Lateralization of the N170 for word and face processing in deaf ASL signers

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Background

The N170 component

- Left-lateralized occipito-temporal N170 for orthographic stimuli [1]
- Right-lateralized occipito-temporal N170 for face processing [2]
- N170 is sensitive to perceptual expertise (larger in right hemisphere RH for expert vs. non-experts on object recognition) [3]
- Emergence of hemispheric specialization for words and faces might be complementary: Learning to read leads LH-lateralization for words and may trigger subsequent RH-lateralization for faces [4]

Hemispheric lateralization in congenitally deaf signers

- Deaf native users of American Sign Language (ASL) have distinct developmental experiences with both words and faces (e.g., the face conveys linguistic information)
- Leftward asymmetries in language regions for deaf signers viewing linguistic and emotional facial expressions [5]

How do distinct developmental experiences of deaf signers and hearing non-signers affect hemispheric organization for word and face processing?

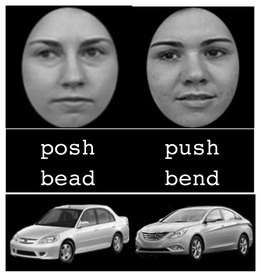
Method

Participants

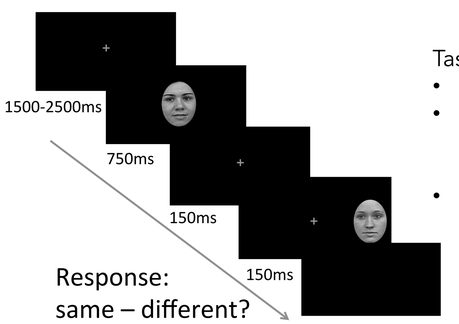
23 **deaf native ASL signers** (11 F; M age = 29, SD = 5.4)
19 **hearing non-signers** (12 F; M age = 24, SD = 5.6)

Stimuli

- 48 Faces: 24 gender-matched pairs
- 48 Words: 24 four-letter word pairs
- 48 Cars: control category



Trial: face stimuli



Task:

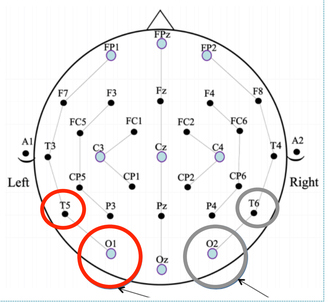
- Adapted from [4]
- 192 trials for each stimulus type with blocks and trials counterbalanced
- Visual angles - center stimuli: faces and words (3.2), cars (5.6); lateralized stimuli centered in LVF or RVF at 5.3 degrees from fixation +

REFERENCES:
[1] Maurer, U., Rossion, B., & McCandliss, B.D. (2008). Category specificity in early perception: face and word N170 responses differ in both lateralization and habituation properties. *Frontiers in Human Neuroscience*, 2.
[2] Bentin, S., Allison,T., Puce,A., Perez,E., & McCarthy, G. (1996) Electrophysiological studies of face perception in humans. *JCN*, 8.
[3] Tanaka, J.W. & Curran, T. (2001) A neural basis for expert object recognition. *Psychological Science*, 12 (1).
[4] Dundas, E. M., Plaut, D. C., & Behrmann, M. (2014). An ERP investigation of the co-development of hemispheric lateralization of face and word recognition. *Neuropsychologia*, 61.
[5] McCullough, S., Emmorey, K., & Sereno, M. (2005) Neural organization for recognition of grammatical and emotional facial expressions in deaf ASL signers and hearing nonsigners. *Cognitive Brain Research*, 22.

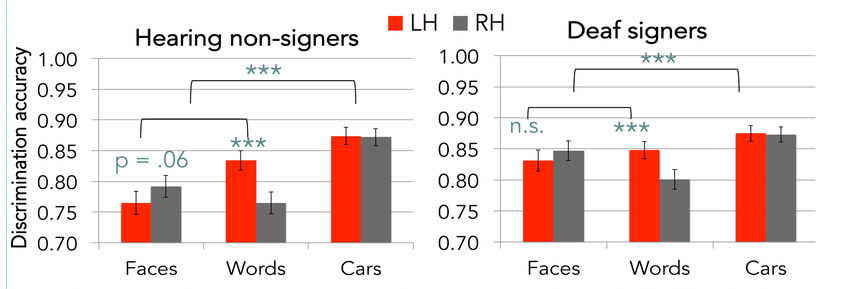
EEG recording and analysis

EEG from 32 electrodes was recorded and referenced to the average of all electrode sites. Amplitude of N170 were measured over left (LH) and right (RH) hemisphere Occipital (O1 & O2) and Temporal sites (T5 & T6) for 130–230 epoch.

