Which Properties Has an Icon? A Critical Discussion on Data Protection Iconography

Arianna Rossi and Gabriele Lenzini

SnT, University of Luxembourg
{arianna.rossi,gabriele.lenzini}@uni.lu

Abstract. Following GDPR's Article12.7's proposal to use standardized icons to inform data subject in "an easily visible, intelligible and clearly legible manner," several icon sets have been developed. In this paper, we firstly critically review some of those proposals. We then examine the properties that icons and icon sets should arguably fulfill according to Art.12's transparency provisions. Lastly, we discuss metrics and evaluation procedures to measure compliance with the Article.

Keywords: Icons · Graphical symbols · Pictograms · Evaluation · Data protection · Privacy · Standardization · Security · GDPR · ISO · Compliance.

1 Introduction

The General Data Protection Regulation (GDPR) obliges data controllers to inform data subjects about how their personal data is processed (Artt. 13 and 14). It requires that such communication is performed "in a concise, transparent, intelligible and easily accessible form, using clear and plain language" (Art.12.1). It also states that "information [..] may be provided in combination with standardised icons in order to give in an easily visible, intelligible and clearly legible manner a meaningful overview of the intended processing" (Art. 12.7).

Such an endorsement has motivated many organizations (private companies, research groups and public authorities) to develop and use icons[1] to improve the aspect, and allegedly the intelligibility, of their on-line and off-line legal documents. Moreover, we believe that there is a feeling of pressure to propose a set of icons for data protection in the hope that others will adopt it and, eventually, standardize it—not necessarily in this order.

However, it is still unclear what makes an icon and an icon set "effective" in the sense intended by the GDPR, *i.e.*, helpful to achieve conciseness, transparency, and intelligibility. There is no doubt that a sheer use of icons is not sufficient to reach the goal. Icons can be as ambiguous as text, while the simplistic explanation 'one picture is worth a thousand words', with an appeal to the 'picture superiority effect', is not necessarily a compelling argument. The first

[1] In this article, the terms "icons" is used interchangeably with graphical symbols and pictograms.

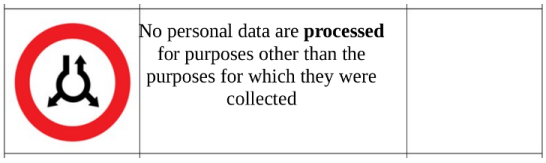


Fig. 1: An icon from a highly criticized code of icons included in an amendment to the GDPR draft [1]

is a popular saying[2], whereas picture superiority does not refer to the clarity of communication, but rather explains why images are recognized more immediately [24] and memorized more efficiently [25] than their linguistic counterparts.

Thus, even though icons can overcome communication barriers due to different languages and literacy levels [7,26] and are thus used to deliver crucial information in public, emergency or dangerous situations [35], one should be aware that the use of icons *per se* is not always the key. Without a systematic understanding of how pictograms are interpreted, of the message they intend to convey, of the context where that message is dispatched, icons can hardly serve GDPR's Art. 12. Indeed, bad example exists: *e.g.*, one of the amendments to the GDPR included a code of icons that was criticized for its lack of intelligibility and later abandoned (see Figure 1). Besides, it should be clarified which *properties* contribute to reach the aims of visibility, intelligibility, and legibility envisaged by the GDPR's transparency principle, and how to measure them.

One question remains pending: how can the use of icons realize, if at all, the provision of GDPR's Art 12? Discussing possible answers to such question is, in part, the goal of this paper. As we will argue in the remainder of this article, the ease of interpretation of an icon depends on several factors [23] like concreteness, familiarity and legibility of the single elements. When included in an icon set, its understandability also derives from established conventions, efforts of standardization, and widespread adoption. Neglecting such facts may lead to sloppy and misleading visualizations which in turn can cause mistaken interpretations [9] and achieve obscurity *in lieu* of transparency. Confusing and badly used icons can even lead to ill decisions [29] and unintentionally lure users into privacy-invasive or security-adverse practices in direct violation of the GDPR's *raison d'être*.

2 An Overview of Projects on Data Protection Icons

The intention of Article 12.7 is to foster the development of a regulated pictographic system which, if consistently used, would help controllers to "effectively" (*i.e.*, more effectively than lengthy, dense, verbose documents) inform data subjects of their data processing. Information duties (Artt. 13-14) provide for the

[2] Apparently, its origin can be rooted back to Leonardo da Vinci, who wrote: "poet [..] the painter betters you, because your pen will be consumed before you can describe fully what the painter represents immediately with its art" (translation from [44]).

