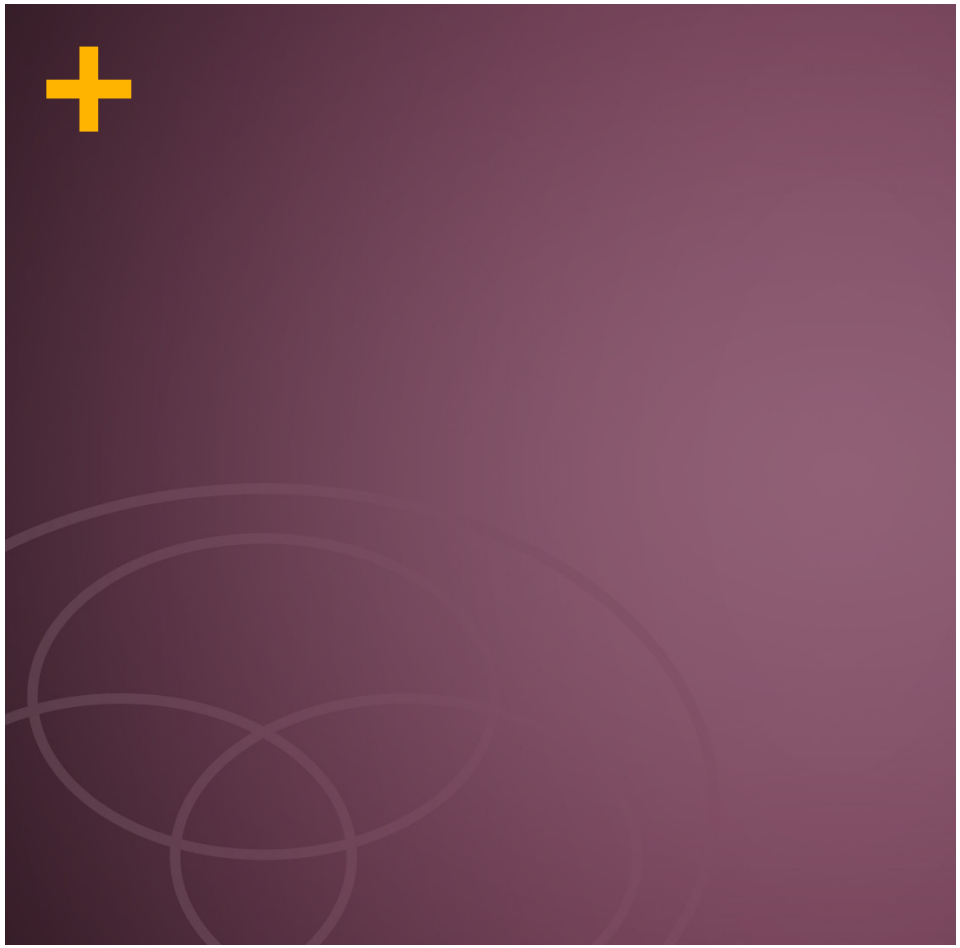

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How do children with developmental language disorders learn?

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ORBI

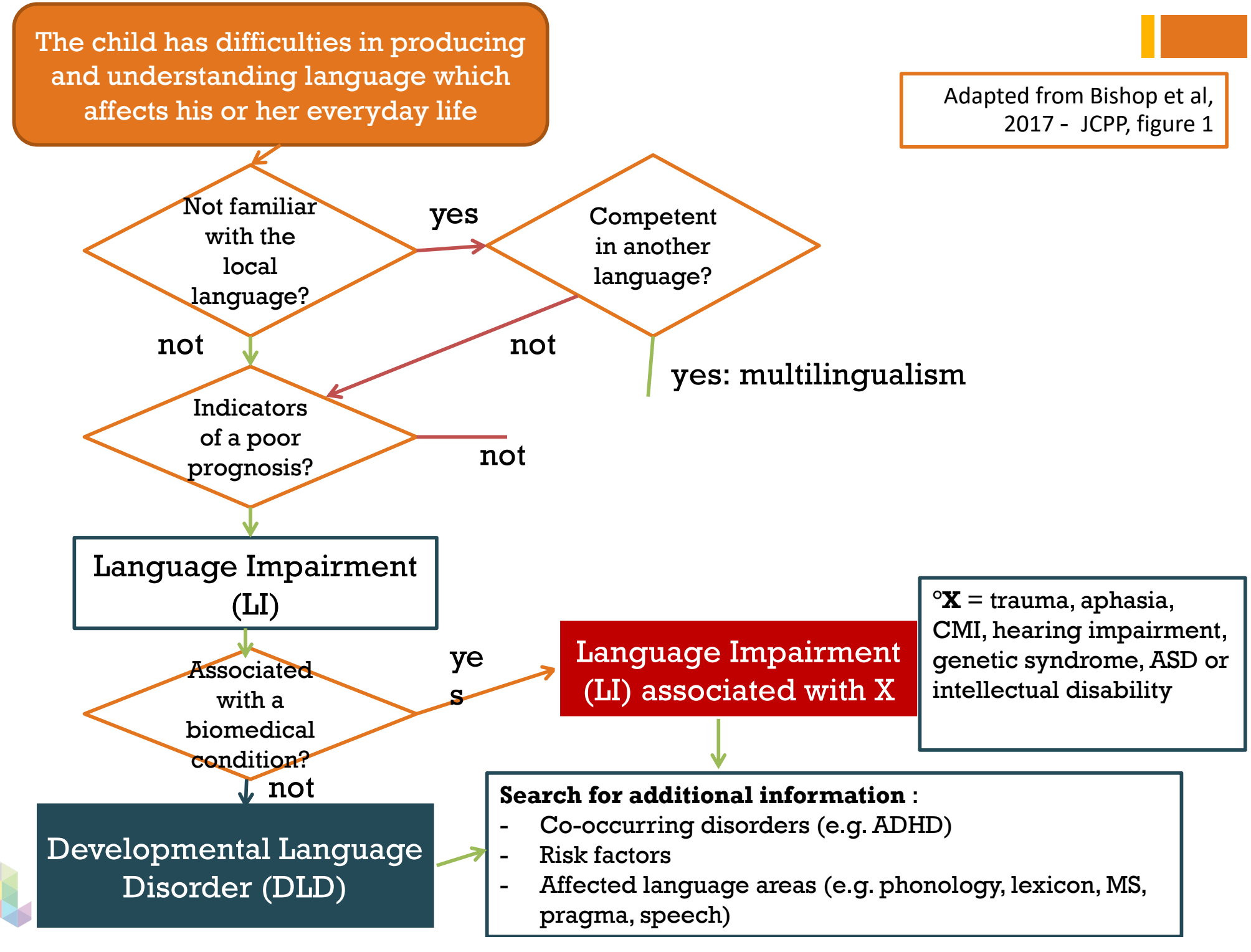
RUCHE - Research Unit for a life-Course perspective on Health & Education

Developmental language disorder

- Recent agreement on common terminology: Catalise

- Diagnostic :
  1. Child with difficulty in producing/understanding language, which affects his/her everyday life → functional impact
  2. Language impairment present in different languages if multilingual
  3. Indicators of a poor prognosis
  4. Not associated with biomedical conditions
  5. Possible (frequent) co-morbidity with other neurodevelopmental disorders

Bishop et al, 2016, 2017; Bishop, 2017


The child has difficulties in producing and understanding language which affects his or her everyday life
Adapted from Bishop et al, 2017 - JCPP, figure 1
Not familiar with the local language?
yes
Competent in another language?
not
not
yes: multilingualism
Indicators of a poor prognosis?
not
Language Impairment (LI)
Associated with a biomedical condition?
yes
Language Impairment (LI) associated with X
°X = trauma, aphasia, CMI, hearing impairment, genetic syndrome, ASD or intellectual disability
not
Developmental Language Disorder (DLD)
Search for additional information :
- Co-occurring disorders (e.g. ADHD)
- Risk factors
- Affected language areas (e.g. phonology, lexicon, MS, pragma, speech)

