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

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Funding: Petitto (PI) NIH 5R01HD45822 and NIH 5R21HD050558, NSF Grant SBE-0541953, Canadian Foundation for Innovation, Ontario Research Fund

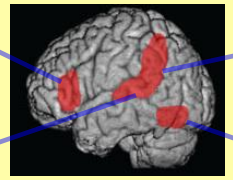
RESEARCH QUESTIONS

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 meaning[3]

Inferior Frontal (IFG)
Word meaning morphology, syntax

Temporoparietal
Letter to sound correspondence

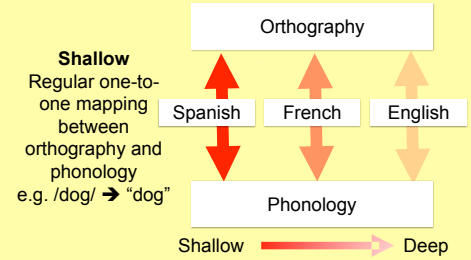


Superior Temporal (STG)
Phonology

Occipitotemporal
Visual word form

Is there a "neural signature" in the young bilingual brain for reading[4-6]? If so, can it be predicted from linguistic features of each language?

The relationship of orthography to phonology differs among languages[2,7,8]



Shallow
Regular one-to-one mapping between orthography and phonology
e.g. /dog/ ➔ "dog"

Deep
Irregular mapping between orthography and phonology
e.g. /s/ & /k/ ➔ "c" "circus"

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	French-English Bilingual	English Monolingual
N = 7	N = 6	N = 11

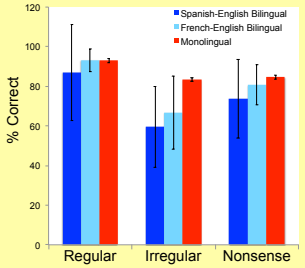
Task

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*

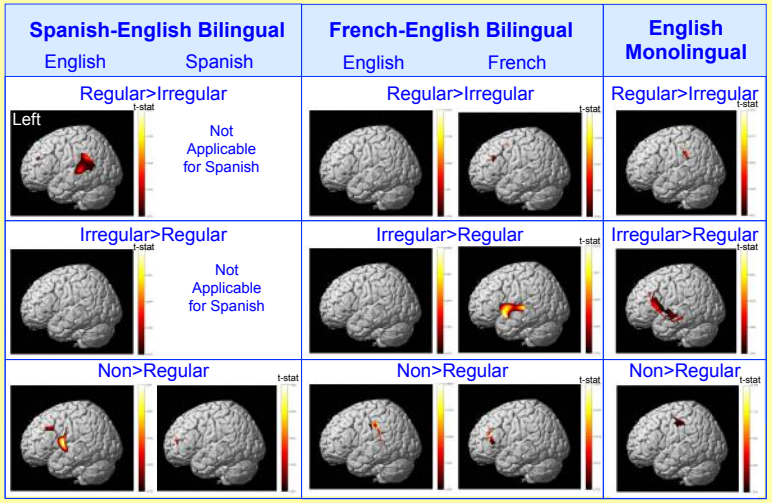
Hitachi ETG 4000
Analysis: NIRS-SPM[5,10]

Reading Performance



RESULTS

Orthography-Phonology Mapping Impacts Neural Activation



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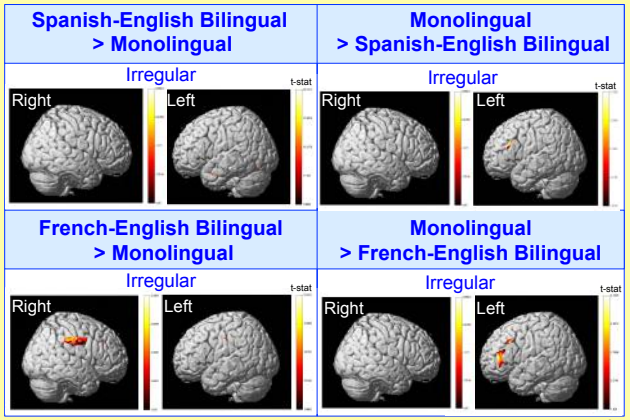
Bilingual "Neural Signature" in Reading Brain



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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 Hypothesis[4-6]

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.

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