

The contribution of auditory attention to reading processes of school-age children with and without dyslexia

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6.2. Summary of findings

In the study detailed in **Chapter 2**, we observed that background speech affected school-age children's reading performance. We found that manipulating two characteristics of background speech led to different effects on reading performance: higher speech intensity slowed down text reading while speech intelligibility affected the accuracy of reading comprehension. Children with lower auditory interference control abilities responded less accurately to reading comprehension questions when intelligible background speech was presented but did not take more time to read the text when louder speech was presented. Surprisingly, we found that more fluent readers, as measured with a standardised word reading task, slowed down relatively more with the louder speech in the background.

Chapter 3 examined non-verbal sustained auditory selective attention and its neural (EEG) correlates in children with and without dyslexia. Sustained selective attention was assessed by asking the children to attend to one of two sound streams and to detect occasional tone sequence repeats. First, we found that directing attention to one of two tone-streams resulted in greater inter-trial-phase-coherence (ITPC) at the attended tone stream rate (3 Hz) in fronto-central sites of the scalp. Unexpectedly, we also found differences in ITPC between active and passive conditions at the cross-band frequency rate (6 Hz). The strongest effect was a decreased phase consistency in posterior regions of the scalp and a smaller effect was found in two fronto-central channels, where ITPC was higher when children were attending. However, we only found a significant relationship between task performance (detection of tone-triplets repeats) and phase consistency at the attended frequency (3 Hz), suggesting that increased phase entrainment at the attended band serves as a reliable index of the ability of the children of directing focus to a target stream and sustaining it over time. Behavioural and neural correlates of selective attention did not differ between children with and without dyslexia, but the data suggested a trend, with dyslexic

readers showing lower modulation of neural entrainment at some fronto-central electrodes compared to typical readers. Children with dyslexia showed significantly lower speech-in-speech perception abilities. Last, the behavioural measure of non-verbal sustained selective attention (d-prime) was predictive of both reading fluency and speech-in-speech perception abilities.

Chapter 4 focused on one of the fundamental processes underlying reading acquisition: letter-speech sound learning. We investigated putative deficits in letter-speech sound learning in children with dyslexia with an artificial symbol-speech sound learning paradigm. Both children with and without dyslexia had no previous knowledge of the correspondences, but after a short time (~6-7 minutes of training), the paradigm revealed that dyslexic readers responded less accurately than typical readers. The subsequent ability to read words and pseudowords written with the artificial symbols was not affected by a diagnosis of dyslexia but was strongly predicted by learning task performance (response accuracy and RTs). Auditory interference control abilities of children with dyslexia were comparable to those of typical readers. Overall, reading fluency abilities scaled with the artificial symbol-speech sound learning paradigm measures (response accuracy and reading within the artificial orthography), although the association between response accuracy and reading fluency did not remain significant when variance associated with dyslexia diagnosis was partialled out. Children's ability to learn the novel correspondences and to read (pseudo)words written with the artificial symbols was predicted by their auditory attention control skills (non-verbal selective sustained attention and interference control).

Chapter 5 aimed at identifying pre-intervention abilities predictive of reading fluency and spelling gains during an intensive intervention for children with dyslexia focused on the learning of letter-speech sound associations. In this study, we included the attentional measures examined

in the previous studies (non-verbal sustained selective attention, speech-in-speech perception, interference control) and reading-specific skills (letter-speech sound learning, rapid naming, phonological awareness). Results of a principal component analysis revealed shared variance among attentional and reading-specific abilities. Two components were subsequently found to be associated with intervention gains. One component indicated an association between non-verbal selective attention and response accuracy during the letter-speech sound learning task. The other component indicated an association between speech-in-speech perception, phonological awareness and, to a lesser extent, non-verbal sustained selective attention. Therefore, we interpreted these components as encompassing the ability to selectively direct attention during audio-visual learning and selectively direct attention to phonological information. The component encompassing selective attention to phonology was related to spelling growth during the first half of intervention, which focused on the acquisition of accurate decoding skills. The component encompassing selective attention during audio-visual learning was related to reading fluency and spelling growth during the second half of the intervention, which was dedicated to skill automatization and fluency development.

6.3. Synthesis of the results, theoretical and practical implications

6.3.1. Do children with dyslexia have impaired auditory attention abilities?

Previous studies reported non-verbal deficits in several attentional components (e.g., selective attention, inhibitory control of attention, attention shifting) in individuals with dyslexia in the auditory and visual modality (e.g., Facoetti et al., 2010; Gabay, Gabay, Schiff, & Henik, 2020; Roach & Hogben, 2007, 2008; Ruffino, Gori, Boccardi, Molteni, & Facoetti, 2014; Ruffino et al., 2010), although they examined more extensively the