Visual cortical tracking of categorical speech features is enhanced for trained lipreaders

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Introduction

1. Neuroimaging research has shown that during silent lip-reading,neuralactivity over the visual cortices can be better decoded with the addition of categorial speech features, on top of low-level features like motion (O'Sullivan et al., 2017; Hauswald et al.,2018).

Q1: Can trained lip-reading elicit a stronger tracking to the categorical visual speech features (i.e. visemes)?

2. Observing visual speech in the absence of auditory speech activates primary auditory cortex (Calvert et al.1997; Pekkola et al., 2005; Bourguignon et al., 2020). However, it remains unclear what this activation reflects.

Q2: Can trained lip-reading elicit a stronger tracking to the unheard speech envelope?

Methods

SUBJECTS n = 16 (11 females, age 19-37) native English speakers recruited from the University of Rochester community.

STIMULI & PROCEDURE

1. Training Subjects were all first asked to watch 5 1-min-long videos of a famous speaker with intact sound. Each subject was randomly assigned 5 out of 15 videos, each played 10 times in a randomized order.

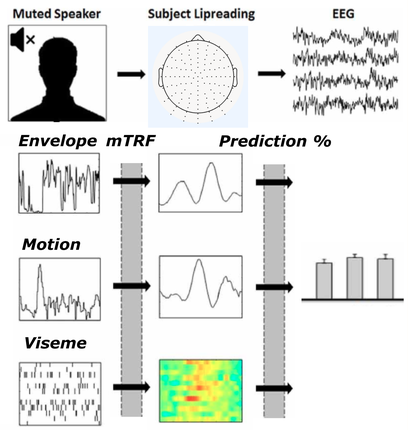
2. Testing

Testing Video Sequence

EEG Data Acquisition

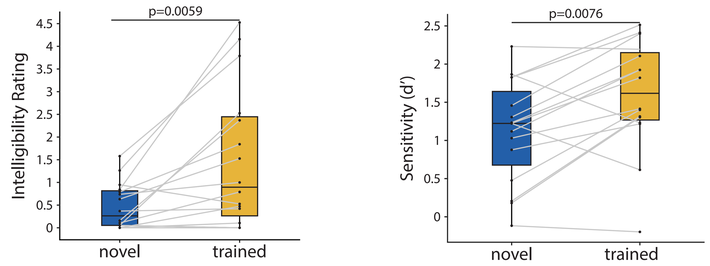
(O'Sullivan, 2019)

3. mTRF Analysis (Crosse,2016)



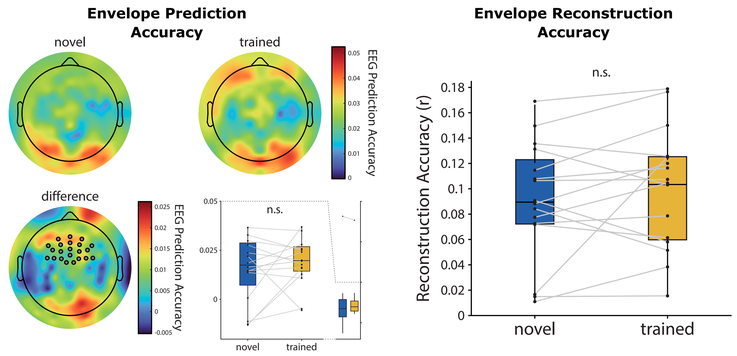
Results

A. Training improved participants' lipreading performances



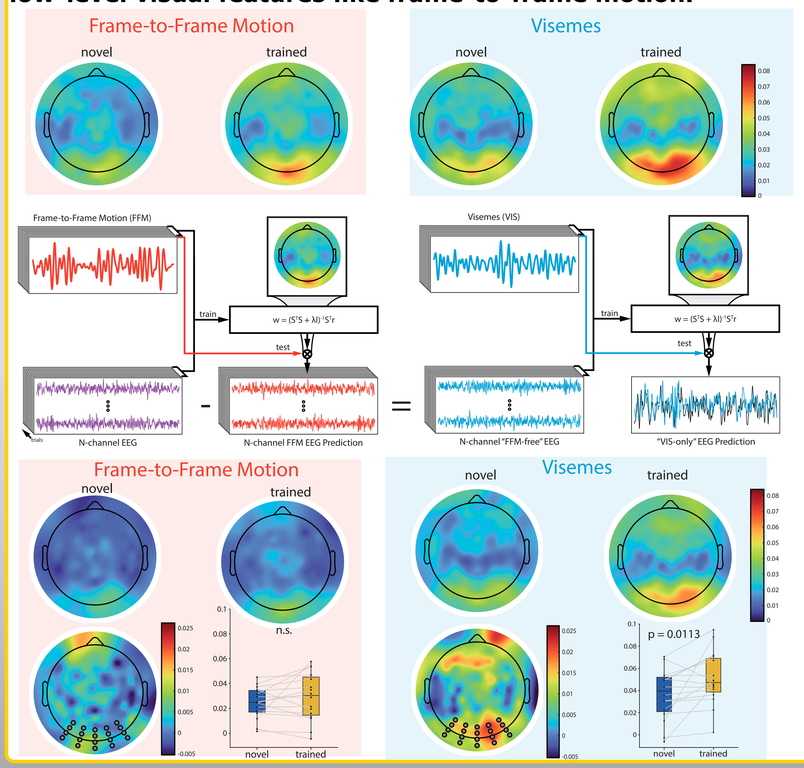
B. Successful lipreading did not result in any improvement of the neural representation of the unheard speech

1. Frontal-central EEG signal couldn't be more accurately predicted by the unheard in training than novel.
2. The unheard speech envelope couldn't be better reconstructed in training.



Results

C. Successful lipreading saw an improvement of the cortical encoding of the catogorical visual speech features, but not low-level visual features like frame-to-frame motion.



Summary

1. We find no supporting evidence for enhanced encoding of the unheard acoustic envelope in the auditory cortex.

2. We find evidence for improved tracking of categorical visual speech features in the occipital area, suggesting speech-specifc processing in the visual cortex.

3. Future work: Isolate visual speech specific processing (i.e., visemes) and examine if it correlates with target word detection task performance.

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Supported by National Institute of Health R01 DC016297