# Auditory and cognitive processes in children with word reading difficulty

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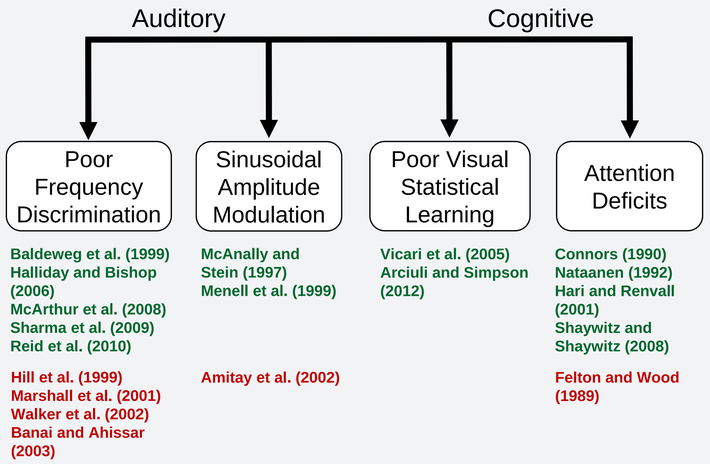
## OBJECTIVE

The aim of the research project is to identify the auditory and cognitive skills that are affected in children with word reading difficulties (WRD).

### BACKGROUND

Some previous literature show significant ***differences*** *(in green)* or ***no differences*** *(in red)* between children with WRD and their typical developing peers across several areas:




There are other auditory processing skills such as Gaps In Noise; Masking Level Difference that have been assessed in the WRD group with **contrary** results in literature (Sharma et al., 2009; Zaidan & Baran, 2013).

Working memory, however, has consistently found to be significantly different in children with WRD when compared to their age matched peers (Jong, 1998; Gathercole et al., 2006).

## METHODS

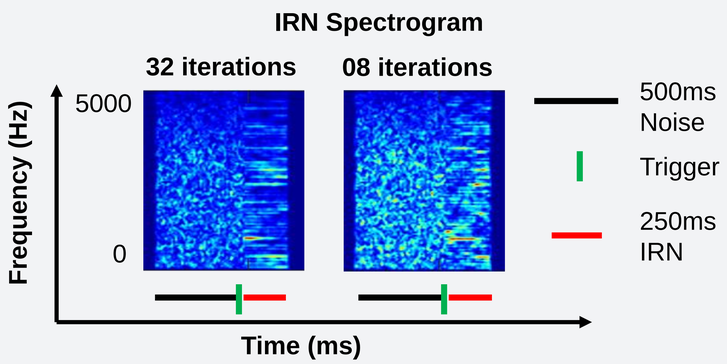
- N=56 children, aged 8-11years, with and without reported reading difficulty (38 M; 18 F).
- All tested on Castles and Coltheart 2 (CC2) word, irregular word and non-word reading test to identify children in WRD group.
- Children with poor performance (z-score < -0.5) on word and non-word reading placed in WRD.

| Control group age, n = 28 Mean Age (SD) | Reading difficulty group, n = 28 Mean Age (SD) |
|---|---|
| 10.04 (1.09) | 9.57 (1.05) |

- T-test showed **no significant** differences for age across groups: ($t$ (30) = 1.69, $p$ = 0.09).

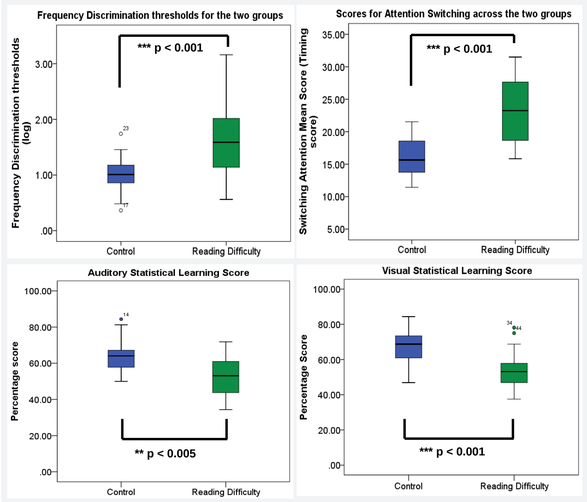
MATERIALS: Auditory and cognitive skills included in the study

