Neural Activation for Lexical Sign and Pantomimic Gestures in Deaf Signers.

Tatiana Matyushkina[1], Kayoko Okada[5], Gregory Hickok[2], Svenna Petersen[4], Ursula Bellugi[4], David Corina[1,3].

[1]University of California, Davis; [2]University of California, Irvine; [3]Center for Mind and Brain, University of California, Davis; [4]Salk Institute, San Diego; [5]Loyola Marymount University

Introduction

- There is debate about the degree to which motor systems are involved in language comprehension.
- Some accounts suggest that speech comprehension relies on motor systems similarly to comprehension of observed actions.
- American Sign Language (ASL) makes use of a variety of manual and body actions to convey meaning. These include conventional lexical signs as well as pantomimic enactments (aka constructed actions).
- We examined neural requirements for the production and processing of lexical signs and pantomimic actions in deaf signers.
- Of particular interest is difference in activation in IFG.

Methods

Subjects

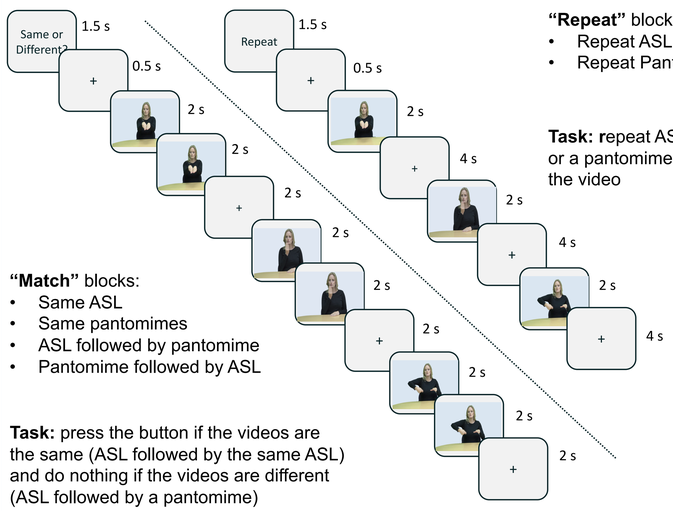
- 16 deaf participants (11 females), age range 18-45.
- All the participants were born to deaf parents and exposed to ASL from birth. All the participants were right-handed

Stimuli

- 2 second long videos of ASL verb signs and pantomimic gestures

Procedure

- 2x2 design: task x video type
- Every block was followed by a 10 s rest interval with a white fixation remained on screen.
- 12 blocks in a run (randomized order), 6 runs per subject.



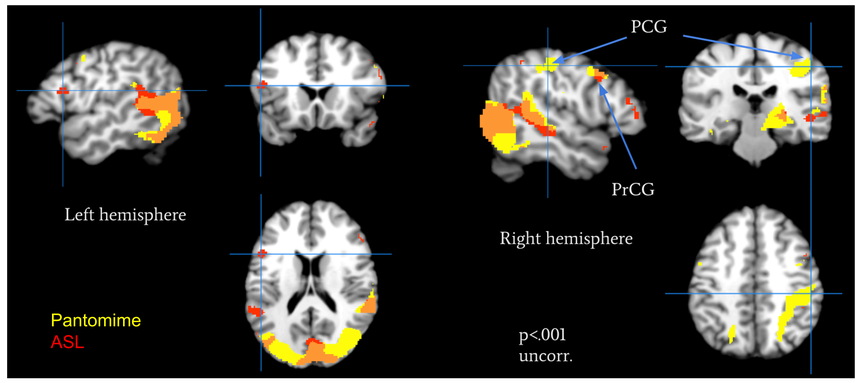
"Repeat" blocks:
- Repeat ASL
- Repeat Pantomime

Task: repeat ASL sign or a pantomime from the video

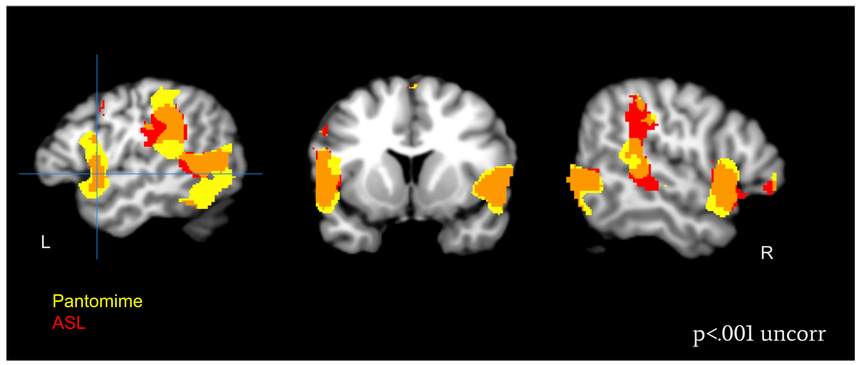
"Match" blocks:
- Same ASL
- Same pantomimes
- ASL followed by pantomime
- Pantomime followed by ASL