TDL

For more information
https://dldandme.org

- About 7% of children (> autism)
- Developmental disorder
- Learning difficulties in speaking and understanding language
- Very heterogeneous: from children who do not speak or speak very little to those who can express themselves but do so in a less rich and complex way
- Socio-emotional, behavioural, academic, etc. consequences

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Tomblin et al, 1997, Norbury et al, 2016

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- Varied language picture
  - Phonological impairment
  - Lexical impairment
  - Grammatical impairment
  - Discursive impairment
  - Pragmatic disorders
- Varied non-language picture
- Profiles that vary with development

More dimensional than categorical conception

Lancaster & Camarata, 2019

+ Explanatory hypotheses

- Two main types:

Deficit in language knowledge

- Computational Grammatical Complexity (CGC) hypothesis (Van der Lely, 1998)
- Extended Optional Infinitive (Rice, Wexler & Cleave, 1995)
- …

Deficit in general non-specific language mechanisms

- Rapid auditory temporal processing disorder (Tallal & Piercy, 1973)
- Procedural memory deficit (Ullman & Pierpont, 2005)
- …

Leonard, 2014

Learning a language

- Role of learning sequential regularities
  - (e.g. phonotactic rules, transitional probabilities between syllables, etc.)
  - disjoint (AxB where A predicts B but X can vary → morphosyntactic rules, ...)

Saffran et al. 1996, 2003; Gomez & Gerkens, 1999; Gomez & Lakusta, 2014, Gomez, 2002

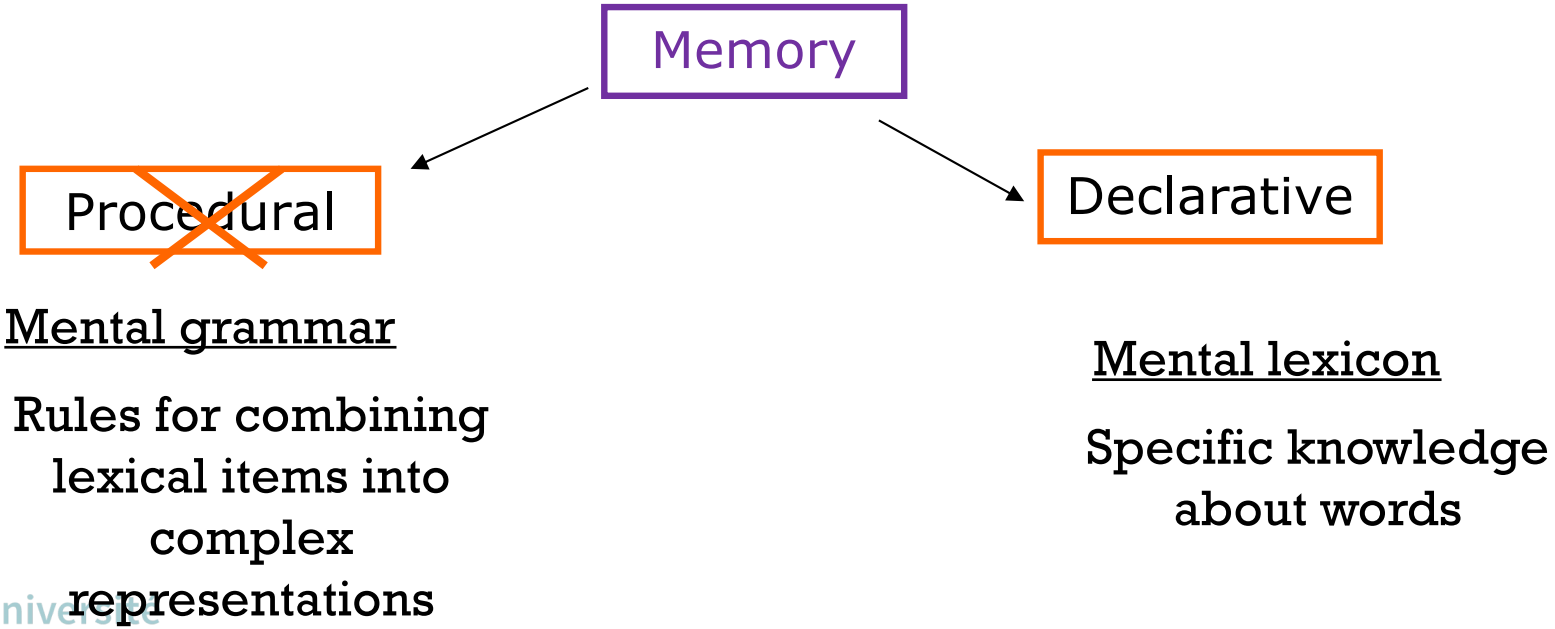
- Lexical learning
  - Identify relevant features (regularities), categorise, extend/generalise

Xu and Tenenbaum, 2007

Learning sequential patterns in children with DLD

- *"Procedural Deficit Hypothesis (Ullman & Pierpont, 2005)*

Children with DLD would show alterations in brain regions related to **procedural memory**, specifically rule learning, namely the cortico-basal region and areas connected to it.



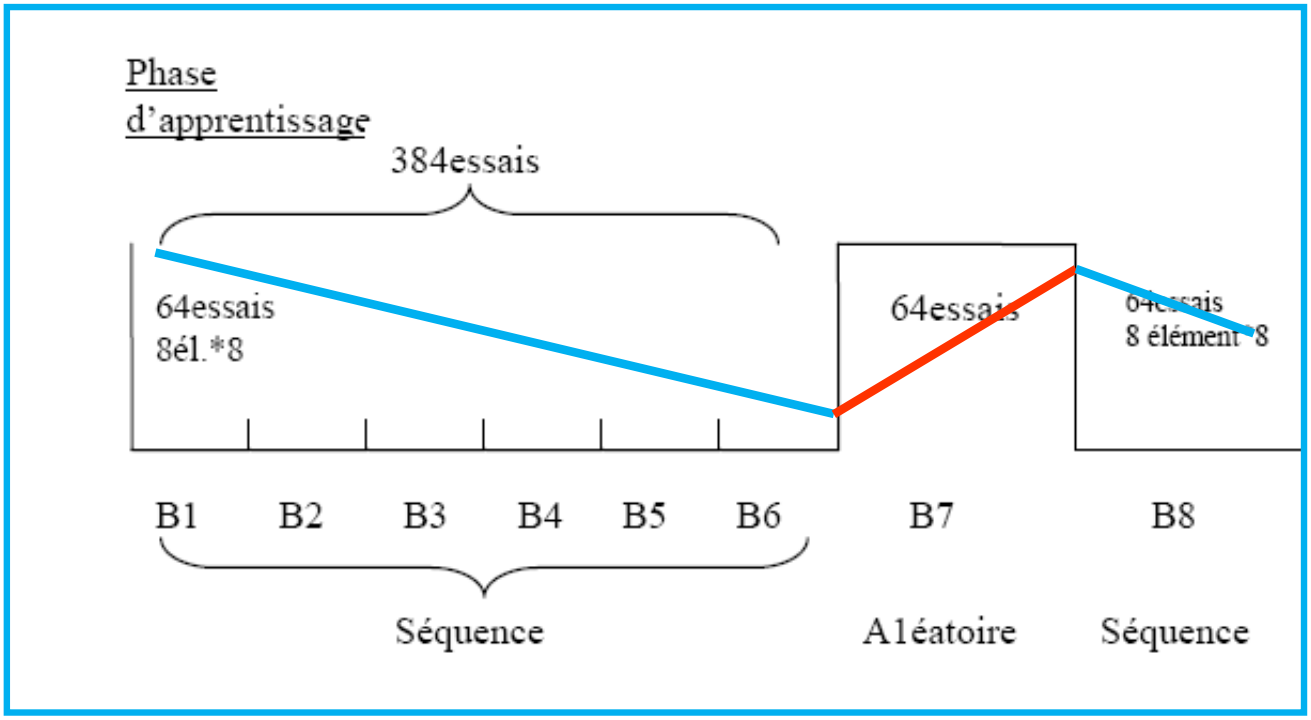
1) Are children with DLD able to detect sequential patterns like their peers?

