

# Age of sign-speech bilingual language exposure and syntactic processing in deaf individuals with cochlear implants using functional Near Infrared Spectroscopy (fNIRS)

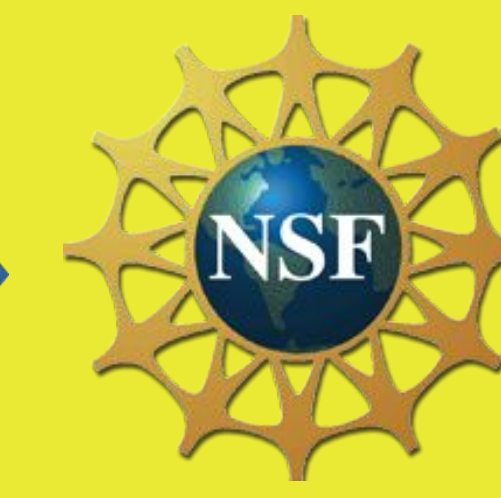


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VISUAL LANGUAGE AND VISUAL LEARNING  
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## Abstract

Age of first language exposure has been correlated with greater extent and variability in classic left hemisphere language areas<sup>1,2,3</sup>. Questions remain, however, about the impact of the modality of first language exposure in deaf individuals who use cochlear implants (CI)<sup>4,5,6,7</sup>. It has been suggested that early exposure to a signed language alters classic neural tissue associated with speech. Here we explore whether early bilingualism, regardless of modality (signed or spoken), supports healthy neural development for language processing and reading.

## Question

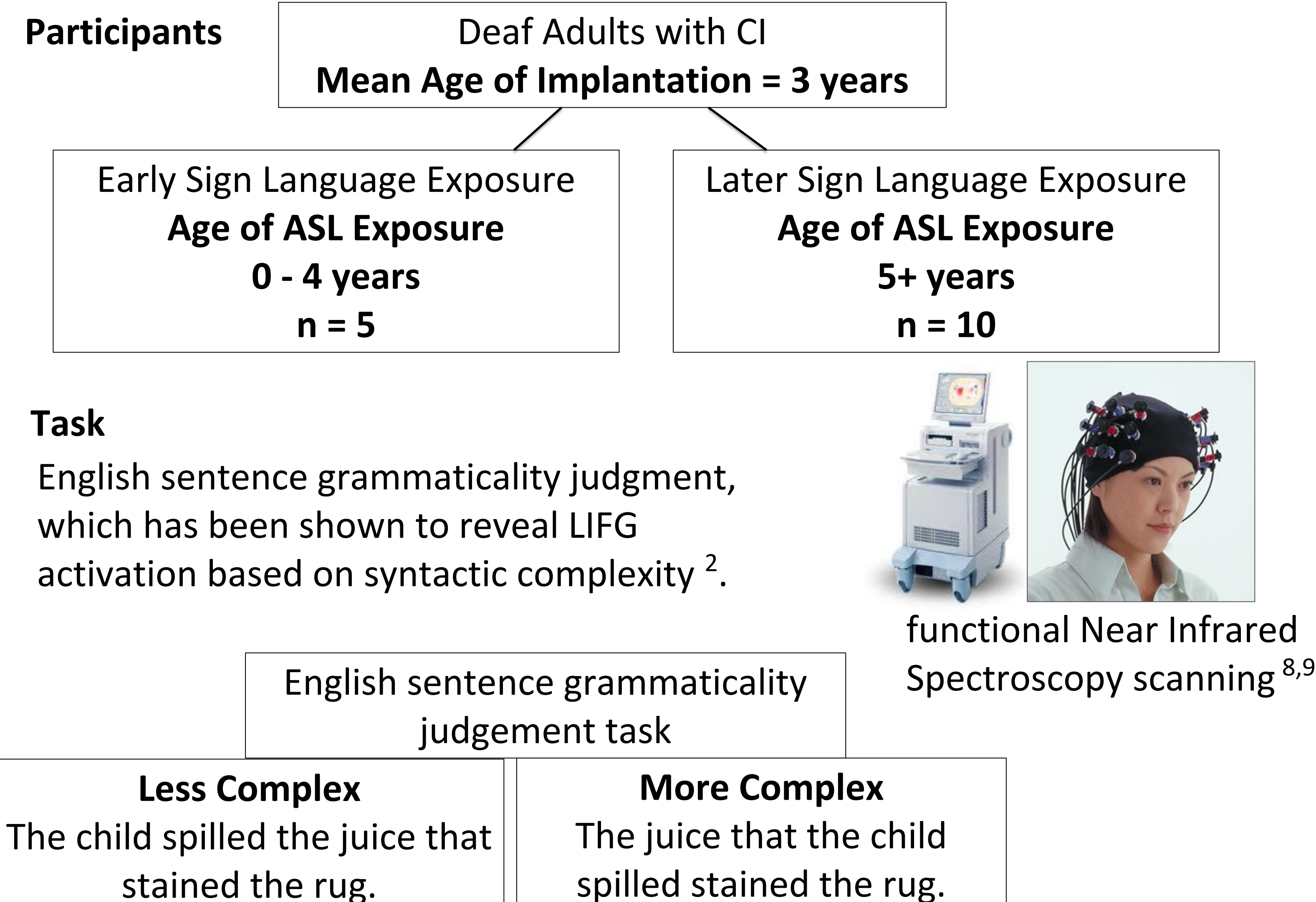
Does early sign-speech bilingual exposure alter neural sites and systems associated with spoken language syntactic processing?

