FOREIGN-LANGUAGE LEARNING IN DYSLEXIA

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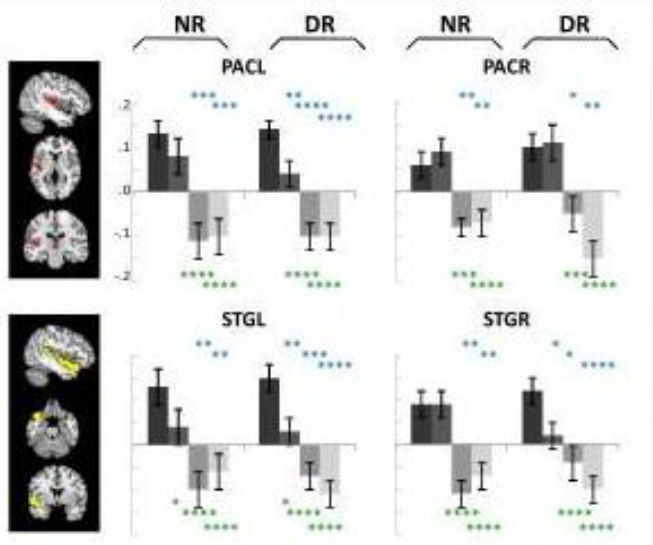
LANGUAGE LEARNING IN DYSLEXIA

- Non-native speech perception (discrimination and repetition) is intact for foreign speech sounds, but the discrimination of foreign word stress was impaired in adults with dyslexia (Soroli et al., 2010).
- No group differences for the Finnish or English speech-sound stimuli, but associations between reading measures and ERPs to uncommon sounds (Hämäläinen et al., 2017).
- The learning of native-language pseudowords and non-native words associated with pictures is deficient in adults with dyslexia, but the processing of word meanings is intact (Di Betta and Romani, 2006).
- Paired associate learning tasks with pseudowords is deficient in adults with dyslexia (Litt & Nation, 2014).

CONNECTIVITY OF THE LANGUAGE NETWORK

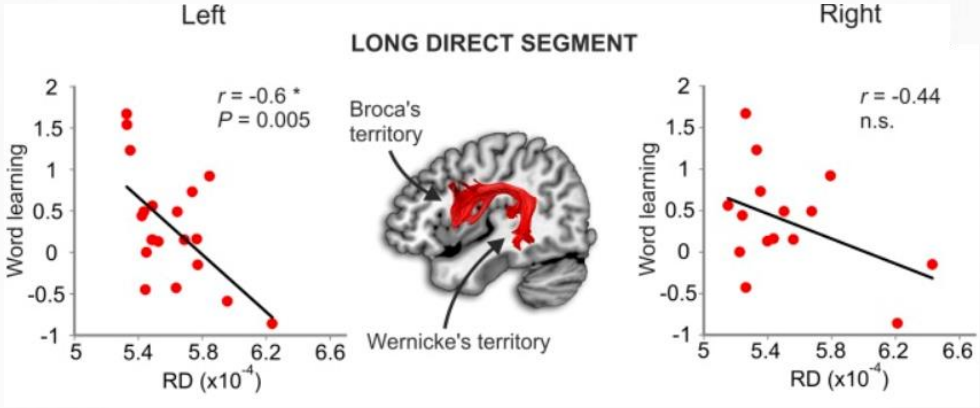
Boets et al. (2013):

- speech sounds induced similar activation of auditory cortices in dyslexic and typical readers
- the structural and functional connectivity of the left *arcuate fasciculus* was hampered in dyslexia.



CONNECTIVITY OF THE LANGUAGE NETWORK

- The processing of foreign speech sounds involves auditory areas in temporal lobes and articulatory brain areas in frontal lobe (Callan et al., 2004; Myers, 2014) and depends on temporo-frontal connections (arcuate fasciculus).
- Also word learning is mediated by the left arcuate fasciculus (López-Barroso et al., 2013).



