Neural Substrates of learning to categorize speech-like sounds
Rutvik Desai, Einat Liebenthal, Brinda Ramachandran, Michael Ellingson, Jeffrey R Binder
Neurology Department, Medical College of Wisconsin, Milwaukee, WI, USA

INTRODUCTION
In a previous fMRI study, we found that an area extending along the left superior temporal sulcus (LSTS) was more responsive to familiar CV syllables than to comparably complex non-phonemic auditory patterns that could not be classified into discrete learned categories (1). Here, we test the hypothesis that the increase in activation along the left LSTS during speech perception is related to the categorical nature of this process, and not to the linguistic status of phonemes. We train subjects to categorize non-speech sounds to achieve a step-like identification curve. FMRI scans are performed before and after the training to observe differences due to training.

METHODS
SUBJECTS: N=19, normal hearing, no neurologic symptoms.
SIMUL:
- Phonemic (P)-Nonphonemic (NP) task to rule out continuity, made by the P2 transition.
- Nonphonemic (NP) training continuum created by spectral imitation of P3 in the syllables.

TASK:
- Subjects trained once (PRE scan), trained, and scanned again (POST scan).
- Before each scan, 2 alternatives forced-choice ABX discrimination of token pairs 3-6 (across category to phonemic continuum) and 1-3 and 67 (token/category in the phonemic continuum).
- In PRE and POST scans, Identification of phonemic and non-phonemic continua.
- Training: three separate days, identification task on P and NP continued 60 criterion (90% accuracy) reached on each day + one training session just before the POST scan.

FMR ANALYSIS:
- GE SIGNA 3T scanner (GE Medical Systems, Milwaukee).
- Axial gradient-echo T1-weighted data: 3D spoiled gradient-echo planar images (TE = 20 ms, flip angle = 80°, matrix = 140 x 140, TI = 7 s, acquisition time = 2 s, 36 axial slices, 3.44 x 3.44 x 3.50 mm3 voxels).
- Multiple linear mixed-effects models with nuisance functions representative of the stimulus conditions (postP, postNP, postP, postNP). General linear models to obtain contrasts map.
- Statistical images: smoothing 4 mm FWHM, threshold at p < 0.02 uncorrected, cluster threshold E211 μL, corrected p < 0.05

RESULTS

Abbreviations
SFG = superior frontal gyrus, MFG = middle frontal gyrus, IFG = inferior frontal gyrus, STG = superior temporal gyrus, MTG = middle temporal gyrus, ITG = inferior temporal gyrus, STS = superior temporal sulcus, ITS = inferior temporal sulcus, pOCC = posterior Occipital gyrus, pCG = postcentral gyrus, CS = central sulcus, IPS = intraparietal sulcus, SMA = supplementary motor area.

REFERENCES