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

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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 the learning of 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. Long-term HA and CI adults self-report high listening effort and brain imaging shows adverse changes to neural networks underlying attention and language. Questions remain about the impact of listening effort with HAs and CIs during critical and sensitive periods in children. Contrary to HAs and CIs being paramount, our novel fNIRS brain imaging results (measuring cognition) during game-like tasks suggest that early sign-speech bilingual language exposure is key for optimal language, reading, and cognitive development in deaf children (pilot data; N=4, mean=6y2m±1m). 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 ($p<0.05$). Deaf CI bilingual child also performed more accurately and with greater neural activation int he left inferior frontal cortex (LIFC) for regular compared to irregular and nonsense words ($p<0.05$). The present results provide tantalizing corroboration for the higher cognitive benefit of early bilingual language exposure. 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.

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