Does early exposure to a visual signed language "hurt" auditory language tissue development: Evidence from fNIRS neuroimaging of language processing in deaf individuals with cochlear implants

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ABSTRACT

Controversy abounds regarding the specific impact of differences in language experience on the acquisition of spoken language in deaf individuals with cochlear implants (CI)[1,2,3,4]. Noteworthy are claims that due to neuroplasticity of auditory language tissue, early exposure to a signed language results in deviance to auditory language tissue development. We find that early, but not later, exposure to a signed language supports typical language development.

QUESTION

Does early exposure to a visual signed language impact classic left-hemisphere spoken language tissue development, including left Inferior Frontal Gyrus (LIFG) and Superior Temporal Gyrus (STG)[5,6,7], in a deaf individual with a CI?

Does age of signed language exposure impact language processing in the deaf CI individual?

HYPOTHESES

H1 Early language exposure, *both signed and spoken*, facilitates normal neural development for language processing

P1 CI individual with *early, but not later,* signed language exposure recruit left-hemisphere language areas

H2 *Only* early spoken language exposure facilitates normal neural development for language processing
Early signed language exposure disrupts development

P2 CI individual with *early and later* signed language exposure do *not* recruit left-hemisphere language areas

METHODS

Participants

Deaf Adults with cochlear implant
(Age of Implant = 13 years)

Early Signed Language Exposure
(ASL before age 5 years)
N = 4

Later Signed Language Exposure
(ASL after age 5 years)
N = 4

Hitachi ETG 4000

Task

Reading aloud English words

Word Reading[10] in English

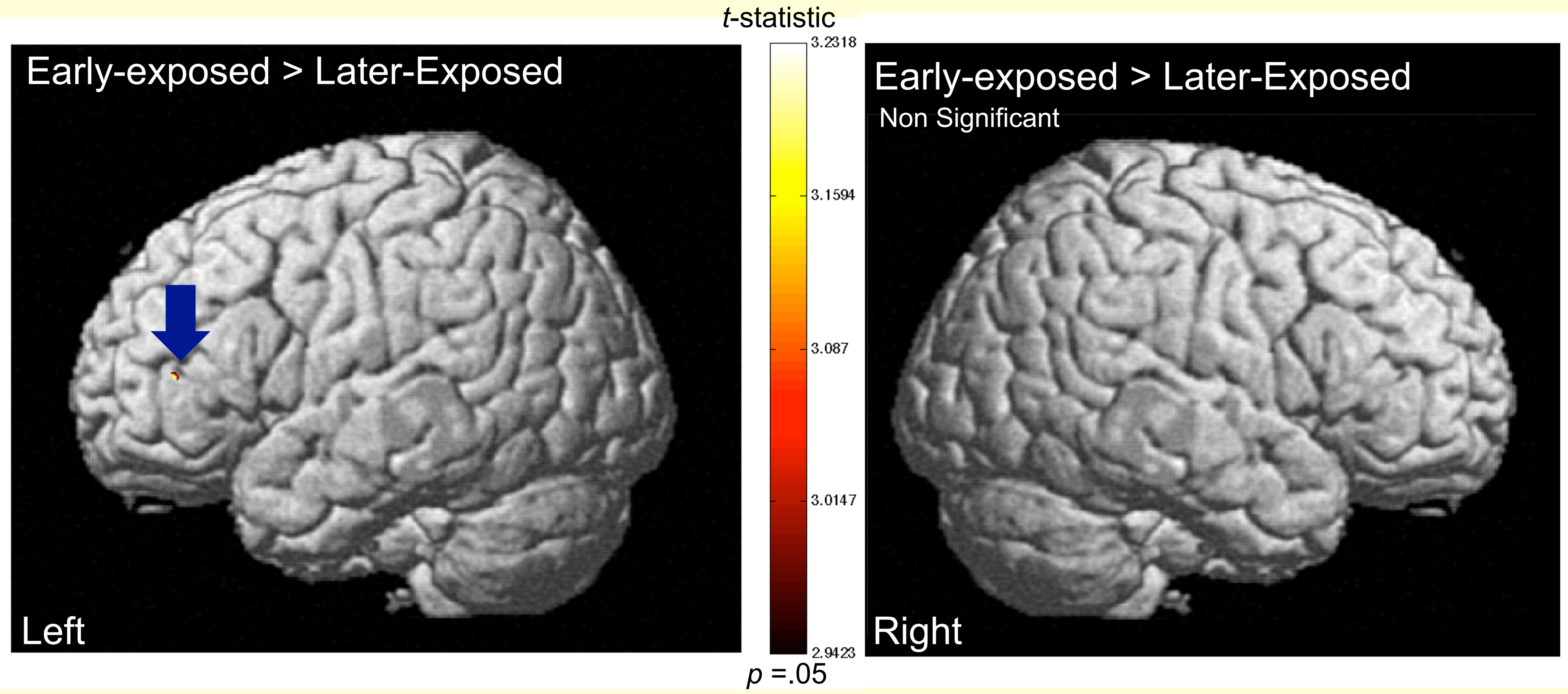
Regular *stop* | Irregular *debt* | Nonsense *zoop*

