "default black" aesthetic style applied and node labels removed. This style represents the nodes with small white circles and edges with thin green lines on a black background, which provides a better topological understanding of the network than the "default" style. Both of these styles display node labels by default and do not visually represent edge weights. These aesthetics are user-modifiable, but the default settings reflect the overall focus in Cytoscape on node information, which derives from its original development for biological research. Nevertheless, the layout algorithms in the software provide for the exploration of network structures as well. Nodes are evenly spaced in the Prefuse layout and clusters are arranged in a circular pattern that clearly shows the interactions among the nodes. Even the many edges connecting the high-degree nodes at the graph's center are visually distinct in this figure. To facilitate comparisons of the layouts and tools, the "default black" style is used in the remaining images generated from Cytoscape.

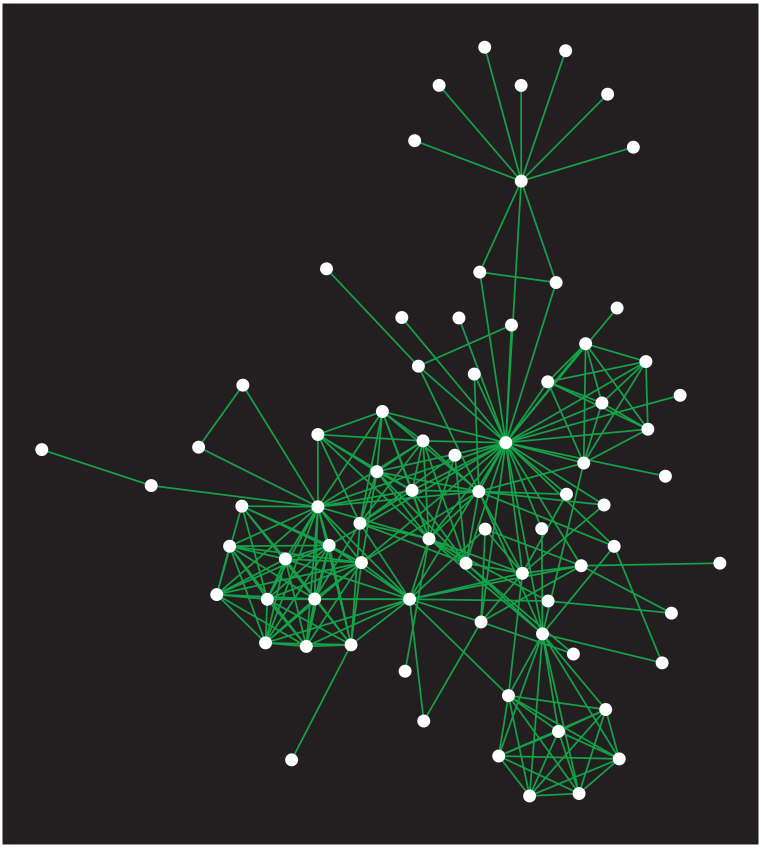

Figure 8: Cytoscape: Prefuse layout with default black style.

Figure 9 shows the *Les Misérables* network in Cytoscape's Edge-Weighted Spring Embedded Layout, which is an implementation of the Kamada-Kawai algorithm. Despite the layout's title and the fact that it includes a weighting parameter, the default aesthetic styles do not visualize the edge weights unless that option is selected by the user. Comparing Cytoscape's implementation of Kamada-Kawai with that in Pajek (Figure 5) shows overall topological similarities, as would be expected, but individual nodes and groups within the network are more clearly separated. The high-degree nodes for Valjean, Javert, Marius and Cosette near the center of the graph can be clearly distinguished from one another; the two groups of political revolutionaries are shown as overlapping but distinct wedge shapes on the left; and the Myriel group is placed in the upper right quadrant of the graph.

Figure 9: Cytoscape: Edge-Weighted Spring-Embedded layout (Kamada-Kawai).

Figure 10 shows the *Les Misérables* network in the Compound Spring-Embedder layout in Cytoscape, which evenly spaces the nodes in the graph and thus tends to arrange nodes in a circular fashion. Clusters of nodes are less clearly distinguished from one another and the node spacing makes the edges in the graph more visible. This layout is thus useful for exploring the paths of connection among individual nodes and clusters. As noted previously, the fact that the Myriel cluster of nodes appears on the left side of this graph rather than on the right, as it did in other figures, bears no significance. What is significant, and represented in each algorithm and tool, is that the characters connected to Myriel are strongly distinguished from those connected to the revolutionaries Courfeyrac and Enjolras, as shown in the annotations in Figure 11.

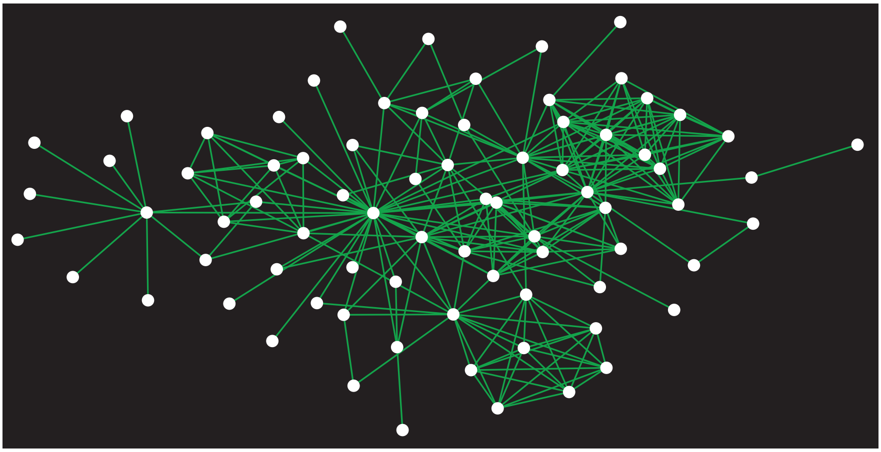

Figure 10: Cytoscape: Compound Spring-Embedder layout.

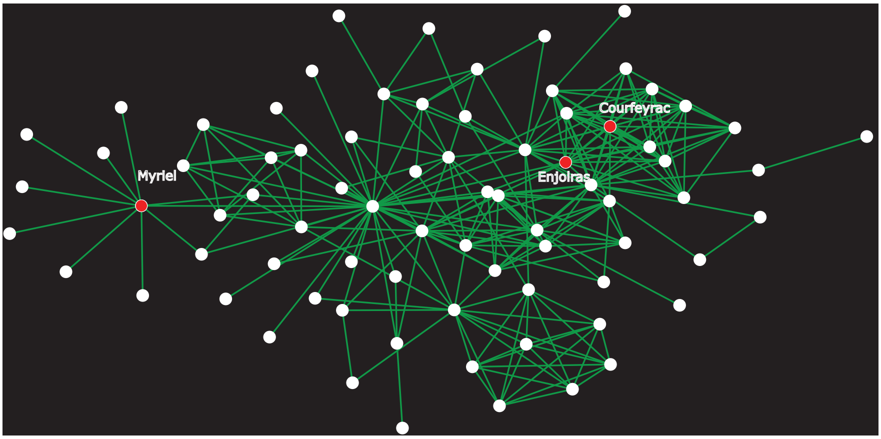

Figure 11: Cytoscape: Compound Spring-Embedder layout with select nodes annotated.

4.3 Gephi

The Gephi interface is divided into three main windows: the Data Laboratory, which displays the node and edge data tables; the Graph window, which allows for analysis and manipulation of the network; and the Preview window, in which the image is fine-tuned for exporting to an image file. Aesthetic choices, such as color and size for nodes and edges, can be applied in both the Graph and Preview windows. Figure 12 displays the initial view of the *Les Misérables* network in the Graph window, before any layout algorithm has been applied. Nodes are displayed as small black circles and edge weights are visually indicated with proportional edge widths. Of the three tools surveyed here, Gephi is the only one that privileges a random view of the dataset by making it the default view of a new network. But this random view is not without an implied interpretive approach: by displaying edge weights in this initial view of the data, certain connections are visually distinguished from the rest, such as the frequent interactions between Valjean and Cosette. Figure 13 displays the same initial view of the data, before any layout or aesthetics have been applied, in the Preview window. Even though networks are displayed with straight edges in the Graph window, the default setting in the Preview window is to display curved edges. In the figures that follow, straight edges are used to facilitate comparison with earlier figures.

Gephi provides four force-directed layouts in the main program: Fruchterman Reingold, Yifan Hu, Force Atlas and OpenOrd (Fruchterman and Reingold 1991; Hu 2006; Jacomy et al. 2014; Martin et al. 2011). As noted previously, the Fruchterman-Reingold algorithm is based on the forces between celestial bodies and the algorithm was designed to produce "even node distribution, few edge crossings, uniform edge length, symmetry and fitting the drawing to the frame" (Gibson et al. 2012: 331). Fruchterman-Reingold layouts tend to produce an overall rounded shape with evenly spaced nodes throughout the graph (Gibson et al. 2012: 332). Figure 14 displays the *Les Misérables* network using the default settings for speed and gravity in Gephi's Fruchterman-Reingold implementation. Because Gephi visually encodes edge weight by default, this graph emphasizes strong connections between particular nodes, rather than node degree. Key groups of nodes are visible in the graph, but are more difficult to distinguish than in some other layouts because of the way low-degree nodes are arranged around the perimeter with long edges connecting them to nodes in the center of the graph. As shown in Figure 15, the Myriel group is on the left side of the graph, but is difficult to discern because it overlaps with the group connected to Fantine. The Gestalt principles of similarity and figure-ground patterns explain why the Myriel group, with some of the lowest edge weights in the network, appears as though it lies behind the Fantine group: darker lines are perceived as though they are in the foreground and thus the Fantine group, with edge

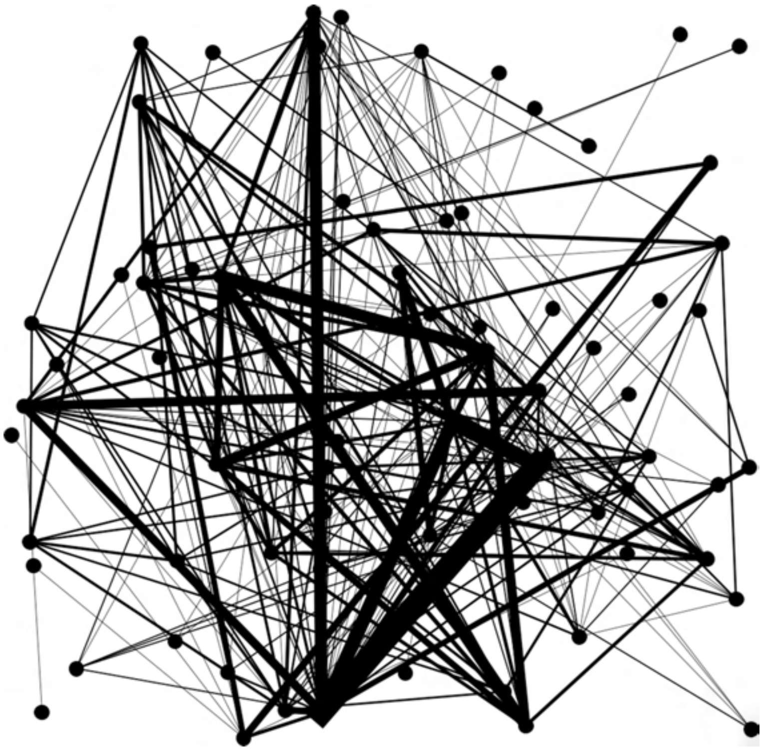

Figure 12: Gephi: initial view of the data in the Graph window.

weights ranging from 9–15, is easier to see (Ware 2013: 189–191). The uniform node separation in this layout creates a strongly rounded shape to the graph as a whole with triangular shapes between connected nodes. This layout thus emphasizes relationships between individual nodes, rather than the structure of groups or clusters within the graph.

The Yifan Hu layout algorithm uses the attraction and repulsion forces produced by pairs or groups of nodes to first produce a version of the graph at a coarse resolution. By iteratively filling in the rest of the graph structure, this algorithm reduces the power required to process very large graphs (Gibson et al. 2012: 336–337). The current version of Gephi offers both the initial Yifan Hu algorithm and the Yifan Hu Proportional layout, which adds more distance between central and outer nodes (Cherven 2015: 76). Figure 16 shows the *Les Misérables* network in the Yifan Hu layout with default settings applied. Compared to Fruchterman-Reingold, the Yifan Hu layout visually separates groups of nodes and distinguishes between tightly interconnected clusters and groups of nodes that fan

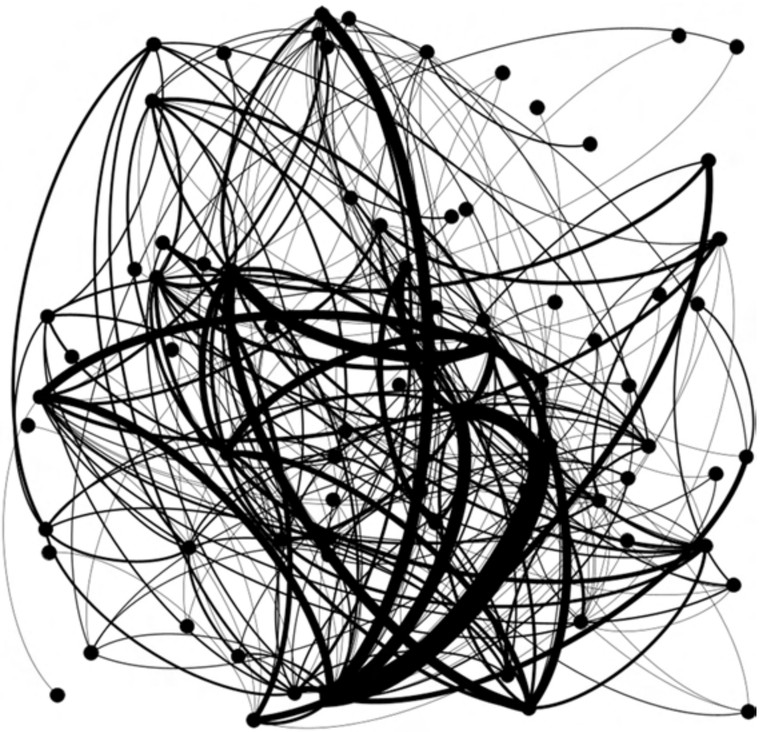

Figure 13: Gephi: initial view of the data in the Preview window.

out from a single shared connection. The Myriel group is clearly visible at the bottom of the graph. However, Gephi's default coloring of black nodes and edges, along with the scaling used to represent edge weights, can make it difficult to see all of the nodes in a network, especially with heavily weighted connections such as those between Valjean, Javert and Marius, shown here with very thick edge lines.

The OpenOrd algorithm, based on simulated annealing processes, is another multi-level approach designed for showing global structure in very large networks; however, with a network like this one with under 100 nodes, it can be less effective than other force-directed layouts (Martin et al. 2011; Gibson et al. 2012: 338). By design, OpenOrd produces longer edges in a graph than Fruchterman-Reingold to help distinguish clusters within the network's structure. OpenOrd offers a number of user-customizable parameters including edge cutting, which affects edge lengths in the graph. Figure 17 shows the *Les Misérables* network in OpenOrd with the Gephi default parameter settings and default aesthetics. Figure 18 shows the same

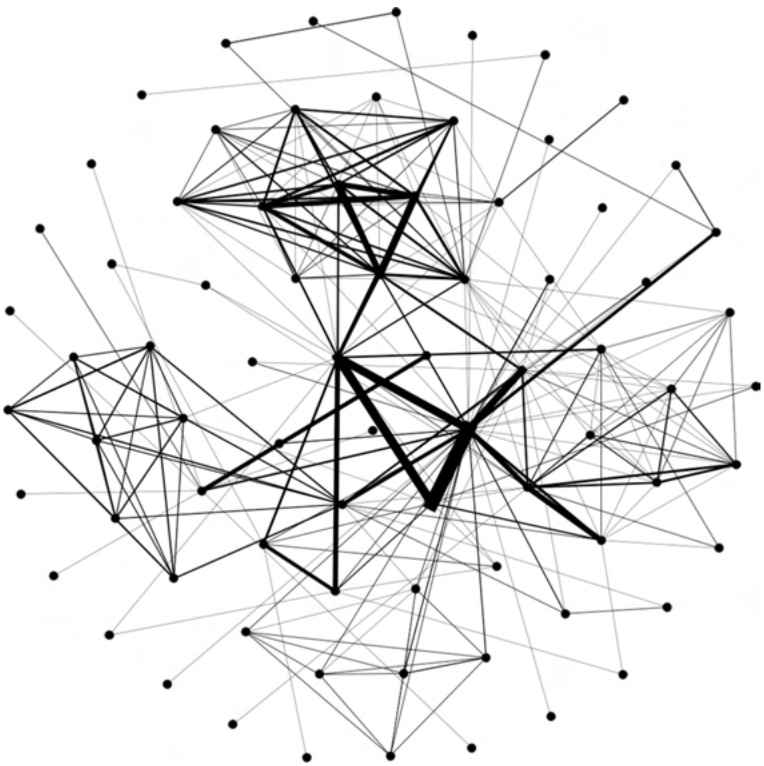

Figure 14: Gephi: Fruchterman-Reingold layout.

layout colored by modularity, which highlights four main clusters in the network: the cluster of Valjean and other high-degree main characters in the center of the graph; the revolutionary cluster at the lower right, which because of the edge width scaling looks almost as prominent; the group of seamstresses connected to Fantine at the upper right and the Myriel group at lower left. This layout emphasizes the highly weighted connections across and within clusters.