| | Auditory Processing | Statistical Learning (SL) | Attention (Visual) |
|---|---|---|---|
| **Task** | **Behaviour** Frequency Discrimination (FD) | Auditory SL<br>Visual SL | Test of Everyday Attention for Children (TEA-Ch) Selective attention |
| | **Electrophysiology** Acoustic Change Complex (ACC) using Iterated Rippled Noise Setup: Fz, M1, M2 250 stimuli per set ISI: 0.9 ms to 1.3 s Stimulation: Diotic Level: 75dB SPL Rejection: >50µV | **Auditory SL** Stimuli: C 440Hz tones<br>**Visual SL** Stimuli: Pictures taken with permission from Fiser and Aslin (2001) | TEA-Ch used to test the Attention switching abilities |
| **Measure** | FD: Just Noticeable Difference in Hz. P1-N1 onset response N1-P2 ACC | Percentage correct response for SL. | Timing score for Attention switching/ selective |
| **Data analysis** | MANOVA | Mann Whitney U | MANOVA |



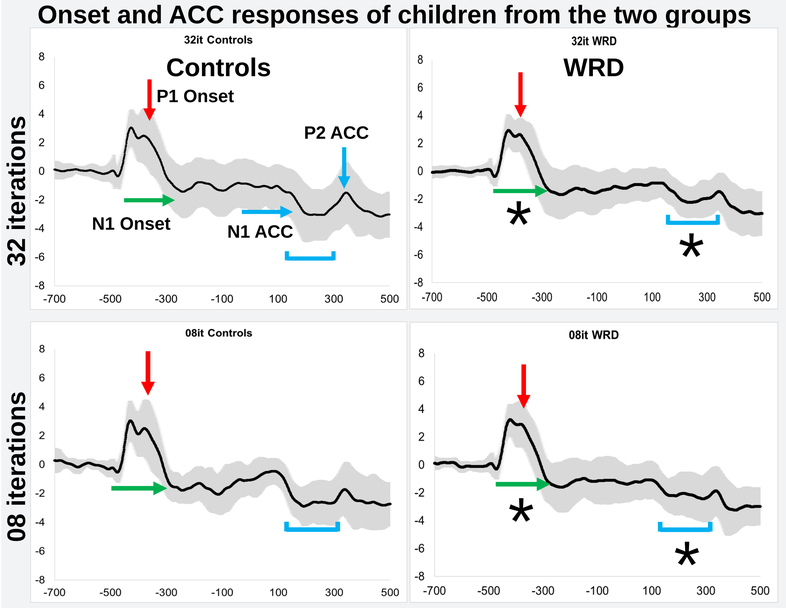

- The diagram displays the spectrogram of the IRN stimuli used in the study.
- The stimulus contained 500ms of noise (no pitch) followed by 250ms of IRN (pitch of 100Hz).
- The strength of the IRN pitch depends on the number of iterations.
- The spectrogram of the 32 iterations IRN (strong pitch) represents a more significant difference between the no pitch to the pitch transition than shown by the 8 iterations IRN (weaker pitch) stimulus.

## RESULTS




- Children with WRD have poorer FD, weaker cortical responses to pitch, poor SL and worse attention switching abilities when compared to the control group.
- An FD deficit leads to impairment in utilizing the phase-locking mechanism, causing reduced ability to discriminate spectral contrasts in speech (McAnally and Stein, 1996).
- SL may be a contributing factor to the reading ability of children by enabling the detection of statistical regularities between letters, within words. (Arciuli and Simpson, 2012).

### Onset and ACC responses of children from the two groups




| Measure | $F$, $p$-value |
|---|---|
| Latency N1 | 7, 0.01 |
| Amplitude of N1 | 6.5, 0.01 |
| Amplitude of ACC | 5, 0.03 |

P1 Onset
N1 Onset
ACC

| Measure | $F$, $p$-value |
|---|---|
| Latency N1 | 6.4, 0.01 |
| Amplitude of N1 | 6.5, 0.01 |
| Amplitude of ACC | 8.8, 0.005 |

### DISCUSSION

- The current findings regarding the poor performance of children with WRD on FD, and their poor percept of pitch suggest that auditory processing plays a significant role in the word reading abilities of children. The same has been debated previously in literature (Banai & Ahissar, 2003; Sharma et al., 2009).
- The successful allocation of attentional resources may drive the associations between good performance on auditory processing tasks. Since attention switching was seen to be poor in children with WRD, it is challenging to efficiently isolate the skill that is the most significant for word reading amidst other skills (auditory processing).
- The overall findings characterize the need to account for auditory and cognitive skills of children with word reading difficulties while formulating treatment plans.

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