How the Bilingual Reading Experience Can Change a Developing Brain
New Insights from fNIRS

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QUESTION

Do differences in early life language experience (bilingual vs monolingual) impact developmental changes in patterns of neural activity in classic language and cognitive tissue during reading?

Here we examine the neural activation patterns of early and later skilled readers to see whether the processing of reading changes with reading skill (from early to later skilled). We further examine how reading is impacted by monolingual vs bilingual early life language experience?

HYPOTHESES

Bilingualism reflects increased (See Box 1)

H1 language specific activity (Broca's Area, BA 44/45; Superior Temporal Gyrus, BA 21/22)[1,2]

H2 cognitive general 'dual task' activity (Dorsolateral Prefrontal Cortex, BA 9/46)

H3 cognitive and language specific resources relative to monolingualism

METHOD

Participants

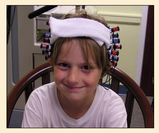
Birth Bilingual = English + French, & English + Other language

Task

Word Reading[3] in English – Accuracy and RT

Near Infrared Spectroscopy (fNIRS)[4,5]

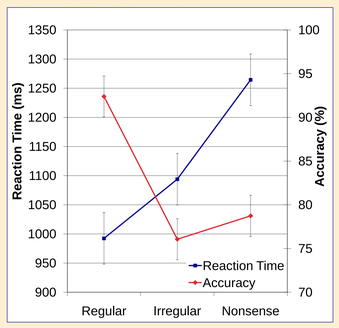
Regular	Irregular	Nonsense
stop	*debt*	*yosh*



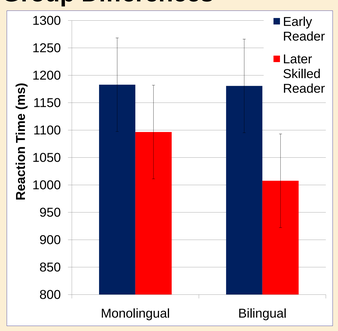
Hitachi ETG 4000
46 Channel

RESULTS BEHAVIOURAL

Word Differences



Group Differences

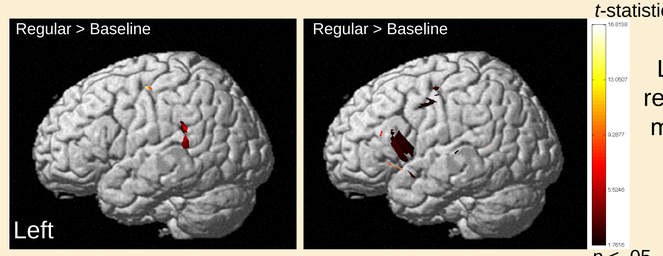


All children showed faster RT and higher accuracy for regular words

RESULTS NEUROIMAGING

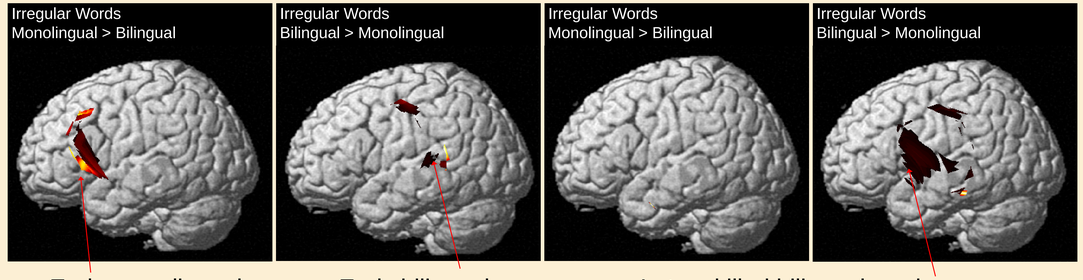
Shift in Brain Recruitment of Classic Language Areas over Time

Early readers recruit more STG



Later skilled readers recruit more Broca's area

Monolinguals **Bilinguals** **Monolinguals** **Bilinguals**

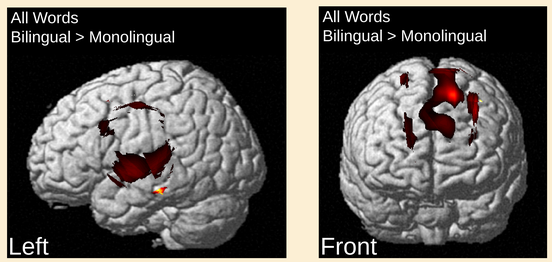


Early monolingual readers recruit more Broca's area relative to early bilingual readers

Early bilingual readers recruit more STG relative to early monolingual readers

Later skilled bilingual readers recruit more Broca's area relative to later skilled monolingual readers

Bilingual Language Experience Impacts Brain Activity



Bilinguals show greater extent and variability in neural activation relative to monolinguals

*All activation maps are significant at p < .05

CONCLUSION

Bilingual language experience yields greater extent and variability in patterns of neural activity relative to monolingualism

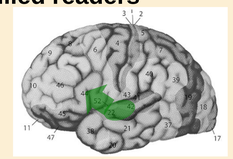
Early bilingual readers recruited more STG and later skilled bilingual readers recruited more Broca's area relative to their monolingual peers

Supports H1 & H3: Bilingualism is predominantly a language specific activity, with greater neural activation (more extent and variability) in classic language and cognitive brain structures, which may lead to enhanced linguistic and cognitive processing. This 'neural signature' reveals the extent of the neural architecture underlying language[1]

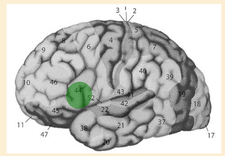
Novel Finding

We observed a first-time age-related shift in the recruitment of classic language areas for reading

Supports greater sensitivity to sound patterns of words in early readers and greater sensitivity to the whole word in later skilled readers



Time 1



Time 2

REFERENCES

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5 Ye, Tak, Jang, Jung, & Jang (2009). *Neuroimage, 44*, 428-447

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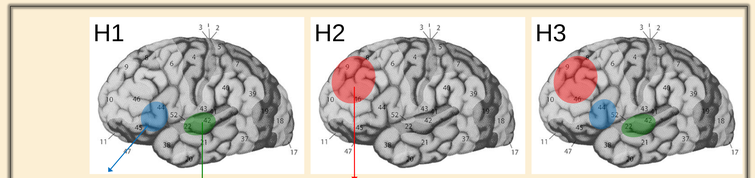
BOX 1