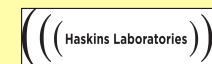




Shedding New Light on Reading in Spanish-English and French-English Bilingual School Children: an fNIRS Investigation

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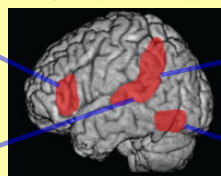
RESEARCH QUESTIONS

How does a bilingual's two languages impact the neural circuitry for reading?

Mapping **letters (orthography)** to **sounds (phonology)** is key for learning to read^{1,2}. In the monolingual brain, a left-lateralized reading network processes the relationship between orthography, phonology and meaning³

Inferior Frontal (IFG)
Word meaning
morphology, syntax

Superior Temporal (STG)
Phonology

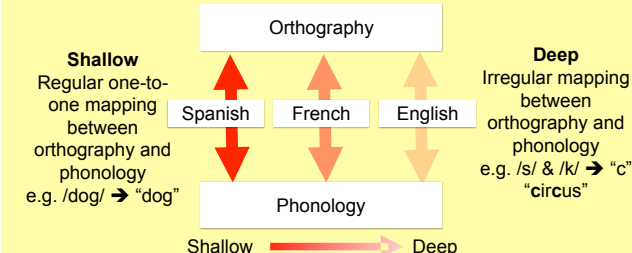


Temporoparietal
Letter to sound
correspondence

Occipitotemporal
Visual word form

Is there a "neural signature" in the young bilingual brain for reading⁴⁻⁶?
If so, can it be predicted from linguistic features of each language?

The relationship of orthography to phonology differs among languages^{2,7,8}



HYPOTHESIS

Specific features of the orthography to phonology relationship in each language predictably recruit the brain's reading network

METHOD

Participants

Children (ages 6-10)

Spanish-English Bilingual N = 7

French-English Bilingual N = 6

English Monolingual N = 11

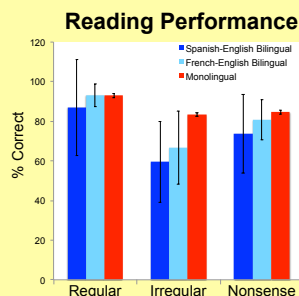
Task

Word Reading^{2,8,9} in English, Spanish, French
Near Infrared Spectroscopy (fNIRS)⁵

	Regular	Irregular	Nonsense
English	stop	debt	yosh
Spanish	piso	NA	rago
French	bleu	clef	tano

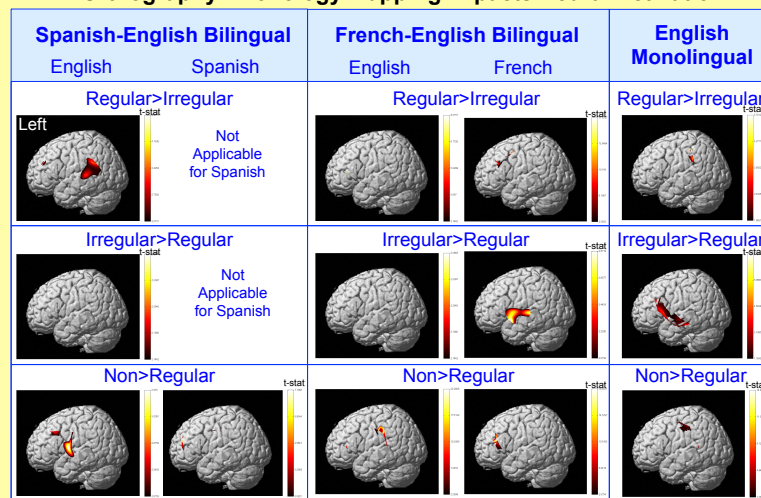


Hitachi ETG 4000
Analysis: NIRS-SPM^{5,10}

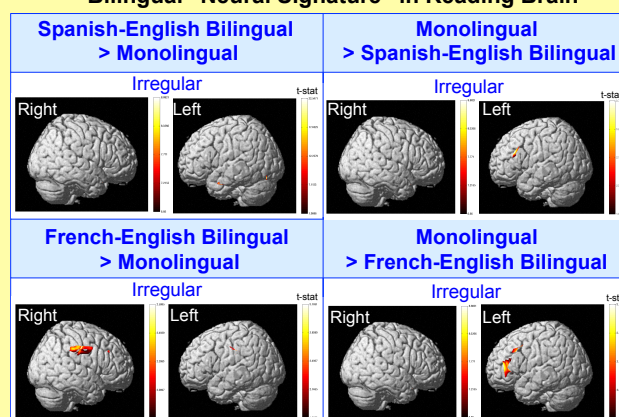


RESULTS

Orthography-Phonology Mapping Impacts Neural Activation



Bilingual "Neural Signature" in Reading Brain



CONCLUSION

Language experience can change how the young bilingual brain reads

Specific differences in orthography-phonology mapping in Spanish, French and English yield differences in neural activation patterns

Shallow orthographies → Greater recruitment of STG
Deep orthographies → Greater recruitment of LIFG

Neural activation patterns for reading are associated with the specific linguistic features of a bilingual's two languages

Supports Bilingual Neural Signature Hypothesis⁴⁻⁶

Translational Impact
Added to the importance of a young bilingual's Age of Exposure (AoE) to its two languages^{2,4-6,8}, **new here** is the observation that differences in the orthographic structure of a bilingual child's two languages can predict reading outcomes

When at least ONE of a young bilingual reader's two languages has shallow orthography, the child may benefit most optimally from reading instruction focusing on phonological processing.



REFERENCES

- 1 Wagner & Torgesen (1987). *Psyc Bulletin*, 101, 192-212.
- 2 Kovelman, Baker, & Petitto (2008). *Biling: Lang Cog*, 11, 203-223.
- 3 Pugh, et al. (2013). *Brain Lang*, 125, 173-83.
- 4 Kovelman, Baker, & Petitto (2008). *J. Cog. Neurosci*, 20, 153-169.
- 5 Jasinska & Petitto (2013). *Dev Neuropsych*, 6, 87-101.
- 6 Petitto, Berens, Kovelman, et al. (2012). *Brain & Lang*, 121, 130-143.
- 7 Ziegler & Goswami (2005). *Psyc Bulletin*, 131, 3-29.
- 8 Berens, Kovelman, & Petitto (2013). *Biling Research J*, 36, 35-60.
- 9 Woodcock (1991). *Woodcock Language Proficiency Battery* – R
- 10 Ye, et al. (2009). *Neuroimage*, 44, 428-44

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