Predicting dyslexia based on pre-reading auditory processing and speech perception skills.

1. BACKGROUND

- Developmental dyslexia is characterized by persistent reading and spelling difficulties.
- It has been well established that one of the major causes of these literacy problems lays in a deficit involving the audiory temporal processing and speech perception.
- Frequently these phonological problems have been linked to more basic perceptual impairments, specifically deficits in deriving phonological representations.
- Studies have suggested the existence of an underlying deficit in low-level auditory temporal processing in the dyslexic population (Goswami et al., 2002, Farmer & Klein, 1995; Habib, 2000; Boets et al., 2006).
- Auditory cues specific to the speech envelope (RT discrimination) have been shown to be a sensitive measures in discriminating dyslexics and controls (see Hamalainen, Salminen, & Leppanen, 2013).

2. PARTICIPANTS

- 44 English speaking children, recruited at ages 4-5 years old in Ontario, Canada.
- Testing occurred at 3 time points: kindergarten, first grade and second grade.
- Retrospective analysis allowed for the creation of a dyslexic group consisting of 17 high-risk children and 4 low-risk children; in addition to a literacy unimpaired (control) sample of 19.
- Groups were matched by age, IQ, SES, and parental education level.

3. MEASURES

Literacy:
- Letter knowledge (WRAT-III)
- Reading & Word attack (WJ-III)
- Spelling (WJ-III)

Phonological awareness:
- Syllable awareness
- Rime awareness
- Phoneme awareness

Speech-in-noise:
- CASPA (word in noise)

Auditory processing:
- Rise time discrimination (RT)
- Frequency modulation (FM)

Intensity discrimination (ID): control variable

4. OBJECTIVES / FINDINGS

Objective 1. Do kindergarten measures of auditory processing and speech perception relate to cognitive and literacy outcomes in first and second grades.
- Significant relations between auditory processing and speech perception were not observed at any time point. Therefore, this study could not support the theorized directional pathway from auditory processing through speech perception to phonological skills.
- Yet, partial cross-lagged correlations, controlling for autoregressive effects, confirmed the directionality between measures of RT discrimination and PA. Where performance on RT tasks was found to have a larger impact on future PA development than PA's influence on auditory processing development. Thus supporting the bottom-up model proposed by Tallal (1980).

Objective 2. Does pre-reading RT discrimination, FM sensitivity and PA predict later literacy achievement.
- Regression analysis demonstrated that RT, FM and PA uniquely contributed to reading at both first and second grade. Yet PA's influence did not extend past the onset of formal reading instruction. These results were contrary to Boets et al. (2011), suggesting that basic auditory processing skill's impact on reading development may not be limited to the time point prior to reading instruction.

Objective 3. Are pre and post reading deficits in auditory processing and speech perception present in children later found to be dyslexic?
- Group analyses demonstrated significant poorer performance of children later diagnosed with dyslexia on the measure of RT discrimination at the pre-reading phase indicating these problems are not consequential of the expressed literacy problems characteristic of dyslexia.
- The lack of group differences of FM task, may imply the existence of a specific deficit in the perception of dynamic auditory cues related to the speech envelope (as measured by the RT task).

5. RESULTS

Correlations:
- Of the auditory processing measures only RT correlated significantly with PA and the reading at all grade levels.
- RT in first grade significantly correlated with PA, while it was found to be approaching significance with reading in first and second grades.
- RT & FM were found to be significantly correlated within and between each grade level.
- Speech-in-noise was not found to relate to any of the target measures across all time-points.
- All significant correlations were maintained when controlling for group, with the exception of the relationship of kindergarten grade one RT with first grade PA.

Predicting later literacy achievement

Table 3 Unique variance in first and second grade reading, and spelling accounted for by Letter knowledge (LK), Phonological awareness (PA), Rise time (RT) and Frequency (FM) (R^2 change and standardized Beta).

Children with dyslexia vs. control group

- Groups were found to be significantly different on all literacy, and PA measures at each of the three grade levels with the dyslectic group performing poorer across all tasks compared to controls.
- Of the auditory and speech measures, significant group differences were only found for RT when standard alpha of 0.05 was applied. Only kindergarten RT remained significant after applying adjusted alphas to correct for multiple testing.

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