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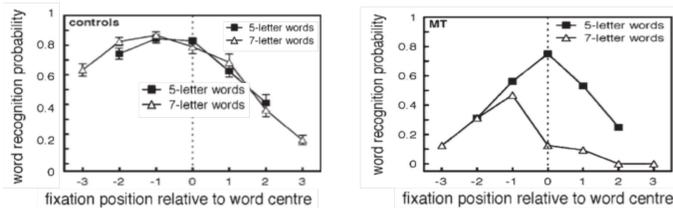
# Simulation of the Atypical Viewing Position Curves of Dyslexic Children

Sylviane VALDOIS, Thierry PHÉNIX, Mathilde FORT and Julien DIARD

## The Optimal Viewing Position Effect in Developmental Dyslexia

The probability of recognizing a word depends on the position of fixation during processing. The **Optimal Viewing Position (OVP)** for word recognition is located **slightly left of the word center**. Performance decreases when the eyes deviates from the OVP, producing an inverted J-shaped curve (O'Regan & Jacobs, 1992; Brysbaert & Nazir, 2005). **A few studies report atypical viewing position curves in dyslexic individuals** (Aghababian & Nazir, 2000; Dubois et al., 2007; Ducrot et al., 2003).

### The viewing position curves in typical (left) and dyslexic (right) individuals

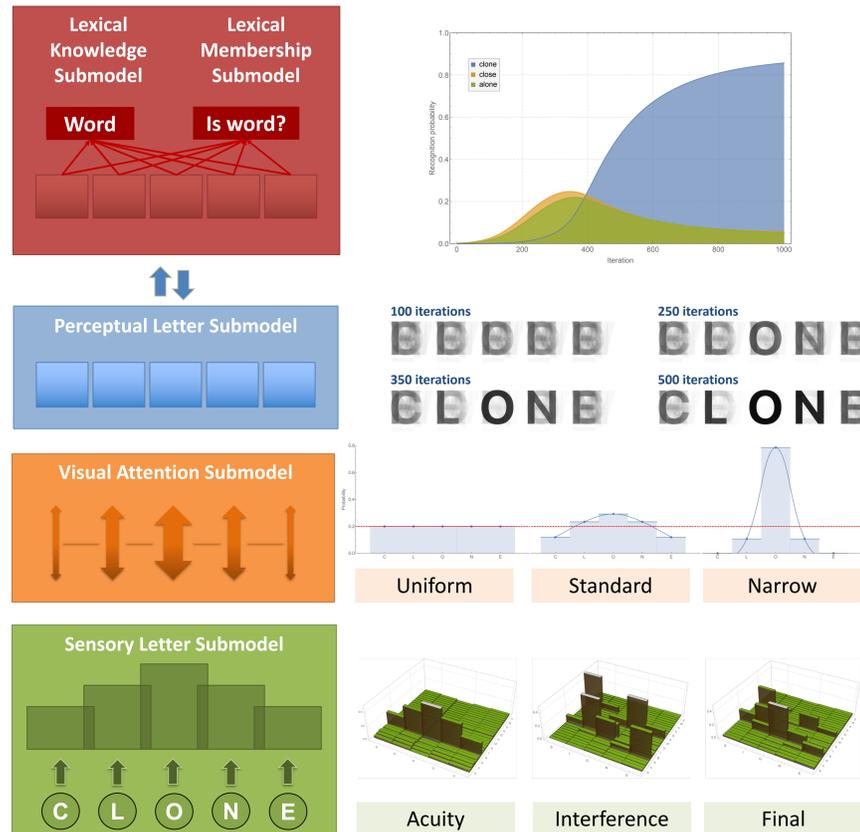


### Goals:

- We report new data on the OVP effect in developmental dyslexia
- We simulate the observed viewing position curves with BRAID, a new Bayesian word Recognition model with Attention, Interference and Dynamics

### The BRAID model

BRAID is a probabilistic model of visual word recognition composed of 5 sub-models.



## Empirical Findings: Atypical viewing position curves in dyslexic children

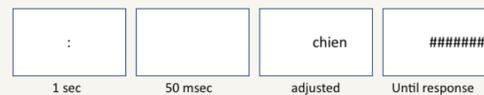
### Behavioral Experiment

#### Population:

- 23 dyslexic children (11 girls); Mean chronological age = 10.9 years; 4<sup>th</sup>-6<sup>th</sup> grade
- Native French speakers; normal IQ; normal or corrected vision / audition
- Free from any neurological or psychiatric history, no medical treatment
- Reading deficit: 71 words correctly read per minute (CTLs:  $m=136.8$ ,  $SD=30.9$ )
- Written consent from the legal tutor of each child

#### Method:

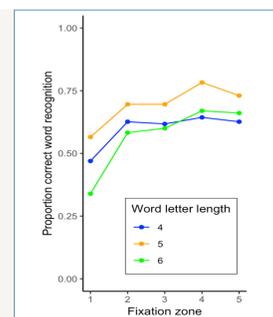
- Stimuli:** 75 4-, 5- and 6-letter words (25 per length) matched in frequency; words of high frequency (mean=200; Manulex database, Lété et al., 2004); matched in age of spelling acquisition (EOLE database, Pothier & Pothier, 2003).
- Design:** Each word was divided into five zones of one fifth of the width of the total word length. The center of each zone was designated as a potential fixation point. Words were presented in blocks of the same length. Exposure duration was adjusted for each child until the percentage of accurate recognition exceeded 50%.
- Procedure:**



#### Empirical curves:

**Atypical viewing position curves:** better word recognition when fixating the **right** than the left half of the word:  $\chi^2(1)=27.4$ ,  $p<.001$ .