CURRENT STUDY

Research questions:

- Where is the ‘bottleneck’ of foreign-language learning - at the level of word representations or smaller units?
- Does the activation of long-term memory representations for spoken words differ in the native and foreign language?

CURRENT STUDY: METHODS

- Auditory event-related potentials (ERP)
  - Mismatch negativity (MMN)

- Literacy and psychological tests:
  - ALLU (segmentation of letter strings into words)
  - LukiLasse (reading single words aloud and writing dictated words or sentences)
  - WISC (block design, digit span, vocabulary, and coding)
  - Rapid naming (colors and letters)
  - Phonological awareness (common unit)

CURRENT STUDY: PARTICIPANTS

- 9-11-year-old native speakers of Finnish, who studied English at school (mean 15-16 months)
  - 19 children with dyslexia
  - 21 typical readers

	Children with dyslexia	Typical readers	P
ALLU	2.42	5.10	<0.001
LL, reading	4.11	11.71	<0.001
LL, dictation	5.63	10.90	<0.001

CURRENT STUDY: STIMULI

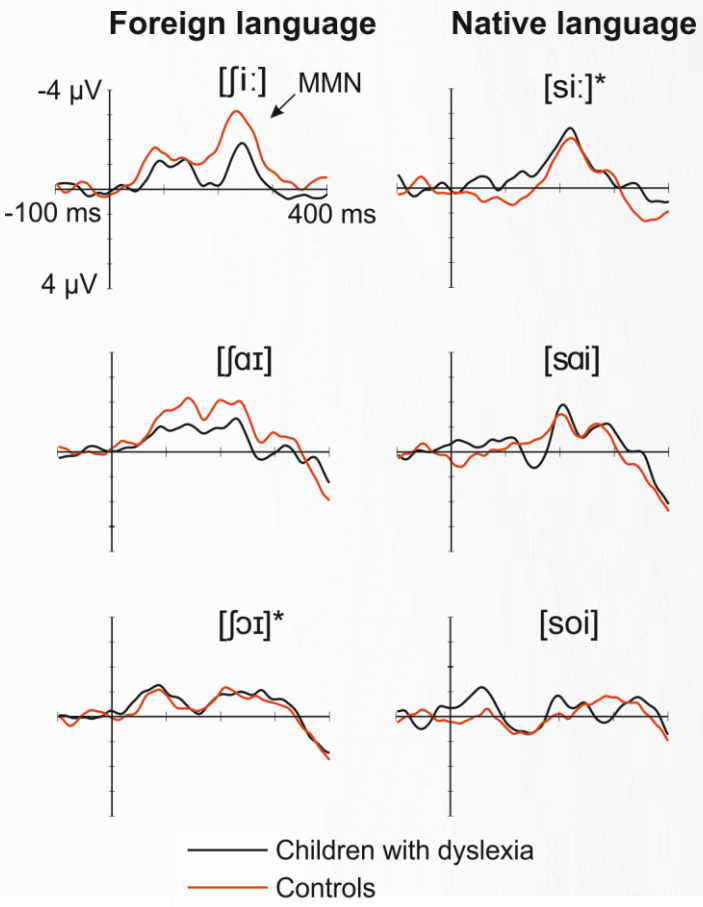
- English:
  - standard: [ʃu:] *shoe*
  - Deviants: [ʃi:] *she*, [ʃɑɪ] *shy*, and [ʃɔɪ]* *shoy**,
- Finnish
  - standard [su:] *suu ‘mouth’*
  - Deviants: [si:]* *sii**, [sɑi] *sai ‘got’* and [soi] *soi ‘plays/rings’*

RESULTS: BEHAVIORAL

- Typical readers outperformed dyslexic readers in
  - WISC digit span [F(1,38)=7.60, P=0.009]
  - RAN speed for colors [F(1,38)=5.41, P=0.025] and letters [F(1,38)=10.06, P=0.003]
  - Phonological awareness [F(1,38)=14.10, P=0.001].
- No difference between the groups
  - WISC block design [F(1,38)=0.04, n.s.]
  - WISC vocabulary [F(1,38)=1.13, n.s.]
  - WISC coding [F(1,38)=2.66, n.s.]

