Relating Braille letter confusion to verbal working memory and language functions

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Recognition of braille characters

- global shape (Nolan & Kederis, 1969)
- location and place of dots – NOT number of dots (Heinze, 1986)
- dot density and/or numerosity – NOT dot locations, outline shapes or symmetry (Millar, 1997)

→ congenitally blind people: as **structures** and not as **global shapes**
Cognitive functions of blind people

Often outperform the cognitive functions of their sighted counterparts:
- short-term memory (Hull & Mason, 1995)
- long-term memory (Röder & Rösler, 2003)
- auditory frequency discrimination
- speech perception (Hötting & Röder, 2009)
- higher WM capacity in auditory word, number tasks

Prónay (2004):
„primary-school-age children with visual impairment achieve the highest rates in practising numbers and in vocabulary tests than sighted children”
Objectives

Aims of the research

- uncover those basic cognitive functions that may contribute to errors occurring during braille reading
- to examine the entire 7-15-year-old blind population

Materials and methods

Subgroup formation
- 7-15 y; VIQ>85
- N_{BLIND}= 62
- Control group: N_{SIGHTED}= 63

matched: age, VIQ, gestation period
→ four subgroups

1. blind-low birth weight premature (BLBW)
   N= 35  
   (gest.period: 24-32 weeks; birth weight: 570-1780 g)

2. blind-full term (BFT)
   N= 27

3. sighted-low birth weight premature (SLBW)
   N= 29  
   (gest.period: 24-31 weeks; birth weight: 610-1720 g)

4. sighted-full term (SFT)
   N= 34
Materials - Language function
- Verbal fluency - tasks
- Phonological processing - tasks

Materials - Memory function
- Hungarian Non-Word Repetition Test (Racsmány, Lukács, Németh & Pléh, 2005).
- Hungarian Listening Span Test

Materials - Reading task
- letters, syllables, words in different modalities (40 items)

Statistical analysis
Results

- Language function
  Verbal fluency task: sign.diff.: BLBW and SLBW ($F(3.36) = 4.602$, $p < .01$)
    SLBW and SFT ($F(3.6) = 4.271$, $p < .01$)
    no sign. diff.: BLBW and BFT ($p = .23$)

- Memory functions
  BLBW group performed worse than all the other groups (*nonsign.*)
  Hungarian Non-Word Repetition Test: blind groups better but nonsign.
- Relationship between letter confusion and cognitive functions

Phonological processing and verbal fluency tasks were related to the reading performance in all four groups.

SLBW and SFT groups: phonological awareness correlated with reading accuracy ($r(61) = .79$, $p < .01$).

BLBW and BFT groups: phonological processing tasks correlated highly with the results of reading tasks ($r(60) = .86$, $p < .01$).
Spearman correlations between reading accuracy, language functions and working memory functions in the blind and the sighted groups.

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<th>Language function</th>
<th>Working memory function</th>
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<tr>
<td></td>
<td>Verbal fluency</td>
<td>Hungarian Non-Word Repetition Test</td>
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<td>Phonological processing</td>
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<td>Blind group</td>
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<tr>
<td>Reading accuracy</td>
<td>.65**</td>
<td>.71**</td>
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<td>Sighted group</td>
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<tr>
<td>Reading accuracy</td>
<td>.35*</td>
<td>.54*</td>
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<td>Braille readers (n=62)</td>
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<td>Print readers (n=63)</td>
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* p < .05
** p < .01
Discussion

- retrieval difficulty in BLBW group: weaker executive functions \(\rightarrow\) strong connection between the recognition of braille characters and the success of delayed memory retention

- level of development of the verbal working memory - successful letter decoding

- verbal WM is highly related to reading accuracy measured in braille readers, while it is not related to any reading measure in print readers (Veispak, Boets, and Ghesquière, 2013).

- Blind groups: well developed linguistic and executive performance correlated closely with the successful braille letter decoding
Concluding remarks
THANK YOU FOR YOUR ATTENTION!