The ForceAtlas algorithm was designed by the Gephi team with the release of the software in 2009 to make possible real-time continuous network visualization with user-customizable parameters for attraction, repulsion and gravity (Bastian et al. 2009: 361). Since the 2014 release of ForceAtlas2, ForceAtlas is considered obsolete, but is still included in the program (Jacomy et al. 2014: 1–2). ForceAtlas2 is a continuous algorithm: "As long as it runs, the nodes repulse and the edges attract. This push for simplicity comes from a need for transparency. Social scientists cannot use black boxes, because any processing has to be evaluated in the perspective of the methodology" (Jacomy et al. 2014: 2). By design, Gephi users

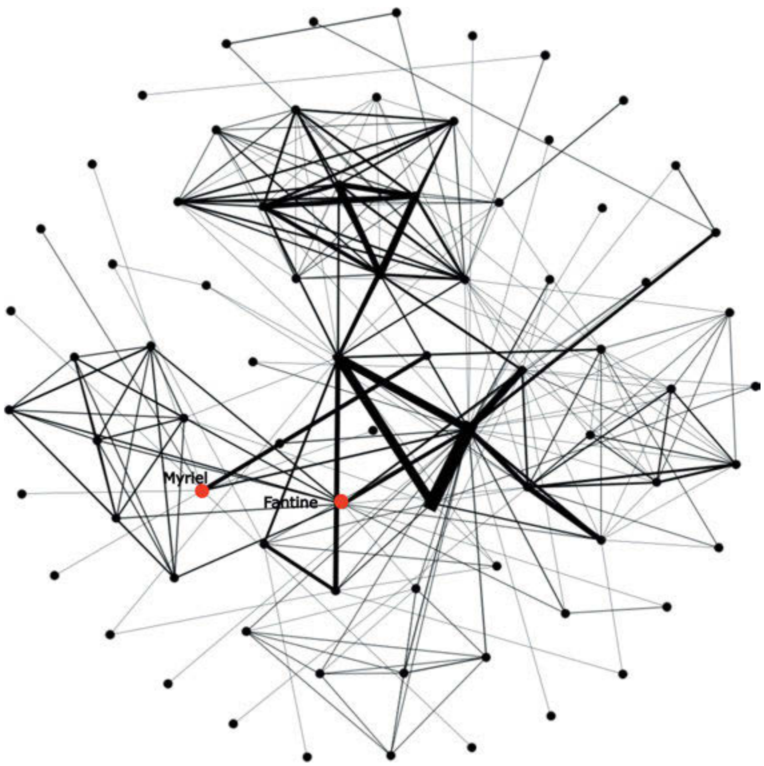

Figure 15: Gephi: Fruchterman-Reingold layout, detail of Myriel and Fantine groups.

can experiment to see the effects of changing the algorithm's parameters. Figure 19 shows the *Les Misérables* network in the ForceAtlas2 layout with default settings applied. Because the algorithm tends to overlap the nodes unless the default parameters are changed, the node clusters are difficult to distinguish in Gephi's default aesthetic, which for this algorithm displays the nodes at a large size relative to the edges. Figure 20 shows the same graph with grey, rather than black, nodes and edges, which provides a better view of the network's structure. Like Yifan Hu, ForceAtlas2 separates smaller node groups from the central highly connected nodes of the network.

As noted above, Gephi's default aesthetics scale the width of the edge lines according to edge weight, and color both nodes and edges black on a white background. As with Pajek and Cytoscape, Gephi makes it possible to change the aesthetics of node shape, size and color according to features of the data, such as node degree, statistical measures of centrality, modularity or categorical partitions in the data. However, Gephi also provides an interactive interface that al-

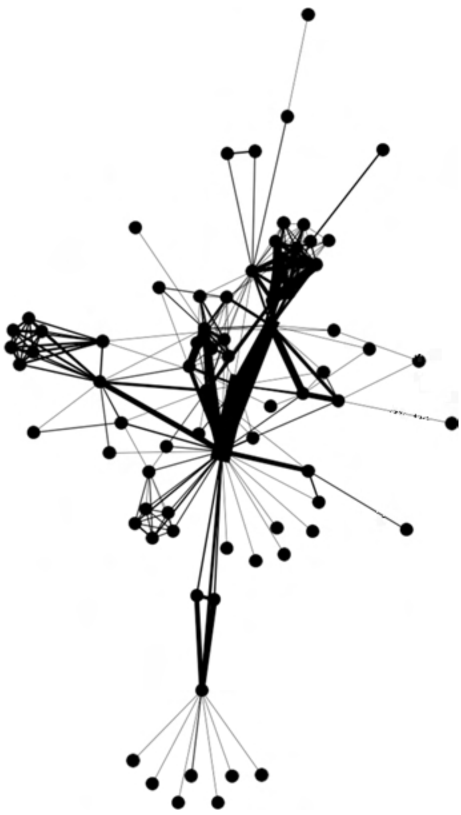

Figure 16: Gephi: Yifan Hu layout.

lows a user to click directly on nodes to move them or to apply specific aesthetics independent of the data features. Edge color, width and style can also be changed to reflect features of the data or other aesthetic preferences. Aesthetic changes are immediately visible in the Graph window and contribute to the exploratory environment for which Gephi is designed. Additional aesthetics for node and edge label styles, node opacity and borders and line shape are applied in the Preview window. With so many aesthetic possibilities, nearly infinite aesthetic transformations are possible for any given network graph, even without adjusting the layout.

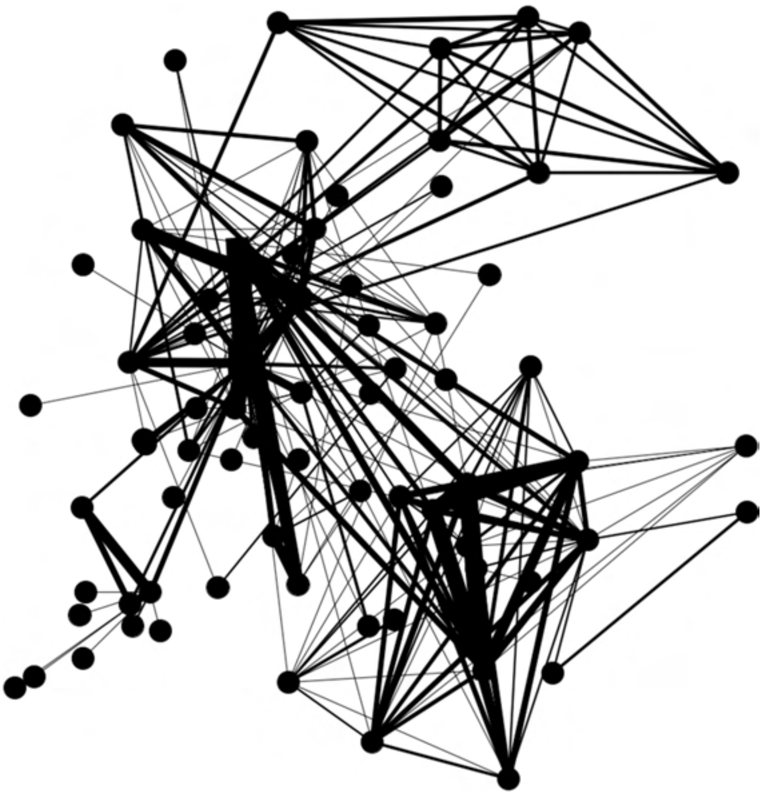

Figure 17: Gephi: OpenOrd layout.

5 Discussion

Because network visualization relies on aesthetic properties to communicate interpretations of data, understanding how different tools implement key layout algorithms and aesthetic styles is important, not only in terms of selecting the best tool for a particular project, but also for critically analyzing the products of these tools. As suggested here, the aesthetic dimension of network graphs produces meaning far beyond their explicit data mappings. Symmetry, contour, shape and color influence our attention and perception and can serve to highlight or obscure certain aspects of the network. Any network visualization is the product of numerous decisions which are too often not only undocumented, but even deliberately hidden from view. This section examines the most widely circulated visualization of the Knuth *Les Misérables* network in order to reveal the technological and aesthetic mystification it embodies.

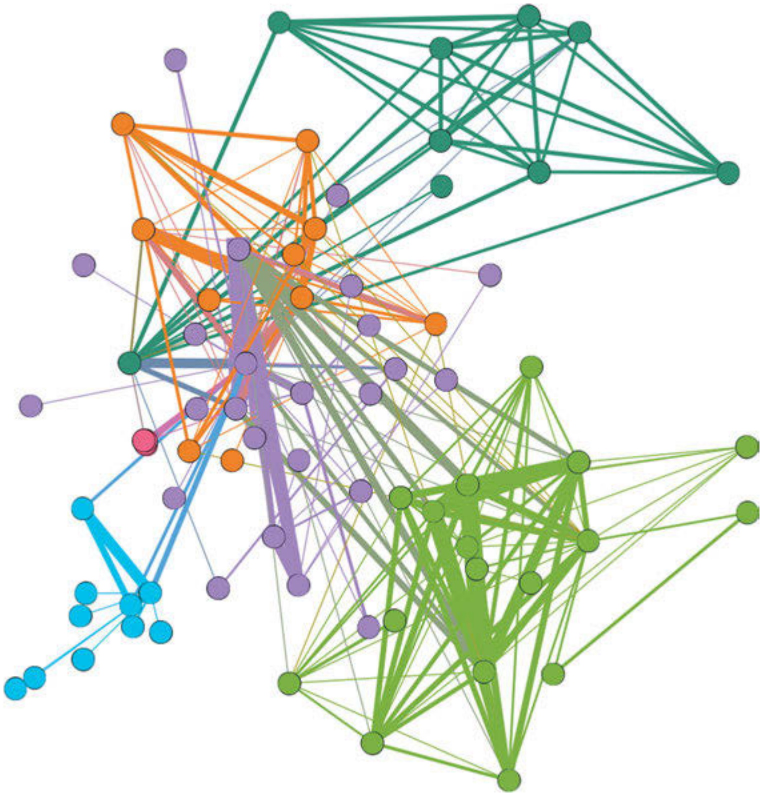

Figure 18: Gephi: OpenOrd layout with modularity.

When a user first opens the Gephi program, a welcome screen offers the user shortcuts to open recent files, to start a new project, or to open one of three network files that are included with the basic installation. These sample files offer insight into some of the assumptions and expectations that were built into Gephi's design. When a user opens the included file of Knuth's *Les Misérables* network, it appears in the program's Graph window not as unformatted, randomly ordered nodes, but with a layout algorithm and numerous aesthetic features already applied, as shown in Figure 21. These aesthetics are presumably intended to do double duty, serving not only to elucidate the character interactions that structure Hugo's novel, but also to exemplify good network visualization practices.

This network graph is built into the visualization software itself and presented without comment or explanation, as if its design makes it fully self-explanatory. However, like all network visualizations, this graph is a construction, so examining how it was made is important. It demonstrates several conventional practices in

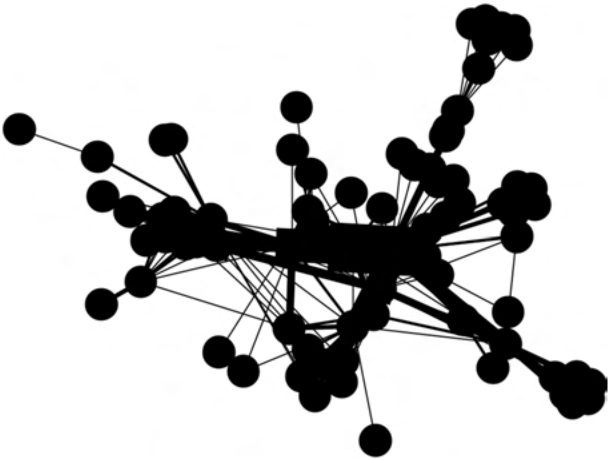

Figure 19: Gephi: ForceAtlas2 layout.

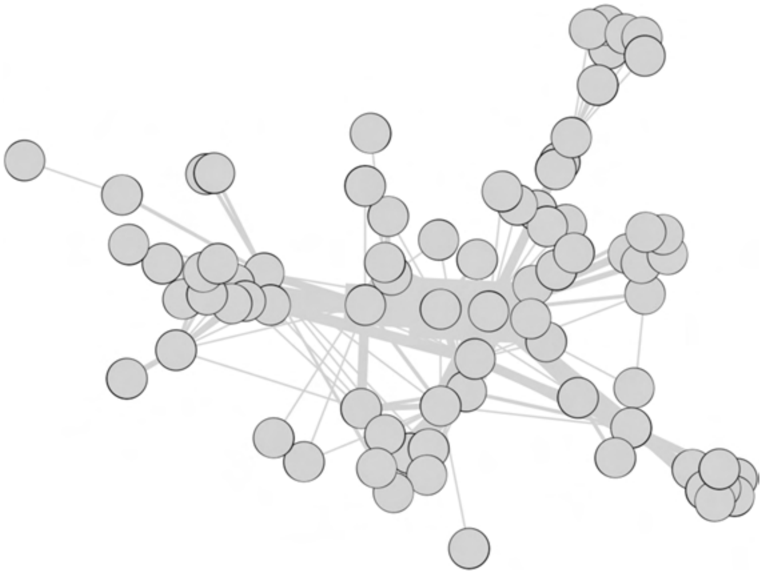

Figure 20: Gephi: ForceAtlas2 layout with grey color applied.

network visualization: nodes are sized according to node degree, edge widths are sized according to edge weight, and nodes are colored by modularity groupings. In addition, this graph embeds a variety of assumptions in its aesthetics. Bright, appealing colors and large node sizes simplify the appearance of the

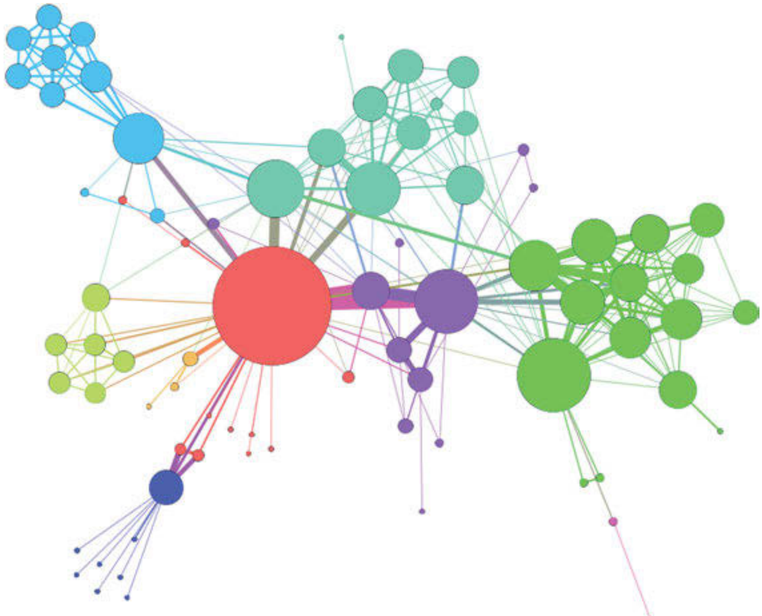

Figure 21: *Les Misérables* network graph included with Gephi installation.

graph. In this visualization, Hugo's multi-character saga is simplified into a story focused on the large red node representing Valjean. The complexity of the characters' connections are visually minimized by using very fine edge lines relative to the node sizes, which modify one's perception of the scale of the full dataset.

Not only is this graph not produced with the default settings in the software, but most of its aesthetics appear to have been manually created to produce certain desired effects. Gephi provides numerous ways for users to alter the aesthetics applied to a graph in order to reveal or enhance certain interpretations of the network; unless these adjustments are documented, which the software itself does not do, viewers may not be able to recognize their effect on the final graph. For example, this visualization uses a bright palette that is not among the standard color sets included with the program; to use this palette, each color would have to be individually specified with RGB or hexadecimal color values. Not including this example's color palette in the software almost seems like a deliberate attempt to frustrate users who might wish to emulate it.

An attempt at recreating the Gephi sample visualization using the ForceAtlas2 layout algorithm is shown in Figure 22. The process of recreating that visualization reveals several key aesthetic manipulations that were used to produce the sample visualization. Several experiments with this layout and with Yifan Hu, which ForceAtlas2 most closely resembles, suggests that the length and placement of the edges towards the periphery of the network may have been manually adjusted to create tighter clusters. In addition, the node sizes have been adjusted to produce the dramatic size differences shown in this sample visualization, rather than using a mathematically scaled approach to representing the node degree range in the network. These adjustments significantly alter the appearance of the graph and the way it guides interpretation of the novel's data.

Figure 22: Reconstruction of the Gephi sample network graph.

As shown in Figure 21, nodes in the sample visualization are colored according to modularity groups. Gephi's modularity analysis tool implements the Louvain method for community detection, which discovers small communities and then iteratively groups them into larger ones within the network (Blondel et al. 2008). When this modularity analysis is run on the *Les Misérables* network using the default settings, the program produces six modularity classes rather than the nine that are shown in Figure 21, suggesting some manual adjustments were made to produce that sample visualization. These adjustments have important effects on the visualization, because the modularity group colors and node sizings used in the Gephi sample visualization sharply distinguish Valjean from other main characters in the novel, including Javert, Thenardier, Marius and Fantine, as shown in the detail in Figure 23. In the sample file, the Valjean cluster consists only of Valjean and a few minor characters with low node degree, and the other high degree characters are clearly separated into other modularity groups.

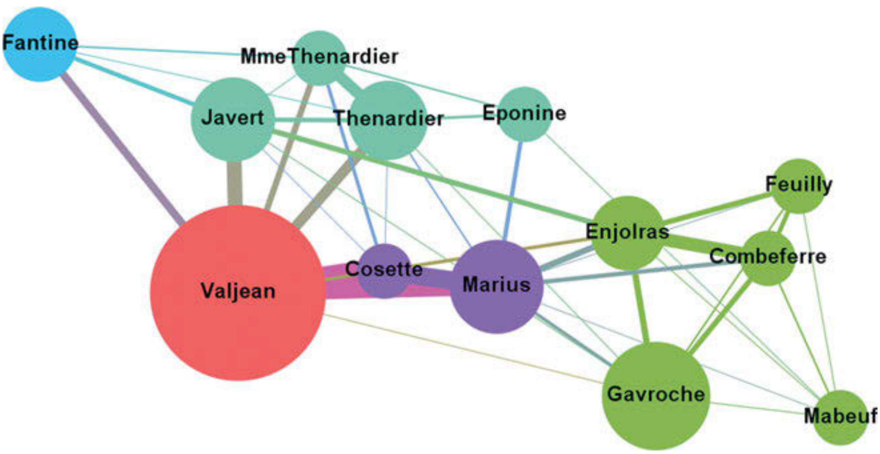

Figure 23: Detail of high degree nodes in the Gephi sample graph shown in Figure 21.

While recreating the sample visualization for Figure 22, multiple experiments were made with adjusting the modularity resolution setting, which affects how many groups are produced. However, Valjean was always grouped with one or more of the high degree characters he is highly connected to. For example, in the reconstruction shown in Figure 22, Valjean is grouped with his antagonist, police inspector Javert, as shown in the detail in Figure 24. These experiments, like the other visualizations presented in this chapter, suggest that Valjean's interconnections with a wide range of characters may be of equal or greater significance in the novel. By setting this graph as an example to learn from, but not providing a full explanation of how it was created, Gephi's designers set unrealistic expectations for simplicity and clarity in network visualizations. Even more problematic

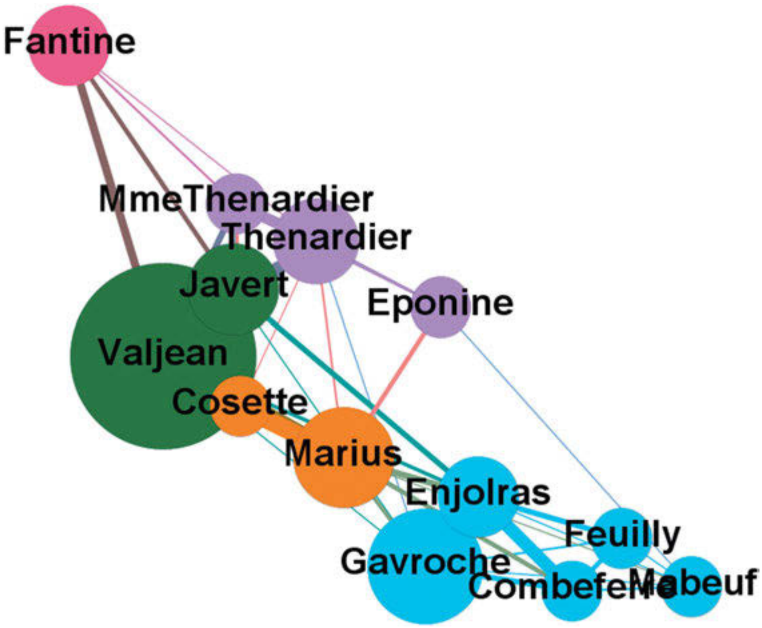

Figure 24: Detail of high degree nodes in the reconstruction of the Gephi sample graph shown in Figure 22.

is the fact that numerous aesthetics in this image were manipulated to create certain effects that shape viewers' perceptions of the underlying data.

