Early sign-speech bilingualism helps children learn reading

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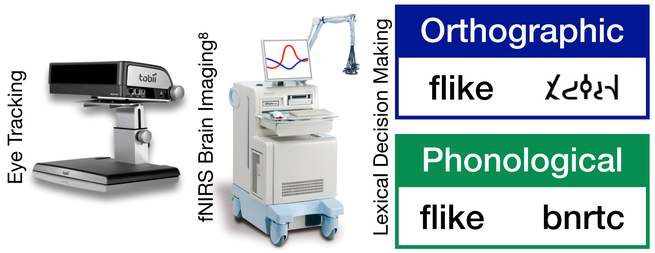
INTRODUCTION

A prevailing assumption in science and society is that learning to read requires sound.[1] Yet, deaf signing children without access to sound still become successful readers.[2] Decades of research have shown similarities between spoken and sign phonological processing in the brain[2], as well as cognitive-behavioral benefits in bilingualism.[3–7] **Does sign-speech bilingualism impact learning to read?**

METHODS

In a cross-sectional study, we investigated higher cognitive factors hypothesized to contribute to reading development, specifically, early bilingual language and reading exposure. Children were trained beforehand. Data were time-locked and analyzed from 32 children across 4 groups (see Demographics): younger and older hearing monolinguals (H1, H2; English only) and younger and older deaf bilinguals (D1, D2; English and American Sign Language, ASL).



RESULTS

Preliminary results revealed H2 were most accurate for orthographic (pseudoword v. false font) and phonological decisions (pseudoword v. nonword), followed by D2, then D1. H1 responded the least accurate for both types of decisions. Significant differences in response variables between ages (younger v. older), but not between groups (hearing v. deaf). Accuracy and reaction time correlated with brain activation in LIFC across all children. Brain activation in LIFC and LpSTG also correlated. D2 gazed at the correct words most for both types of decisions. D1 gazed at correct words more than H1 for orthographic decisions, with the opposite being true for phonological decisions.

DISCUSSION

Children's reading develops similarly from ages 5 to 7 years, regardless if the children are hearing monolinguals (English) or deaf bimodal-bilinguals (English+ASL). ***Learning to read does not require sound.*** These findings also suggest neurocognitive advantages for sign language bilingualism in reading. Through novel brain+eye+behavior technology integration, new insight is revealed about the neuroplasticity of the human brain and the positive bootstrapping impact of visual sign phonology on reading development. This work has broad scientific and translational impact by identifying ***factors that may benefit all children*** in learning to read.

Learning to read does not require sound

Scan with camera to access all materials!

International Mind, Brain and Education Society, July 21–23, 2022, Montréal, QC, Canada
Supported in part by USA NSF and a Gallaudet Sponsored Programs and Research Services Priority Research Grant

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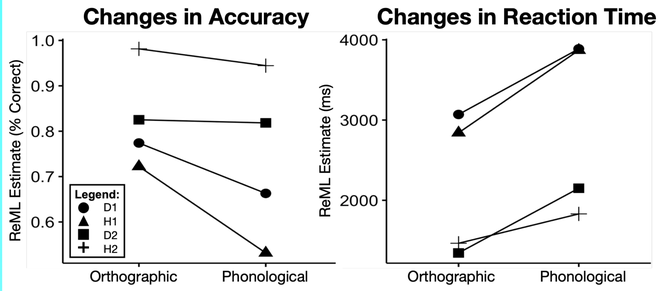
CHILD DEMOGRAPHICS

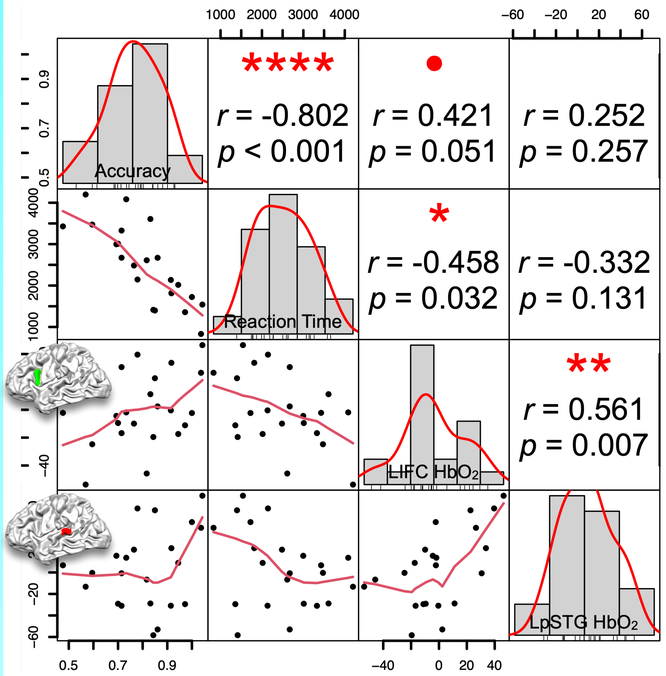
M (SD)	D1 Younger Deaf	H1 Younger Hearing	D2 Older Deaf	D2 Older Hearing
***N* = 32 (Sex)**	10 (8F, 4M)	7 (4F, 3M)	9 (5F 4M)	6 (3F, 3M)
Age at Session	5.01 (0.91)	4.93 (0.56)	7.05 (0.79)	7.21 (0.37)
Letter Naming Accuracy (%)	0.99 (0.04)	0.96 (0.06)	–	–
Letter Naming Speed (ms)	49851 (10654)	3600 (12996)	–	–
English Understanding[1]	–	–	468.56 (12.59)	493.83 (20.51)
Sign Lang. Understanding[2]	0.56 (0.29)	–	0.73 (0.10)	–
Nonverbal Intelligence[3]	102.00 (24.99	117.14 (12.05)	97.67 (17.42)	107.00 (20.31)

Letter Naming used English letters; 1. Woodcock Johnson Language Proficiency Battery Revised, W Score; 2. American Sign Language Receptive Skills Test, Raw Score; 3. Primary Test of Nonverbal Intelligence, Standard Score.

BEHAVIOR



BRAIN-BEHAVIOR



EYE TRACKING