Near Infrared Spectroscopy (fNIRS) neuroimaging[8,9]

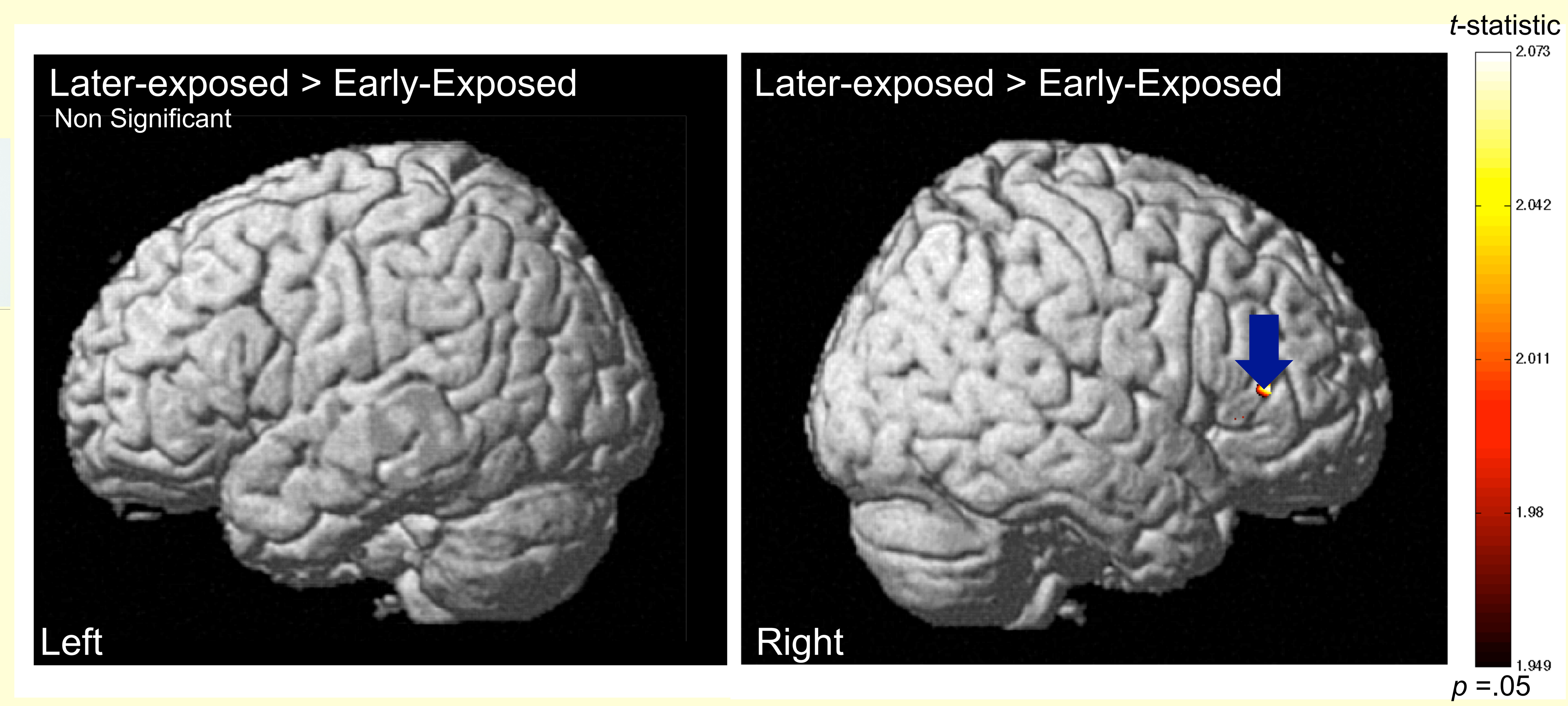
Advancement: Optical imaging is safe for cochlear implant users

RESULTS

Early Signed Language Exposed Deaf CI Individuals Show Greater Neural Activation in Left Inferior Frontal Gyrus



Later Signed Language Exposed Deaf CI Individuals Show Greater Neural Activation in Right Inferior Frontal Gyrus



CONCLUSION

Early exposed deaf CI individuals showed greater activation in classic **left**-hemisphere language areas (LIFG)

Late exposed deaf CI individuals showed greater activation in the **right**-hemisphere (RIFG), not in classic left hemisphere language areas (LIFG)

Supports Hypothesis 1
Early signed language exposure facilitates normal language processing

No evidence of a negative impact on language processing as a result of early visual signed language exposure

Implications
Optimal developmental timing of signed language exposure
Early language exposure, be it signed or spoken, supports healthy, typical language development

New view on how early life language exposure, irrespective of modality (signed, spoken), can facilitate language processing in the deaf CI individual

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