This critical account of the default settings in three open source network visualization tools network reveals how visualization aesthetics encode meaning both explicitly and implicitly. Each of these tools offers numerous ways that the user can customize the appearance of the graph so as to promote interpretations of the data. Learning more than one tool allows the researcher to select the software that will be most appropriate for a given project. Although it works very well on large graphs, Pajek's visualization capabilities are somewhat less flexible than the other tools, due to the limited color selection, low resolution images in the Draw screen and differences between the working view and the exported image. The Cytoscape style palettes offer simple one-click adjustments to the appearance of the graph that alter multiple aesthetics at once, but most of these are designed for specific scientific purposes. Although the Gephi sample visualization demonstrates some of the rich aesthetic possibilities in the tool, its default aesthetics are very spare and learning to manipulate the many different aesthetic controls can take some time. No single tool or algorithm is necessarily better than the others; rather, understanding the differences among them and exploring a given network in multiple layouts and in different tools can provide new insights. Because network visualizations assist in understanding data structures at a variety of scales, critical awareness of how network graphs are produced contributes to a more situated, self-reflective data visualization practice that recognizes how aesthetics are always creating meaning.

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Quentin Lobbé, David Chavalarias and Alexandre Delanoë

Defining Level and Scale as Socio-technical Operators for Mining Digital Traces

Abstract: In this article, we investigate the epistemological dimensions pertaining to the notion of *scale* in Digital Humanities (DH). We first echo the growing concerns of digital tools makers who call for separating the notion of *complexity* from the metaphor of *scale* frequently used in the DH literature. We then harvest a corpus of 825 DH papers related to the notion of *scale* and we build a semantic map on top of them to highlight the various ways DH scholars make use of *scale* in their contributions. By reviewing this map, we show that *scale* acts as a blurry concept in DH literature along with *level* used as a sibling. We then argue for distinguishing between *level* and *scale* to reconstruct and visualize the complexity of the social sphere. We redefine *level* and *scale* as operators of a *socio-technical algebra*. This algebra aims at increasing our collective capacity to mine digital traces. We then give practical examples of the joint use of *level* and *scale* with the *phylomemy reconstruction process*. We finally introduce *GarganText* a free text mining software heir of de Rosnay's *Macroscope*. We explain how *GarganText* embeds our definitions of *level* and *scale* considering mathematical foundations, programming technologies and design principles.

Keywords: level, scale, phylomemy, semantic map, macroscope

1 Introduction

The metaphor of *scale* has spread widely in the literature and daily vocabulary of Digital Humanities (DH). As scholars in Social Sciences (SS) are more and more interested in the scientific potential of digital resources, they look for new terminologies to revisit classical concepts and define innovative approaches. However, the epistemological definition of *scale* remains blurry and each sub-domain of DH has its own interpretation. In the best-case scenario, it can either refer to the promises of digital data or to some exploration mechanisms implemented within software; otherwise, *scale* is simply used as a stylistic formula. Yet, other research domains – especially the field of Complex Systems (CS) – have deeply investigated the notions of *scale* and have also introduced the sibling concept of *level*. This vocabulary issue is of great importance: by clearly shaping the notions of *level* and

https://doi.org/10.1515/9783111317779-015

scale we might reinforce the epistemological connections between Social and Computer Sciences. Indeed, we argue for the creation of a socio-technical algebra able to translate any research question of Social Sciences as a mathematical proposition interpretable by computer scientists and implementable in a software. Regarding the current confusion around the metaphor of *scale* in DH, we have chosen to focus on both *level* and *scale* to turn them into the first two operators of our future socio-technical algebra. As part of the *Zoomland* effort, our paper will thus argue for re-defining *level* and *scale* (section 4) by using arguments from digital tool-makers (section 2) and by conducting a wide review of the DH literature (section 3). We will then give practical examples of how *level* and *scale* can be used to reconstruct socio-historical processes from digital resources (section 5) and introduce *GarganText* a free text mining software that implements these two notions (section 6), which makes it possible to combine these operators for investigating a research question.

The evolution of social sciences

Social Sciences have been deeply impacted by the 2000's revolution of the Information and Communications Technologies (Borgman 2003). Over the past 20 years, the unprecedented flow of digital data produced by communication devices and electronic networks has induced an epistemological shift among SS: as new research questions arose, fieldwork and experimental practices evolved to study the digital world. SS had to investigate the inner nature of digital data, explore the scientific capacity of such new materials and create dedicated tools (Edelmann 2020). Scholars then organized themselves and gave birth to the wide domain of *Digital Humanities* (Mounier 2012) and sibling fields: *Digital Studies* (Stiegler 2016), *Digital Sociology* (Boullier 2015), *Digital History* (Kemman 2021), *Digital methods* (Rogers 2013), *Cultural Analytics* (Manovitch 2016), etc. Within the scope of DH, researchers now consider the digital world as a new reflexive way to study our societies and collective memories.

The promises of digital resources

In the same time, archiving and knowledge institutions (libraries, museums, etc.) invested in state-of-the-art infrastructures to store, curate and browse large databases of digital resources (born-digital data or late-digitized data[1]). By doing so, they allowed for diving into the richness of these catalogs and mine digital traces. Indeed, digital resources are *charged* with an *evidential power* (Ginzburg 2013) that bear witness to some socio-historical processes and can thus be considered as *traces* of the social sphere. But investigating such data is not a trivial task and DH scholars have to tackle various socio-mathematical issues when they face digital traces: volume, heterogeneity, discontinuity, incompleteness, etc. Yet, these efforts are worthwhile as the power of connectivity of digital resources (hypertext connections, dynamical properties, multi-dimensional relationships, etc.) enables more complex and valuable studies (Boullier 2015).

The point of view of digital tool-makers

The mutation of part of Social Sciences into Digital Humanities is intrinsically connected to scholars' comprehension of the nature and potential of digital resources. Consequently, digital tool-makers[2] have become central within the scientific ecosystem of DH and their voices should be taken into account and integrated into our own discussions. So far, the notion of *scale* in DH has mostly been empirically investigated and materialized through the uses of software designed by digital tool-makers: *scale* is an *in situ* feeling whose potential is still largely unexplored. Recently, tool-makers have been interested in the mathematical, technical and visual *explainability* of their own tools (Jacomy 2021). They aim at preventing *complexity questions* from being hidden behind the metaphor of *scale* and the illusion of continuity induced by software between original data sets and experimental outcomes. This idea of *not hiding the complexity* will now guide our reasoning and help us to re-define *scale* and *level*.

2 A false feeling of continuity

In what follows, we will focus on data exploration tools used by scholars in Digital Humanities as they all share a common *undertone*: they are powered by *scale* mechanisms. Tool-makers usually denominate exploration tools as *datascapes*; that is, ad hoc exploratory environments used by scientists to study digital mate-

1 With some exceptions, we will mainly use *digital resources* to refer to both *born-digital* and *late-digitized* data.

2 Engineers, computer scientists or social scientists acculturated to digital technologies.

rials (Girard 2017). These tools are always built in relation to a specific data set, an issue or a research topic– in the same way as R. Rogers issue-driven methodology for building digital tools (Rogers 2013). Datascapes can thus be seen as a *monadic* way to investigate digital traces.[3] (Tarde 2011) There, what matters most is the upstream harvesting of an input digital material and the initial hypothesis formulated by the researchers that will later drive the making of the datascape. Sometime datascapes become standalone software such as the graph analysis software *Gephi* (Bastian 2009): a datascape that emancipated itself from ad hoc constraints and became generic. Overall, every datascape conveys a shared feeling, the impression that one can zoom within the data, navigate the digital resources, change the *"scale of analysis"*.

Scaling mechanisms are inherent to datascapes. For instance, some researchers use *zoom* features to explore a citation network with Gephi, other scientists apply a change of scale by annotating individual documents to reveal – from a bird's eye view – interactions that structure a body of texts, some scholars take advantage of geographical data to analyze the dynamics of an historical process in various places, etc. In the context of digital humanities, tool-makers rely on the nature of digital resources to unblock the navigation from individual elements to collective structures. *Zooming in* or *out* thus appears to be a natural metaphor to explain how the majority of exploration tools work (Boullier 2016). However, *change of scales*, as a DH notion, has never been investigated. This is a major issue because *zoom* mechanisms induce a fake feeling of *continuity* between the original digital resources and their future explorations. Tool-makers hide a lot of un-natural tasks behind *multi-scale* features (Boullier 2016): filtering, aggregations, re-processing, etc. The intrinsic complexity contained within the original digital resources is thus reduced before being explored through any interface. We think that this is the source of the paradox described by M. Jacomy (tool-maker and co-inventor of Gephi) in his thesis:

> A Gephi user once told me: "*Gephi understands the network, but I do not understand Gephi.*" I understand this statement as an acknowledgement that the visualization is correct despite being incomprehensible. (Jacomy 2021: 190)

By hiding the complexity of the digital resources behind a false feeling of continuity, implicit *zoom* mechanisms induce *visual explainability* issues. The notion of *scale* needs to be defined and separated from the notion of *complexity* to improve

3 In Metaphysics monad means unity, in Mathematics monads are used to define sets of rules between categories sharing a common space (ie, adjunctions), in functional programming monads are used to abstract control flows and side-effects.

exploration and analysis processes in DH. Our goal in this paper is to follow a *complex systems* approach to define the concept of *scale* along with the sibling concept of *level*. We think that this clarification can contribute to the conceptual corpus of Digital Humanities and guide the making of innovative tools as suggested by M. Jacomy to study social and historical phenomenon:

> We cannot see into the complex as if it was simple. We must switch metaphors and build our scientific apparatus from a different perspective. We must build something else, for instance, *complexoscapes* — composite visualization systems where inevitable reductions are counterbalanced by the possibility of navigating between complementary views and visualizations. (Jacomy 2021: 190)

3 Scale and level as undertones in Digital Humanities

To complete the point of view of digital tool-makers (see section 2) and support our thought, we will now conduct a wide review of a corpus of Digital Humanities papers that somehow use the words *scale* and *level* in their arguments. By analyzing the many ways *scale* and sibling expressions are used in the DH literature, we will understand how the DH community organizes itself (or not) around this notion. We will use bird's-eye visualizations of the whole corpus and review individual contributions to improve our analysis.

We first harvest a corpus of 825 scientific papers' metadata[4] (titles and abstracts) extracted from both the *Web of Science* and *Scopus* and matching the query *("digital history" or "digital humanit*") and (scale or level or multi-level* or multi-scale* or macroscope or "scalable reading" or "deep mapping").* With the free text mining software *GarganText*[5] we then extract a list of terms and expressions used within the papers by the researchers. GarganText next reconstructs connections between these terms by computing the conditional probability of having one term written in a paper jointly with another from the list. The resulting map (Figure 1) shows the semantic landscape of our corpus. There, terms are dots and semantic relationships are edges. Colors highlight communities of terms more frequently used together, these groups represent the main subjects of research and communities of interest hidden within our 825 papers. We count 5 distinct communities: *digi-*

4 The corpus, the list of terms and the resulting map can be downloaded at https://doi.org/10.7910/DVN/8C1HKQ. Accessed July 10, 2023.

5 See https://cnrs.gargantext.org/. Accessed July 10, 2023.

tal history and the detection of patterns in literature (purple), *the issue of digitization of cultural heritage* (pink), *modeling as goal* (brown, Figure 2), *digital library and the quality of metadata* (orange) and *the issue of visualization* (blue, Figure 3)

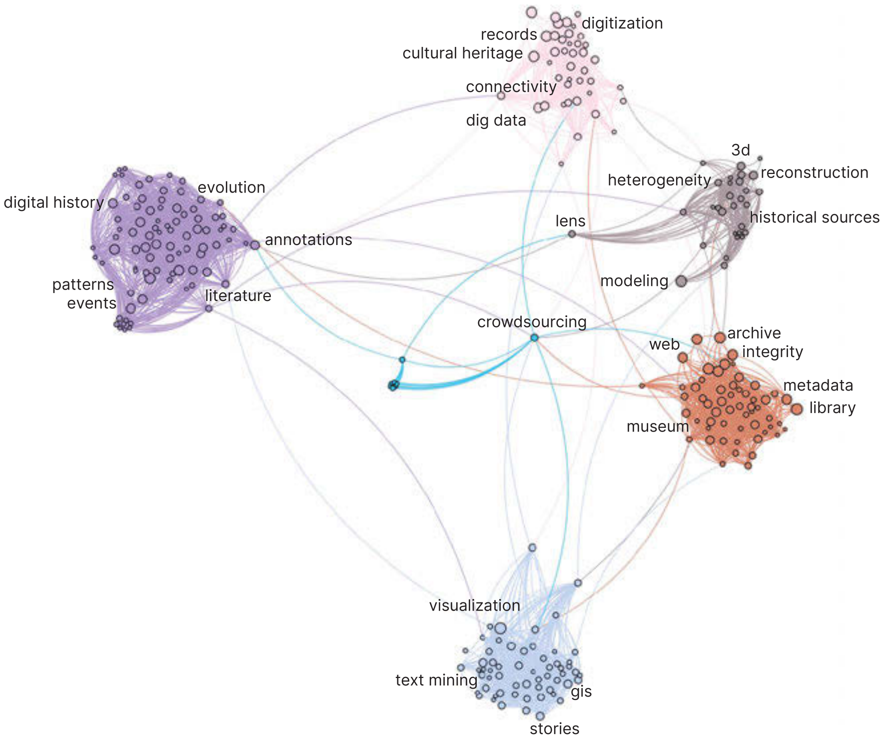

Figure 1: Semantic map of 825 scientific papers extracted from both the Web of Science and Scopus. Built with Gargantext and spatialized with Gephi.

The semantic map (Figure 1) shows that *scale* is not a unified notion in the DH literature as our corpus of papers organized itself in very distinct and distant communities (a unified literature would have produced a single, large and central community). Yet, *scale* lives through the entire DH literature, not as a well-defined concept, but more as blurry undertone. There, *scale* conveys various meanings among different communities:

– promises for future works ("how to scale up the solutions based on collaborative research efforts" (Tolonen 2019))
– range of actions over a digital data set ("micro-scale uploads" (Mcintyre 2016), "fine-grained annotation" (Wang 2021))

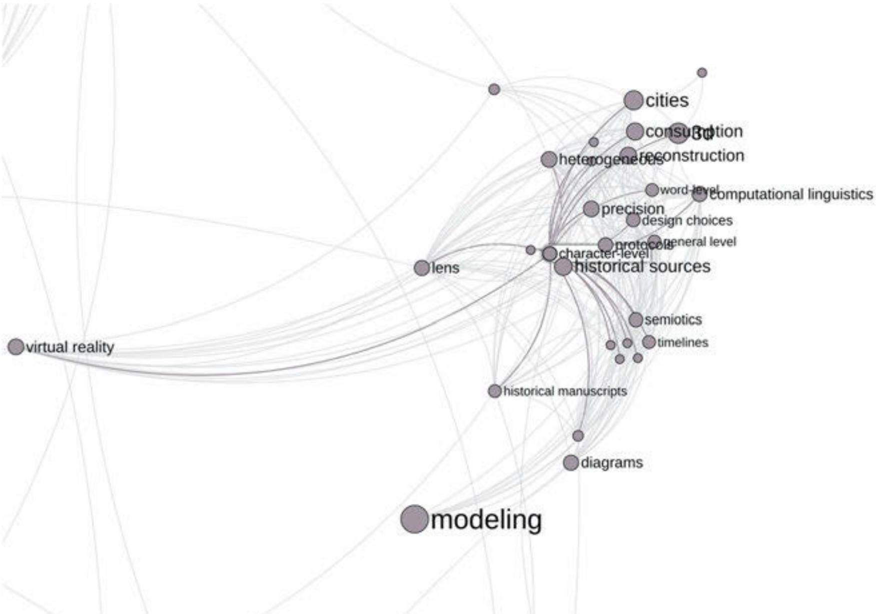

Figure 2: Detail of the community modeling, reconstruction and virtual reality from the map of Figure 1.

- impact, quality or context of an historical event / object ("the rise of revolutionary movements made manifest through large-scale street actions" (Sakr 2013), "a center of high level of artistic production" (Boudon 2016), "the reconstruction of macro- and micro-contexts" (Nevalainen 2015))
- quantity of data analyzed in a paper ("large scale analysis" (Risi 2022), "visualizing information on performance opens new horizons of significance for theatre research at scales" (Bollen 2016))
- scalability issues for data engineering ("regarding the overall archiving storage capacity and scalability" (Subotic 2013))
- scope of the observed patterns or temporal motifs ("macro-level patterns of text and discourse organization" (Joulain 2016))
- choice of an analytical layer in the case of multi-dimensional or cross-domain analysis ("every object that is catalogued is assigned entry-level data, along with further data layers" (Edmond 2017))
- exploration and visualization tasks ("interfaces are a valuable starting point to large-scale explorations" (Hinrichs 2015), "screen-based visualization has made significant progress, allowing for complex textual situations to be captured at the micro-and the macro-level" (Janicke 2017)) see Figure 3;

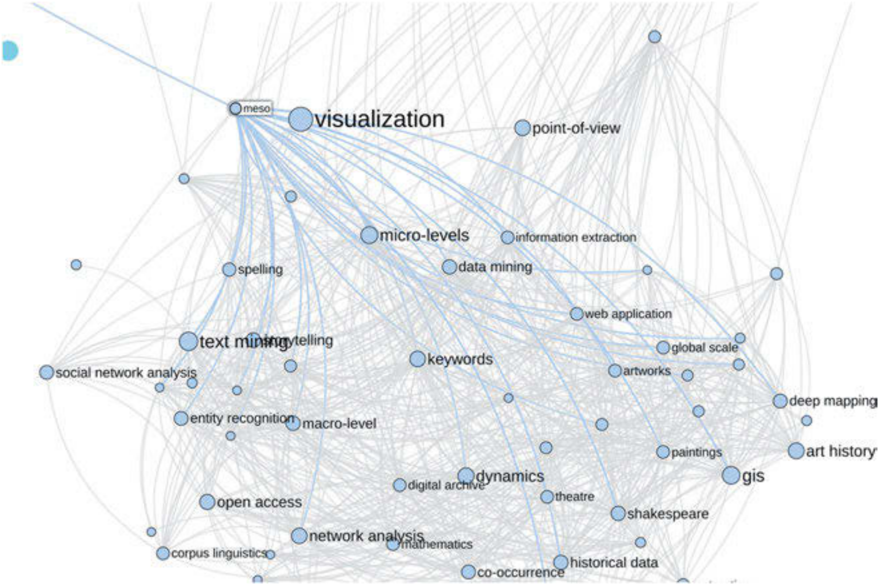

Figure 3: Detail of the community data visualization from the map of Figure 1.