- At the visual level
- At the auditory level

"It's a language problem but they can't string beads..." "they don't deduce the rules"
"They have to learn everything by heart

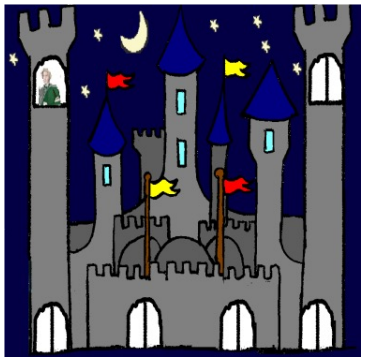
Regularities learning & DLD ?

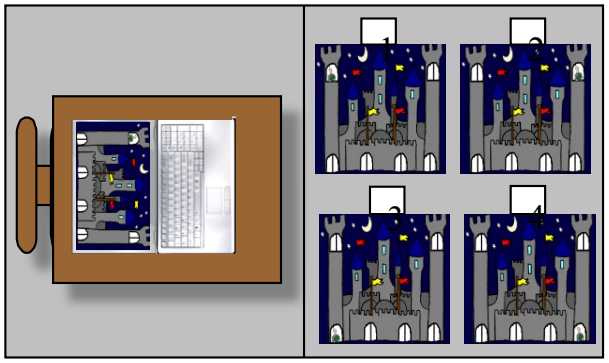
Serial implicit learning paradigm
SRT, Nissen & Bullemer, 1987
Sequence: 1-3-4-1-2-4-1-3

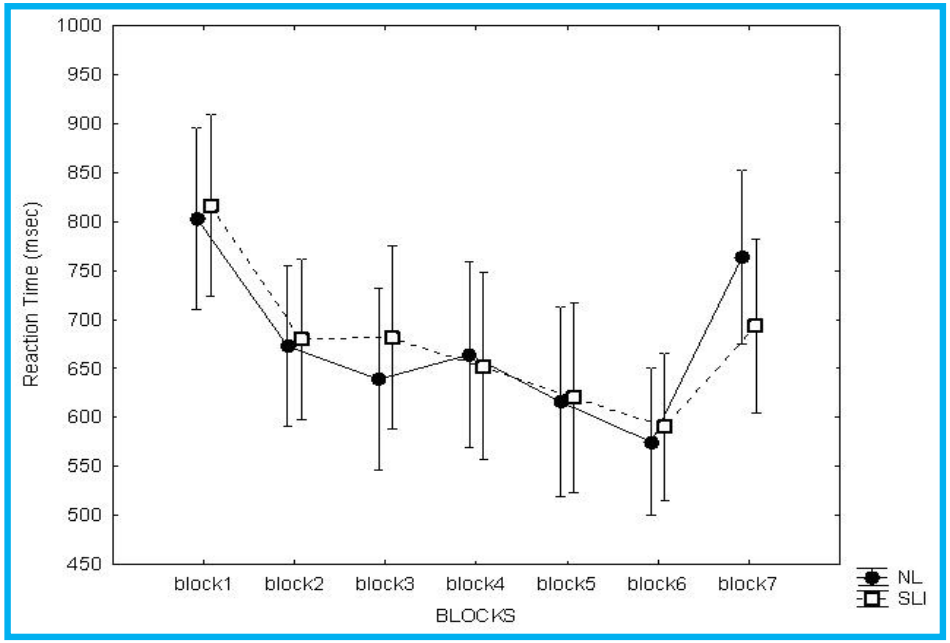


Regularities learning & DLD ?

- ➔ Use of a touch screen in SRT (visual modality)





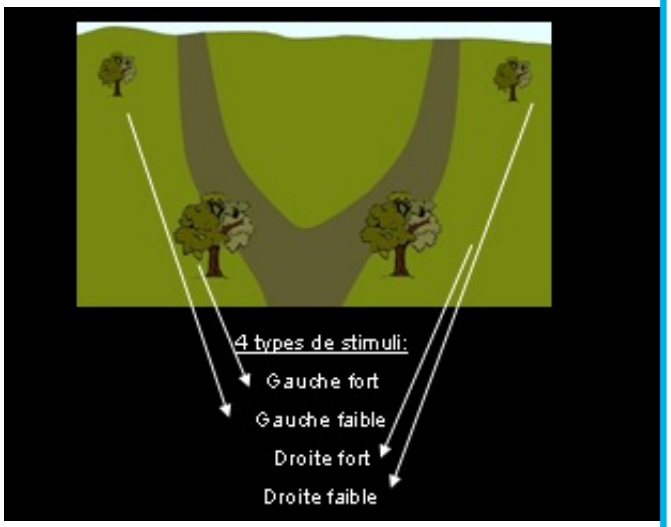


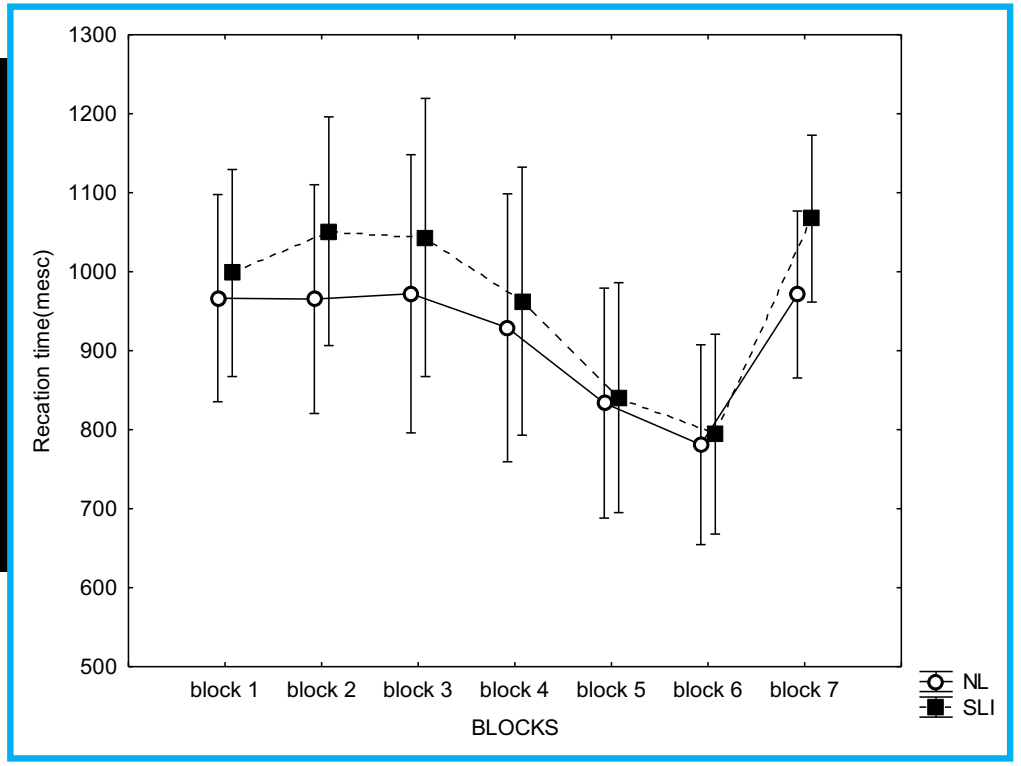
Children with DLD learn the sequence, like their peers, if the motor components are minimised

Gabriel, A., Maillart, C., Guillaume, M., Stefaniak, N., & Meulemans, T. (2011). Exploration of serial structure procedural learning in children with language impairment. *Journal of the International Neuropsychological Society*, *17*(2), 336-343

Regularities learning & DLD ?