Analysis: 2 (Faces, Words) x 2 (LH, RH) x 2 (Temporal, Occipital) ANOVA

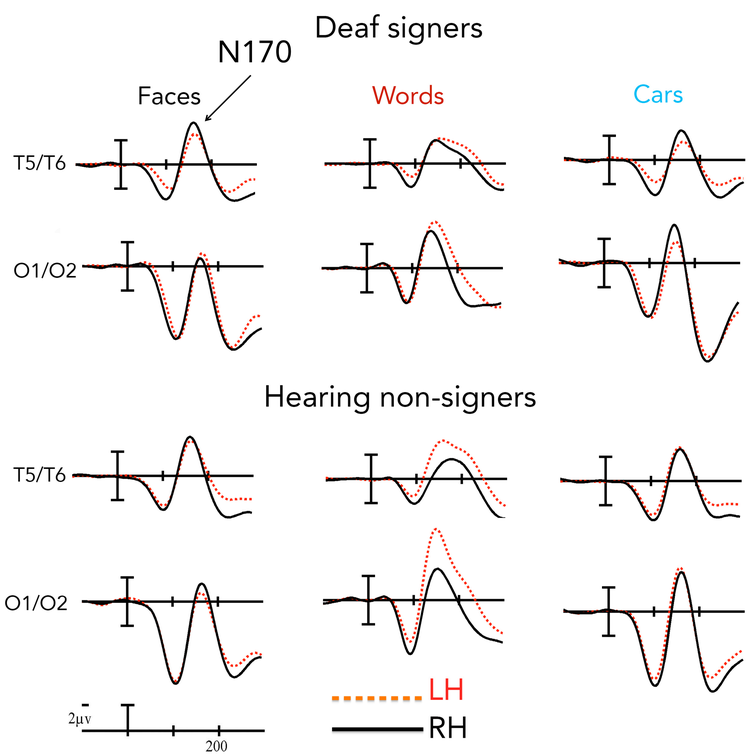


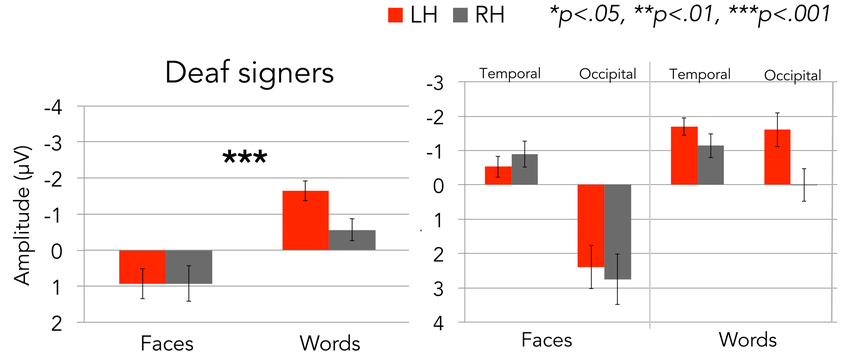
Behavioral lateralization: accuracy

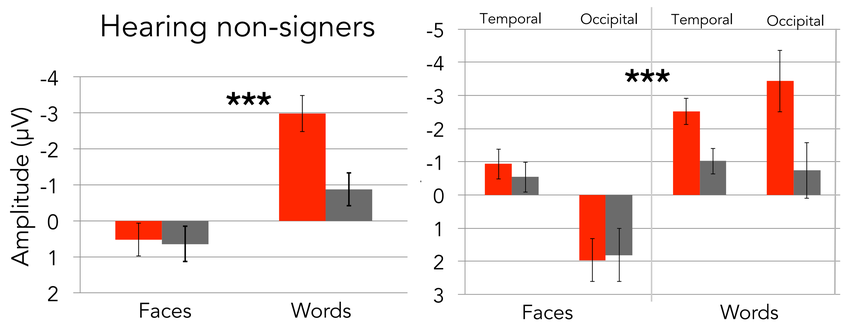


- Both groups show higher accuracy for words than faces (F (2, 82) = 29.3***
- LH bias for words but no RH bias for face processing; only hearing group approached significance at p = .06.

Results: Lateralization of N170 (center stimuli)







Stimulus X Hemisphere:
deaf: F(1,22)=4.8*), hearing: F(1,18)=15.3***

Stimulus X Hemisphere X Temp-Occip: hearing: F(1,18)=12.2**

Discussion and Conclusion

- **Face processing**: Deaf and hearing showed a bilateral N170 to faces. Deaf signers showed a slightly right-lateralized response to faces at temporal sites, but behaviorally the hearing non-signers showed a small RH advantage.
- **Word processing:** Both groups showed a left lateralized N170 response to words, but the asymmetry was somewhat larger for hearing non-signers. At temporal sites, deaf signers exhibited a more bilateral N170 response while hearing non-signers exhibited a strong, left-lateralized N170 response. This result might reflect phonological-orthographic integration in hearing, but not deaf, individuals.
- Deaf signers and hearing non-signers showed a similar laterality pattern for N170 to words (left-lateralized) and to faces (bilateral). However, the scalp distributions for the laterality effects differed between the groups and might reflect unique organization of visual pathways in the occipito-temporal cortex for deaf signers.

Research supported by NIH grants DC014246 & HD25889 and NSF 180897

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