- choice of a fragmented / elementary reconstruction approach ("our method relies on character-level statistical machine translation" (Scherrer 2015), "a relatively novel technology which allows to effectively represent the intrinsic word-level uncertainty" (Prieto 2021))
- an ad hoc question of complexity ("levels of granularity" (Allen 2011), "levels of complexity" (Rose 2016)) see Figure 2.

Thanks to the Figure 1 and details, we reveal that the epistemological frame of *scale* in DH literature is not yet stabilized. For our part, we think that *scale* should be separated from all notions of *complexity* to clear its definition and help tool-makers to create the next generation of datascapes (see section 2). After having reviewed the corpus used for building the map, we are able to clear two distinct proto-definitions of *scale* and *level* as notions:

1. connected to *visualization* and exploration tasks, *scale* can be seen as a zoom mechanism. Here, *scale* becomes a design principle, a feature of interactivity. By allowing the user to navigate through *multiple* scales, the ergonomic choices behind the datascapes become an *empirical and analytical algebra* for social scientists;

2. the word *level* is used as a sibling for *scale* but not as synonym. In fact, *level* is mostly associated to the notion of *complexity* of the research subject; that is, a *reconstruction* choice made upstream from the visualization task.

In what follows, we will use these two proto-definitions enriched with Complex Systems concepts to introduce our own definitions of what we call: level of observation and scale of description.

4 Level of observation and scale of description

In order to distinguish between the notions of *level* and *scale*, we now use elements of knowledge from the Complex Systems' literature (CS). As a research domain, CS naturally addresses the questions of *scale*, *level* and *complexity* as it aims at studying how collective structures and global dynamics emerge from individual interactions and how natural or artificial phenomena evolve, connect or enrich themselves throughout time. Furthermore, the two proto-definitions outlined in section 3 echo the most recent outcomes of CS' literature.

4.1 Level

CS scholars have recently made a clear distinction between *level* and *scale* (Chavalarias 2021). *Level* is generally defined as a domain higher than *scale* and *scale* refers to the structural organization within a given *level*. Choosing a level of observation means making a choice of complexity. In Biology, for example, the choice of a given *level* determines what the main entities under study (organs, cells, genes, etc.) are. Applied to Digital Humanities, choosing a *level* means choosing the intrinsic complexity of the processes we want to analyze. In the case of quantitative Epistemology for instance, choosing a micro *level of observation* means choosing to reconstruct the evolution of a given scientific domain (from a corpus of scientific publications) by looking at the way this domain has resulted from the temporal and internal combinations of many sub-research fields. There, these small fields of research can be considered as elementary entities of analysis. But choosing a macro *level of observation* instead means choosing to consider larger research domains (for instance, Sociology or Biology) as elementary entities of analysis. By doing so, we will focus on the evolution of the inter-disciplinary interactions between wide research domains.

4.2 Scale

For its part, the choice of a *scale* determines the resolution adopted to describe a phenomenon at a given level. The *scale* can be seen as an exploration principle used for zooming through a given visualization. By re-scaling this visualization, we explore different scales of description and we navigate among layers from individual interactions to macro structures (Lobbe 2021). The choice of a given *level* occurs once and for all during what we call the *reconstruction* step upstream from the visualization task. The goal of the reconstruction task is to model a phenomenon from a collection of harvested, curated and annotated digital traces. We then use these traces to create a mathematical approximation for the phenomenon's structure and behavior (a network for instance). This reconstructed object is then projected in a visualization space where it can be explored and described throughout different *scales*.

4.3 Socio-technical algebra

Levels and scales can now be combined as distinct operators of a socio-technical algebra. Such an algebra aims at translating any social science research questions into mathematical formulas comprehensible by computer scientists. These formulas will eventually be implemented within software or graphically translated through interactive user-interfaces. So, let's call φ a generic data analysis process (represented by a triangle in Figure 4). φ consists of three standard steps: the data collection (*digital resources* in Figure 4), the reconstruction (i.e., the computer-based modelling of the targeted socio-historical phenomenon) and the visualization (i.e., the exploration of the reconstructed phenomenon through an interface by a researcher). The choice of a level occurs during the reconstruction step. The choice of a scale occurs during the visualization step. According to our socio-technical algebra, φ can be seen as a function of both levels x and scales y such as $\varphi = f(x,y)$ (see Figure 4). Thus, DH scientists first start by harvesting digital traces related to their research question. Then, they choose a level of observation that will determine the complexity of the modelling of the phenomenon under study. Finally, they visualize the complex object (a map for instance) reconstructed by the computer through an interface. By interacting with this interface, they will move from one scale of description to another and base their upcoming analysis upon this choice of scale. In the future, this socio-technical algebra will be enriched with additional operators. For instance, in Section 6 we will introduce the *order 1* and *order 2* metrics: two extra operators that can be combined with level and scale.

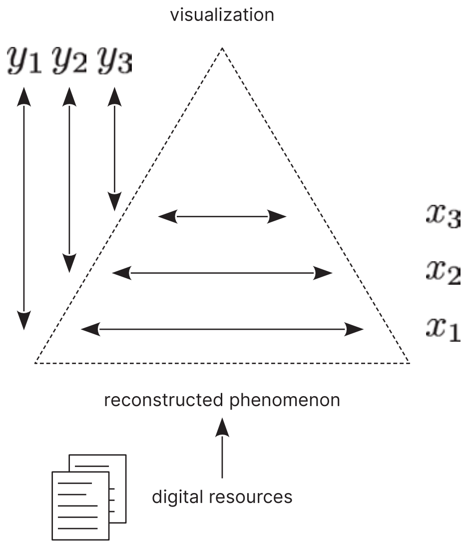

Figure 4: Diagram of the generic digital data analysis process φ seen as a function of levels x and scales y.

5 Using level and scale with phylomemy reconstruction

In this section, we will give a concrete example of how *level* and *scale* can be used by DH scholars to reconstruct and explore socio-historical processes. We address the following epistemological research question: how can we reconstruct the evolution of the scientific landscape of a given research domain throughout time? This question assumes that the evolution of science can be reconstructed from the main traces left by researchers and scholars; that is, publications and scientific papers. As a constraint, we won't use any pre-existing structured resources (citations graphs, ontologies, etc.) apart from an initial corpus of scientific publications: the dynamic structure will emerge from the co-occurrence and co-use of scientific terms and expressions in time. In fact, this research question can be extended to all type of timestamped corpus of textual documents: how can we reconstruct the evolution of a corpus of letters? How can we reconstruct the evolution of a literary genre? How can we reconstruct the evolution of online debates? How can we visualize the coverage of a targeted public event by newspaper through time? etc.

To answer this question, we will make use of a new scientific object: the phylomemy (Chavalarias 2021; Lobbe 2021). Phylomemies can be reconstructed on top of any timestamped corpora of text data. The *phylomemy reconstruction process* is part of the larger family of co-word analysis approaches: a type of text mining techniques used to analyze the co-occurrences of words, terms or expressions within texts (Callon 1986). More precisely, Phylomemies are designed to reconstruct the dynamics of *terms-to-terms relationships* through time and visualize the evolution of *semantic landscapes*. Phylomemies are thus inheritance networks of textual elements of knowledge. Applied to the analysis of the evolution of science for instance, phylomemies can be seen as genealogical trees of scientific fields that structure themselves in evolving branches of knowledge; that is subdomains of research contained within a given discipline.

5.1 Methodology

Phylomemies have first to be *reconstructed* from a collected set of documents before being *visualized* and explored through dedicated software (see Section 6). The reconstruction process can be divided into four subsequent steps:[6] 1) *Indexation*, we first frame a corpus of texts and then extract its core vocabulary (terms or expressions). We next choose a temporal resolution (e.g. 3 years) that chunks this corpus among ordered sets of equal periods. Within each period, we compute the terms' co-occurrence their co-presence in the original documents. 2) *Similarity measures*, within each period we use the co-occurrence of terms to compute a similarity measure. It results in graphs of similarities potentially containing meaningful groups of terms frequently used together. We call these groups *fields*. 3) *Field clustering*, a clustering algorithm is then used to detect coherent fields of terms within each period. 4) *Inter-temporal matching*, an inter-temporal matching mechanism reconstructs the kinship relations between fields from one period to another. It assigns each group of terms a set of parents and children by using a semantic similarity measure. By doing so, we highlight elements of semantic continuity over time called *branches*.

5.2 Level and scale with phylomemies

The phylomemy reconstruction process already considers the notion of *level* and *scale* as defined in section 4: the level can be set up during the reconstruction step; the scale can be set up during the visualization step. There, the *level of observation* has been modelled as a continuous variable $\lambda \in [0,1]$ and a quality function F_λ has

6 See Chavalarias 2021 for details concerning the algorithms and text mining techniques used in the phylomemy reconstruction process.

been designed to control the intrinsic complexity of the phylomemy (Chavalarias 2021). F_λ aims at answering the following question: “What should be the global shape of the phylomemy, so that for any term x I could be able to find an *informative* branch of knowledge dealing with x?”. By choosing a level λ between $[0,1]$, we influence the informativeness of the branches of the resulting phylomemy: they thus might vary from very precise branches to very generic branches. For a low *level* ($\lambda \to 0$) all fields and terms will be connected within few but large branches; For a high *level* ($\lambda \to 1$) the phylomemy will look like an archipelago of specific and accurate branches. Then, once the phylomemy has been reconstructed, it is projected in a visualization place – a dedicated datascape – where researchers can explore the evolving structure from term relationships to branch similarities and choose the good scale of description and resolution to analyze the whole object (Lobbe 2021).

As we have already harvested a corpus of scientific publications in section 3, we will now reuse it (along with its list of terms) and reconstruct its semantic evolution. This will give us clues of how the domain of Digital Humanities has positioned itself regarding the notion of *scale* in the last 15 years. This will enrich our analysis of Figure 1 with a temporal perspective. We first reconstruct the phylomemy for a *level* $\lambda = 0$.

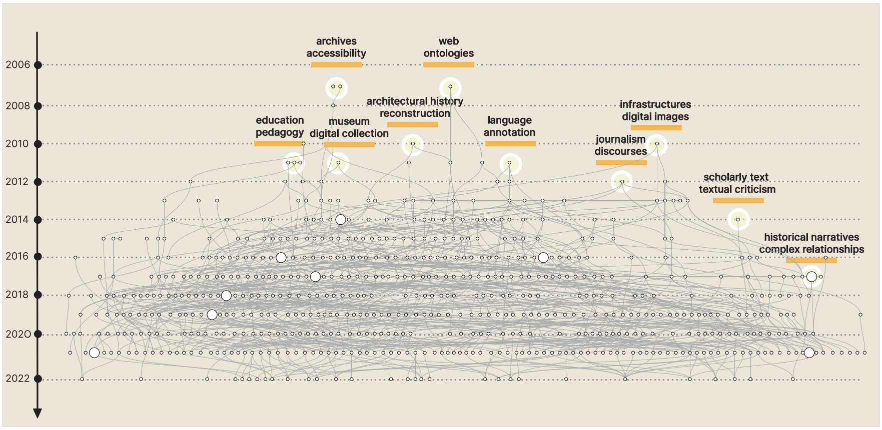

Figure 5: A phylomemy of the scientific literature of digital humanities reconstructed for $\lambda = 0$.

In the resulting Figure 5, the phylomemy must first be read from top to down. Circles represent groups of terms jointly used together in a set of papers at the same time. The bigger the circle, the larger the number of matching documents. For readability motive, we here choose not to display the textual content of the circles. We highlight in yellow the origins of significant sub-research domains of DH motivated by classical pre-digital research subjects (*archiving*, *education*, *textual criticism*, etc.) or new type of digital resources (*web data*, *digital images*, *digitized scholarly texts*, etc.).

But this phylomemy (Figure 5) cannot be considered as informative: its complexity is too high, we need to simplify it (ie, remove weak kinship links) to reveal more structured shapes. To that end, we now reconstruct the same phylomemy for higher *levels* $\lambda > 0$.

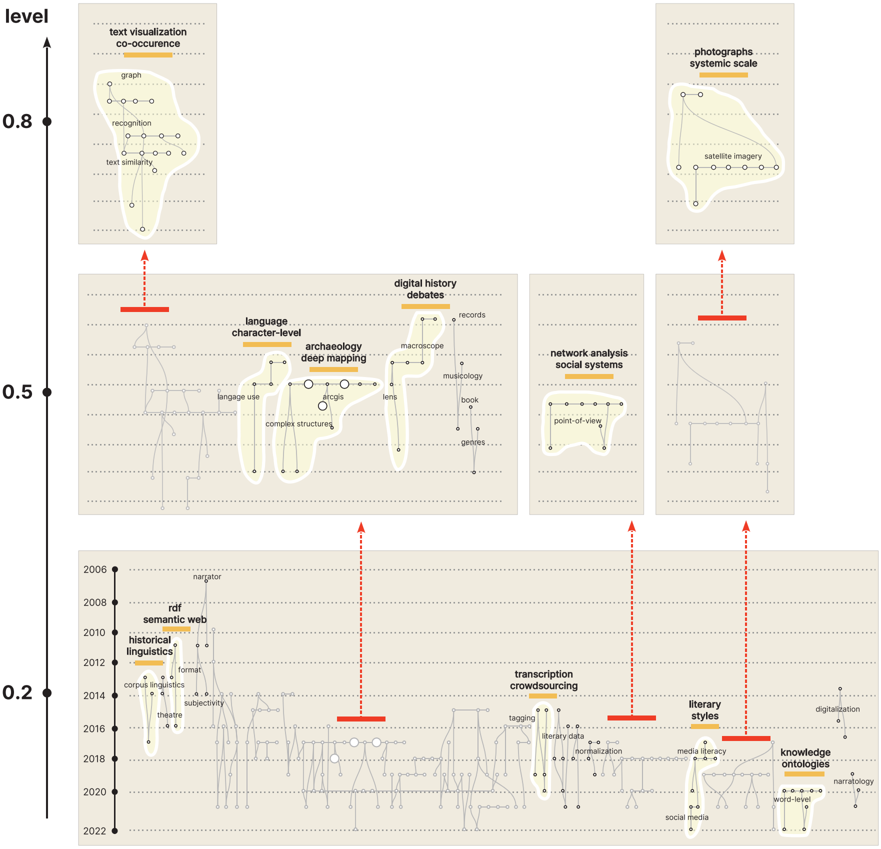

Figure 6: The progressive specialization of phylomemies of the scientific literature of digital humanities reconstructed for $\lambda = 0.2$, 0.5 and 0.8.

The resulting Figure 6 shows how the phylomemy specialized itself for subsequent *levels* $\lambda > 0$. To build this visualization, we have first tested many values of λ and we have then taken on the values for which the complexity of the phylomemy significantly changed that is: $\lambda = 0.2$, 0.5 and 0.8. Thus, the scientific landscape of DH – regarding our original corpus of papers – starts to structure itself at $\lambda = 0.2$: the single and large branch (Figure 5) breaks into smaller branches that represent satellite sub-research domains of DH like *historical linguistic*, *literary style analysis*, *crowdsourced transcription and annotation*, etc. We then need to reach $\lambda = 0.5$ to see the emergence of the main Digital Humanities' research branches: *digital history*, *archeology*, *network analysis*. Finally, very specific branches like *text visualization* appear and stabilize themselves at $\lambda = 0.8$.

By choosing the example of phylomemies, we see how our definition of *level* can be used to analyze the same process – the temporal evolution of DH literature – at different degrees of complexity and how we influence the intrinsic structure of the resulting visualization. We finally invite the readers to explore the Figure 6 in our online datascape[7] to experiment some *multi-scale* navigation mechanisms. Indeed, phylomemies embed an endogenous *scaling* mechanism that builds on the kinship links of each branches. The weights of these links (ie, the semantic similarity measure) are sorted and distributed among increasing ranges that result in a finite number of *scales* per branch. By moving from one *scale* to another within our datascape, scholars can choose a suitable resolution for each branch and aggregated groups of terms whose link weight is inferior to the selected *scale*. In the Figure 7, we show how this mechanism can be used on the unnamed grey branch of the phylomemy $\lambda = 0.2$ of Figure 6. This branch embeds about twenty different *scales* of description.

6 Beyond level and scale, introducing GarganText

Recent technical reviews (Chavalarias 2021; Lobbe 2021) have shown that no software or datascapes are today able to implement the notions of *level* and *scale* as defined in Section 4. That's the reason why we have decided to create our own *complexoscope* (see Section 2). We here want to introduce GarganText[8] (Delanoe 2023) a free text mining software, heir of De Rosnay's *macroscopes* (Derosnay 2014); that is,

7 The phylomemy reconstructed for level 0.2 can be explored at http://maps.gargantext.org/phylo/zoomland/. Accessed July 10, 2023.

8 GarganText has been invented and is developed by A. Delanoë at the ISCPIF CNRS, see https://gargantext.org/. Accessed July 10, 2023.

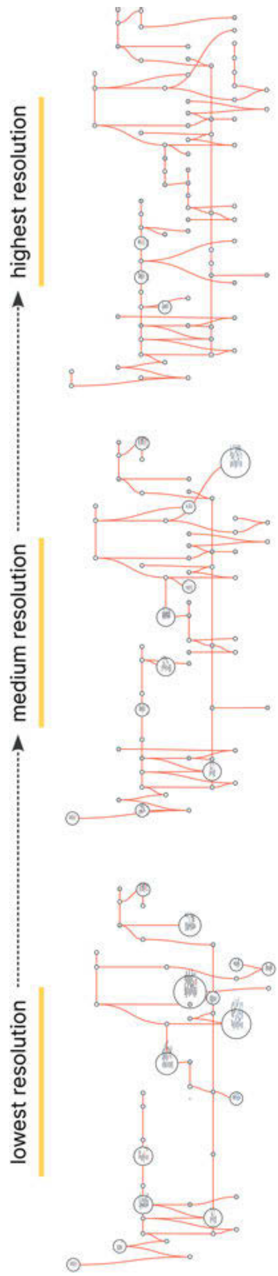

Figure 7: Multi-scale mechanism for choosing a suitable resolution for a given branch of knowledge.

a software designed to reveal the global structure and dynamics of corpora of textual documents by computing individual interactions (co-occurrence,[9] conditional probability,[10] temporal similarity,[11] etc.) between terms and expressions. Contrary to classical datascapes, GarganText is *data agnostic*, it takes any textual elements as input data (short texts, novels, corpus of thousands of papers, etc.) and produces three types of visualizations: basic charts, semantic maps and phylomemies. Between the initial corpus and the resulting visualizations, GarganText uses the functional capacity and mathematical stability of the programming language *Haskell*[12] to materialize an agile data analysis process. By using a functional programming language, GarganText allows scholars to control and customize their analysis at will by choosing between different strategies (implemented as standalone functions in the source code) and even by going backward to previous steps. The researchers can thus choose a first *level* of complexity, jump to a phylomemy, explore its *scales* and then go back to another *level*, and so on. By doing so, GarganText creates a true continuum of data exploration, from backend functionalities to design principles. Finally, GarganText enables collaborative and decentralized analysis.