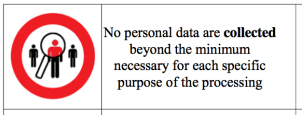
communication of *e.g.*, the identity of the data controller; if data is shared, with whom and if it is transferred outside the EU; the data retention period; the purpose and the legal bases for the processing; as well as recalling the rights of the data subjects.

There are already many attempts to visualize this information. Some pre-exist the GDPR and were reviewed in [38]. Other initiatives, incentivized by Art 12.7, have followed (*e.g.*, [34,39,41]), while others are currently under development[3] (*e.g.*, [11,6]). This inventory integrates our previous work on data protection icons [37,39,40] and a literature review made by other scholars[4]. The kind of information visualized by all these icon sets shows extreme variation: individual concepts (*e.g.*, financial data, profiling, see Figg. 2a, 2b); statements about the presence of a data practice (*e.g.*, "The site contains 3rd party ads", see Fig. 2c); and indications on the lawfulness or riskiness of data processing (*e.g.*, "No personal data are collected beyond the minimum necessary for each specific purpose of the processing" see Fig. 2d). Such iconographic richness is

(a) Concept of financial data [34]

(b) Concept of profiling [39]

(c) Statement [33]



(d) Lawfulness [1]

Fig. 2: Variegate examples of data protection icon sets

not necessarily negative. In icon design it is envisaged to create at first many variants for the same referent and then select the best one through user studies. Besides, since the European Commission is expected to regulate on the topic, no authoritative indication exists on the modality of conception, realization and implementation of an icon set. However, in agreement with both the GDPR (Recital 166) and its interpretation by the WP29 [5], which emphasize the need for an evidence-based approach to study how icons can promote transparency, we expect that a selection should be based on the assessment of specific "effectiveness qualities". Yet, a comprehensive evaluation methodology for GDPR icons has been only marginally discussed in the literature.

Critical Discussion of GDPR Icon Evaluation and Design Methodologies. The vast majority of icon projects that we have reviewed focuses on producing a

[3] We are even aware of additional initiatives, that are not public yet.

[4] I.e. the Research group 'Data as a Means of Payment', Weizenbaum Institute for Networked Society (see `https://www.weizenbaum-institut.de/en/research/rg4/`).

graphical system, without however gauging the outcomes towards the fulfillment of the GDPR's Article 12. Only a minority of the previously cited attempts have been evaluated [1,17,19,39]. Moreover, in such experiments, we observed that the focus is placed on the immediate comprehensibility of the icons, but disregards what makes them understandable, like the legibility of the elements of the graphical symbol, familiarity with the corresponding concept or learnability of the graphical language (see Section 4). This approach has brought researchers to cursorily discard the majority (or even the totality) of the elements of an icon set, for instance in [17,32]. Rossi and Palmirani [39], assessed legibility and comprehensibility and albeit their testing outcomes admittedly constitute a first indication of good or bad design choices, the research did not reach definitive and generalizable results. Other relevant qualities, that we will define in Section 4, have been simply disregarded. None of the above initiatives proposed an holistic approach for the evaluation of icons' effectiveness.

Moreover, none of the above works have considered the intended context of use to shape the goal and function of the icons: should they simply attract attention? Or are they expected to facilitate comprehension, thus fulfilling transparency goals? Or should they rather help to browse through a text quicker? In addition, even when the function was specified, it remained unclear whether the selected icons were a good fit for that function: for instance, if icons are meant to help search for specific items in long textual privacy policies, it should be assessed whether they efficiently support that task.

The research that we reviewed has also methodological limitations: the respondents' number is generally low (10 - 20), selected from a population of high school or university students (thus indicating a rather young and well-educated population, arguably even tech-savvier) and mostly mono-national. Thus, the outcomes of such studies cannot be generalized to the EU population to which the GDPR applies.

3 Methods and Tools

We aim to develop an evaluation scheme for "effectiveness" that might serve several icons initiatives to answer the following questions:

(i) *Which properties characterize an "effective" icon?*
(ii) *Which methods are commonly used to evaluate such properties?*

We focus on properties that can be evaluated and on methods that can be followed in the evaluation because the use of icons as a means to implement transparency in data protection has legal consequences on individuals. Therefore, gathering evidence to motivate whether a graphical solution is effective according to the GDPR' intended purpose is a fundamental and necessary matter. In this perspective, providing tools to assess an icon's effectiveness is a task that completes and assists the icon design process, as it will also be discussed in Section 8.