➔ Use of a **touch screen** in an SRT (**auditory** modality)





Children with DLD learn the sequence… with more mistakes

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Gabriel, A., Meulemans, T., Parisse, C., & Maillart, C. (2015). Procedural learning across modalities in French-speaking children with specific language impairment. *Applied Psycholinguistics*, *36*(3), 747-769.

Regularities learning & DLD ?

What we know:

- Children with DLD are able to learn some visual or auditory regularities (Gabriel et al., 2011, 2012, 2013, 2014, 2015; Desmottes et al., 2016a, b, c; 2017)
  - If we take into account the slowing of motor skills
  - If the sequence is not too complex (8 but not 12)
  - Easier visually than auditory

But…

+ Regularities learning & DLD ?

- Lum et al, 2014: Meta-analysis of different SRT tasks in children with DLD

- Result:

  → **impaired procedural learning skills**

  especially if children are young

  with a shorter exposure time

  // Procedural memory deficit.

1) Are children with DLD able to detect sequential patterns like their peers? Rather no

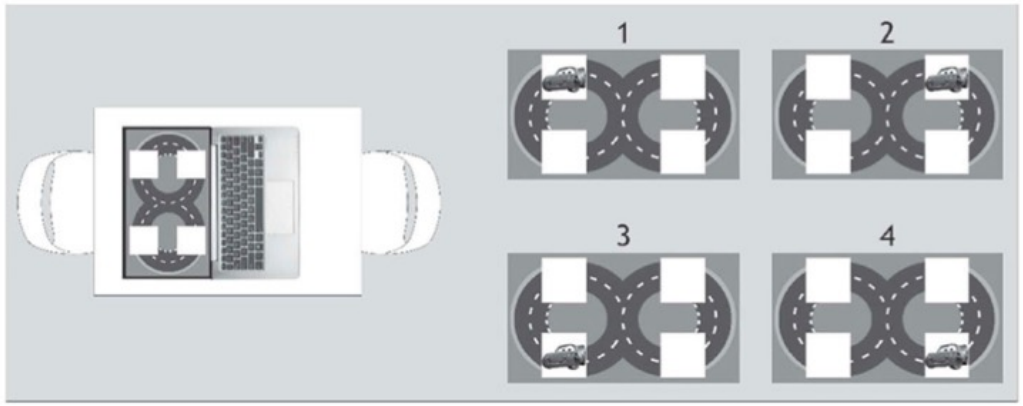
Regularities learning & DLD ?

2) Is it the initial learning that is lacking or is it the consolidation of learning?

"Learning is hard work »
"they forget faster"...
"You always have to start over".

- Same strategy - after 24 hours and 1 week

a.



b.

Experiment 1: No interference

Role of sleep

Long-term maintenance

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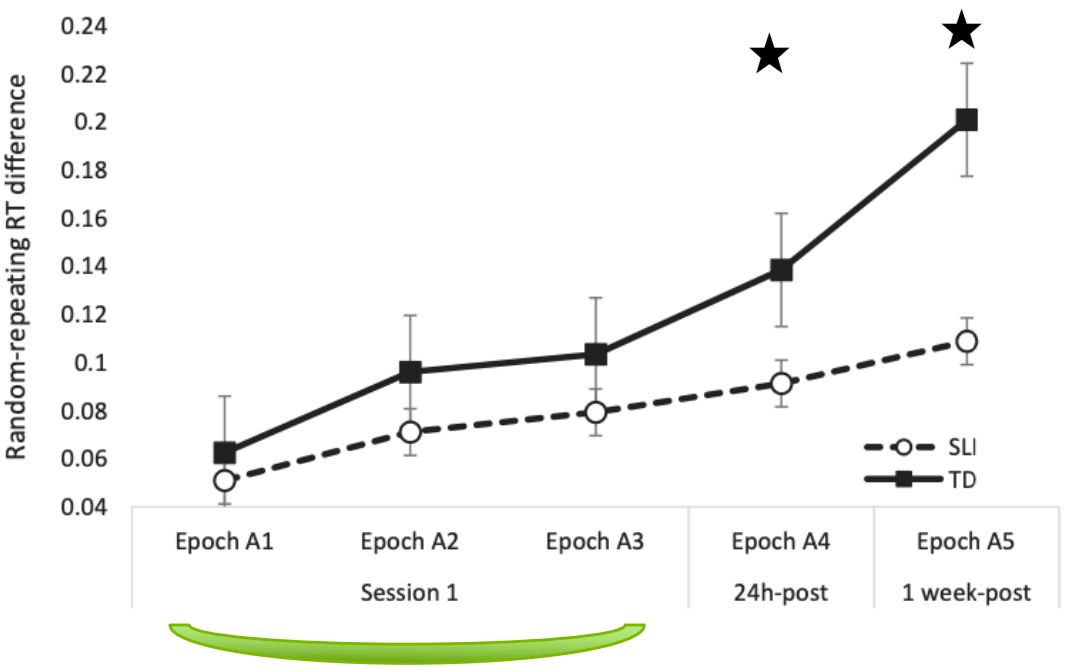
Desmottes, L., Maillart, C., & Meulemans, T. (2017). Memory consolidation in children with specific language impairment: Delayed gains and susceptibility to interference in implicit sequence learning. *Journal of clinical and experimental neuropsychology*, *39*(3), 265-285



DLD = controls

DLD ≠ controls

CTRL - Initial learning & consolidation (deferred gain)

DLD - Initial learning then ceiling effect (no gain 24H/ 1 week after)

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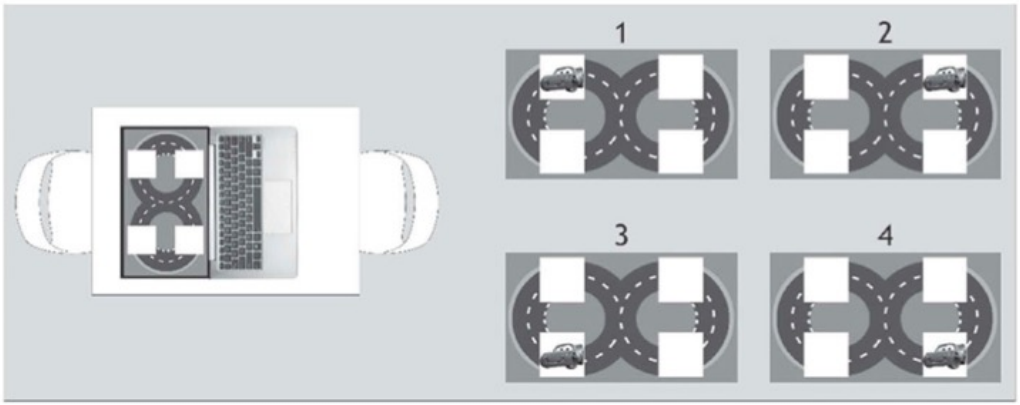
- What is the effect of interfering learning?

a.



b.