## Hypotheses

**H1.** Early sign-speech bilingual experience renders typical LIFG recruitment for syntactic processing.

**H2.** Only early spoken language experience results in typical neural development of LH language regions; early sign-speech bilingualism disrupts the typical recruitment of neural tissue for syntactic processing.

## Methods



## Behavioral Results

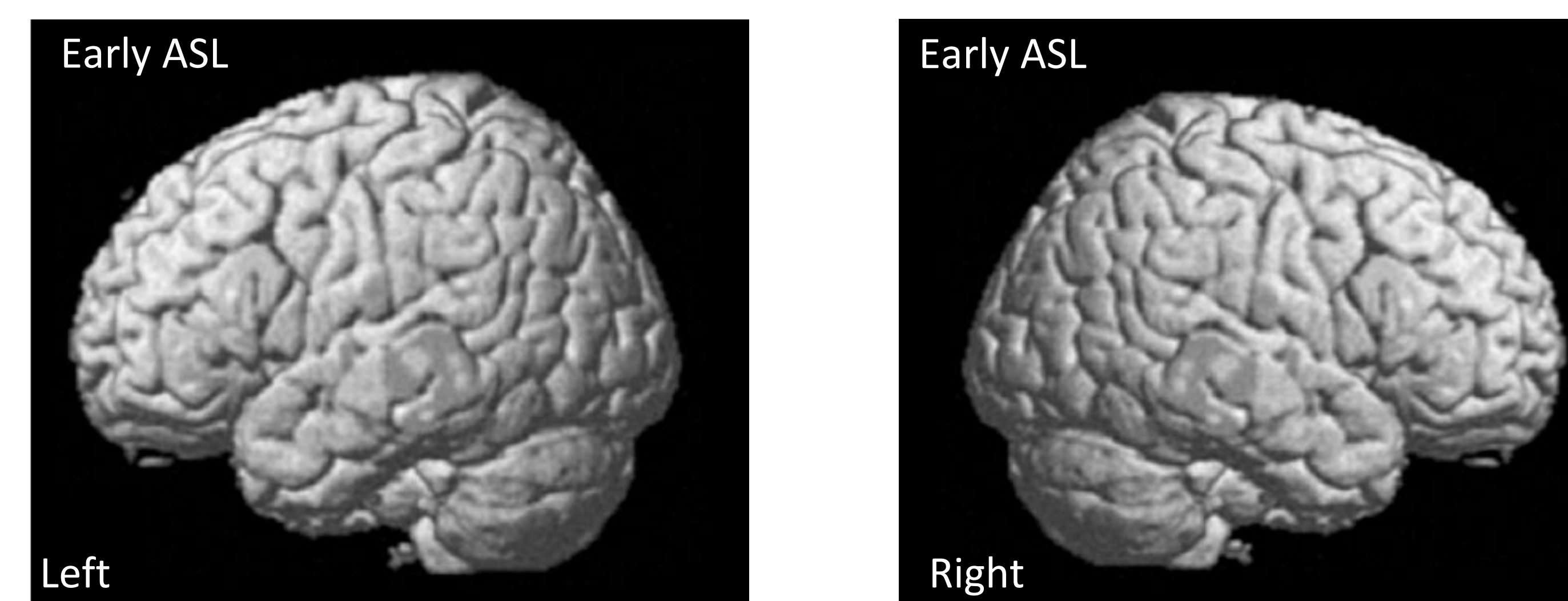
No group differences were found for accuracy or reaction time. Both groups performed equally well on the sentence grammaticality judgment task.