In order to define properties and methods, we followed a workflow that consists of 5 steps: **step**.1 - **literature review**: collect the different properties usually discussed in relation to icons from the literature about ergonomics of graphical symbols (Section 4); **step**.2 - **completion**: *complete* the collection with some properties of our own (Section 4), and determine the intended efficacy of an icon in specific contexts of use (Section 5); **step**.3 - **selection**: *select* among those properties that fulfill GDPR's requirements (Section 6); **step**.4 - **measures and metrics**: determine and discuss measures and metrics to gauge such dimensions (Section 7); **step**.5 - **assessment procedures**: discuss such properties and measures for the framework of data protection (Section 8).

The first step, literature review, has been conducted orderly. We looked for (i) previous studies on privacy icons; (ii) works on Google Scholar digital library using the following terms, searched anywhere in text (in brackets the term in disjunction):

$$\left\{\begin{array}{c} properties, \\ qualities, \\ characteristics \end{array}\right\} \textbf{ and } \left\{\begin{array}{c} icons, signs \\ graphical\ symbols, \end{array}\right\}$$

$$\left\{\begin{array}{c} evaluation, \\ assessment \end{array}\right\} \textbf{ and } \left\{\begin{array}{c} icons, signs \\ graphical\ symbols, \end{array}\right\}$$

(iii) previous reviews or summaries of icons' characteristics and evaluation methods, namely [8,23,27,43,46,47,49]; (iv) reference lists from the above articles; (v) inquiry on International Organization for Standardization (ISO) library with the following combination of terms:

$$\{evaluation\} \textbf{ and } \{graphical\ symbols\}.$$

We read titles and abstracts and browsed the articles, and retained studies and standards about public information signs, warning signs, and GUIs. We excluded studies on medical pictograms and road signs.

Our literature research is limited by the criteria we used, the data sources we queried, and by when we performed our research (till July 2019): projects on data protection icons are blooming, therefore more works will likely be published. Additional digital libraries can be considered in the future (*e.g.*, ScienceDirect and its Applied Ergonomics Journal). Our queries can also be expanded with additional combinations of terms and synonyms. Finally, documents from other domains can be included in the search (*e.g.*, medicine, bio/chemical-hazards, code of the road).

4 Icon Properties

To propose a categorization of the properties found in the literature on ergonomics of graphical symbols, we recur to the notion of semiotic triangle that defines the sign [31] (as shown in Fig. 3): some characteristics only concern the graphical symbol (Section 4.1); some others concern the referent, *i.e.*, the concept to which the symbol refers (Section 4.2); others concern the interpretant,

i.e., the process of interpretation (Section 4.3). A few dimensions do not concern individual pictograms, but the icon set as a batch (Section 4.4). Lastly, a few characteristics (marked with an asterisk *) have been derived from others and do not find an explicit definition in the literature. These constitute our own addition to the set of properties.

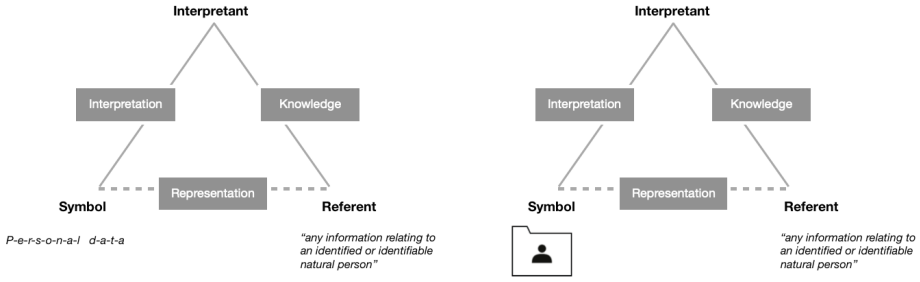


Fig. 3: Two semiotic triangles showing the relation between symbol, referent and interpretant. The concept of personal data is represented with two different symbols, i.e. a written, linguistic utterance in the left triangle and an icon in the right one, that can originate different interpretations.

4.1 Properties of graphical symbols

These are the characteristics pertaining to the graphical and perceptual aspect of the icon, i.e. the graphical symbol.