Discussion. Can we go beyond *level* and *scale*? Can we imagine additional variables to our data analysis process $f(\varphi)$? We think that the answer is yes and GarganText already implements a *linguistic order* when one wants to reconstruct a semantic map. Using the graph functionality of GarganText after having selected together the right terms to throw light on, we can analyze two types of graphs, the one of order 1 and the one of order 2. Each type of graph has its own interpretation regarding our research purpose.

The **order 1** graph is used to approximate the global quality of the corpus. Analyzing its clusters gives a simple idea of the main picture of the corpus by detecting eventual noise in it. The order 1 graph results in semantic clusters from association of terms in conjunction (i.e., terms A and terms B are in the same textual context). The central clusters show the main topics of the corpus and its peripheral clusters describe the secondary themes.

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9 For instance, in the corpus of, the terms *micro-digitisation* and *sustainability* are jointly used three times by various authors so their co-occurrence count is 3.

10 For instance in the Figure 1, the weight of the link (ie, the conditional probability) between *knowledge graph* and *rdf* is 0.8. It means that we read *knowledge graph* in a paper, it will be very likely associated to *rdf*.

11 For instance in the Figure 5, the temporal similarity between the group of terms *language, debates, corpus linguistics, historical linguistics & discourse structure* (in 2014) and *term annotations, language, software, corpus linguistics & historical linguistics* (in 2017) is 0.65 as they share 3 out of 5 terms, knowing that these terms are weighted regarding their specificity in the corpus.

12 See https://www.haskell.org/. Accessed July 10, 2023.

The **order 2** graph shows the clusters built from the graph of association of terms in disjunction (i.e., terms A and terms B that can be interchangeably used in same textual context). As a consequence, the clusters throw light on the main concepts of the current corpus. For instance, the Figure 1 is an order 2 graph.

Hence the order 1 and order 2 present two different types of interpretation. First order graph shows the subjects to improve both the quality of the set of documents and the selection of the terms under study. Second order graph shows the main concepts highlighted in the corpus for the research goal of the team working together in the GarganText collaborative working space.

To conclude, we want to call to mind that *level* and *scale* – as defined in Section 4– are two orthogonal notions of a much more complex socio-mathematical algebra meant to mine digital traces. In the future, we invite DH scholars to enrich this algebra by the defining new notions or objects (such as *order 1* and *order 2* graphs) along with interoperability operators: for instance, *the level is a higher order entity than the scale*. GarganText already lays the groundwork for more innovative analytical variables that will take advantage of the power of reflectivity and connectivity of digital resources.

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Francis Harvey and Marta Kuźma

Zooming is (not just) Scaling: Considerations of Scale in Old Maps from Cartographic Perspectives on Generalisation

Abstract: This chapter examines how cartographic concepts of scale are developed to help provide a framework for traditional map production including generalization. Contemporary digital humanities researchers rarely have knowledge of this framework and practices. Geographers work closely with cartographers, leading to map scale possessing a wide array of epistemological and ontological characteristics that is inherent and even implicit. Map scale is essential to other fields. The digitization of traditional maps and the creation of scanned map applications for computers in the 1990s open new types of access. Combined with scale-dependent raster graphics, the convincing illusion of zooming through space developed as the primary interface for digital maps. The informationalization of geographic knowledge and cartographic functions has extended zooming to these maps, although these digital maps are distinct from traditional paper media maps. Theories and methods of historical interpretative research extend new possibilities for DH research to consider cartographic generalization and its manipulations indicated by scale.

Keywords: generalisation, cartographic scale, historical maps, old maps, map interpretation

1 Introduction

Cartographic scale can become a surprisingly challenging concept considering contemporary possibilities for zooming (and panning) digitized old maps. Working with digitized copies of old maps, which researchers can easily find, ignores the

Acknowledgements: We thank our colleagues at the University of Warsaw and Leibniz Institute of Regional Geography in Leipzig for their helpful comments and insights. We also acknowledge the support of the People, Places and Events project. The project is co-financed by the Polish National Agency for Academic Exchange within the NAWA Chair programme. Finally, we are most grateful to the editors of the Zoomland book and the helpful comments provided by participants of the Zoomland workshop in June 2022.

https://doi.org/10.1515/9783111317779-016

condition of old maps, but this approach runs the risk of misinterpretation. Considering scale in historical interpretative work involves many issues. Addressing these issues, this contribution draws on cartographic research, provides some background into cartographers' concept of generalization and the process for making graphic alterations for different scales and purposes, and suggests some analytical techniques to gain helpful insights into potentially significant alterations of old maps. These insights are primarily directed at digital historical researchers yet have relevance for curators and others in the public humanities working with old maps and seeking helpful insights to make old maps more accessible to any audience. For readers, we stress that our focus is on "Generalization", the term for cartographic operations that change cartographic features, usually from large-scale maps of smaller areas to smaller-scale maps of larger areas. These operations can make fundamental and even possibly arbitrary changes to the representation of map features. A generalization can correspond to scale directly, but its relationship with scale involves more complex representational and epistemological aspects. Changes to a map through the processes of generalization are often also a matter of a map's intended function or use. We point out in the contribution that cartographic scale refers, on the one hand, to a metric relationship; it also refers to complex to ascertain semiotic graphic choices arising from the selective implementation of generalization operations that alter shapes, change locations and even refigure the relationships among map elements. Cartographic scale, carefully considered in both the creation and consideration of maps, is a very demanding topic. Of course, generalization is just one part of the cartographic process and production. Projections can famously produce very significant changes in the shapes of cartographic features. Our focus on better understanding the impacts of generalization in historical maps reflects the significance of its consequences (see Figure 1).

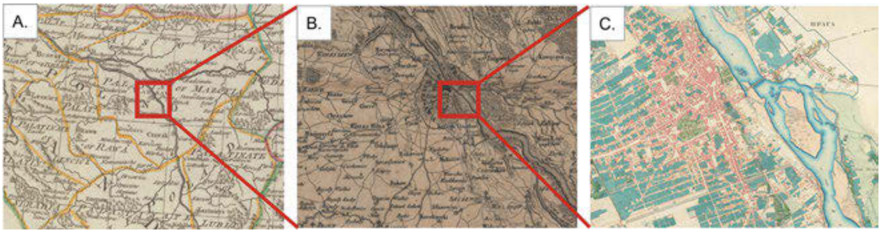

Figure 1: Three old maps (from A. Palairet (1765), B. Perthées (1794), C. "Plan of the Warsaw suburbs" (1836)) showing different scales and generalisations of the Vistula (Wisła) River.

In our contribution to this book, we also place the changes arising from generalization operations in the context of contemporary zooming capabilities, which most readers today are more likely familiar with. Zooming a digital map (mostly a scanned version) involves a very different epistemology for a map reader who can now interactively zoom around a digital(-ized) map. The generalization may occur during zooming, but is not intrinsic to an interactive map reading process focused on the user's ability to zoom arbitrarily and pan. In contrast, old maps were prepared and generalized for a so-called "bird's eye view", but as D. Haraway suggests, the view from nowhere requires learning to read and interpret the map in its preformed objectivity and perspective (Haraway 1988: 575).

A central point in this contribution is that traditional cartographic generalization might seem even whimsical to the public humanities and digital historians. Still, cartographers of past epochs were mostly bound by partially defined but often idiosyncratic design processes and rules. In more traditional handwork-orientated work organizations producing maps with various print processes, the more expert cartographers provided guidelines and checked the map in production; these were usually strictly enforced in the hierarchical organization of the workplace. Readers (or users) getting these cartographic products and using maps before digital versions became available did not have to learn how to read the alterations made in the generalization process. Still, changes to other map products meant readers relying on maps had to become experts (implicit or explicit) in particular maps or map series. In other words, generalized maps were logocentric, bound up with cultural and institutional values in straightforward ways (Abend and Harvey 2017). We still experience this when we use unfamiliar maps of specific fields (such as city fire department maps, electrical utility maps or cadastral maps). We might not understand the guidelines, but we may be able to assess the impacts on our understanding of old maps. In contrast, our current use of most digital maps (especially GoogleMaps and similar applications on mobile devices) involves an egocentric experience of map media – we quickly learn to apply this interface that allows us, as in so many other graphical applications, to zoom and pan. The activity of zooming is always related to a sensory experience and rests on digital habits of visual engagement. In the most significant epistemological way, working with logocentric media, such as old maps, requires us to learn some of the logocentric approaches from another way of presenting and positioning map elements we now frequently rely on.

The issues and approach we present to consider scale in interpretative historical work involve many issues. This contribution aligns with spatial humanities research, specifically taking up cartographic research and to the digital public humanities. We understand an important and relevant goal of the digital public humanities is the engagement of participants in a historically contextualized conversation like in the *Photogrammar* project (Cox and Tilton 2019). Importantly, for our contribution to this book, most of the place-related knowledge from the past for working with old maps is now lost. In the approach we introduce here, we turn to some metric measures to assess and thus better understand past generalizations' effects on old maps.

1.1 Generalization exemplified

Considering the effects of generalization operations as the implementation of mainly scale-related changes in historical interpretative work involves many issues. These issues can be significant for historical researchers using old maps, particularly topographic maps from the 17th through 20th centuries (See Figures 2 A–C and 3 A–C).

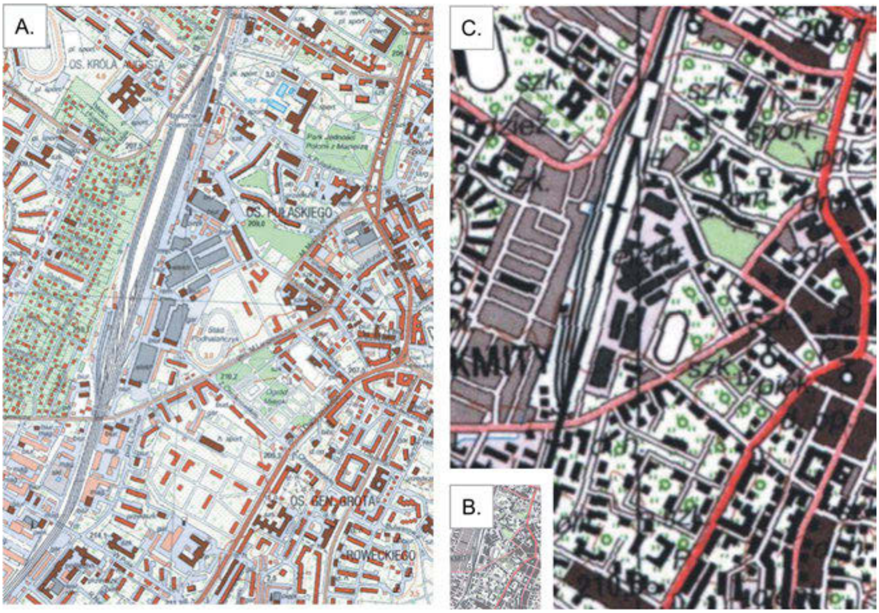

Figure 2: A. Part of the topographic map in 1:10,000 (Rzeszów sheet), B. The same area on a 1:50,000 map (Rzeszów-Zach). C. Part of a 1:50,000 map enlarged to 1:10,000 (Ostrowski 2003). The didactic pair of maps illustrates the numerous effects of scale-related changes in all traditionally prepared maps.

Scale-related changes in generalized maps can be significant. Generalization operations can alter locations, relationships and even the graphical presentation of

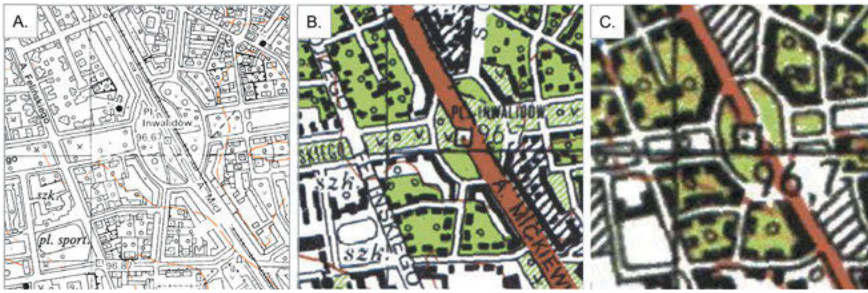

Figure 3: A. Part of topographic map in 1:10,000 (Warsaw, sheet 263.343, 263.344, 1982), B. Part of a 1:25,000 map (Warsaw, sheet 263.34, 1981) enlarged to 1:10,000, C. Part of a 1:50,000 map (Warsaw, sheet 263.3, 1973) enlarged to 1:10,000. The reduction of graphic information and changed emphasis on road connectivity, large buildings and monuments for orientation purposes is common in the generalization of smaller-scale topographic maps.

places (see Figures 1–3). During generalization, cartographic elements move, change shape and combine with other elements. In Figure 2, for example, note how the bushes and paths of the square disappear or how street areas are abstracted from the 1:10,000 to 1:25,000 and 1:50,000 scale maps. Depending on the scale and often the projection, generalization is a step in the traditional cartographic process to enhance the map's legibility for its intended use. As we show, the resulting challenges of distortions, errors and omissions involve specific changes that, once recognized, can always be considered in an interpretative research process and frequently quantitatively analyzed to assess their epistemological significance and consequences for the research.

As we suggest here, the generalization of old maps is almost always challenging to understand in the digital humanities. This almost contradiction to familiar ways of thinking of maps as veridical representations (of some) of the world makes it an exciting way to access old maps in the public humanities and consider what has changed over time in distinction to what has changed in the cartographers' representations. Further, critical cartography literature (Crampton and Krygier 2005; Harvey et al. 2005; Michel 2017; Pickles 2012) offers insights into the roles of projections in global and world regional maps, the rich semiologies of map symbols and the potential of map layouts to focus readers' attention and help remove areas from visual perception. However, the significant alterations of generalization receive only scant attention in these critical engagements. Fortunately, in seeking to automate the processes of generalization, some cartographers have produced some exciting studies and approaches that we draw on to help generate some statistics and comparisons to at least improve our understanding of generalization's effects on a historical map.

After reviewing generalization concepts and presenting examples, the paper points to available resources for analzsing generalization's effects. We see this as a further contribution to the spatial humanities (Bodenhamer et al. 2010) and the critical assessment of the geographic information system (GIS). Before concluding, we draw on the macroscope concept (Börner and Polley 2014) to describe a framework for using these tools in a prototype to support interpretative historical analysis of old European topographic maps, which have now been made digitally available as graphic rasters or vector graphics. The conclusion summarizes key issues and discusses future research topics and methodological developments.

2 Cartographic generalization: Concepts and relevance

The issues related to scale in historical interpretative work can be well understood by considering cartographic concepts of generalization. The first principles of cartographic generalization taught to cartographers reflect the commonly used definition of cartography as the art and science of map-making (Lapaine et al. 2021). In map production of paper maps, the generalization would frequently have guidelines for that particular type of map, its intended uses and distinct stylistic elements. However, the actual process was done by individuals, following guidelines or rules, but usually with some flexibility and tolerance. It was not unusual for specific individuals with more experience or skills to assist in the process and to organize generalization to distribute the work based on skills and competencies (Meyer 2021).

Ratajski's (Ratajski and Lipiński 1973) well-known work in cartography divided generalization into content and quality. Content generalization connects to selection-based semantic operations while quality generalization is related to symbolization and graphic map design's classification and enhancement dimensions. Generalization operators with rules based on Polish cartographic literature, which has strong parallels to cartography texts in other languages and countries, suggest several criteria to consider for each generalization operation (Ratajski and Lipiński 1973):

1. Size (Figure 4) – the number of people for cities and the frequency of running trains for a railway. The length of line objects or the area of polygons decides which line or area is on the map (Pasławski 2010), e.g. lakes under one mm^2 area at map scale, rivers under 1 cm wide in the map scale should be omitted (Grygorenko 1970).

2. Function – a city can have administrative (capital city), communication (railway junction), trade, industry (industrial city), tourist or educational functions; roads can have technical functions, e.g. state roads, voivodeship, provenance roads, roads which are the best connection between cities represented on the map, railway – central railway (international, express) should be presented on the map, narrow-gauge railways can be omitted (Pasławski 2010).
   a. Historic-traditional – the places which were interesting or important in the past, e.g. *Wiślica*, Pompei.
   b. Centrality – when one particular place significantly influences others, e.g. capital city, car manufacture. Small cities in the area without people should appear on the map, but not always near a large city. In urban areas, we can omit big cities because around them are bigger (Pasławski 2010).
   c. Up-to-dateness – when a place is important according to current events, situations, it should be presented on the map, e.g. headquarters of an international organization (Geneva – United Nations (UN)), places of art festivals.
   d. Tendency to changes – objects which show the development tendency, e.g., roads and highways, but railways can be omitted.
   e. Typically – we should keep shorter rivers, which are close to a state borders, those rivers flowing through the big cities. Retain the density of the hydrographic network (Pasławski 2010).
   f. Selection rule – square root law (Töpfer and Pillewizer 1966).
3. Classification (Ratajski and Lipiński 1973):
   a. Qualitative – merging objects based on qualities (attributes), e.g. the system of classification – land cover classification, types of tree (deciduous, coniferous or mixed forest) are presented on the maps in large scale, forests, which embrace all types on small-scale maps (Grygorenko 1970).
   b. Quantitative – grouping the numbers in classes, e.g. number of people in the city.
   c. Reference area.
4. Simplification (Pasławski 2010):
   a. Line – we can leave slight bends of rivers and shorelines. Shorelines have the most details and are elaborated at first (as the first object).

The breadth, depth and overlaps of the criteria make plain that even after hundreds of years of cartography, no clear rules or guidelines define how to generalize or even provide “best practices.” Instead, as cartographers describe the field more generally, generalization involves artistic and scientific dimensions. The choices in generalization are effectively limitless. What matters is the graphical quality of the resulting map, especially its legibility. Scale is central to under-

Figure 4: Lakes on two example maps (A. Sikorski and *Litografia Artystyczna* (1904), at 1:1,000,000 scale; B. *Topograficzna Karta Królestwa Polskiego* (Richter 1839)).

standing generalization, but the actual transformation of graphic representations will be pragmatic regarding production constraints, (considered) user requirements and existing conventions. Generalization is more than a veil or grid; it can involve countless choices and considerations beyond an inventory or single theoretical analysis. We need to take up generalization for source criticism research approaches as a complex and inaccessible process used with all old historical maps. Focusing on the products instead can open the door to understanding consequences and comparing old maps.

2.1 Related work

The broad range of cartographic production environments and contingencies meant a pragmatic approach to map creation defined contemporary cartographic textbook presentations of scale and generalization for the practical demands of map production. For example, in his guidelines for cartographers in British colonial territories, Arthur Hinks assesses scale in terms of a balance between showing as much as possible at a particular scale and making as much as possible from them (cartographically) (Hinks 1947). More recent cartographic texts highlight the distortions that must accompany creating maps (Jones 1997). Scale is related to the process of generalization that must increase graphical abstraction while retaining the necessary graphical meaning of the information conveyed through symbols and geometrical shapes. Semantics stands out but is never a measure or even a concept.

Not knowingly indicating a future post-structuralist engagement with the roles of the reader, Hinks, in writing for creators and users of colonial maps and here relevant to the reconstruction of generalization, stresses the logocentric nature of map use: “it [facility in map reading] can only be attained by constant practice in the field, and it is useless to attempt to lay down many rules for it” (Hinks 1947: 41).