Experiment 1: No interference

Experiment 2: With interference

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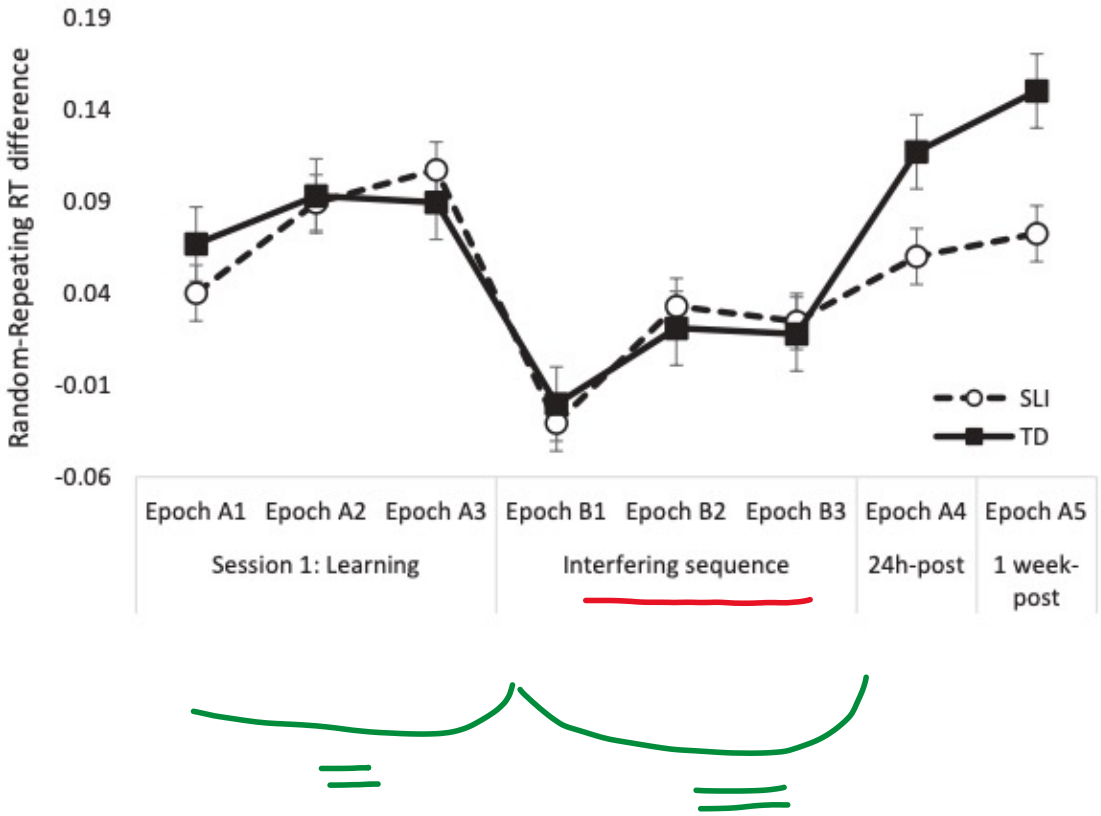

CTRL - initial learning & delayed gain after interference
(A3 ≠ A5)

DLD - loss
(A3 > A4 and A5)

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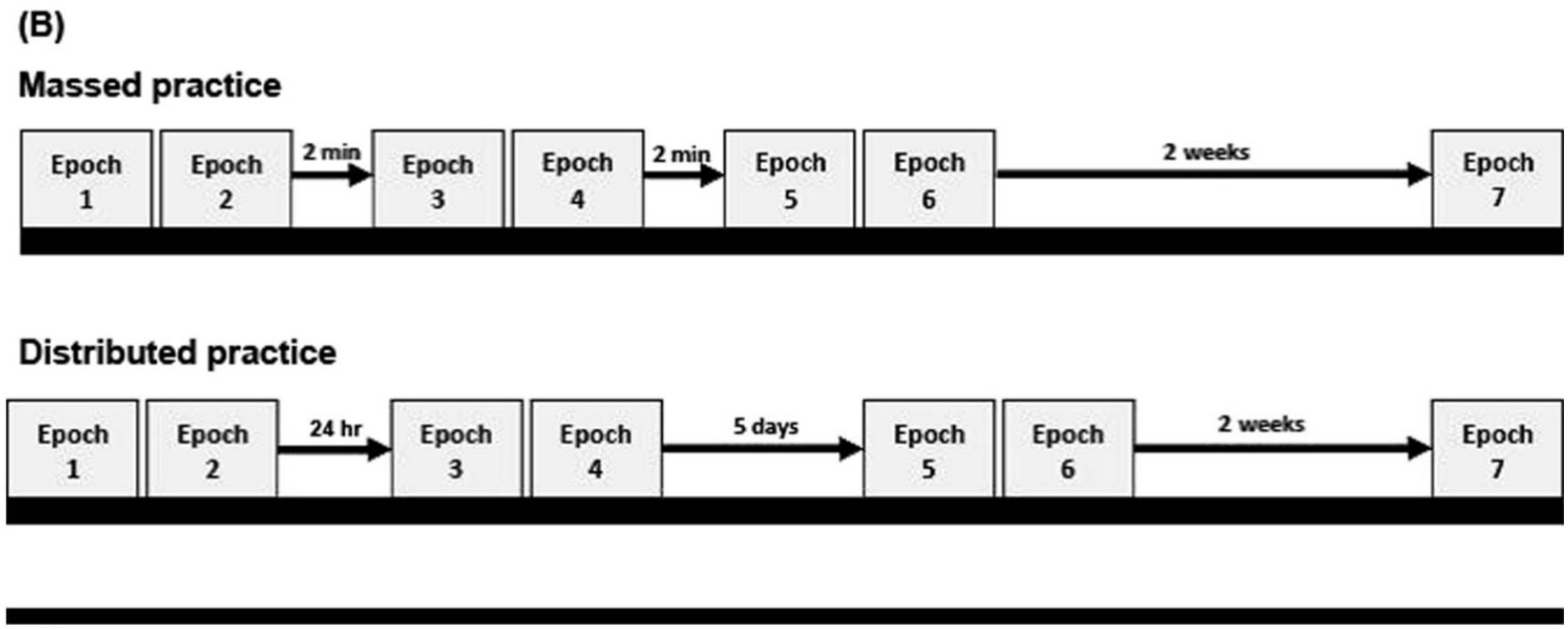
2) Is it the initial learning that is lacking or is it the consolidation of learning?

Unlike their peers, children with DLD do not show consolidation gains and are more sensitive to interference.

3) What conditions support learning in children with DLD?