Visibility	Capacity to stand out from other stimuli in the immediate environment [47].
Legibility	Ease of identification of the shapes composing the icon [15].
Complexity	Amount of details and their intricacy [23]. Affects *legibility* [14] and *ease of recognition* [47], but leads to more precise interpretations [50], thus impacting *comprehensibility*.
Concreteness	Extent to which a symbol depicts objects or people [23]. Determines faster learning and more accurate *comprehensibility* for new exposures compared to abstract icons [47].
Familiarity	Frequency of using a symbol. Impacts ease of access to memory and time of recognition [23], related to *comprehensibility*.
Distinctiveness	Ease of discriminability of one icon w.r.t. others [43]. Can impact *comprehensibility*.
Style	The way an icon is designed (e.g. filled-in or solid, color, outline). Can influence ease of recognition [3], i.e. *comprehensibility*.
Quality	How professional an icon looks. Relates to *legibility* [49,47].

Hazard	How specifically an icon displays a threatening or harmful condition [49]. Relevant for warning signs.

Table 1: Properties of the symbol

4.2 Properties of the referent

These are the properties that characterize the concept represented by the graphical symbol.

Visualizability	Ease of creating a mental image of the concept. Impacts ease of depiction and thus *comprehensibility* at first exposures [47].
Concreteness	Reference to objects and people, as opposed to abstract concepts (e.g. feelings) [23]. Relates to *visualizability* and thereby impacts *comprehensibility*.
Complexity	Amount of details of the concept [23]. Can influence icon design, therefore impacting *legibility* and *comprehensibility*.
Familiarity	Extent to which the concept is known to the interpreter [23]. Determines *comprehensibility* at first exposures.

Table 2: Properties of the referent

4.3 Properties of the interpretant

The following properties concern the process of interpretation, *i.e.*, the thought that originates from the sign [28].

Comprehensibility	Ease of understanding of an icon's meaning. Depends on *legibility*, *familiarity*, and *semantic distance*.
Semantic distance	Closeness of relationship btw. symbol and function [23], also defined as arbitrariness or meaningfulness [27]. Determines *learnability* and *comprehensibility* [47].
Learnability*	Ease of learning of a symbol. Determines ease of *comprehensibility*.
Culture-independence*	Extent to which an icon is comprehensible to more than one culture or linguistic community. Thus affects *comprehensibility*.
Text-independence*	Ease of icon interpretation without verbal label. Relates to *comprehensibility*, *concreteness*, and *familiarity*.

Table 3: Properties of the interpretation process. The ones marked with an asterisk have been derived from other properties

4.4 Properties of an icon set

These properties concern the icons as a set, rather than an individual icon.

Amount*	Number of icons composing the set. If excessive, can cause cognitive overload.
Completeness*	Capacity of representing all the items of information the icon set is meant to represent.

Table 4: Properties of an icon set, that are marked with an asterisk because they have been derived from other properties

4.5 Interdependencies among properties

We conclude this section by highlighting which qualities determine other qualities. For instance, *legibility* depends on *complexity* and *quality* of the icon design. In turn, legibility is a reliable indicator of *comprehensibility* - indeed, as it will be illustrated in Section 7, these are the classical qualities considered by standardized evaluation methods. However, comprehensibility is affected by a complex mix of dimensions: *complexity* (of symbol and referent), *concreteness* of symbol, *familiarity* (of symbol and referent), *distinctiveness*, *style*, *visualizability* (in turn influenced by concreteness of the referent), *semantic distance*, *culture-independence*, *text-independence* (affected by concreteness and familiarity) and *learnability*. It is fundamental to consider these relations not only to define relevant measures to determine if an icon 'works', but also to develop useful guidelines for icon design.

5 Icons in Context

Three types of context should be considered for the analysis of pictograms [51]:

1. 'immediate', i.e. referring to the various symbols within one icon that interact to compose its meaning. It is therefore related to *legibility* and *complexity*.
2. 'proximate', i.e. intended as the field of interaction of one icon within a system of icons to construct meaning. It is therefore related to *distinctiveness*, *account*, and *completeness*.
3. 'environmental' (or context of use), i.e. referring to the place and actual conditions under which the icon is meaningful. It determines *comprehension*.

Section 2 has shown that the environmental context has not been properly considered in many privacy icons projects. Yet, previous research has emphasized the necessity of providing context to disambiguate a pictogram's intended meaning [43]: without contextual cues, low comprehension rates would falsely suggest that further design and testing is necessary [48]. Such consideration must be included in the evaluation procedures (see Section 7) to achieve a reliable indication of the effectiveness of an icon, by reproducing actual usage conditions, instead of asking to speculate about the meaning of icons in a vacuum.