A significant **Position effect:**  $\chi^2(4)=50.21$ ,  $p<.001$   
A significant but atypical **Length effect:**  $\chi^2(4)=21.99$ ,  $p<.001$ . Five-letter words are better identified than 4- or 6- letter words. No Length by Position interaction.



#### Conclusion:

- As in typical readers, word recognition performance in developmental dyslexia differs depending on fixation location.
- Children with dyslexia show atypical viewing position curves: words are better identified when fixated to the right of word center instead of the left as in controls.
- Similar viewing position curves have been reported in a letter-by-letter brain damaged reader (Montant & Nazir, 1998).

#### References

Aghababian, V. & Nazir, T. (2000). *J. of Exp Child Psych*, 76, 123-150. – Brysbaert, M. & Nazir, T. (2005). *J. Res in Reading*, 28, 216-228. – Dubois, M., Lafaye de Micheaux, P., Noël, M.P. & Valdois, S. (2007). *Cog Neuropsych*, 6(1), 623-660 – Ducrot, S., Lété, B., Sprenger-Charolles, L. & Billard, C. (2003). *Current Psych Letters*, 10, 1. – Lété, B., Sprenger-Charolles, L. & Collé, P. (2004). *Behavioral Res, Methods, Instruments and Computers*, 36(1), 156-166. – O'Regan, J.K. & Jacobs, A.M. (1992). *J. Exp Psych: HPP*, 18, 1, 185-197. – Phénix, T., Valdois, S., & Diard, J. (submitted). BRAID: a Bayesian model of word recognition with attention, interference and dynamics. – Pothier, B. & Pothier, P. (2004). EOLE. Editions Retz.

## Simulation Results

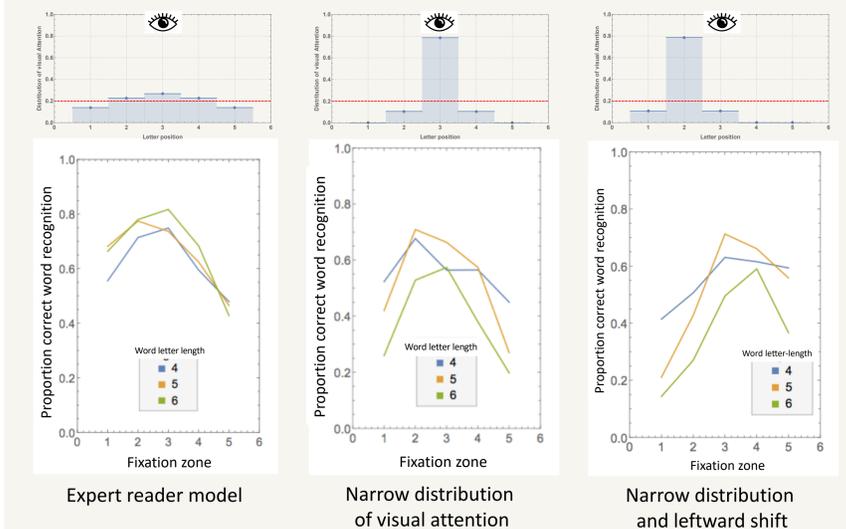
### Simulations with the BRAID model

#### Purpose:

The dyslexic participants show atypical viewing position curves when asked to identify words of 4-to-6 letters.

- First, we simulate word recognition curves depending on fixation location with the BRAID model using the same set of words and the model default parameters (expert reader model).
- Second, we explore whether and how a narrow distribution of visual attention affects the shape of the viewing position curves (simulation of visual attention span deficit (Dubois et al., 2007; Aghababian & Nazir, 2000).
- Last, we combine narrow visual attention distribution and leftward shift of attention to simulate the empirical curves observed in the dyslexic participants.

#### Simulation Results:



- Typical optimal viewing position curves are generated when using the BRAID model default parameters (expert reader model).
- Lower word recognition performance follows from narrowing the visual attention distribution, with a tendency towards reversed V-shaped curves.
- Asymmetric (better to the right) OVP curves are simulated following narrow visual attention distribution and a leftward shift of visual attention.

#### Conclusion:

- For the first time, an optimal rightward viewing position is reported in children with dyslexia, mimicking patterns found in letter-by-letter readers.
- BRAID can successfully simulate the atypical viewing position curves observed in the dyslexic participants following a double dysfunction: abnormally narrow visual attention distribution and atypical leftward shift of attention.