Optimizing Lexical Learning through Manipulation of Phonological Training Environment

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Introduction

1: Reflective and reflexive learning systems for non-native phonological category learning in adulthood

- Phonological category structures are often based on multiple perceptual dimensions.¹
- In adults, non-native phonological categories can be acquired through a trial-by-trial feedback training phase.²
- There is immense individual variability in phonological category learning performance.³
- Manipulation of training environments (minimal > full feedback; mixed > blocked talkers) can lead to enhanced phonological learning performance.⁴
- The dual-learning systems (DLS) theory posits that these environments selectively target reflective (i.e., explicit; dominant during early learning) and reflexive (i.e., implicit; dominant during later learning) learning systems.⁵

2: How to optimize lexical learning

- Listeners proficient in identifying pitch patterns have been shown to be successful learners of vocabulary items that differ based on lexical tones.⁶
- Cooper and Wang (2013) found that individuals who received tone feedback during lexical training outperformed those who did not.

Aims

Can we optimize lexical learning through manipulation of the phonological training environment? We predicted individuals in an optimal group who trained initially in reflective environments would demonstrate higher phonological category learning performance.

Methods

Participants

- Native, monolingual American English speakers (N = 40; 23 f; ages 18-35) reported no previous exposure to tonal languages & ≤ 6 years of continuous, formal musical training.
- Pure tone audiological thresholds < 25 dB HL for 1, 2, and 4 kHz in both ears.
- Random assignment to 4 between-subjects groups (N=10 each): Optimal, Suboptimal, Reflective, & Reflexive.

Phonological training

- 4 lexical tones (T1-T4) were produced by 4 native Mandarin Chinese speakers (2 f) in the context of 5 syllables (h/ou/, /id/, /iu/, /im/), yielding 80 total stimuli.
- Participants completed 1 session of phonological training (6 blocks of 80 trials for 480 total trials). They were asked to categorize Mandarin tones given trial-by-trial feedback.
- Feedback type varied (Minimal: "Wrong" vs. Full: "Wrong, that was a 3").
- Talker presentation also varied (Blocked: grouped talker sequence vs. Mixed: randomized talker sequence).
- Groups either received the same feedback type and talker presentation for all 6 blocks of training (Reflective & Reflexive) or they switched training environment after 3 blocks (Optimal & Suboptimal).

Lexical training

- Lexical training was identical for all groups.
- Immediately after phonological training, participants completed 1 session of lexical training. They completed 2 sessions on days 2 and 3, totaling 5 sessions.
- Pitch patterns from 4 lexical tones produced by a female, Mandarin Chinese speaker were superimposed onto 6 English pseudowords (dree/, /futel/, /meri/, /pesh/, /truck/, /vece/) produced by 4 native American English speakers (2 f), yielding 96 total stimuli.
- Participants learned to associate sound-to-meaning one pseudoword at a time by viewing object images with associated auditory stimuli. They were tested on each pseudoword and given trial-by-trial feedback.
- At the end of each training session, they were tested on all 96 lexical items.

Results

1: Equivalent phonological categorization performance

- Participants in all groups learned to identify phonological categories above chance.
- For the training stimuli (blocks 1–6), the optimal group showed a lower learning rate than all other groups.
- For the generalization stimuli (Gen), no group differences were found.

2: Lexical items learned better with “optimally” trained phonological categories

- Participants in all groups learned to identify the lexical items across the multiple sessions.
- Across sessions, the optimal group outperformed all other groups in terms of learning rate, as well as final accuracy.

Discussion

- Groups differed in categorization accuracy, but not in the direction predicted by the DLS theory. In generalization, tone category knowledge was retained (above chance), but group differences were no longer seen.
- All groups learned lexical items, but with < 60% accuracy, emphasizing the difficulty of lexical acquisition and the importance of studying this in adult L2 learners.
- The optimal group did not perform the best in phonological training, yet they had the highest accuracy learning lexical items. This suggests something beyond accuracy (ex. differences in strategy or representations) may be occurring that affects learning lexical.

Conclusions

- Since the lexical training paradigm was identical for all participants, performance differences can be attributed to the preceding phonological training paradigm.
- Our results suggest that optimized manipulation of the phonological training environment can boost lexical learning.

References