Everything that we do leaves a trace in our mind and our brain.

The development of our brain is shaped by our experiences.
Neuroplasticity

CHILDHOOD
Examples of children with only one hemisphere

Hou Guozhu from China

10-year-old girl from Germany
Despite lacking one hemisphere, the girl has normal psychological function and is perfectly capable of living a normal and fulfilling life. She is witty, charming and intelligent.

Experiences can restructure our mind and brain
Multi-lingualism
An experience that can change our mind and brain?
Execution functions

Selection conflict

- “Int”
- “Pato”
Executive functions

Engel de Abreu, Nikaedo, Puglisi, Abreu, Tourinho, Miranda, Bueno, Befi-Lopes, & Martin (2013)
Executive functions and multilingualism
Bilingualism Enriches the Poor: Enhanced Cognitive Control in Low-Income Minority Children

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Grant #CO09/LM/07

Bilingualism Enriches the Poor
Engel de Abreu, Cruz-Santos, Tourinho, Martin, & Bialystok, 2012

40 Portuguese-Luxembourgish bilingual children living in Luxembourg
40 Portuguese monolingual children living in Portugal
• Low socio-economic status
• Age: ~ 8 years
• Cycle 2.2
• “Matching”:
  ➢ Age
  ➢ Gender
  ➢ Ethnicity
  ➢ Socio-economic status

Bilingualism Enriches the Poor
Engel de Abreu, Cruz-Santos, Tourinho, Martin, & Bialystok, 2012
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Bilingualism Enriches the Poor
Engel de Abreu, Cruz-Santos, Tourinho, Martin, & Bialystok, 2012

![Graph showing the effect size of bilingualism on executive functions.](image)

Bilingualism is shown to enrich executive functions, with effect sizes ranging from small to large. The graph illustrates the positive impact of bilingualism on cognitive development, particularly in impoverished areas.
Executive functions and multilingualism in older ages

Symptoms of dementia/Alzheimer develop 4-5 years later

(Bialystok, Craik, & Freedman, 2007; Craik, Bialystok, & Freedman, 2010)
Multilingualism

Do children with SLI show this „cognitive advantage“?
What is SLI?

Child fails to make normal progress in language learning for no obvious reason
Language disorder in DSM 5

Diagnostic Criteria

• **Persistent difficulties** in the acquisition and use of language across modalities (i.e., spoken, written, sign language or other) due to deficits in comprehension or production that include:
  ❖ Reduced **vocabulary** (word knowledge and use)
  ❖ Limited **sentence structure** (ability to put words and word endings together to form sentences based on the rules of grammar and morphology)
  ❖ Impairments in **discourse** (ability to use vocabulary and connect sentences to explain or describe a topic or series of events or have a conversation)

• Language abilities are substantially and quantifiably **below those expected for age**, resulting in **functional limitations** in effective communication, social participation, academic achievement, or occupational performance, individually or in any combination.

• Symptom **onset** in **early developmental period**.

• Difficulties are **not better explained** by intellectual disability (intellectual development disorder), global developmental delay, hearing or other sensory impairment, motor dysfunction, or another mental disorder or medical condition.

*The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, (Copyright © 2013). American Psychiatric Association. All rights reserved*
In practice, however....
Simple characterisation is deceptive

Deciding who should or should not be regarded as having SLI can be extremely difficult.

Major problems

- Discrepancy between IQ and language level
- Heterogeneity of SLI
- Comorbidity with and differentiation from other developmental disorders
Major problems

- **Discrepancy between IQ and language level**
- Heterogeneity of SLI
- Comorbidity with and differentiation from other developmental disorders

**Discrepancy between IQ and language level**

SLI diagnose: traditionally – discrepancy between language and nonverbal IQ

Language standard score – 78 (1.5 SD below mean)
Nonverbal IQ standard score – 85 (1 SD below mean)

Bishop (1994): one twin with SLI other twin with similar language profile but no discrepancy criterion

Language impaired children benefit as much from language therapy as low IQ language impaired children
Look if you find evidence for SLI.

There is a huge magnetic machine. It took a picture inside the brain. You could talk but not move your head because that would ruin the whole thing and they would have to start all over again. After it’s all done they show you your brain on a computer and they see how large it is. And the machine on the other side of the room takes pictures from the computer. They can take pictures instantly. Ohm and it was very exciting.

17 year old woman with an IQ of 50
(Bellugi, Marks, Bihrlle, & Sabo, 1988)
Discrepancy between IQ and language level

SLI diagnose: traditionally – discrepancy between language and nonverbal IQ

- No discrepancy criterion but nonverbal IQ within normal limits (often above 80)
- Nonverbal IQ is irrelevant: focus on the language profile

Major problems

- Discrepancy between IQ and language level
- Heterogeneity of SLI
- Comorbidity with and differentiation from other developmental disorders
Heterogeneity of SLI

Many different aspects of language can be affected in SLI

<table>
<thead>
<tr>
<th>EXPRESSIVE</th>
<th>RECEPTIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vocabulary</td>
<td>Vocabulary</td>
</tr>
<tr>
<td>Grammar</td>
<td>Grammar</td>
</tr>
<tr>
<td>Narrative</td>
<td>Narrative</td>
</tr>
</tbody>
</table>

Major problems

- Discrepancy between IQ and language level
- Heterogeneity of SLI
- Comorbidity with and differentiation from other developmental disorders
Children with SLI have high rates of ADD (Beitchman, Brownlie & Wilson, 1996), developmental co-ordination disorder (Powell & Bishop, 1992), literacy problems (Bishop & Adams, 1990), and impairment of social interaction (Brinton, Fujiki, 1993).