However, most of the data protection icon sets were developed as standalone elements and were assessed as such, even when their function and context of use had been envisaged, i.e. headline function in privacy policies [17,40]; in combination with text in a tabular format [32]; as specification of privacy preferences on social networks [19]. As discussed in Section 2, this limitation determined high discard rates of the evaluated icons.

Therefore, specifications about the environmental context must be taken into account to design a holistic evaluation methodology that realistically determines the efficacy of data protection icons. For exemplifying purposes, we propose three specific environmental contexts and usages, sketched in Fig. 4. Icons representing aspects of data processing activities can give salience to relevant information contained in a privacy policy that would otherwise be lost in undifferentiated text. If a privacy policy has a layered architecture, the function should be similar for both the first layer that summarizes the main points and the extended version. Previous research on the usability of legal documents, *e.g.*, [30], has focused on 'companion icons' [18, p. 26], i.e. icons that represent the meaning of the text they accompany and that facilitate quick finding of relevant information. Alternatively, 'alert icons' [45, p. 23] can draw attention to risky practices (e.g. automated decision-making). Even consent management tools can benefit from pictograms: clickable icons can signify a data subjects explicit consent to certain practices or the witdrawal of such consent[5] [4]. Icons can also be conceived as elements of an identity management dashboard [42] where the data subject can adjust her privacy preferences and exercise her rights (e.g. access, erase or transfer her personal data). By conceiving icons within their intended environmental context, the selection of appropriate measures to evaluate if an icon 'works' in that context logically follows.

6 Mapping Properties to GDPR's Requirements

Among the properties described in Section 4, in the following we select those that correspond to the requirements set forth by the GDPR. Article 12.7 states that the information disclosed to data subjects "may be provided *in combination* with *standardised* icons in order to give in an easily *visible*, *intelligible* and clearly *legible* manner, a *meaningful overview* of the intended processing. Where the icons are presented electronically, they shall be *machine-readable*." Although the GDPR recitals do not provide any clarification, the principle of transparency was partially interpreted by the advisory body Article 29 Working Party [5]: we integrate this partial interpretation with our own interpretation to map icon properties with the legal provisions (see Fig. 5).

In combination : icons are meant to accompany, rather than replace text, thus excluding text-independence.

[5] This practice is already established on smartphones, e.g. when users press on the pin icon to activate or disactivate geolocalization.

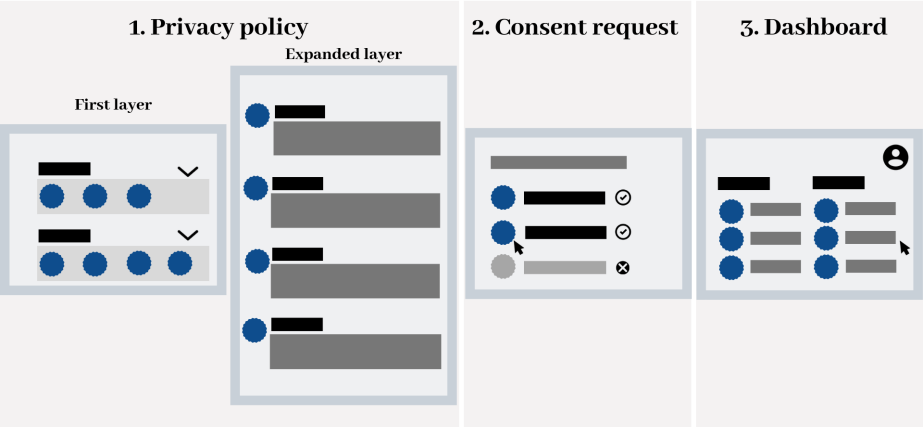


Fig. 4: A sketch exemplifying three possible contexts of use: 1. layered privacy policy; 2. consent management; 3. privacy dashboard. The blue circles represent placeholders for the icons

Standardised : polysemous term. 1. Standardized evaluation procedures [12,21,20] envisage testing for *legibility*, *comprehensibility* and *culture-independence*; 2. widespread and homogeneous usage across applications enhances familiarity, oftentimes stimulated by large corporations (*e.g.*, padlock symbolizing secure connection). Thus *style* and *quality* seem also relevant.

Visible : capability of being readily noticed (i.e. salience) or easily found (i.e. accessibility) [5, p.8]. Corresponds to *visibility*.

Legible : corresponds to icon's *legibility*.

Intelligible : property of "being understood by an average member of the intended audience" [5, p. 7]. Corresponds to *comprehensibility*.

