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Project

Letter, digit and symbol processing in the brain of children with dyslexia

Johannes Ziegler[1], Mariana Boros[1], Antoine Giovanni[2]

(1) LPC, (2) LPL

Abstract

Goals

The goal of the present study is to investigate whether dyslexics' visual word form system located in the OTC responds abnormally to letter strings, digit strings, and symbol strings. If so, this could well be the "neural" core deficit of dyslexia, which prevents children with dyslexia from processing letter strings rapidly in parallel. In contrast to most previous fMRI studies, we will test children rather than adults with dyslexia. Importantly, we will not rely on a reading task per se but on the processing of consonant, digit, and symbol strings. The advantage is that dyslexics "can do" the task, and henceforth, we are not just measuring the consequences of their well-established reading deficit. The comparison between symbols and letters allows us to shed new light on the visual-attentional causes of dyslexia.

Background

Developmental dyslexia affects about 5% of children in primary school. These children exhibit severe and long-lasting problems in acquiring written language despite normal intelligence, adequate educational opportunities and in the absence of any obvious neurological or sensory deficiencies [1]. Although much is known about the cognitive causes of dyslexia, fairly little is known about the neural substrates of dyslexia. Several brain imaging studies revealed an underactivation of the occipito-temporal cortex (OTC) in dyslexic participants [2-4]. This brain area is thought to host the visual word form system, a specialized area in charge of processing letter strings [5]. It has also been shown that successful intervention (i.e. remediation) might lead to a normalization of brain activity in this region [6]. Despite this converging evidence, previous studies suffer from major shortcomings that prevent firm conclusions. First, literally all studies used reading tasks to establish the neural deficits. Given that fluent reading is severely impaired in this population, the underactivation in OTC could be the consequence rather than the cause of dyslexia. Second, most studies scanned adult dyslexics [2], which leaves open the possibility that the

underactivation of OTC is again a consequence of a deficit that occurs earlier in development. Finally, over the past decade, the possibility that poor letter and word processing might result from poor visual- attentional processing has received a lot of attention. However, many of the supposedly visual-attentional tasks are performed on letter strings [7], which makes it impossible to know whether deficits are due to poor attentional processing or poor letter string processing (see [8]).

References cited

1. Snowling, M.J., *Dyslexia*. 2000, Oxford: Blackwell.

2. Paulesu, E., et al., *Dyslexia: Cultural diversity and biological unity.* Science, 2001. 291(5511):p. 2165-2167.

3. Richlan, F., M. Kronbichler, and H. Wimmer, *Meta-analyzing brain dysfunctions in dyslexic children and adults*. Neuroimage, 2012. 56(3): p. 1735-42.

4. Richlan, F., M. Kronbichler, and H. Wimmer, *Functional abnormalities in the dyslexic brain: A quantitative meta-analysis of neuroimaging studies*. Human Brain Mapping, 2009. 30(10): p. 3299-3308.

5. Dehaene, S. and L. Cohen, *The unique role of the visual word form area in reading.* Trends Cogn Sci, 2011. 15(6): p. 254-62.

6. Brem, S., et al., *Brain sensitivity to print emerges when children learn letter-speech sound correspondences.* Proceedings of the National Academy of Sciences, 2010. 107(17): p. 7939- 7944.

7. Bosse, M.L., M.J. Tainturier, and S. Valdois, *Developmental dyslexia: the visual attention span deficit hypothesis*. Cognition, 2007. 104(2): p. 198-230.

8. Ziegler, J.C., et al., *Rapid processing of letters, digits, and symbols: What purely visual-attentional deficit in developmental dyslexia?* Developmental Science, 2010. 13: p. F8-F14.

Publications

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Fiche-résumé contribution CREx

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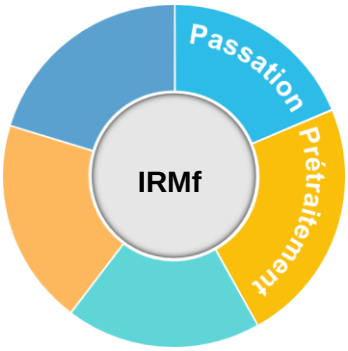

Boros

Profil d'activatiojn de sujets dyslexiques et témoins dans la reconnaissance de lettres, de chiffres et de symboles.

Investigateurs : Marianna Boros (LPC), Johannes Ziegler (LPC)

Durée : 5 mois (de juillet à novembre 2013)

Contribution : aide à la passation et prétraitements des données en IRMf

Objectif : *déterminer chez des enfants dyslexiques si le système de la « forme visuelle des mots » répond anormalement à des chaînes de lettres, des chaînes de chiffres et des chaînes de symboles.*

Paradigme – Le tâches en IRMf consistent en une tâche de détection de symboles (lettres, chiffres, symboles (cf. Figure 1) et une tâche passive de localisation dans laquelle des pseudo-mots « false fonts » et des mots audio-visuels ont été présentés.

Passation – Aide à la passation de 16 enfants dyslexiques (âgés entre 8 et 12 ans) et 18 témoins appariés en âge en quotient intellectuel ont réalisé l'expérience.

Prétraitement – Conseil pour le prétraitement des données en particulier sur un problème de segmentation dû à la petite taille des cerveaux des enfants.

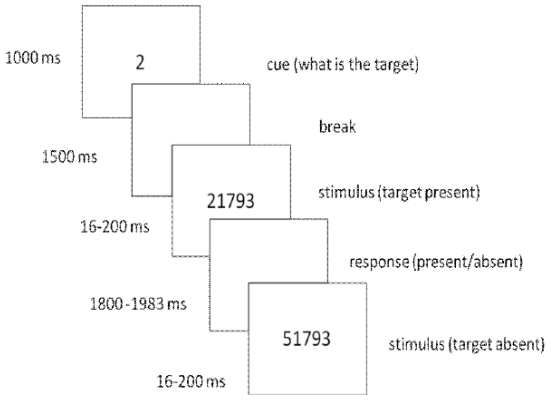

Figure 1. Tâche de détection de symboles

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