Task: press the button if the videos are the same (ASL followed by the same ASL) and do nothing if the videos are different (ASL followed by a pantomime)

Activation overlap: perception



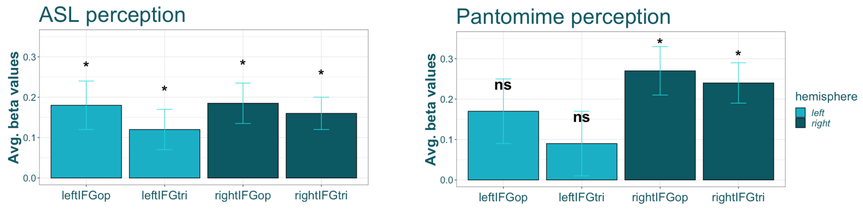
Activation overlap: production



ROI analysis results

No significant effects in Pantomime perception > ASL perception

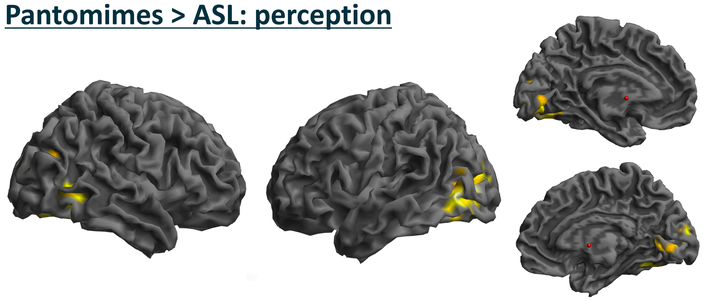
IFG activation in ASL and pantomime perception:



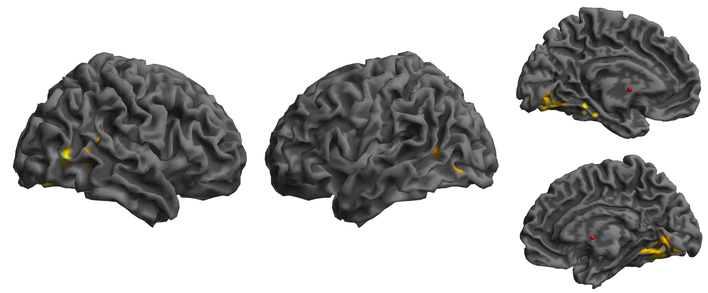
Activation in ASL and pantomime production:

- Data analysis was performed in SPM 12
- Anatomical ROI defined using wfu-pickatlas toolbox
- ROI analysis carried out using REX toolbox

Pantomimes > ASL: perception



Pantomimes > ASL: production



Conclusions

- **Perception:** a graded activation of anatomically similar bilateral visual cortical and posterior temporal areas which suggests commonality in the neural regions involved in perception.
- In **production**, we observe an expected pattern of bilateral motor-sensory and inferior frontal gyrus activation, with increased middle and selected inferior frontal activation for pantomime relative to ASL production.
- These patterns of activation suggest differential metabolic demands reflecting a cognitive efficiency for linguistic processing and production and increasing demands for the on-line construction of pantomimic gestures.
- These data raise questions about the neural integration of constructed actions (i.e. pantomimic inaction) used in the context of ASL signing

References

Emmorey, K., Xu, J., Gannon, P., Goldin-Meadow, S., & Braun, A. (2010). CNS activation and regional connectivity during pantomime observation: No engagement of the mirror neuron system for deaf signers. *Neuroimage*, *49*(1), 994-1005.

Okada, K., Rogalsky, C., O'Grady, L., Hanaumi, L., Bellugi, U., Corina, D., & Hickok, G. (2016). An fMRI study of perception and action in deaf signers. *Neuropsychologia*, *82*, 179-188.

Xu, J., Gannon, P. J., Emmorey, K., Smith, J. F., & Braun, A. R. (2009). Symbolic gestures and spoken language are processed by a common neural system. *Proceedings of the National Academy of Sciences*, *106*(49), 20664-20669.

Cognitive Neuroscience Society – May 2020. The research presented here was supported by Grants DC011538 and DC014767 from the National Institutes of Health, National Institute on Deafness and Other Communication Disorders. **Contact: tmatyushkina@ucdavis.edu**