Meaningful : polysemous term[6]: 1. effective at conveying the intended meaning[7] (in a specific context), i.e. *comprehensible*; 2. useful[8]; 3. not misleading. For some authors, icon meaningfulness corresponds to *semantic transparency* [27].

Overview : ability to represent a summary of the processing practices. Overlaps with *completeness* of the icon set.

Machine-readability : ability to be read or interpreted by software applications [5]).

[6] GDPR's translations in other languages do not disambiguate the term, *e.g.*, Italian: none; French: *bon* (i.e. good); German: *aussagekräftig* (i.e. meaningful/informative); Spanish: *adequato* (i.e. appropriate)

[7] American Heritage Roget's Thesaurus.

[8] Collins dictionary.

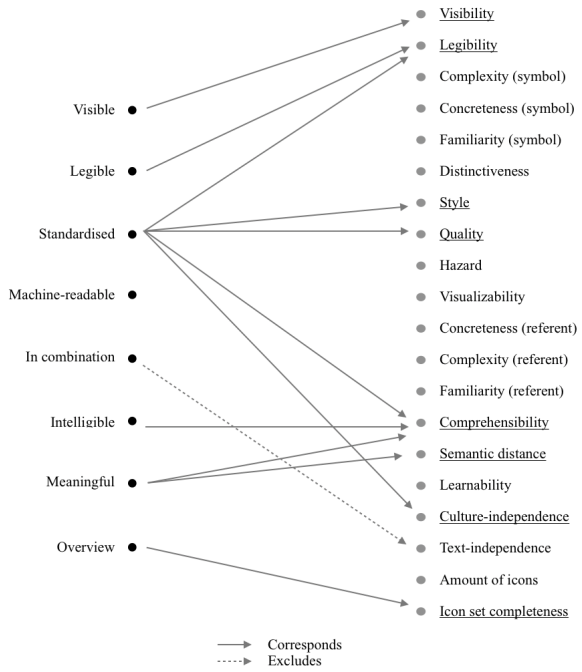


Fig. 5: Correspondences: GDPR's requirements (left) icon properties (right)

7 Methods of Icons' Evaluation

This section summarizes the main evaluation methods that were found in the literature.

Visibility. Visibility has a twofold nature: salience and accessibility. *Salience* is classically defined as the fixation points the viewer is most immediately drawn to and can be observed through eye-tracking software. The ease of finding of a target can reflect *accessibility* and can be indirectly determined through speed of recognition in a specific environmental context.

Legibility. Legibility consists in the correct identification of the icons' elements and can be operationalised by two measures: one assessing the accuracy of responses (i.e. if one icon object is correctly recognized) and one assessing their completeness (i.e. if all the objects depicted in the icon are recognized). To correcly evaluate this dimension, it is important to reproduce real-world interpretation conditions [49]: as the example in Fig. 6 shows, the icon size (like

screen resolution and contrast) can affect legibility and, thereby, *comprehensibility*. Since *complexity* reliably indicates icon's legibility, during icon development, simple designs should be preferred.

(a) Icon as conceived

(b) Icon as possibly implemented

Fig. 6: Examples showing the impact of icon size on legibility, taken from [34]

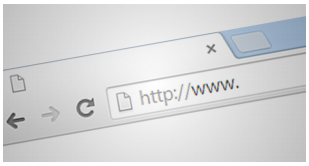
Comprehensibility. Comprehensibility is the most important index of icon effectiveness [10]. This is why much research has been devoted to the elaboration of relative measuring protocols. Accuracy of association between graphical symbol and intended meaning is a typical assessment of icon comprehensibility: the ISO method [21] combines hit rate (i.e. the number of correct associations) with missing values and error rates (i.e. number of wrong associations) indicating possible flaws. The European Telecommunications Standards Institute (ETSI) [12] also adds subjective certainty about the association and subjective suitability, *i.e.*, a personal estimation of a pictogram's ability to represent its referent.

Multiple choice recognition tests, where respondents choose the meaning of an icon from a pool of possible candidates, are acceptedly discarded because they do not reflect realistic interpretation conditions [48]. Open-ended questionnaires where participants formulate hypotheses about the expected meaning of a pictogram are thus preferred, even though determining if an answer is correct or wrong can ultimately depend on subjective judgments. The latest published ISO testing procedure [21] elects the most comprehensible icon among three variants for the same referent, by calculating the highest mean percentage of correct interpretations. Acceptance criteria have been set to 66% of correct answers to declare a public sign understandable and 86% for safety signs. In other methods [12,14], participants simply choose the best symbol among multiple candidates for a specific referent.

