Declarative and procedural memory substrates of the categorical perception of speech

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Introduction

• Categorical perception of speech is experimentally defined as a combination of two perceptual behaviors:
  - Identification: Non-linear identification of sounds across a linear continuum
  - Discrimination: Better across category than within-category discrimination

• Based on this definition, it is often assumed that performance on these tasks index a common underlying speech sound representation.
• However, growing behavioral evidence suggests that these two tasks may reflect qualitatively different types of speech knowledge (e.g. Schouten, Gerrits, & van Hessen, 2003; Antoniou, Best, & Tyler, 2013; Earle & Myers, 2015).
• We propose that the building of phonological categories involves capture of acoustic-phonetic information by the declarative and procedural memory systems in parallel (Earle & Myers, 2014).
• Under this view, observed dissociations in performance on speech-perceptual tasks (such as identification and discrimination) may reflect task-specific, preferential recruitment of declarative or procedural knowledge.

Hypotheses:
Following training on a ‘new’ (non-native) speech sound contrast:

H1: changes to speech identification performance will rely on learning and consolidation of declarative memory
H2: changes to speech discrimination performance will rely on learning and consolidation of procedural memory

In examining the relationships between speech-perceptual tasks and declarative and procedural memory, we explicitly tested the memory processes (i.e. post-training consolidation) that act upon the learned information. This was done in order to rule out differences in preexisting knowledge that could potentially contribute to differences in initial learning.

Methods

Participants
N = 33 (18-35, mean 22.04[2.64]), 6M adults with no hearing, or neurological impairments, and who do not have previous experience with a language that contains the dental-retroflex contrast in its consonant inventory, completed the experiment.

Declarative Learning
Recognition memory
Outcome variable: proportions correct during recognition converted to Z (raw) – (TAU ALMA)

Procedural Learning
Serial Reaction Time
Outcome variable: mean reaction time (RT) for Random – Sequence trials: block each test

Speech Learning
Nonnative contrast training
Outcome variable: proportions correct during discrimination and identification: Tests converted to Z (raw) – (TAU ALMA)

Results

• Examined by each day independently, neither declarative nor procedural memory appear to correlate with perceptual task performance.
• However, consolidation processes acting upon declarative memory appear to facilitate changes in speech-perceptual identification
• In contrast, consolidation processes acting upon procedural memory appear to promote changes in speech-perceptual discrimination
• Speech-perceptual task performance may rely on knowledge acquired by declarative and procedural memory, and moreover, different aspects of speech processing may depend differentially on these types of memory

Conclusions

References