Atypical auditory adaptation to repeated speech in children with dyslexia

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Summary

• Dyslexia is a neurological disorder characterized by difficulty learning to read words accurately and fluently.
• Atypical phonological processes are the most common underlying deficit in dyslexia (Gabrieli, 2008).
• How does a phonological impairment adversely affect reading development but leave speech abilities intact?
• Here, adaptation to auditory repetition was used to assess neural sensitivity to stimulus consistency.
• Children with dyslexia exhibit atypical neurophysiological adaptation compared to children with typically developing reading abilities.

Adaptation in dyslexia

• Individuals with dyslexia exhibit perceptual deficits in tasks that involve neither reading nor language, but for which adaptation-related processes enhance the perceptual performance of typical readers.
• Impaired thresholds in frequency discrimination with a consistent (anchor) stimulus (Ahsar et al., 2009).
• Impaired detection of visual and auditory targets in background noise (Sperling et al., 2005; Ziegler et al., 2009).
• Impaired ability to recognize voices (Perrachione et al., 2011).
• Atypical auditory brainstem response to repeated vs. unRepeated syllables (Choudhur et al., 2008).

Adaptation fMRI

• Stimulus repetition typically results in reduced BOLD response in cortex containing neurons sensitive to that stimulus type (Grill-Spector & Malach, 2001).
• Children with typical reading development showed extensive adaptation to repeated speech in the superior temporal lobe, especially aSTG.
• Outlines depict areas of significant adaptation (voxel p < 0.05, cluster FWE p < 0.05).
• Children with dyslexia exhibited minimal to modest adaptation over a more circumscribed area.
• The amount of adaptation to repeated speech was not significant in children with dyslexia.

Results

Neural Adaptation to Repeated Speech (Variable > Repeated)

A. Control
B. Dyslexia
C. Control > Dyslexia

Discussion

• Children with dyslexia exhibit atypical neural adaptation to repeated spoken words in aSTG and PT; core auditory association areas for speech and phonological processing (Scott et al., 2000; Hickok, 2009).
• Atypical adaptation to repeated speech stimuli in children with dyslexia closely reflects the same neurophysiological deficits seen on this task in adults with dyslexia (Perrachione, 2012).
• A neural insensitivity to repetition may impair detection of phonetic consistency, precluding development of the robust phonological residual skills that are critical for learning to read (Scott et al., 2000).
• Different models of speech perception differentially emphasize the importance of predictive-phonemic mapping for recognizing words (Goldinger, 1998).
• Children and adults with dyslexia may preferentially recognize spoken language via episodic routes, which emphasize mnemonic processes over top-down adaptation from phonetics to phonemes.
• May contribute to intact speech, but impaired reading, in dyslexia.

References

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