Comparison between massed and distributed learning



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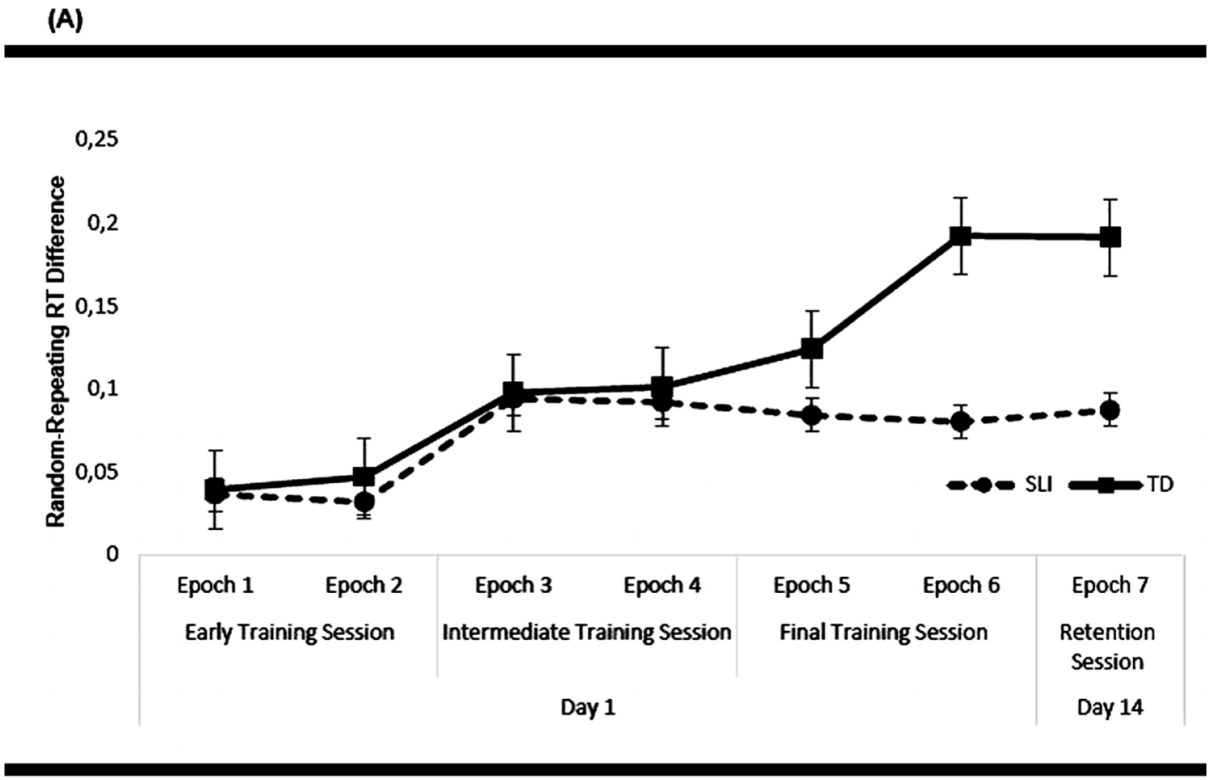
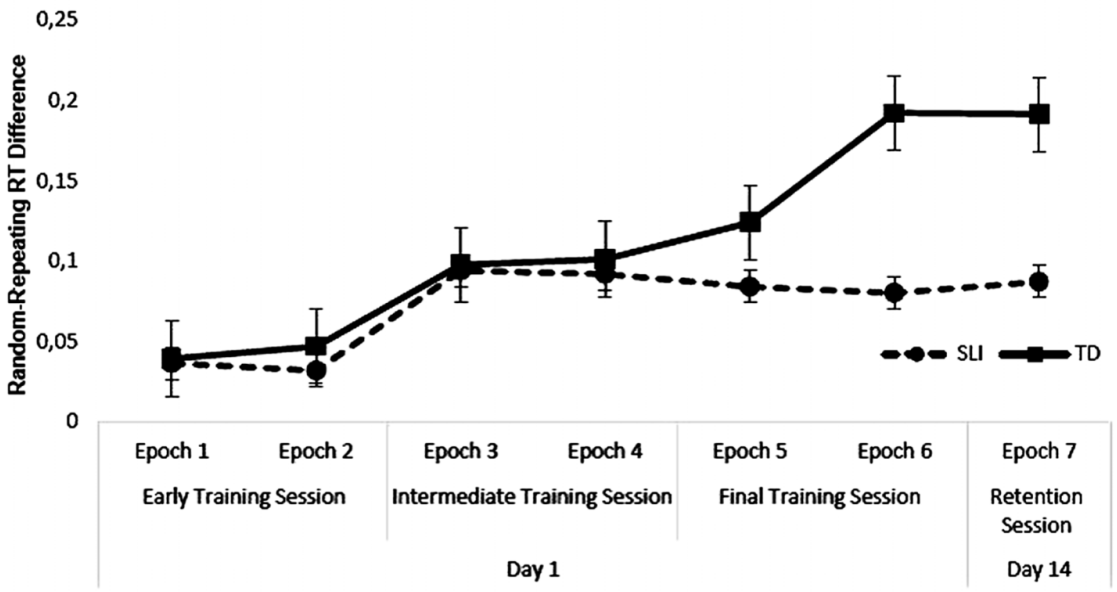
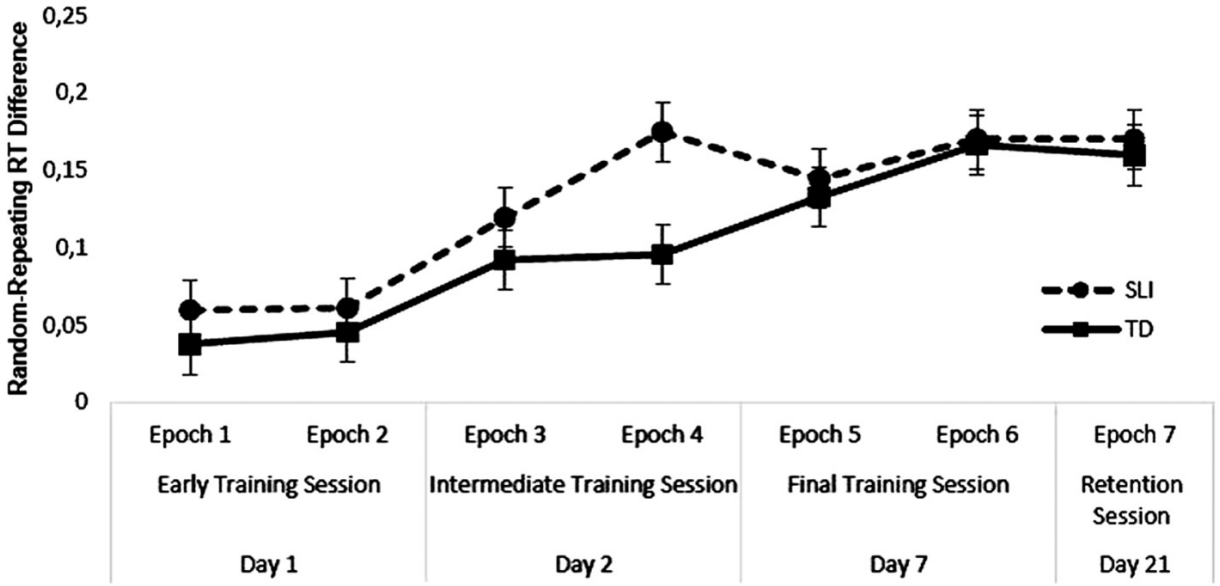


Massed practice: learning & ceiling effect for children with DLD

(A)



(B)



Massed practice: learning & ceiling effect for children with DLD

Distributed practice : both groups learn in the same way

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- 3) What conditions support learning in children with DLD?

The distribution of learning clearly supports the learning in children with DLD, which is then similar to that of their peers

Lexical learning & DLD

- In DLD, lexical limitation both in breadth (number of known words) and in depth (what they understand about the known words)

- Children with DLD are able to learn new words but their semantic representations are often less rich

- What is known about lexical extension?

  « Poodle »

  → facing other animals: poodle or not poodle?