Some test procedures [21] require to provide a verbal or visual description of the proximate or the environmental context where the symbol is expected to be used (e.g. Figure 7), thus restricting the number of possible interpretations. This would reflect real-world understandability and enhance the ecological validity of the test [48]. Otherwise, as anticipated earlier, low comprehension rates would wrongly indicate that an icon is not understandable.

As shown at the end of Section 6, comprehensibility is impacted by other dimensions: faster and more accurate comprehension at first exposures directly

(a) Padlock symbol



(b) Padlock symbol's context

Fig. 7: In a test, the provision of the intended context of use must not be misleading nor revelatory of the intended meaning [21]

depends on the icon's *concreteness*, the *semantic distance* between icon and referent, and the interpreter's *familiarity* with both pictogram and meaning. It is not strictly necessary to assess such dimensions (although this can be done through *e.g.*, subjective ratings [27]). However, should such properties not be at least considered in a comprehensibility test, its outcomes might indicate that some icons must be discarded because their meaning is not immediately evident. Yet, when icons are abstract, arbitrary, or unfamiliar, meaning must be learned rather than deduced [47]. To obviate such problems, another ISO standard [22] introduces two consequent phases of testing. The first part consists in a familiarity training: test participants learn a list of concepts and their definitions. The second part tests the comprehensibility of graphical symbols as an association test between one symbol and six learned definitions.

Learnability. For the reasons explained above, it can be meaningful to measure ease of learning of an icon set [10]. For instance, longitudinal studies quantify speed of learning over a period of time, by monitoring number and frequency of exposure to the symbol before it is retained, and the evolution of accuracy of answers.

Culture-independence. Unless symbols are made for a specific national audience, it is recommended that the testing is carried out in more than one nation and with more than one linguistic community. This ultimately impacts the number of participants: e.g. ISO standard for legibility [20] provides for 25 participants from one country, while ISO standard for comprehensibility requires 50 participants for each variant in each country [21].

Discriminability. Determining how easily one icon is discerned from another can be assessed through an association test between one or more icons and one or more referents. Not only the number of correct interpretations, but also the consistency of wrong associations can reveal which pictograms resemble too much for being used in the same context. As Figure 8 shows, a low level of discriminability can also reflect similarity of the underlying concepts. This dimension is pivotal because it ultimately impacts *comprehensibility*.

(a) Right to object to processing

(b) Right to restrict the processing

Fig. 8: These two icons from [39] might be easily confused because of the similarity of their design and concept

Evaluation of icons' function in the context of use. According to the function they assume in a specific context (see Section 5), it should be determined if the icons are able to convey their intended meaning and enable the task they were designed for. For instance, if the icons are used as information markers in privacy policies to enhance information finding, than classical usability tests can determine whether participants can find specific pieces of information quicker, with more accuracy and with more satisfaction (and other relevant UX dimensions) [30], with respect to a pure-text document. If the icons are rather used as alert icons, than evaluation should focus on their ability to convey a sense of *hazard* and to stand out from the rest of the information (*i.e.*, *visibility*). Comparing the comprehensibility of a document enriched by icons with a pure textual document can indicate if they do improve understanding - or if their function is rather that of attracting attention, supporting memory, etc. This point is key to determine whether the data protection icons can achieve the transparency goals envisaged by the law-makers.

8 Discussion

At the end of this preliminary exploration of icons' evaluation methods, it becomes evident that there are a number of dimensions that should be embedded during icon design and a number of issues with established practices that are commented in the following.

The lack of objectivity in assessing answers to open questions concerning comprehensibility constitutes a first obstacle to the development of a reliable methodology. It can be however counterbalanced with inter-evaluators agreement measures and with the *a priori* establishment of a rigid set of acceptable answers, *e.g.*, through a pilot test. Yet, since it is hard to foresee the entire set of potential answers, a solid policy for such cases should also be set up. Interpretation tests can also be complemented with cognitive interviews to elicit further responding and thus attain higher comprehension rates [47]. Moreover, given the great quantity of privacy icon sets, electing the best alternatives is also viable, provided that style uniformity is ensured to avoid choices based on aesthetic judgments rather than perceived efficacy.

Acceptance rates proposed by ISO also pose a dilemma: the established percentages are arbitrary and shall be rather adjusted to the gravity of the consequences of misinterpretation [7]. Since wrong understanding of an icon related to

data processing has legal consequences for the data subject, it can be arguably proposed to adopt strict criteria of acceptance.

