Enhanced peripheral lexical processing in deaf individuals: perceptual or linguistically driven?

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Recent research suggests that skilled deaf readers have a wider perceptual span, and can perceive more information from upcoming words allowing them to process text more efficiently than their reading-level matched hearing counterparts (Bélanger, Slattery, Mayberry, & Rayner, 2012; Bélanger & Rayner, 2015). We investigated whether superior visual processing abilities potentially explain why these skilled deaf readers are so successful. Research shows that Deaf signers are better able to process peripheral dot stimuli (Bavelier, Brozinsky, Tomann, Mitchell, Neville, & Liu, 2001; Dye, Baril, & Bavelier, 2007; Neville & Lawson, 1987), but no studies have addressed their ability to process linguistic information in the periphery, outside of reading tasks. To bridge this gap, we conducted three experiments to determine whether enhancements to perception extend to ASL stimuli. We tested whether real linguistic stimuli (i.e., signs or fingerspelled words) allow deaf signers to use lexical knowledge to facilitate perceptual processing in the far periphery. We hypothesized that signers would show a sign superiority effect, similar to the *word superiority effect* (e.g., Wheeler, 1970) relative to non-signers. Evidence of a word superiority effect would be if discrimination of a middle letter were better when embedded in a real word fingerspelling sequence than a nonword (e.g., B-O-Y compared to Y-O-B), and a sign superiority effect would be if discrimination of a sign component (e.g., handshape) were better when the stimulus was a real sign (i.e. claw handshape in "WANT") than if it was not (i.e., contained unfamiliar combinations of handshape, orientation, and motion; an invalid alteration of WANT where the claw handshape moves in reverse).

In three experiments, we tested the ability to process stimuli in the near and far periphery. Participants fixated the signers' face and performed recognition or discrimination tasks for manual signs. In Exp 1 stimuli were static pictures of ASL letters flashed for 400ms; we compared the abilities of deaf signers ($n = 22$) and hearing signers ($n = 47$) to identify them via free response and predicted that deaf signers would outperform hearing L2 signers. In Exp 2 & 3, stimuli were 500ms long videos of a signer. We compared the ability of deaf signers ($n = 29$) and hearing non-signers ($n = 25$) to identify the middle letter of a fingerspelled three-letter English word or non-word (Exp 2), or the handshape of a ASL sign or non-sign (Exp 3) via a two-alternative forced choice response. Of particular interest is the pattern of data comparing meaningful stimuli to nonsense stimuli in Exps 2 & 3. We predicted a word/sign superiority effect that would lead to enhanced performance for real words and real signs among deaf participants only, and that this word/sign superiority effect might be particularly evident at the far periphery.

As predicted, in all experiments, deaf signers outperformed hearing participants (all ps < 0.001) and performance was always better in the near than in the far periphery (all ps < 0.05). In Exp 1, hearing signers' ASL proficiency also predicted accuracy ($p < 0.05$), showing the contribution of language knowledge to peripheral perception. There was no interaction with eccentricity in Exp 1, but there were in Exps 2 & 3 (both ps $< .005$) suggesting a linguistic processing enhancement only for linguistically rich peripheral stimuli, not isolated handshapes in static images. Although there was no word superiority effect in Exp 2 ($p = 0.67$), there was a sign superiority effect in Exp 3 ($p < 0.001$). These results suggest that deaf signers become particularly adept at identifying information in the periphery when the task (1) contains dynamic linguistically meaningful information and (2) resembles real world processing demands. This superior ability to process linguistic information in the periphery in ASL may underlie the superior peripheral processing abilities that allow skilled deaf readers to process text efficiently when reading English.

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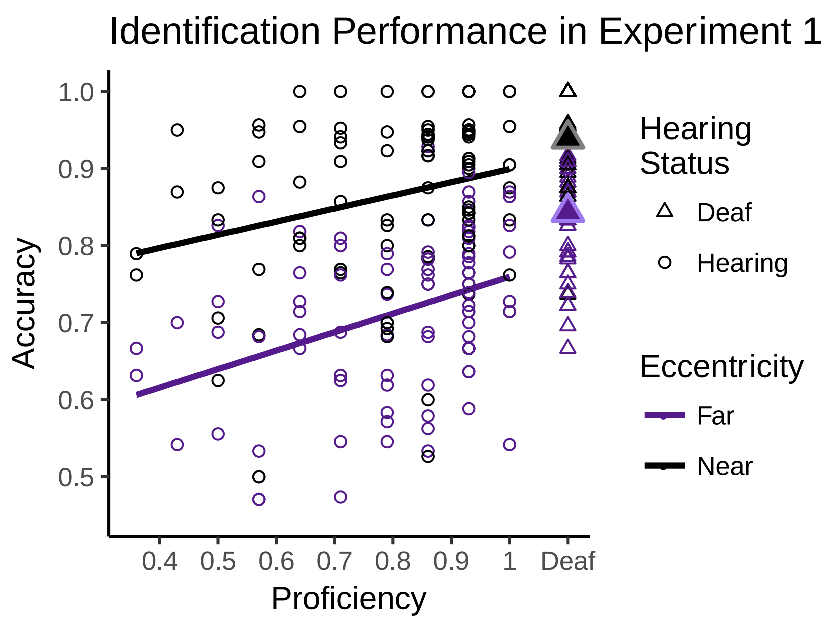

Figure 1. Accuracy of letter identification for hearing participants (n = 47: open circles) and deaf participants (n = 22: open triangles) in Experiment 1 as a function of proficiency in ASL (trend line for hearing participants only) and hearing status (filled triangles are the mean for deaf participants).

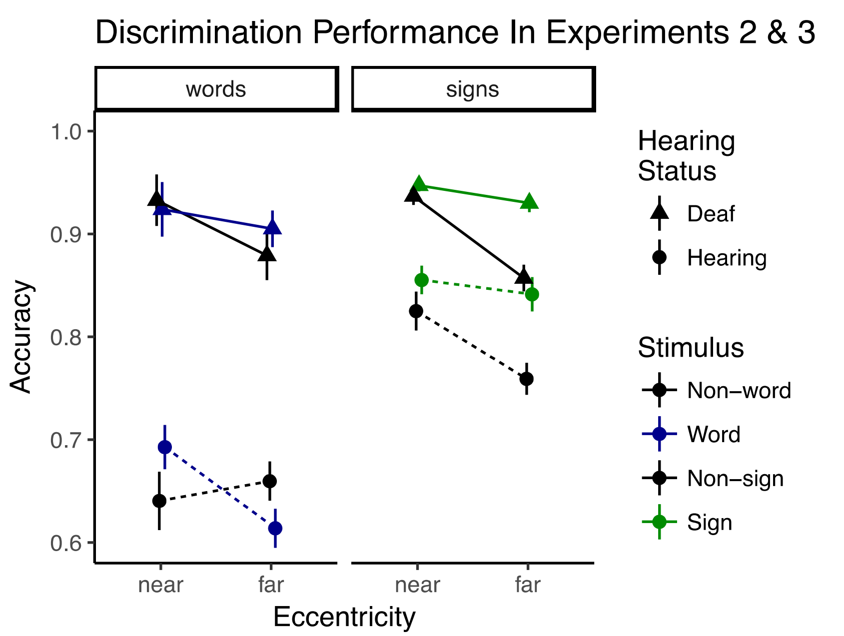

Figure 2. Accuracy of deaf (n = 29) and hearing (n = 25) participants' middle letter identification for three-letter word and nonword sequences as a function of eccentricity (Experiment 2) and handshape identification for signs and nonsigns as a function of eccentricity (Experiment 3).