The pragmatic focus with considerations of economics and efficiency aligned with aesthetics and quality objectives meant cartographic generalization concepts were an advanced topic for training future cartographers. Another emphasis was on on-the-job learning at the United States Geological Survey (USGS), writes Patrick McHaffie in a valuably insightful study of cartographic production (McHaffie 2002).

Given the overwhelming pragmatic orientation of map production and hence of generalization, historical research considering generalization's impacts must carefully consider the contexts and contingencies of the map producers and the researchers. The latter's theoretical frameworks, institutional affiliations and goals are crucial in interpreting generalization in old maps as the same factors were for map producers of earlier periods. Whereas a textbook on cartography from the era of Hinks situates map production in a colonial context, more recent cartography publications, drawing on information age concepts, focuses on computational approaches to enhance generalization and, if possible, describe it in terms of separate functions, which can be broken down into algorithmic components for implementation in digital map production processes (Chaudhry et al. 2009). A common thread for present-day interpretation of old maps is present in the cartographic, logocentric understanding and presentation of geospatial phenomena, which defined generalization for cartographers in terms of goals, data quality and, above all, legibility.

Jean-Claude Müller and co-authors point out these issues in a framework in their 1995 edited collection. The introductory discussion offers insights into production issues and challenges for large national mapping agencies and the role of academic research. The so-called cartographic gaze (Müller et al. 1995) is less immediately evident in generalization. There is no single cause but a modern even instrumental focus on objectives in a complex system, further divided into a broad range of categories by academics. The implementation can lead to contradictions. A collection of modelling operators became inventories of functions provided by early commercial GIS software companies. This change, a harbinger of new software-based capabilities, so-called toolboxes, for specific implementations, drew on existing cartographic knowledge from mapping agency guidelines and challenges of extracting procedural knowledge, described abstractly earlier. However, researchers envisioned logical programming or hypergraphs as potential technologies to develop systematic generalization using computers (Müller et al. 1995).

Legibility of the results at more minor scales remains the focus of the generalization, but data quality is becoming more crucial to it in digital approaches to generalization. Metrical, topological and semantic accuracies are aspects, but the implementation in GIS was the more important matter for pragmatic cartographic approaches.

The research on automated map generalization offers starting points and techniques for analyzing old maps, which we will take up in the next section. Before moving to that analysis, we first briefly consider some relevant epistemological aspects to help distinguish and understand map generalization with actual examples.

The epistemological aspects of scale and generalization, taken in the context of any cartographical representation, are complex, but a brief contextualization is due. Contemporary approaches to generalization emphasize instrumental functions that should achieve goals expressed by metrics and visual assessment (Lee 1996). The goals are rarely simple, but the instrumental approach lends itself to an iterative process that can be refined and scaled to production needs and goals using digital tools. While legibility and truth are over-arching aspects, pragmatic concerns focus on evaluation and more functional concerns gain the upper hand in considerations over epistemological aspects. With the pragmatic emphasis on efficient production, legibility and truth (see discussion of Müller et al. 1995) were in, the development of automated generalization is most often part of cartographic critique (Harley 1989). Most generalization efforts seldom took up the challenge of finding a compromise of legibility and veridicality.

To give this consideration some context and digital humanities relevance, we analyzed the Vistula River to explain cartographic line and cartographic visualization for this research. We compare the length of the Vistula river based on nine maps of the area around Warsaw (Footnote: All maps were previously digitized, making comparisons straightforward in a GIS) presented in Table 1 and Figure 5. We present the results of the comparison in Figure 6. Several developments among surveyors and mappers are relevant for interpreting these maps. In 1775 a corps of crown engineers measured fortifications and offensive buildings; they had to build roads and bridges and create maps. They also worked on establishing the borders of Poland between Prussia, Russia and Austria (Bartoszewicz 2020). Thanks to this, the length of the Vistula river was surveyed more accurately. From 1832 to 1865, Prussians advanced triangulation with support from Russian surveyors. They developed a more accurate triangulation including observatories in Krolewiec and Dorpat (Tartu) as part of the connection between the west and Russian triangulations (Kryński 1970). The length of the Vistula river ranges from 968 to 1,070 km. In the most recent nine surveys, we consider (2012), its length is 1,027 km.

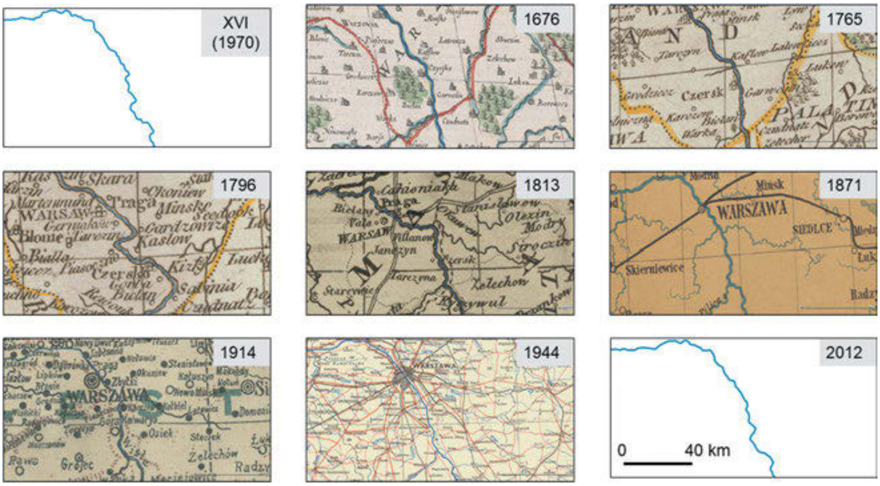

Figure 5: Portions of nine maps of approximately the same area, including Warsaw (16th century (Atlas Fontium 2022), 1676 (Speede and Dirck 1676), 1765 (Palairet 1765), 1796 (Dunn 1796), 1813 (A Map of Poland: Engraved for the Military Chronicle 1813), 1871 (Baraniecki 1871), 1914 (Map of the Polish lands from the Oder to the Dnieper, from the Carpathians to the Baltic Sea and the Dvina, 1914), 1944 (Bartholomew and *Sekcja Wojskowego Instytutu Geograficznego* 1944), 2012 (EU-Hydro – River Network Database – Copernicus Land Monitoring Service, 2012)). We used digitized versions of these maps to compare the length of Vistula, part of Vistula close to Warsaw.

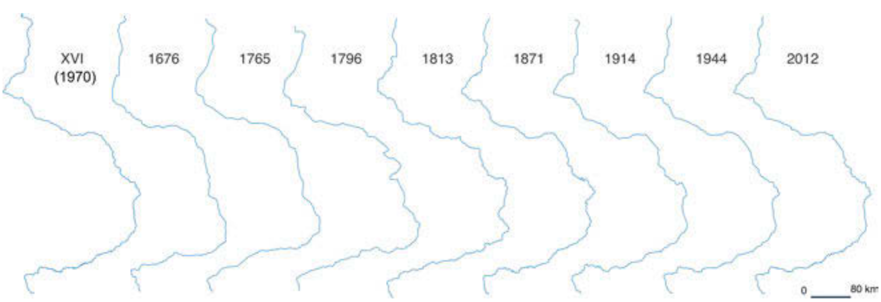

Figure 6: The Vistula river from the nine various maps (Figure 2.1) with the extracted Vistula river from each (corresponding dates of the map are indicated).

Table 1: The length of the Vistula river from the nine maps compared.

Year/time	XVI (1970)	1676	1765	1796	1813	1871	1914	1944	2012
Scale	1:250,000	1:1,400,000	1:2,800,000	1:4,100,000	1:3,000,000	1:1,450,000	1:2,500,000	1:1,500,000	1:250,000
Length [km]	1,070	897	868	964	1,014	1,024	968	952	1,027

3 Heuristics for interpreting old maps

3.1 No rules, no guidelines, only interpretation with some metrics

Given the epistemological complexity of generalisation and the pragmatic focus of cartographers creating generalized maps, we approach heuristics for considering the effects of generalization in the practical interpretation of old maps. In the generalization of old maps, the grounding assumption followed specifications and conventions. Yet, generalization practices could be idiosyncratic. Therefore, analyzing old maps for generalization effects precedes that quantitative analytical approaches can establish systematic changes. The actual changes created in a generalization process are impossible for most people to reconstruct in a reasonable amount of time. However, researchers can use metric measurements to assess the impacts of generalization and gain the necessary insights to interpret generalization's impacts on a particular historical map. These changes can have significant implications for historical interpretation.

The three metrics for three different types of generalization, reflecting the earlier considerations of generalization's impacts, we suggest using for the historical interpretation of old maps are

- Counts of features in different maps for comparisons of generalization impacts (Elimination)
- Use of shape metrics from computer graphics to assess and compare features in multiple maps (Simplification)
- Calculation of displacement using a verified reference or contemporary data (Displacement)

These metrics offer the potential of being comprehensible to most historical researchers with limited knowledge of cartographic production processes. However, we need to point out that the presentation here is preliminary. These metrics emerge from automated map generalization research (van der Poorten et al. 2002) and will need to be refined and often reconfigured and implemented to assess the impacts of generalization in old maps. This work is a task far beyond the scope of this paper but certainly the direction for future research. We also are developing usability assessments to guide the development and refinement of the implementation.

3.2 Counts of features in different maps for comparisons of generalization impacts (Elimination)

Elimination is perhaps the most brute force generalization operation. Based on a selection which follows specific criteria, in simple versions, just the size of a feature, those features, usually smaller than a particular size, are selected and removed. An example of the effects of this operation can be seen in Figure 3 above and Figure 7 here. The concept is straightforward, but the application calls for restraint and careful iterative trials. Still, given its speed and ease of implementation, it is more frequently used in digital cartography. Traditional cartographic production required a more judicious application together with other generalization operations due to elimination's destructive consequences, which could be daunting to correct in the traditional production process.

Figure 7: Two maps (from 1915, scale 1:25,000 (Warschau 1915) and 1943, scale 1:20,000 (Stadtplan Warschau 1943)) showing elimination. The right panel shows the elimination of the paths in Royal Castle Garden (1) and the left panel shows the elimination of some slope information (2, 3).

3.3 Use of shape metrics from computer graphics to assess and compare features in multiple maps (Simplification)

For vectorized old maps, shape metrics offer a well-established approach from computer graphics and automated map generalization (Basaraner and Cetinkaya 2017; Brus et al. 2014; Fan 2012; Visvalingam 2016) to assess changes to the shapes of features. While, to some extent, with some training and sufficient time, many changes can be visually located, shape metrics do this more quickly and will detect many changes that most people readily overlook. Computer graphics have developed many shape metrics (Ware 2008; Ware 2021) because of their importance in automated visual analysis. While this area has moved to computational neural networks to improve accuracy and speed, automated generalization frequently relies on earlier work to account for the complex geometric changes that come with simplification operations of both Euclidean geometry and orientation changes

Figure 8: Two maps (from 1915, scale 1:25,000 (Warschau 1915) and 1943, scale 1:20,000 (Stadtplan Warschau 1943)) showing simplification. The left panel shows the outline of churches simplified to symbols (on the map St. John's Cathedral) and the right panel creates generalized built-up areas instead of indicating particular buildings (5).

among elements of individual features (see Figure 8). While these techniques may still be more cumbersome than neural networks, they are possibly easier to understand. Still, the equations' complexity may prove a barrier to implementation in historical interpretative research.

3.4 Calculation of displacement using a verified reference or contemporary data (Displacement)

Displacement is often an essential operation in the cartographic generalization that retains relationships among cartographic features that correspond to experiences, while altering their locations or distorting their shape (see Figure 9). The assessment of displacement relies on applying functions developed to displace cartographic features in map generalization for the assessment of displacements from larger-scale to smaller-scale maps. These approaches again make use of metrics that describe line geometry and shape.

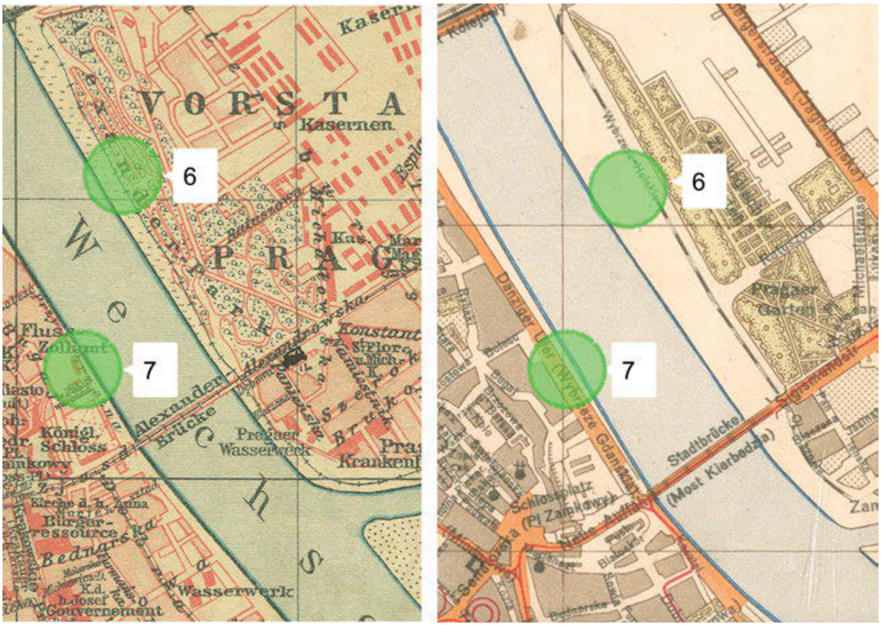

Figure 9: Two maps (from 1915, scale 1:25,000 (Warschau 1915) and 1943, scale 1:20,000 (Stadtplan Warschau 1943)) showing displacement. The left panel shows the displacement of a railway (6) and the right panel shows this displacement as well as the displacement of a road.

Obviously, at the level of features, the assessment of displacement is computationally involved and requires vectorization and differentiation of different types of features, which can be very complex. A more straightforward but relevant analysis of displacement is possible at the map sheet level. Also, researchers must ascertain if ageing, warping or fundamental geodetic differences between the old map in question and other maps or recent maps influence displacement. The software package MapAnalyst offers this functionality (see Figure 10).

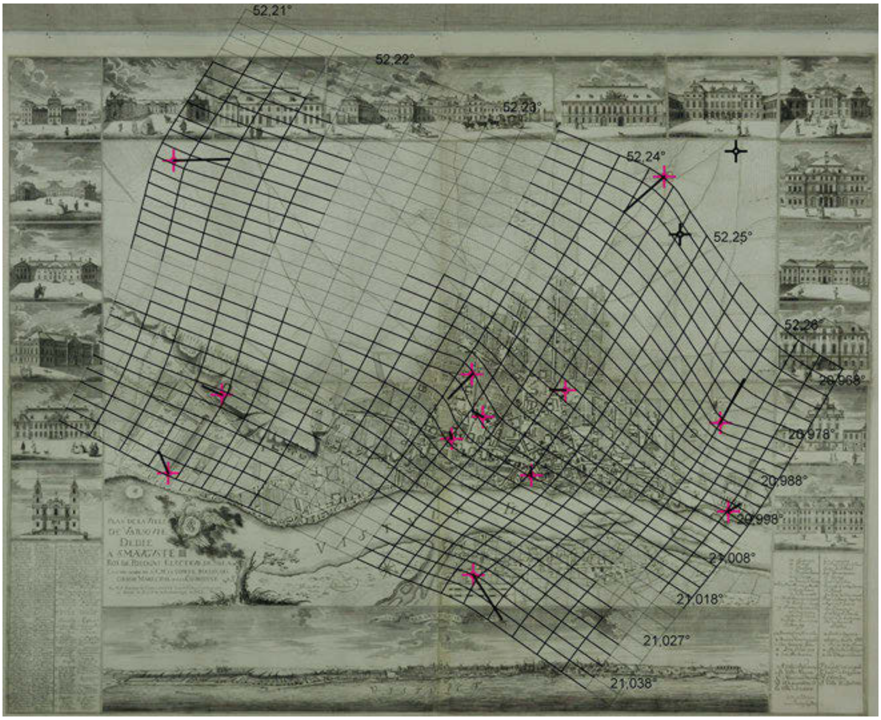

Figure 10: Georeferenced map showing displacement of points which was used to the georeference. Vectors show the displacement.

3.5 Heuristics (initial) for interpretation in the digital humanities

In historical research involving old maps, assessing generalization's impacts involves multiple considerations of potential relevance. Although there are problems with a scheme that goes from more to less complex, we hope simplifying issues to consider in heuristics of old map interpretation provides a valuable framework for the many uses of old maps in historical research, e.g. in museum work. These heuristics are clearly starting points. Much work is needed in specific contexts and to systematically consider scale in interpretative historical work.

4 Summary and outlook

This contribution describes a conceptual framework for assessing generalization's impacts on old maps for historical interpretative research, curation and wider humanities discourse. Clearly, given the limited work to assess generalization in old maps, this chapter should be seen as a beginning, not an end. Looser stressed that public humanities should seek many audiences, not just scholars, academic audiences or the smartest readers, viewers or listeners (Looser 2019). The assessment of map generalization could give a broader audience a chance to understand maps in a more confident way. Further, this contribution takes up issues for historical cartographic research and considerations of both quantitative and qualitative uncertainty showing features from old maps (Figure 11).

Figure 11: A sample mockup for a user interface for exploring old maps.

Further work on considering scale in historical interpretative work in its relevance to digital humanities is called for implementing the described metrics in an accessible interface. For this, we are commencing usability studies. Also, the considerations here of generalization operations are limited to, in our experience as cartographers, the main generalization operators in terms of their consequences and, therefore, significance for historical interpretative research. We are intrigued by the limited consideration of generalization in historical research with old maps and strive to develop a more thorough analysis of old maps and the impacts of generalization operations.

A central epistemological issue for interpretative research in digital humanities work with historical maps remains the relationship between cartographic features and historical objects and processes. Due to generalization, old maps will always have limited value in addressing these questions but can provide unparalleled information when other resources are limited or their accuracy is in question. Thus, old maps can be invaluable even with the noted limitations, and considering generalization's impacts on the maps can provide additional relevance.

The future research directions for considering scale in historical interpretative work involve pragmatic and theoretical issues. Zooming is (not just) scaling. Pragmatically, in the digital source critique, it is essential to clarify how present-day comparisons using current online maps and old maps can lead to numerous errors. The cartographic features of an OpenStreetMap (OSM) can greatly bias interpretations of old maps without understanding current approaches to mapping production and the differences between zooming and scaling. While zooming challenges historical analysis to understand what has not changed in the graphics, allowing a sense of getting close to graphical elements in zooming in and an overview in zooming out, considering multiple historical maps at different scales benefits from a better understanding of generalization changes made to support visual communication and the relating graphic changes, which can lead to very different graphic presentations in historical maps. The consequences for historical interpretative research can be considerable.