Users' characteristics also play an important role. In the view of international standardization, test participants should ideally be representative of the European population of data subjects. Whether tests should be carried out in every single Member State is open to discussion. Yet, given the pivotal role of familiarity, different levels of education, technology expertise, age, and even privacy awareness should be represented. Moreover, the meaningfulness of the icon set mostly depends on individual preferences and concerns. Although comprehensibility tests should be ideally carried out both on paper and on screen, the second option can reach a higher and more diverse number of participants. One first step in this direction has been the recent creation of the Privacy Icons Forum[9], a platform that promotes best practices and the exchange of results among projects and institutions that research, develop and design privacy icons worldwide.

As seen earlier, a specific methodology for testing symbols with unfamiliar referents exists [22]. However, it is unclear how such tests can be carried out for longer lists of referents without causing user fatigue, which would compromise the soundness of test results. Indeed, it is recommended [20] to show no more than 15 symbols per respondent. Moreover, the familiarization procedure does not mirror realistic conditions: the majority of data subjects are not explicitly educated about the privacy, protection and security of data. To overcome the familiarity issue, one might resort to data protection experts — however, this would not mirror the intended audience of the icon set. For such reasons, longitudinal studies where ease of learning in context is observed should be preferred. Indeed, by drawing a parallel with familiarization processes with new GUIs, it is through repeated experience that people improve comprehension accuracy and speed on task. There is no reason why this should not apply to interfaces to the law, like legal documents, consent requests or privacy dashboards.

Finally, observations on concreteness, complexity, familiarity and style should influence icon design rather than icon evaluation, in order to avoid effortful testing that ultimately discovers obvious limitations of the icon set. For example, [50] found that adding complexity to an icon can lead to more precise interpretations. However, in realistic conditions of exposure, where an icon is quickly perceived rather than attentively observed, visual complexity might actually hamper legibility and recognition [14]. Besides, this result is not generalizable to symbols that must be recognized even if displayed at small size, *e.g.*, few pixels of al screen. In the context of digital privacy, this concern is of utmost importance. Therefore, whereas it is self-evident that adding details sharpens comprehension, the real conundrum is the opposite, namely the extent to which an icon can be simplified without losing the ability to convey its meaning. Depending on the type of support and the icon function, the same symbol must be adapted to different sizes (see e.g. Google's or Apple's design guidelines on

[9] `https://www.privacyiconsforum.eu/`.The authors of this article are among the founding members.

iconography [2,16]). Moreover, it should be possible to adjust the symbols to a specific graphical house style without altering their recognizability: the icons should be adopted by services with strong brand identity to ensure widespread adoption and ultimately international standardization. This controversial point still needs to be carefully addressed and discussed with relevant stakeholders.

9 Conclusions and Future Work

This article has been motivated by the will of understanding under which conditions icons can support transparency of communication about data processing in an "easily visible, intelligible and clearly legible" manner, as envisaged by the GDPR's Art. 12. Thus, we collected and defined several properties that are relevant to evaluate icons and icon sets in correspondence with GDPR's requirements. Our list can be expanded and modified as the research progresses.

We presented several evaluation measures and critically discussed their appropriateness for the context of data protection. The properties we presented are not yet organized in a taxonomy with relations and dependencies, nor have we defined precise metrics for each of them: this constitutes future work. In the view of EU standardization and in support of the European Commission preparatory work, future research will tentatively provide a holistic evaluation methodology with precise metrics to assess the efficacy of icons as standalone elements and as functional elements in determined contexts of use. Ideally, such methodology will help the many entities that have designed, or are designing, data protection icon sets to empirically validate their work. Indeed, the necessary condition for indicators of on-line privacy and transparency to gain traction is, according to Reidenberg *et al.* [36], the development of evaluation criteria, the production of objective and demonstrable output, and the reliable proof of intelligibility and accessibility.

The research outlined in these pages has scientific and practical relevance even beyond the GDPR's scope. Both the current proposal for an ePrivacy Regulation and the US Federal Trade Commission recommend the use of icons to increase transparency [13]. Requirements on standardised templates and visual indicators to enhance information transparency have been advanced in consumer protection (*i.e.*, Consumers' Rights Directive) and in the insurance sector (*i.e.*, Directive on Insurance Distribution). The definition of design and evaluation guidelines for icons can also be usefully applied to other domains, *e.g.*, in the communication of security and privacy risks.

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