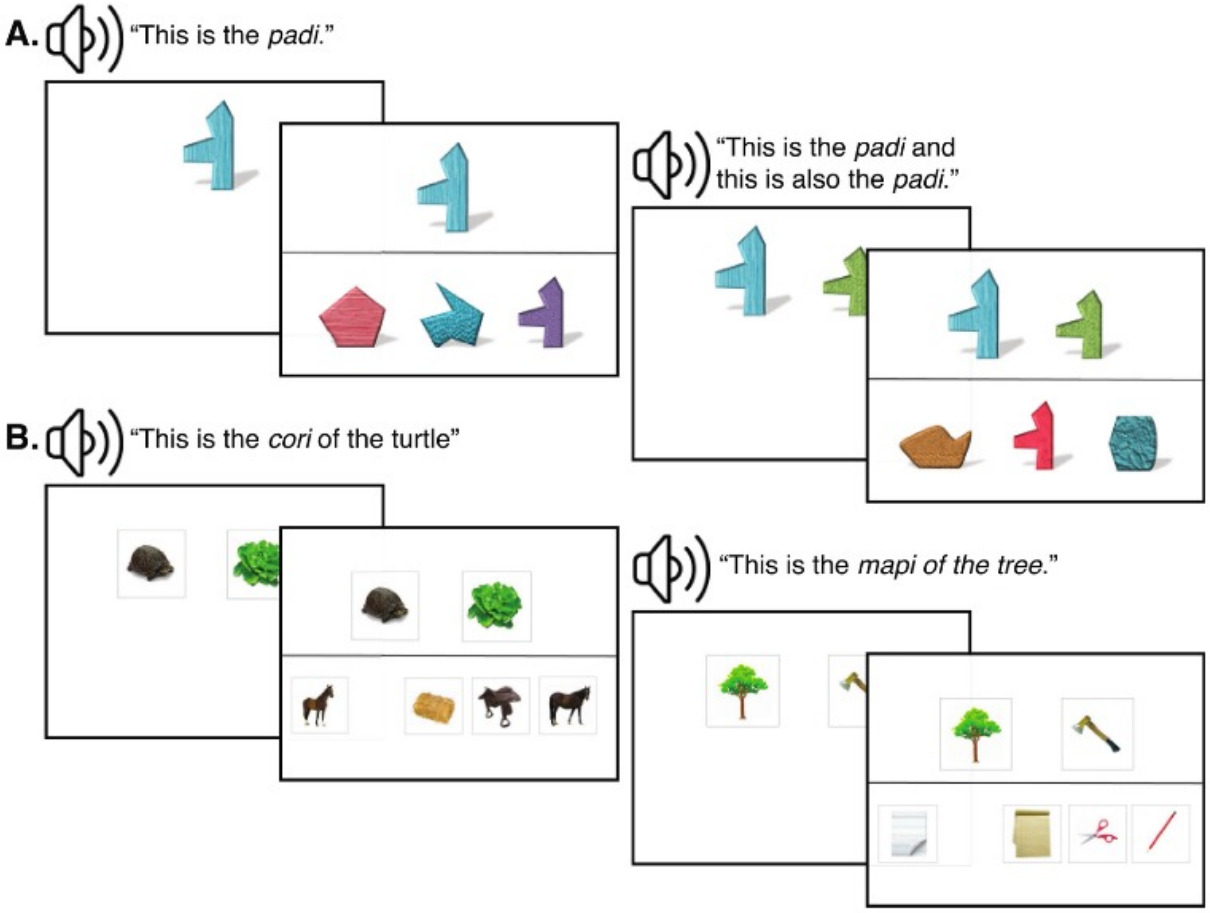
  use of strategies such as form bias

4) Do children with DLD extend words like their peers?

Lexical extension task

1er test

If KO 2nd try



Extension by shape

Extension by relationship

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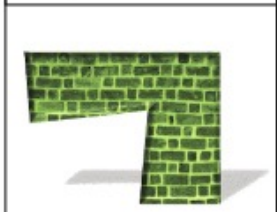
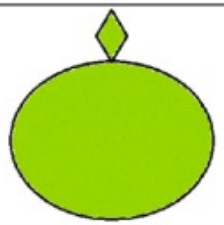
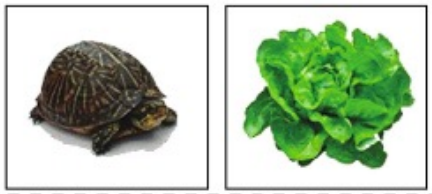
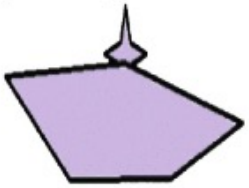
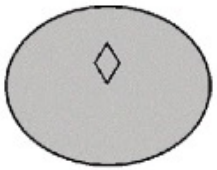
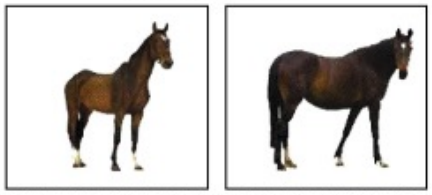
Krzemien, M., Thibaut, J. P., Jemel, B., Levaux, E., & Maillart, C. (2021). How do children with developmental language disorder extend novel nouns? *Journal of Experimental Child Psychology*, *202*, 105010.

	i) Solid	ii) Non-solid	iii) Animate	iv) Spatial configuration	v) Functional role
Learning exemplar					
Target	shape match 	texture match 	shape & texture match 	spatial configuration match 	functional relationship match 
Distractor 1	color match 	shape match 	shape & color match 	shape match 	perceptual match 
Distractor 2	texture match 	color match 	color & texture match 	color match 	thematic match 

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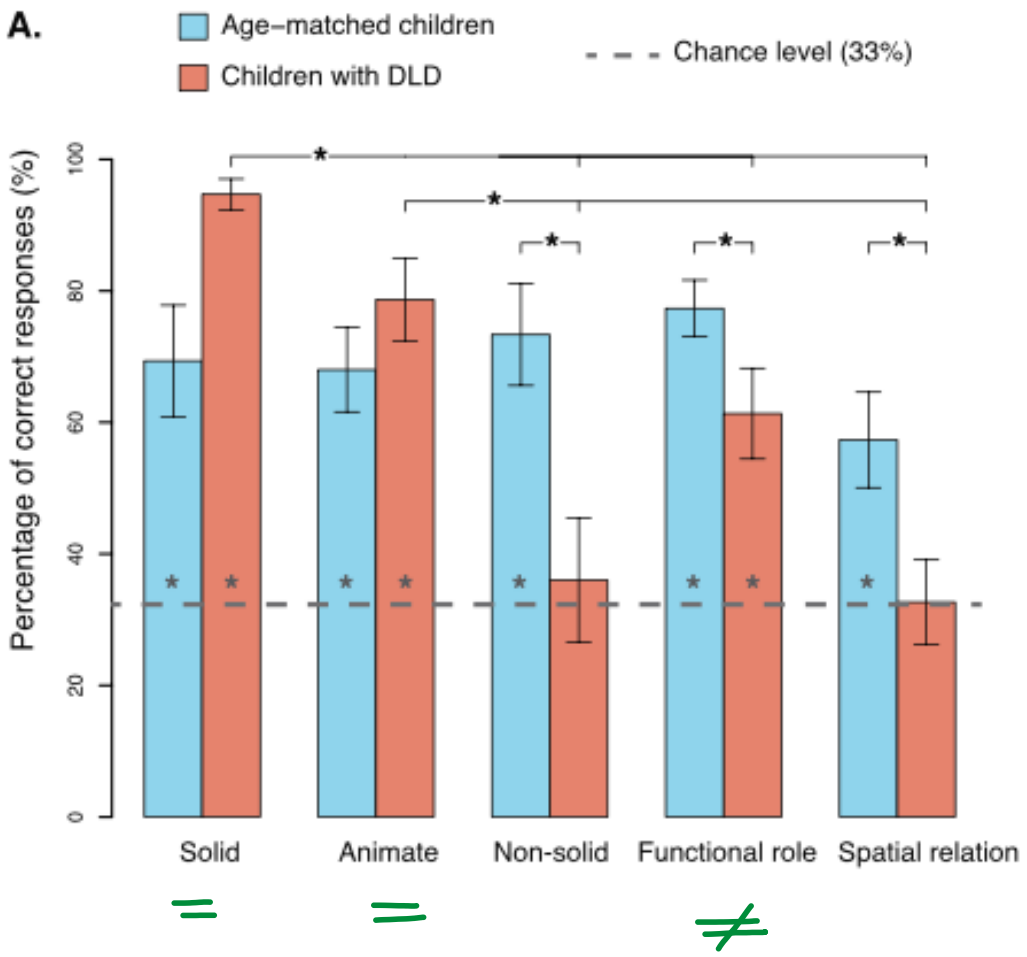