List of abbreviations

GIS	geographic information system
NAWA	National Agency for Academic Exchange
OSM	OpenStreetMap
UN	United Nations
USGS	United States Geological Survey

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Dario Rodighiero and Jean Daniélou

Weather Map: A Diachronic Visual Model for Controversy Mapping

Abstract: The Weather Map is a visual model to investigate public debates on media. Relying on the Media Cloud archives, the visual model transforms a simple query into a sophisticated visualization by employing the visual grammar of synoptic weather charts. Peaks of pressure and clashes between airmasses are used to describe the conflicts in media through the temporal dimension, diving into the human and non-human dynamics that make the controversy alive. The Weather Map was conceived as a digital tool to help students and scholars analyze public debates, according to the controversy mapping field founded by Bruno Latour. In particular, the visual model pushes the boundaries of network visualization, exploring advanced techniques of graphic design. The outcome is a web-based application developed in JavaScript and Python at the disposal of education and research.

Keywords: controversy mapping, network visualization, visual literacy

Representing time using a single static image is one of the most challenging exercises in visual arts. An excellent example of this gesture comes from the photographer Etienne Jules Marey whose "photographic gun" captured living beings' movements in controlled environments. Such a photographic technic gave life to a series of shots that followed one another in a linear narrative, revealing the complexity and elegance of motion (see Figure 1). Similarly visual, the Futurist movement represented technical progress by depicting the mechanics and dynamics of locomotives, airplanes and cars. One of its representatives, Umberto Boccioni, was ambitious enough to imagine the human body as a mechanical system in motion, molding one of the most famous sculptures of all time, titled Unique Forms of Continuity in Space (see Figure 2). Exhibited in New York by MoMA and the Met, Boccioni's sculpture portrays all potential athlete's movements over time through the static materiality of bronze. These two artists represent time differently: while Marey breaks down the motion linearly into an

Acknowledgments: Appreciation for proofreading and comments goes to Anne Beaulieu, Selen Eren, Sarah Feron, and all the members of the Knowledge Infrastructure department at Campus Fryslân, University of Groningen, and Sabina Rosenbergova from Bibliotheca Hertziana.

Thanks to Francis Harvey and Marta Kuźma for their constructive feedback, and Florentina Armaselu and Andreas Fickers for this initiative. This book chapter is dedicated to my friend Daniele Guido and his loving family composed of Mirella, Viola, and Gaia.

https://doi.org/10.1515/9783111317779-017

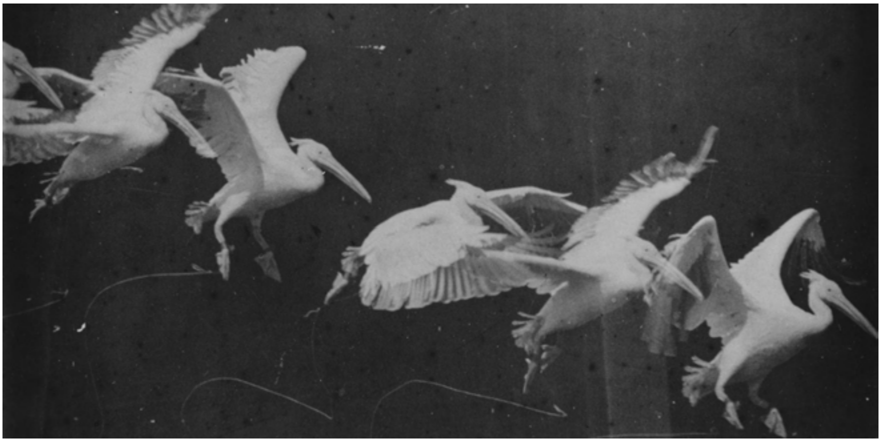

Figure 1: Etienne Jules Marey's photographic gun represents the linearity of time from right to left (Wikimedia Commons contributors 2021).

Figure 2: Umberto Boccioni's Unique Forms of Continuity in Space represents motion in a nonlinear form (Wikimedia Commons contributors 2015).

interpolated sequence of images, Boccioni's artistic gesture molds time by composing a multifaceted form nonlinearly. This latter vision by Umberto Boccioni inspires this text in representing information through nonlinear forms (Flusser 2014), with close attention to the temporal dimension.

The representation of time is a challenge that attracted not only artists over time but also designers who deal with temporal information. In much the same way as the artworks by Marey and Boccioni, data visualizations can portray time through linear or nonlinear representations (Rosenberg and Grafton 2010). While the timeline (see Figure 3) is an established linear model investigated in different doctoral theses (Huron 2014; Kräutli 2016; Vane 2019), nonlinear representations are considerably less frequent. Among these, two examples (see Figures 4 and 5) provide a more accurate picture of the nonlinear interpretation of time. Inspired by tree-ring dating, Pedro Cruz's diagram of U.S. immigration uses radius for time and direction for provenance (Cruz et al. 2022), while Kirell Benzi's network shows the spread of CERN's original tweet to illustrate the Higgs boson's discovery (Benzi 2017). The data visualizations by Cruz and Benzi are pertinent for two reasons. The first reason is formal: the visual compactness prevents any readability issues created by wide-image linearity; the second is practical: representing time in a nonlinear way is a less intuitive and more challenging intellectual exercise. These reasons make the premises present a new visual model.

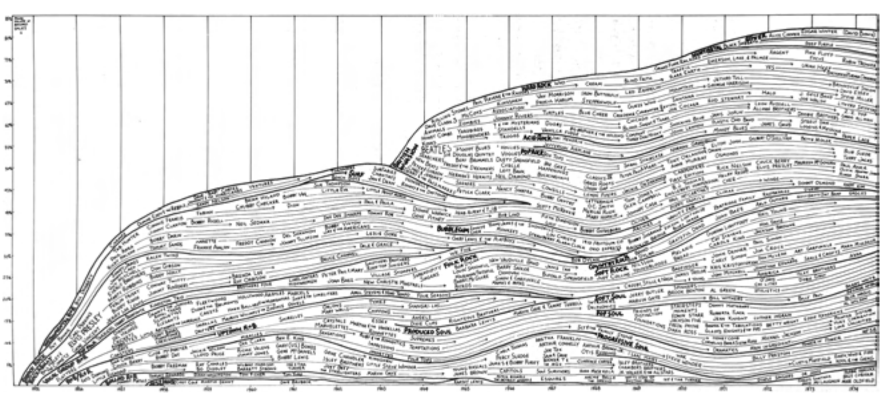

Figure 3: Steeve Chapple and Reebee Garofalo's timeline describes the history of music linearly. Each layer indicates a music genre by showing the start and end dates. The height of the visualization corresponds to the number of genres recorded in a given period (Chapple and Garofalo 1977).

This text further investigates the nonlinear representation of time by using weather maps as metaphors to draw diachronic network visualizations. Also known in meteorology as synoptic weather charts, these maps are visual instruments to predict

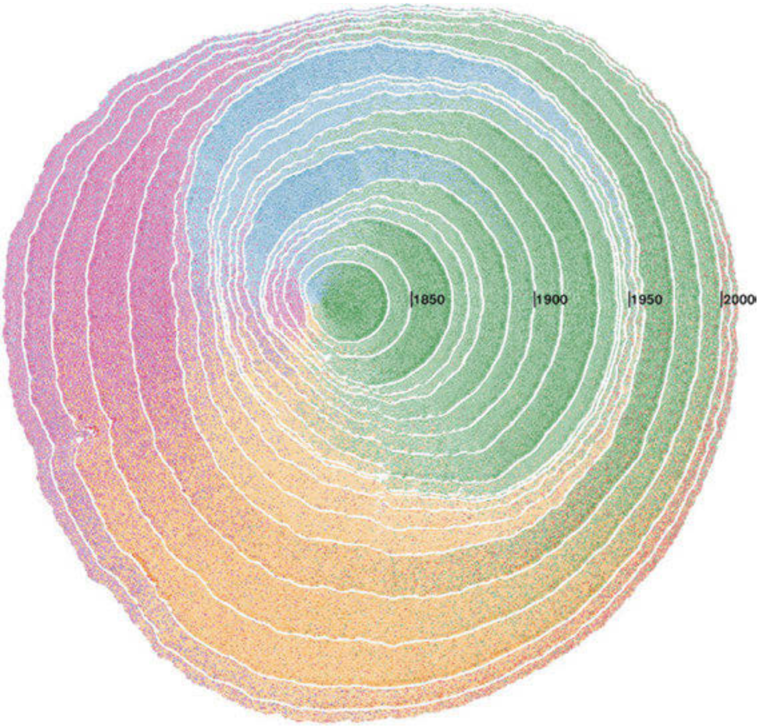

Figure 4: This diagram shows the provenance of immigrants in the U.S. over time. The flow of European immigration appears in green, while the more recent Asiatic flow is pink (Cruz et al. 2022).

weather changes. Their accuracy is high in the hours following computation, but the precision decreases over prolonged periods. Although we all are accustomed to seeing them in newspapers and television, their interpretation is so complex that experts often need to illustrate the meaning. One reason for such complexity is the multiple information levels that compose weather maps, which will be more understandable with a brief explanation of their visual grammar.

This section is an introduction to the graphic design of synoptic weather charts. Many experts in the field published comprehensive books on this subject (Ahrens and Henson 2019; Pearce 2002), but the illustration by the cartoonist Randall Munroe (see Figure 6) is sufficient for our purposes (Munroe 2015). The most noticeable layer of information in weather maps probably corresponds to elevation lines, usually employed in topographic maps to indicate altitude. Meteorologists use elevation lines to represent air pressure, the primary measurement to forecast weather conditions. When the pressure is high, the sky is clear; when it is low, the weather is rainy. Like topographical maps, the number of lines indicates intensity. Unlike

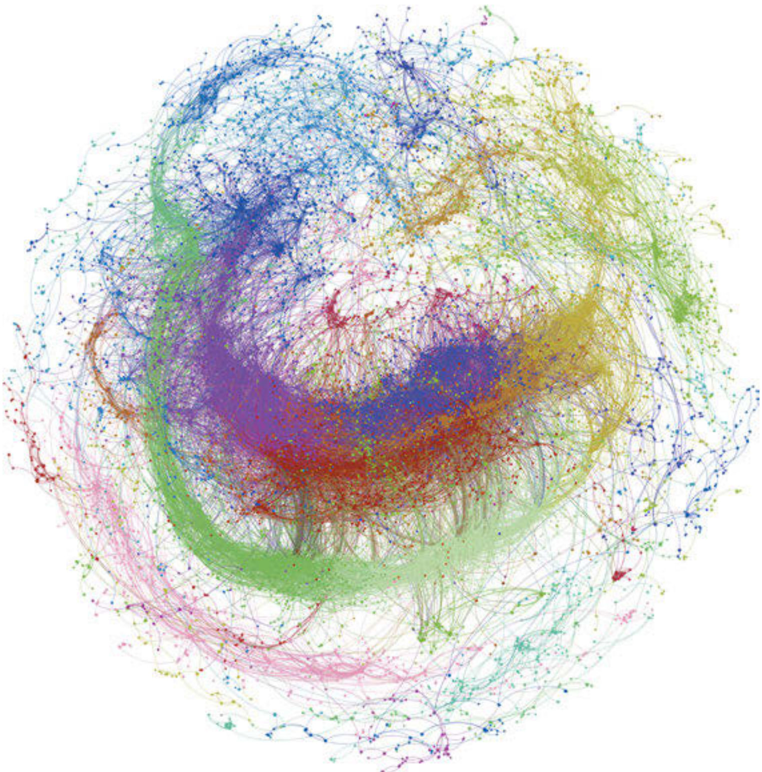

Figure 5: The scientific community found evidence in 2012 of a particle hypothesized by Peter Higgs. This graph shows the retweets originating from CERN's initial post on Twitter (Benzi 2017).

topographical maps that use colors to distinguish between land and sea, weather maps' elevation lines are uncolored but mark the peaks of high and low pressure with the letters H and L, which might be colored in red and blue to increase readability. Although these graphic elements already give a static image of weather conditions, a further layer of information enriches pressure with dynamism by marking air collisions with front lines. Front lines draw attention to the friction between different pressures by tracing a thick curve. While elevation lines form a pattern all over the map, front lines indicate precise areas of interest by marking the movement with a thicker line. When the cold air gains ground, the front line features a series of triangles, substituted by semicircles when the warm air advances; both are aligned along the front line to indicate the direction of movement.

As already mentioned, the central idea is to design a diachronic visual method inspired by weather maps' visual grammar, but diving deeper into the cultural context will help to understand the primary purpose. The visual method

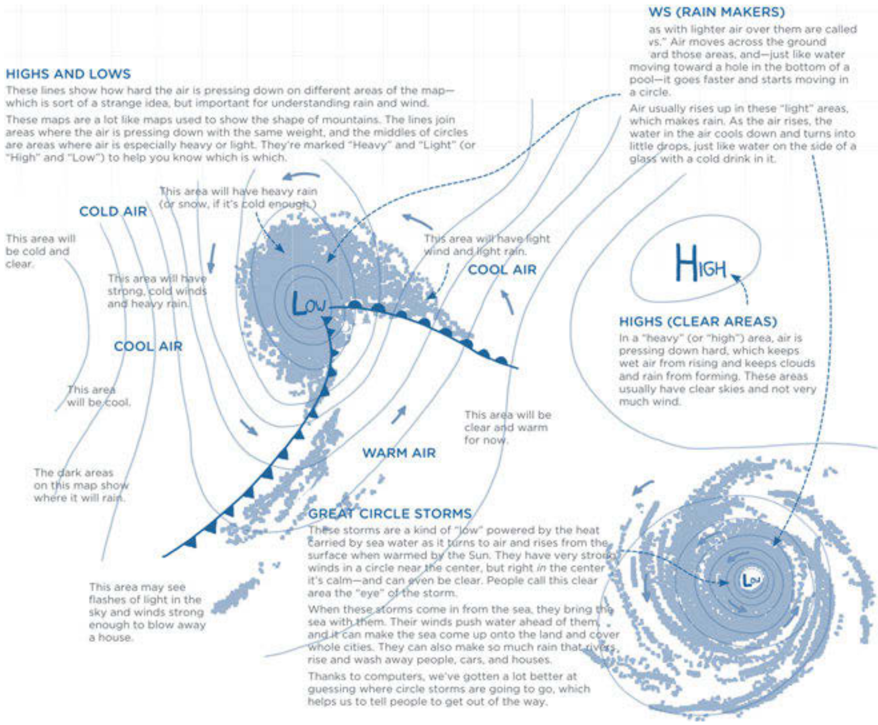

Figure 6: The illustration shows the weather forecast's visual grammar (Munroe 2015). Among the various graphic elements that compose the visualization, elevation and front lines provide critical information to understand weather changes by indicating pressure and movement.

finds its practical use in controversy mapping, a pedagogical method created by the philosopher Bruno Latour from the analysis of scientific controversies.

The analysis of scientific controversies origins in Science and Technology Studies to investigate the necessary conditions for scientists and engineers to recognize their work (Latour 2021). When teaching at *École des mines*, only then did Latour transform it into a pedagogical method to study public controversies. While the analysis of scientific controversies focused on science, the controversy mapping shifted the method's attention to public debates external to the scientific world (Venturini and Munk 2022; Gray et al. 2022; Latour 2021). In Latour's course, students were encouraged to investigate scientific debates starting from public broadcasting. For example, during the online course Scientific Humanities, given in the fall of 2014 through the platform *France Université Numérique*, students were asked to analyze a debate of their choice starting from a newspaper article. Following the Actor-Network Theory (Latour 2005), the initial analysis aimed to identify in the article the human actors (i.e., politicians, journalists and scientists) as well as the non-humans (i.e., innovative technologies, information systems and political organizations). The identified actors were later divided into two factions according to their standpoint on public debate, trying to delve into the subject by mapping oppositions. This diagrammatic representation was the basis for the investigation's backbone on which to add further information, such as hierarchical structures, verbatim quotations and relationships between actors in a sort of ontological scheme. Although many of Latour's pupils are today concerned with climate change (Baya-Laffite and Cointet 2014; Pryck 2022; Venturini et al. 2014), the controversy mapping covers a large variety of subjects (Seurat and Tari 2021). This great diversity reminds us how controversy mapping is not aimed at achieving specific knowledge but rather at learning a method of analysis with a wide range of applications and use cases.

A set of digital tools were at students' disposal to integrate their inquiry. When Sciences Po's curriculum included controversy mapping, the médialab supported institutional pedagogy by working on open-access software to explore public debates. The list of digital tools included Gephi to analyze networks (Jacomy et al. 2014), Sigma.js to visualize networks (Jacomy [2012] 2022), Hyphe to trace Web hyperlinks (Jacomy et al. 2016) and Seealsology to reveal Wikipedia connectivity (Density Design [2014] 2022). It is interesting to notice that all these tools represented an effort not only to collect and analyze but also to visualize data. Indeed, the visual form of information enhances the process of interpretation and provides evidence to support arguments during presentations. When visual expertise was increasingly valuable for data analysis, the médialab was probably one of the first laboratories in the world to recognize the importance of visual tools for students and scholars.

The theory and practice of médialab found common ground in *networks,* which acted as boundary objects between different application domains (Bowker and Star 1999): on the one hand, the Actor-Network Theory was interested in the complexity of social relations in technological discourses (Akrich, Callon and Latour 2006); on the other hand, social network analysis was emerging with more intensity in the scientific environment (Lazer et al. 2009; Scott [1991] 2000). In addition, networks' popularity increased through the advancements in data visualization, as confirmed by books (Lima 2011), visual models (Rigal and Rodighiero 2017; Windhager et al. 2020) and retrospective exhibitions (Barabási et al. 2020). The Weather Map described in these pages is precisely situated at the intersection of controversy mapping and network visualization, focusing on the lack of relational time-based visual models. Although innovative algorithms advanced the computational load of networks, leading to the analysis of complex structures, visual grammar barely evolved from the drawings made by Jacob Moreno almost one century ago (Moreno 1934). The Weather Map, in this sense, represents an effort to fill this gap by developing a new aesthetic metaphor for network visualization, in line to what Johanna Drucker teorized a few years ago (2010: 72–73).

The back end of the Weather Map finds its foundation in the Media Cloud, an open-source platform to analyze media ecosystems through millions of newspaper articles (Roberts et al. 2021). The platform allows users to make different requests, including queries on specific subjects treated in media. Even though mainly related to American culture, its collection was perfect for examining public debates from a temporal dimension — information rarely accessible online in newspaper archives. When the project started, the Media Cloud covered around ten years of online newspapers, a perfect time window to investigate the subject of biomass energy. The choice of mapping biomass energy for a case study had many reasons: among them, it was considered the involvement of private and public actors, the growing visibility in public broadcasting and the presence of technology as one of the non-human actors.

The Weather Map visual model answers questions related to the public debate on biomass. Who are the individuals and the organizations involved in the discussion? What are the specific topics of discussion to which they are committed? Who and what is emerging from this discussion? Who are the actors leaving the debate? Moreover, where are the frictions between opponents? Compared to other network visualizations, the insights that the Weather Map can provide are more multifaceted because of the different layers of information. However, as explicitly described in this text, temporality covers a central role in the diachronic visual model.

