

## **The neural correlates of comprehending ASL-English code-blends (ENGLISH)**

Bimodal bilinguals fluent in English and American Sign Language (ASL) often “code-blend”, producing signs and words simultaneously, when conversing with each other. Recent evidence indicates that code-blending facilitates comprehension in both languages. We investigated the neural basis of this facilitation using fMRI to examine which brain regions are recruited when bimodal bilinguals perceive code-blends. We expected code-blends to recruit a combination of brain regions that are active when comprehending sign or speech alone, but those regions may be differentially modulated by the perception of simultaneous sign and speech. In addition, code-blend comprehension may engage regions involved in lexical, semantic, or multimodal sensory integration.

During scanning, 14 hearing ASL-English bilinguals (CODAs) (mean age = 27.0 years, education = 15.5 years, 7 female) viewed audiovisual clips of a native hearing signer producing a) an ASL sign; b) a spoken English word; or c) a sign and spoken word simultaneously (translation equivalents). Participants made a semantic decision (‘Is it edible?’) for 60 unique items in each condition, and responded via button press. For the control task participants viewed the model at rest and indicated when a dot superimposed on the chin changed color and/or if an accompanying tone changed pitch. Each of three imaging runs (3T, TR = 2s, 30 sagittal slices with voxel size = 3.75 x 3.75 x 4.5) contained two 30s blocks of each condition (10 trials/block), in pseudorandom order, plus two 20s fixation periods as a low-level baseline condition. Individuals’ BOLD responses were estimated using multiple regression, and parameter estimates for each condition were entered into a group-level mixed effects ANOVA.

Direct comparison of brain responses during speech versus sign comprehension revealed greater activation for speech in bilateral superior temporal gyrus (focused near Heschl’s gyrus), and for sign in bilateral occipitotemporal (MT/V5, fusiform gyrus), and parietal cortices, and in left prefrontal/inferior frontal gyri. This pattern reflects, in part, differential sensory engagement required by the modality of each language. Simultaneous perception of sign and speech (code-blends), relative to perception of each alone, led to increased activation in the relevant modality-specific regions, indicating that code-blend perception recruits a combination of brain regions active for each language alone. No regions responded more during speech alone than during code-blend comprehension, indicating that code-blends did not influence neural activity related to speech comprehension. In contrast, several regions showed reduced activation during code-blend comprehension compared to sign alone, including bilateral

occipitotemporal cortex (area MT/V5), left precentral gyrus, and right anterior insula. Reduced activation in these regions during code-blend perception may be a neural reflection of the behavioral facilitation previously observed for comprehension of code-blends, compared to ASL signs alone. In addition, given that hearing ASL-English bilinguals tend to be English-dominant, greater neural activity when comprehending ASL alone may reflect the increased effort required to process ASL without the redundant cues provided by spoken English. Overall, the results indicate that code-blends reduce neural activity in sensory processing regions associated with language perception, rather than in regions associated with lexico-semantic processing (i.e., left frontotemporal regions).