RESULTS: MMN

- Group x Language x Word type interaction [F(2,76)=3.63, P=0.031]
- No difference between the groups in the native language
- Children with dyslexia had weaker responses to the most familiar English word *she* (p=0.004)
- No difference between the groups for the English pseudoword

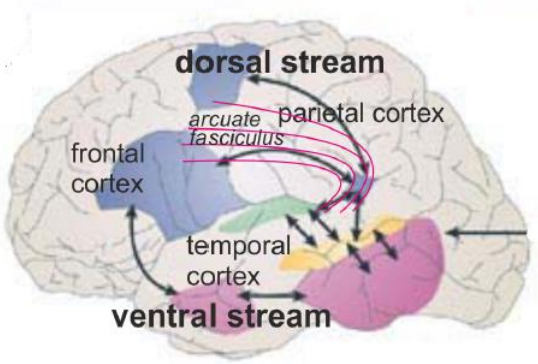


DISCUSSION

- In children with dyslexia, auditory or speech processing was not generally impaired.
- Poor sublexical representations for foreign language do not account for the results.
- The bottleneck of foreign-language learning in dyslexia seems to be at the lexical level, caused by impairment in forming brain representations for new word forms.
- This impairment could be linked with the deficit in serial processing in dyslexia (Hari & Renvall, 2001; Laasonen et al., 2012; Ramus & Ahissar, 2012; Romani et al., 2015; Majerus & Cowan, 2016).

DISCUSSION

- Dual stream models of speech processing (Scott & Johnsrude, 2003; Hickok & Poeppel, 2007): auditory-motor interaction in the dorsal stream of speech processing
  - segmental level involved in articulatory-phonetic processing and learning
  - sequence level involved in learning new words by coding the sequences of sounds and syllables (Hickok & Poeppel, 2007).
- Sequence-level auditory-motor processing in the dorsal stream – a possible account for the correlation between literacy skills and brain representations for spoken foreign-language words.

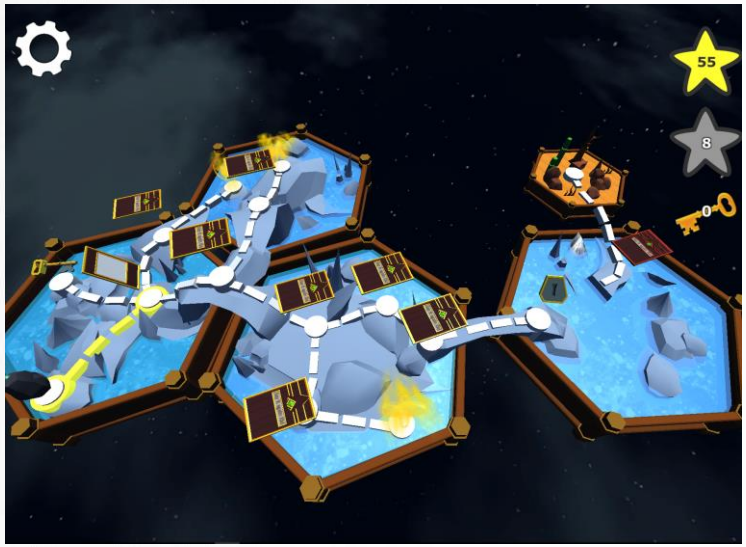


CONCLUSIONS

- Reading and naming skills appear to be more strongly associated with foreign-language than native-language speech processing.
- Impairment in forming brain representations for new or foreign word forms in dyslexia, possibly via the dorsal stream of speech processing.

FUTURE PLANS

- Training English with a speech-based digital language-learning game Say it again, kid!



THANK YOU!

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TULOS

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