When <u>only one item is provided</u>,
interaction between the group and the categories

children with DLD(10 years old) behave like their peers
- for objects (solids)
- anime

are at the level of chance
- for liquids
- for spatial relationships

Are less effective for functional relationships

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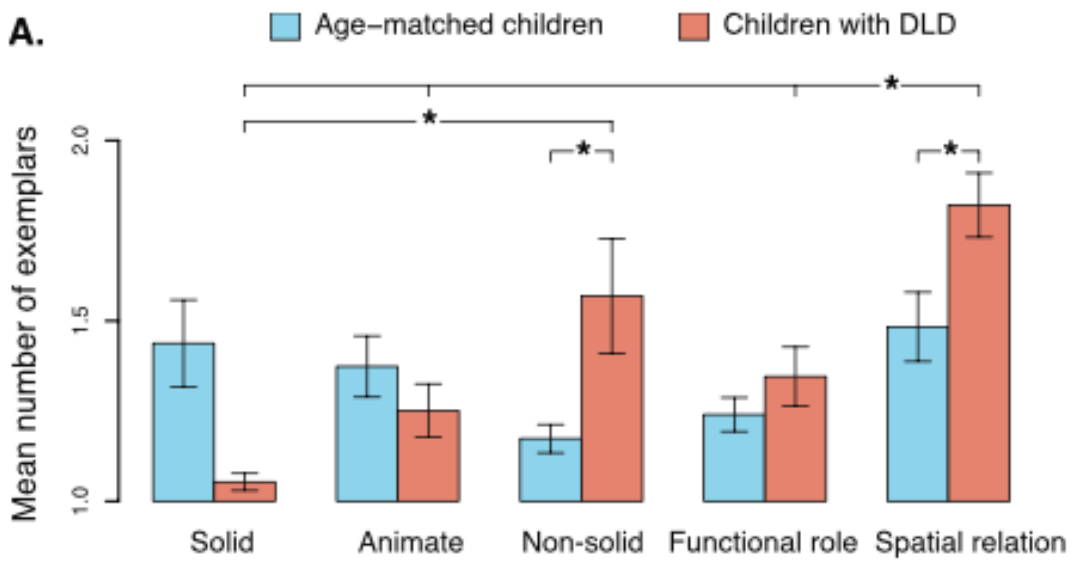
Number of items needed to achieve this



Overall no group effect but group/condition interaction

Difficulties with liquids and spatial relationships

Analysis of selected distractors: some differences (overuse of form for children with DLD)

4) Do children with DLD extend words like their peers?

It depends… on the categories and properties to be processed
They developed, at a later stage, attentional biases present in the youngest

- Ok bias for the form
- KO for texture
- KO for learning arbitrary relations

→ Difficulty in identifying some regularities between names and characteristics

! Assessment of lexical skills: objects = non-discriminating at school

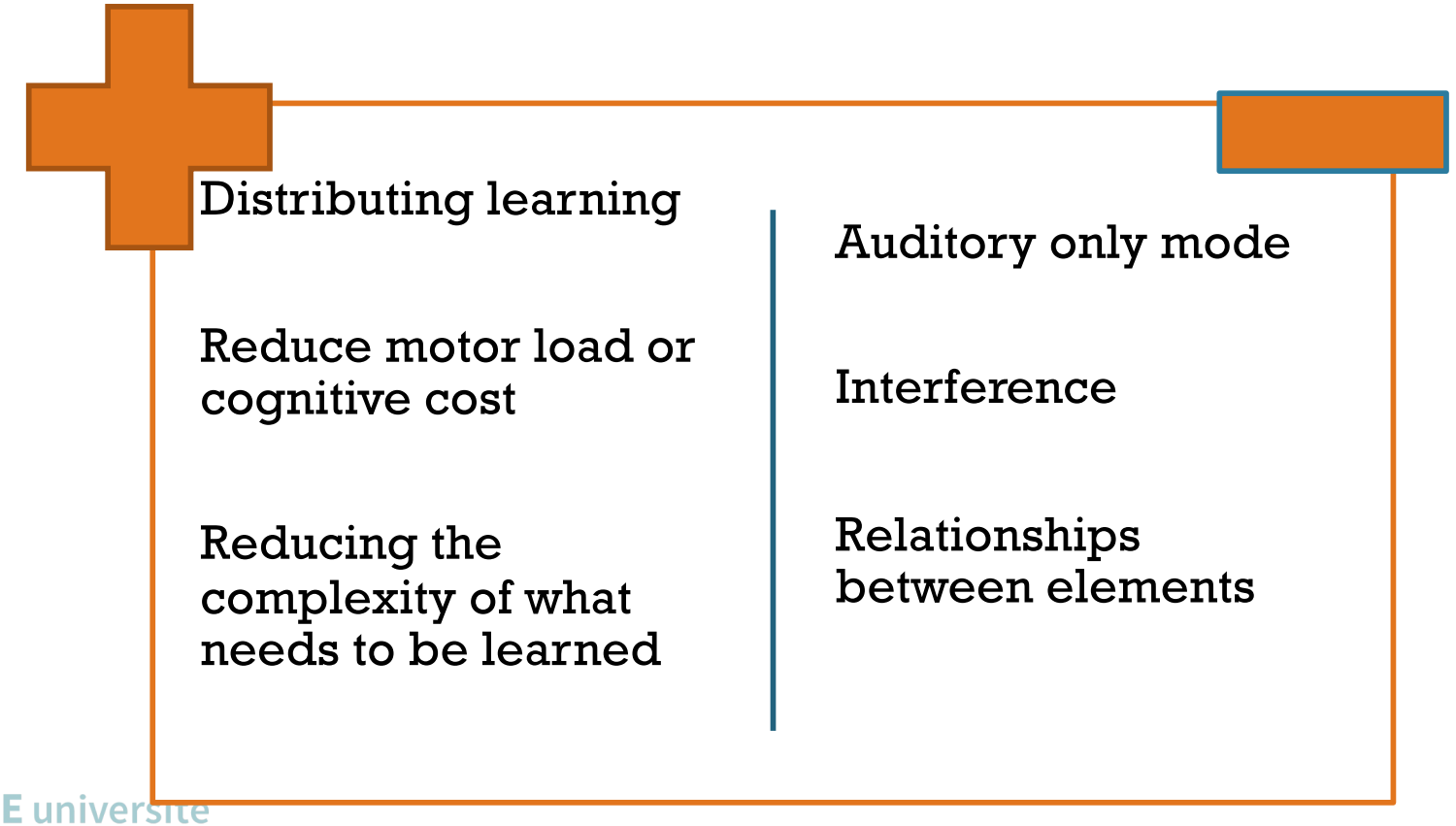
In summary,

- Currently, developmental language impairment can be seen as a language learning disability.

- Among the hypotheses envisaged to account for this, the study of the processes/mechanisms underlying learning is interesting

- No conception in terms of deficit /preservation

- Searching for the conditions that make learning possible



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