## Neuroimaging Results

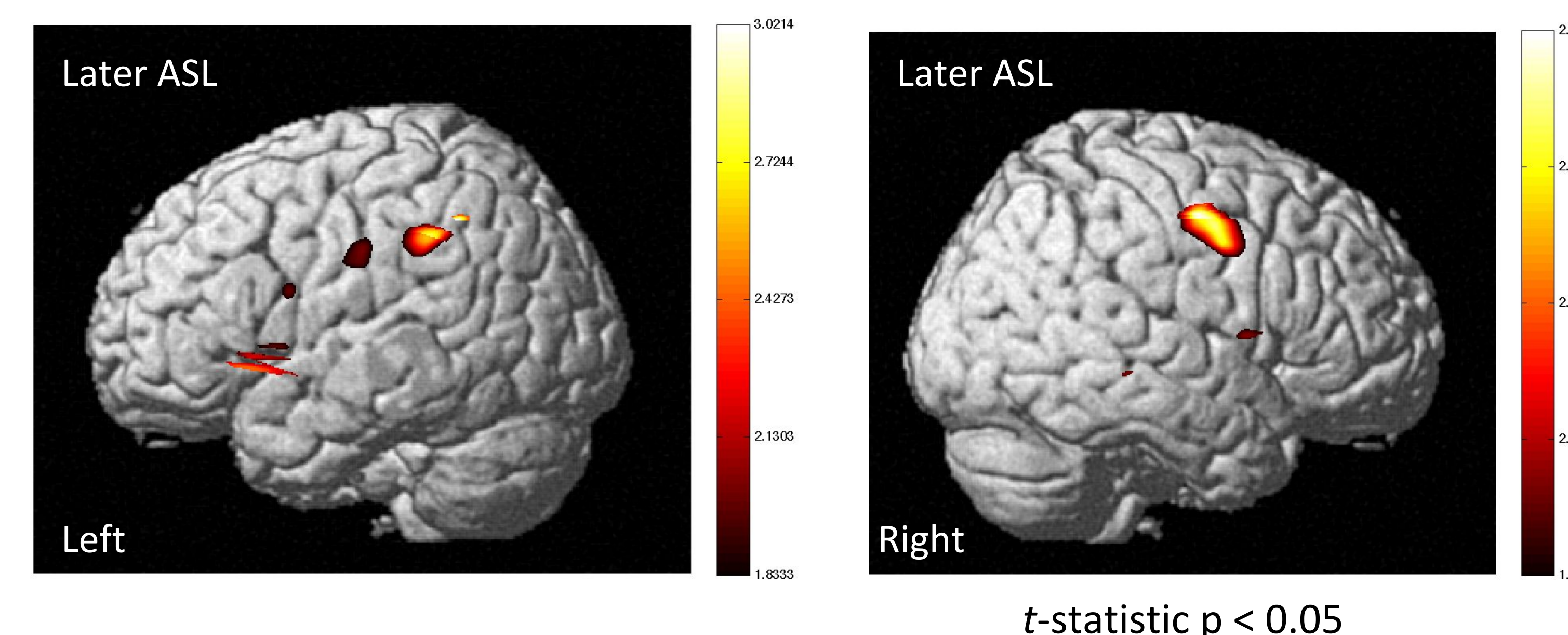
**Contrast: Less Complex > More Complex Syntax (n.s.)**

**Contrast: More Complex > Less Complex Syntax**

**Early ASL** exposed CI individuals recruited LIFG for sentence processing and revealed no differential activation for more vs less complex syntax. The results demonstrate how typological differences in syntactic structure of a signed language can influence sentence processing in a second language<sup>1</sup>.



**Later ASL** exposed CI individuals showed a greater extent and variability in activation of LH language areas and bilateral parietal regions, reflecting increased processing demands for more complex syntax<sup>10, 11</sup>.



## Conclusions and Implications

**The present findings indicate support for H1:** Early sign-speech bilingual exposure renders typical neural development supporting syntactic processing.

**Early ASL CI bilinguals** may have neural networks that are more resilient to syntactic difficulty in English compared to **later ASL CI bilinguals**.

These findings shed new light on the impact of age of sign-speech bilingual language experience and on the development of language processing in deaf CI individuals. We did not observe a deleterious impact of early sign language exposure on the processing of English syntax in classic spoken language processing tissue.

**Early exposure to two languages, signed or spoken, supports typical language development.**

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