The creation process starts from Media Cloud with data extraction. After refinement, the most appropriate query to cover the subject of biomass was *"(biomass OR 'bio-energy' OR 'bio energy' OR 'bio-economy' OR 'bio economy') AND language:en"* for English-speaking collections including United States, India, Russian Federation, France, United Kingdom and Ghana. The request returned 20,000 articles published between 2011 and 2020 as a list of JSON files downloaded via API (Rodighiero 2021). Each file contained metadata and the outcomes of text analysis to avoid copyright infringements for sharing full texts. Metadata such as title, source, date and URL came along with extracted entities generated from Natural Language Processing techniques to identify people, organizations and places mentioned in the full-text body. In addition, Media Cloud's topic modeling provided a list of keywords from the New York Times' classification, which is valuable for pairing specific topics with individuals and organizations. For Weather Map, entity extraction is a key computational technique to identify and space out actors on the Cartesian plane, facilitating the distant reading of hundreds of thousands of documents.

Individuals, organizations and keywords were selected to draw the network visualization. Each entity was profiled by collecting name, type, frequency and co-occurrence by processing the downloaded JSON files. It is essential to keep in mind from the beginning that frequency is used to measure the trend of every entity, while the co-occurrence of entities is fundamental to arranging network visualization. The latter is processed first via UMAP dimensionality reduction that spaces out individuals, organizations and keywords (McInnes, Healy and Melville 2018). Word embedding, usually employed in digital humanities to visualize corpora by word frequency (Berger, McDonough and Seversky 2017), organizes entities in the bi-dimensional space: the more two entities are mentioned in the same article, the closer they appear on the map. Such a spatial organization of individuals, organizations and keywords makes possible the identification of thematic clusters, which are critical to divide the biomass debate into subcategories for better understanding.

As with many algorithmic outputs, the Weather Map undergoes a process of parametrization. Entities, for example, are manually filtered to limit the number of elements and reduce visual complexity. For biomass energy, the entity's threshold of visibility was set to 50 mentions over ten years. In addition, UMAP hyperparameters must be tested to find a proper arrangement for the network. Within data selection and treatment, parametrization covers a necessary procedure in the design process, affecting the final result through subjective configurations.

Another critical element of Weather Maps concerns how actors' activity is measured, which is correlated to the frequency of entities' appearance in newspapers. The meteorological pressure is used as a metaphor to show whether an entity is taking up space in the public debate. Pressure measurement results from simple linear regression applied to each entity according to their yearly frequency of appearance in newspapers. When the line's inclination results are positive, mentions have grown over the years and the entity has become visible in public debates. Then, inclinations are normalized by subtracting the public debate's average trend. The resulting frequency and arrangement are visualized during the design process for intermediary inspections (see Figure 7). Finally, high- and low-pressure clusters of entities are recognized using HDBSCAN (McInnes, Healy and Astels 2017), allowing the identification of collisions between warm and cold air when they overlap (see Figure 8). One of the most exciting outcomes of this process is the decomposition into subcategories, demonstrating that more specific controversies give form to the whole public debate.

The computed data were then exported in CSV files, ready to be integrated into a web-based interface offering an advanced level of interactivity. The functions of zooming or selecting, for example, permit the distribution of information on different layers (Shneiderman 1996). Indeed, the Weather Map is a data visualization embedded into a web-based interactive interface composed of different layers and

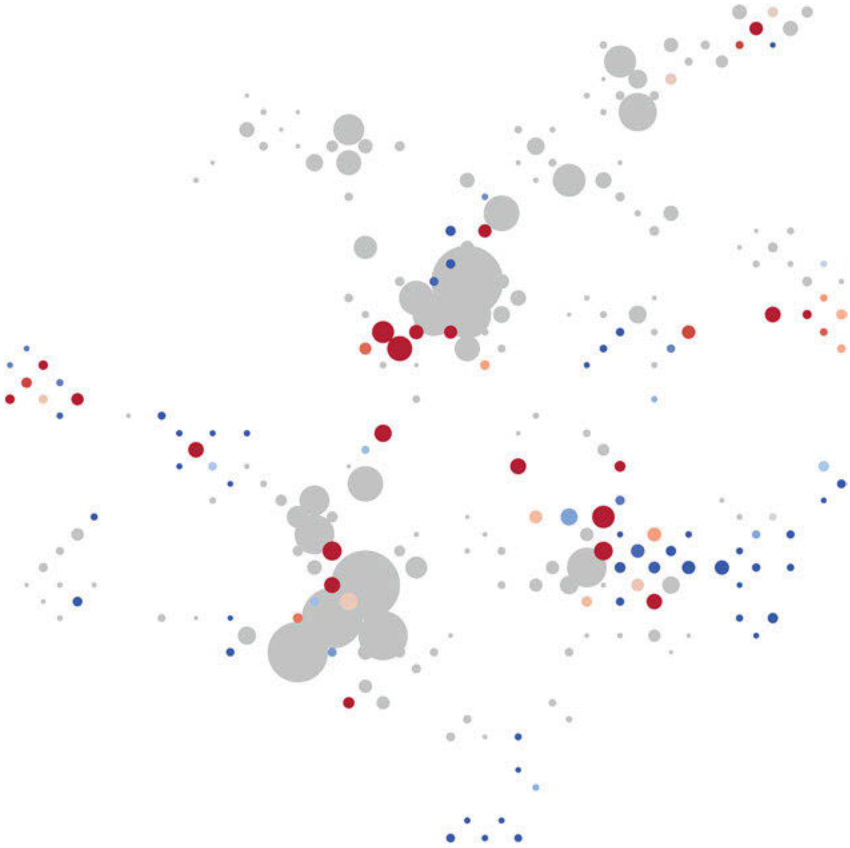

Figure 7: Blue and red correspond to emerging and disappearing actors in the public debate, while gray indicates keywords from the New York Times' classification. The size of the circles is proportional to frequency.

panels (see Figure 9). The entities' frequency gives form to elevation lines by molding "peaks" over the network visualization, indicating the most active clusters of debate that would be harder to recognize otherwise (Rodighiero and Romele 2022). Its graphic rendering relies on d3-contour, made available by the well-known library for data visualization d3.js (Data-Driven Documents [2017] 2023; Bostock, Ogievetsky and Heer 2011). This topographical background is then enriched by keywords, which orientate viewers by showing different topics treated in clusters. The size differs according to frequency, so the most used keywords are more visible than others. Entities at this level of zoom are represented by placeholders with the sign "+" to leave more visibility to keywords and contours at the forefront. Then, emerging and disappearing clusters are indicated by letters H and L, situated at the

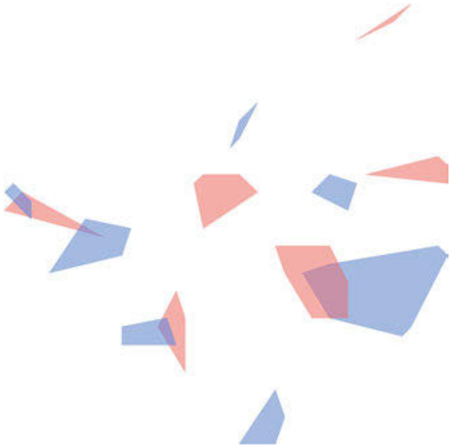

Figure 8: The algorithm for cluster identification is run twice, one for emerging and one for disappearing actors. The overlaps between blue and red clusters point out collisions like in a zero-sum game.

center of the polygons introduced in Figure 8. The front lines represent the most valuable graphic element that enriches the distant view by marking the antagonisms between opposing groups of actors. They are geometrically generated starting from the average point between two centers of opposed clusters, accentuating the curve's convexity toward the emerging actors. The result of such a mapping differs from Latourian controversy mapping, in which two factions usually represent the entire public debate. Indeed, the Weather Map proves that public debates are not composed of two fronts but multiple. Figure 9, for example, shows how the general discussion on biomass is multifaceted, identifying three more prominent topics: climate change, energy production and national politics.

When exploring the concept of Anti-Zoom, Bruno Latour correctly concluded that the optical zoom in digital maps is still a myth. Maps of one territory change according to scale and zooming is necessary to glue to connect them in a continuous visual effect (Latour 2014). In the Weather Map, elevation lines, keywords and front lines offer different affordances that invite readers to zoom into specific areas. Figure 10, for example, shows the area associated with politics where some notable actors can be identified. After zooming, the "political cluster" reveals in red the actors entering the public debate and in blue the ones leaving it. Among them are Barack Obama and Donald Trump, with the former leaving room for the second — it is essential to remember that this map is updated to December 2020. In addition, the left panel allows users to access more detailed information: clicking on Trump's icon activates a contextual panel containing the Wikipedia link, some statistics of frequency, the general trend and a random selection of ten hyperlinks to newspaper articles used as sources of information. The contextual panel complements the network visualization, offering additional insights to readers and developers.

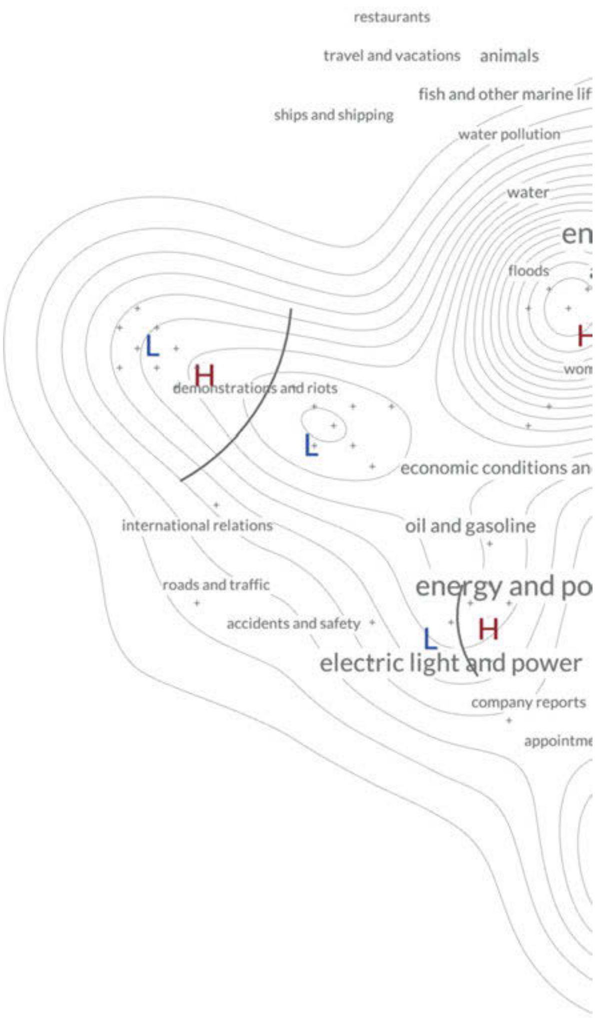

Figure 9: This Weather Map represents the public debate on biomass energy. At first glance, the elevation lines indicate the most active areas, enriched by keywords to summarize the content. Letters H and L stand for high- and low-pressure peaks, whose collision is marked by curved front lines. The interface is publicly available for testing at https://rodighiero.github.io/weather-map/ (Rodighiero 2021).

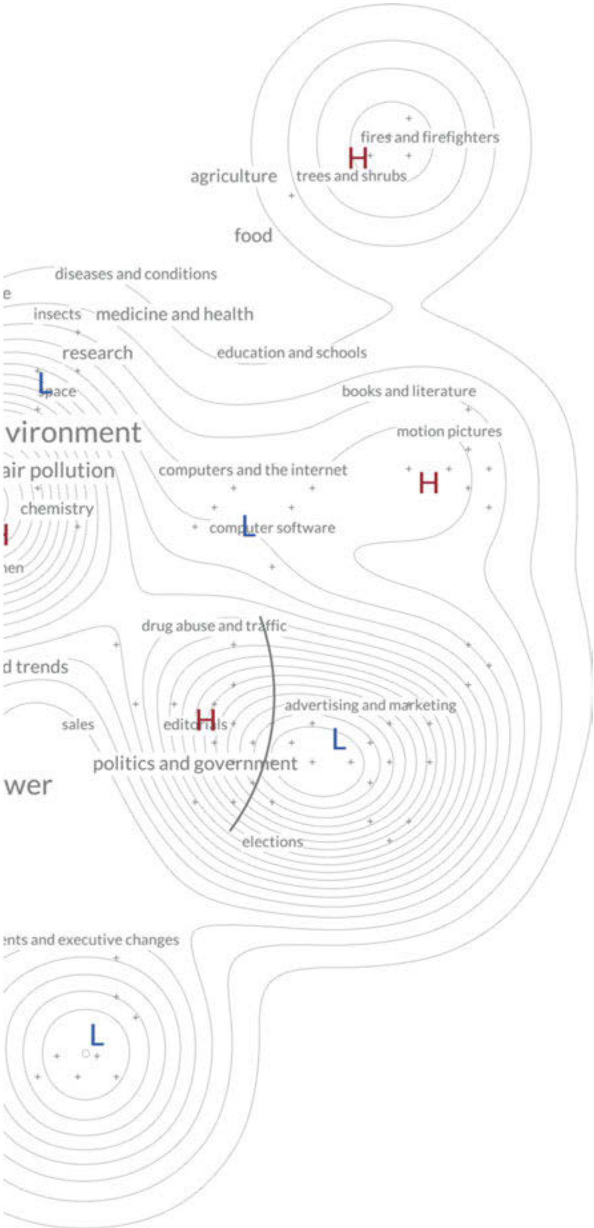

Figure 9 (continued)

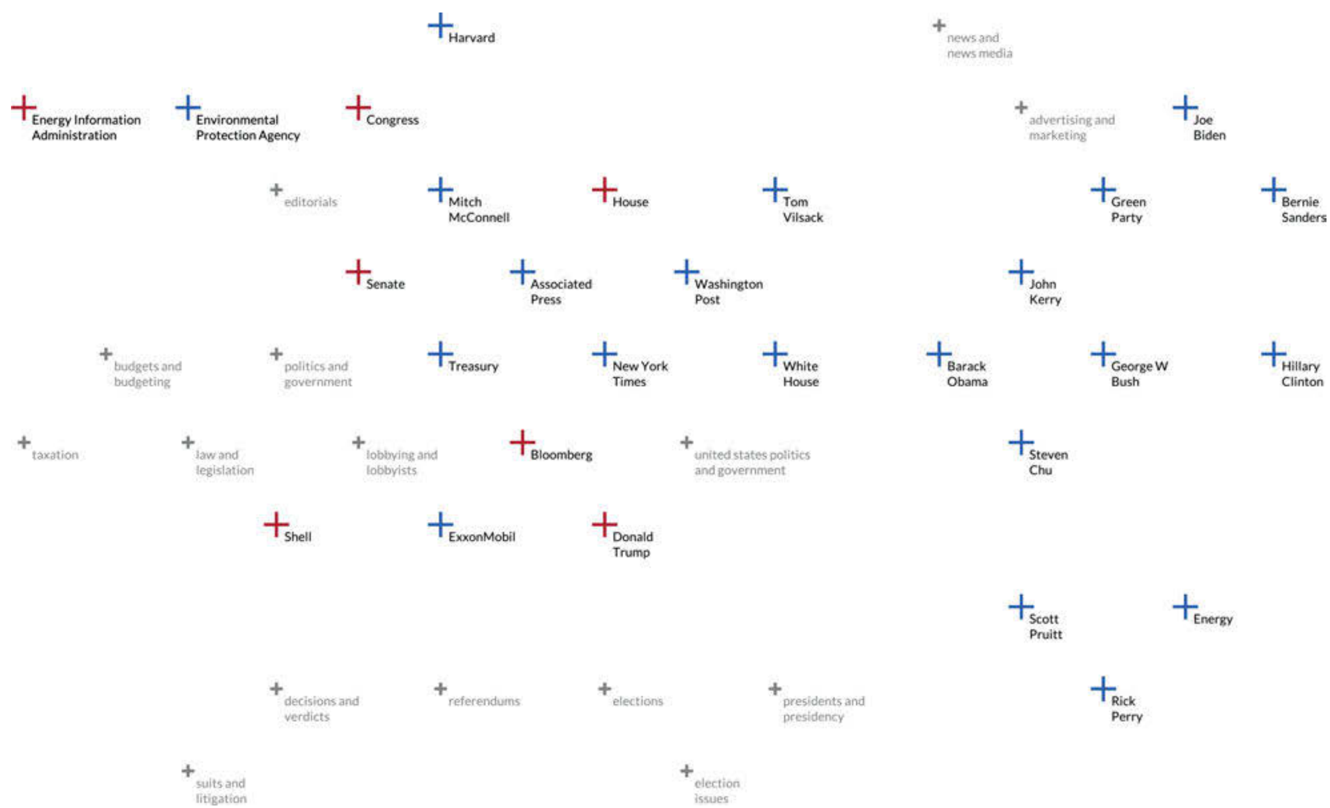

Figure 10: This screenshot shows the weather map's web interface at a deeper level of zoom. When users zoom on the lowest cluster of Figure 9, elevation lines and the keywords vanish while the actors fade in.

An example of navigation can start from this area (see Figure 10). Looking for companies involved in U.S. politics, a reader might click on Shell, a multinational active in oil and gas. From the contextual panel, the reader might successively open a newspaper article describing how Shell is interested in reusing coffee beans to create biofuel. This simple example also shows how instruments like the Weather Map are not intended to provide proof but rather exploratory systems to delve into complexity (Klein 2022).

Conclusions

Weather Map's visual grammar transforms the heuristic scope of controversy mapping by modifying the conditions of the representation. At Sciences Po and *École des Mines*, the field of controversy mapping uses static networks of actors or event-based chronologies. According to this methodology, the relations that articulate networks remain invariably inert. The lines connecting the different points harden, reduce and immobilize the social game of friction (Tsing 2005), enrolment tactics (Callon 1986) and alliance strategies (Callon and Latour 2017). A static representation prevents viewers from seeing lines' whole life, including the passage into new arenas of debate (Dodier 2003). The same is true for the chronological frieze, which reframes the past into a dot alignment whose relational logic is summarized in a game of successions and accumulations: this event + this event + this event = the controversy. Like entomologists killed and pinned butterflies on blank sheets of paper to observe them, controversy mapping is currently equipped with tools that kill the controversy to study it.

Faced with these challenges, the Weather Map offers an alternative. First, it uses thermal semiotics polarized between warm and cold to approach the controversy in the making by mapping the formation of fronts where the debate crystallizes. This visual method opens the way to studying multi-positional movements through the plurality of actors that shape controversial events. Instead of reexamining once it occurred, the controversial event is captured *in statu nascendi* before becoming an event. In addition, the whole logic of visualization is turned upside down. To put it with an image, it is no longer a question of waiting for the rain to fall but of considering the clouds announcing its coming. Technically, the Weather Map promises a shift in observing controversies' emergence and growth by placing the inquiry's standpoint one step ahead of their institutionalization and public recognition. This shift brings the controversy studies closer to social life in motion. It makes it possible to return to the initial program expressed by Bruno Latour, which consisted of looking at science and society in the process of being made rather than already made (Latour 1999).

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https://doi.org/10.1515/9783111317779-018

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Kirill Mitsurov is a user interface developer at the Luxembourg Centre for Contemporary and Digital History (C²DH). He offers design solutions to optimize the UX/UI domain and specializes in integrating and creating 3D environments for data visualization, which is a fundamental aspect of his work.

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https://doi.org/10.1515/9783111317779-019