Evidence that Sign-Speech Bilingualism Supports Optimal Learning in Deaf Children

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Sign language helps deaf children learn and promotes school readiness

INTRODUCTION

Hearing aids (HAs) and Cochlear Implants (CIs) are used worldwide to treat reduced hearing across the lifespan. The prevailing assumption is that these devices provide robust augmentation of sound, and, thus, optimal access to learning, especially language and reading. **Are HAs and CIs enough for optimal learning?** New findings challenge this prevailing view and demonstrate the deleterious impact of listening effort on the brain.[1] Long-term HA and CI adults self-report high listening effort, and brain imaging shows adverse changes to neural networks underlying attention and language.[2] Questions remain about the impact of listening effort with HAs and CIs during critical and sensitive periods in children.

METHODS

3 hearing monolingual (Eng) and 1 deaf CI bilingual (Eng+ASL) children participated in game-like classic science tasks: Simon Cognitive Flexibility (congruent and incongruent colored-shape pairs) and Overt Word Reading (regular, irregular, and nonsense words). Cognition was measured using fNIRS brain imaging time-locked with behavioral accuracy and reaction time. Behavioral data were analyzed using summary statistics. Brain imaging data were preprocessed and analyzed using the NIRS Brain AnalyzIR Toolbox in MATLAB.[3] We used Mixed Effects GLM with AR-IRLS pre-whitening. Source localization was performed using 3D Photogrammetry (bottom right).[4]

RESULTS *(preliminary, proof-of-concept)*

Cognitive Flexibility: Reading deaf CI bilingual and hearing monolingual children performed comparably. Both performed faster and more accurately than the non-reading hearing monolingual child. Deaf CI bilingual child showed greater neural activation in the right prefrontal cortex (R-PFC) for incongruent compared to congruent conditions. Overt Word Reading: Deaf CI bilingual child performed more accurately and with greater neural activation in the left inferior frontal cortex (LIFC) for regular compared to irregular and nonsense words. *Data collection and analyses are ongoing.*

DISCUSSION

Contrary to HAs and CIs being paramount, our novel results during game-like tasks suggest that early sign-speech bilingual language exposure is key for optimal language, reading, and cognitive development in deaf children. The present results provide tantalizing corroboration for the higher cognitive benefit of early bilingual language exposure.[5-9] These findings yield insight into cognitive development involving learning in young children (attention, language, reading). This work has broad scientific and translational impact by elucidating the optimal conditions that give rise to all children's school readiness for lifelong learning success.

Scan with camera to access **all materials**!

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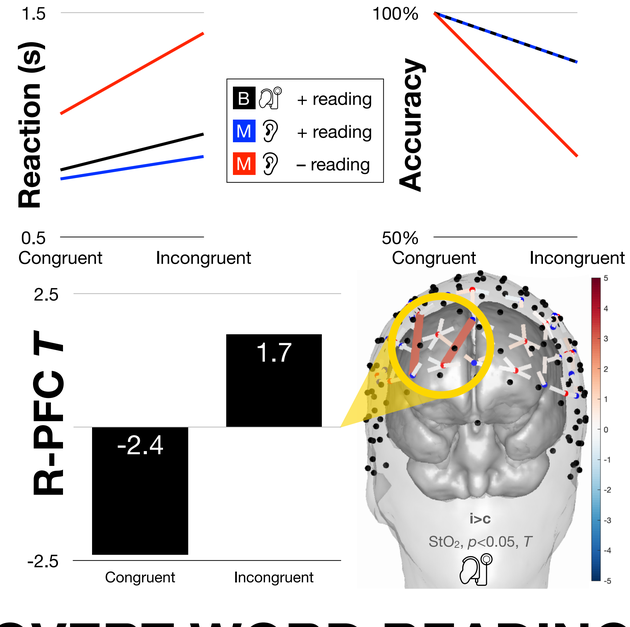
CHILD DEMOGRAPHICS

	HM1	HM2	HM3	DB1 (CI)
Age at Scan	6Y 3M	6Y 3M	6Y 1M	6Y 1M
PBK Word Test	96%	100%	100%	96%
WJ Reading	99	–	118	127
KBIT NV IQ	104	136	125	109
PROMIS® Health	62.6	66.1	64	**55.4***
PROMIS® Fatigue	39.2	34.1	34.1	34.1

All values represent standard scores. *One full standard deviation healthier. Index: HM, Hearing Monolingual; DB, Deaf Bilingual; CI, Cochlear Implant; PBK Word Test, Phonetically Balanced Kindergarten Word Test; WJ Reading, Woodcock-Johnson IV Passage Comprehension; KBIT NV IQ, Kaufmann Brief Intelligence Test II Matrices.

COGNITIVE FLEXIBILITY



OVERT WORD READING