Comorbidity is the rule – not the exception! (Gilger & Kaplan, 2001)
Same child – different diagnosis

• Educational psychologist – Dyslexia
• Speech and language therapist – SLI
• Psychiatrist – Autism Spectrum Disorder
• Pediatrician – ADHD

Comorbidity

Poses challenges for how we categorize disorders and think about their causes.
What causes SLI?

Neurodevelopmental disorders

Disorders where abnormal neurodevelopment is inferred: actual cause in unknown e.g. developmental dyslexia, autistic spectrum disorder, SLI, developmental dyscalculia
Types of Theory

• Linguistic theories (deficits in “innate” linguistic rules)
  – Gopnik & Crago’s feature blind hypothesis
  – Rice & Wexler extended optional infinitive (EOI)

• Cognitive theories
  – Tallal’s rapid auditory processing hypothesis
  – Gathercole and Baddeley’s phonological memory hypothesis

• Hybrid theories
  – Leonard’s phonetic substance hypothesis
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**Engel de Abreu, Cruz-Santos & Puglisi, 2014**

*International Journal of Language and Communication Disorders*

Verbal working memory

Bi-SLI < TD-Monolingual = TD-Bilingual

Specific verbal working memory limitations in SLI constrain the processing and storage of speech material which negatively impacts language learning.
Single deficit models of SLI

Multiple deficit models
Multiple deficit models

No single etiological factor is sufficient for a complex disorder like SLI.

Instead etiology involves the interaction of multiple risk and protective factors.

What about genes?
Genetic influences on Specific Language Impairment

SLI runs in families
Rates of language learning difficulties are higher in relatives of those with SLI, compared with controls of similar background

Twin studies

Monozygotic twins (MZ): “identical twins”
Same DNA sequence, genetically identical

Dyzygotic twins (DZ): “non-identical twin” ~ 50% identical genes
Twin studies

SLI diagnose in co-twin more likely if MZ than if DZ twins (Bishop, North, & Donlan, 1995)

KE family

If affected parent 50% chance of having SLI

Hurst, Baraitser, Auger, Graham, & Norell, (1990)
A gene for language?  
**FOXP2?**

**FOXP2**

FOXP2 gene – located on chromosome 7  
clear-cut genetic mutation to explain all language disorders?

DNA change in KE family is very unusual

FOXP2 mutation – rare in individuals with language impairments
Genetic influences on Specific Language Impairment (SLI)

Language impairments behave like “complex” multifactorial disorders

Can run in families but not according to simple Mendelian genetics!

Genes do not act in isolation in a predetermined way

Complex human traits are influenced by numerous genes that interact with one another, and with the environment, to produce a specific phenotype!
Genes might determine if it is likely to have problems but do not say anything about how specific the problems will be or how likely they are to resolve.
SLI is just as likely in a multilingual child as in a monolingual child

Multilingualism does not make it more likely to have SLI

**Multilingualism does not cause SLI!**

Signs of SLI are the same as in a monolingual child

- difficulties in learning new words
- understanding sentences
- explaining things
Difficulties will be present in all the languages

Important to get a clear picture of the language development in the first/home language

Just being behind in vocabulary is not an indication of SLI

If children manage to learn new words and react to appropriate intervention there might not be a need for concern
Lack of code switching can be a concern

Children with SLI sometimes have difficulties linking the meanings and labels for words in one language with the label in the other language.

Do children with SLI show the „cognitive advantage“?
Do children with SLI show the "bilingual advantage"?

YES
Executive function tasks

Monolingual SLI < Monolingual TD & multilingual SLI

Multilingualism protection against some of the cognitive limitations usually associated with SLI?
Can children with SLI become bilingual?

Children with SLI can and do become bilingual.

Bilingual children with SLI will learn both their languages more slowly than monolinguals.

Growing up bilingually does not make SLI worse.
Learning one language at the cost of another?
Learning one language at the cost of another?
Can multilingualism confuse children and produce a language delay or impairment?

- Mixing is normal
Can multilingualism confuse children and produce a language delay or impairment?

- Mixing is normal
- Language milestones - same for monolinguals

- Multilingualism does not cause a language delay or impairment
How important is the mothertongue?
How important is the mothertongue?

If the mothertongue is not used:

- No cognitive advantage
- Culture, identity
- School languages not necessarily better

How important is the mothertongue?

Second language builds on first

Strong knowledge base in first language facilities second language acquisition
Concept PATO

Animal
Asas
Bico
nadar

Sound structure “PATO”

Animal
Asas
Bico
nadar

Sound structure “INT”
Sound structure “PATO”
My child should become a fluent multilingual — What should I pay attention to?
My child should become a fluent multilingual
What should I pay attention to?

- Sufficient input through **human interaction**

Parent training: listen and stimulate discussions
Teacher training: long and elaborate sentences
My child should become a fluent multilingual
What should I pay attention to?

- Sufficient input through **human interaction**
  - high **quality** language
  - create a **real need** to use the language
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FIND OUT MORE ON MY RESEARCH:
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The Language and Cognitive Development Group