DOES TRAINING TO PERCEIVE L2 ENGLISH VOWELS IN ONE PHONETIC CONTEXT TRANSFER TO OTHER PHONETIC CONTEXTS

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1 Introduction

Implicit in most second language (L2) pronunciation teaching materials is a belief that training learners to perceive and produce a target phoneme in one word will generalize to their perception and production of the same sound in other words. This view is at odds with Flege's Speech Learning Model [1], which argues that knowledge of a phonemic category in one phonetic context does not necessarily transfer to other contexts. While some have found evidence that categorical learning can generalize to new words [2, 3], others have demonstrated that there are limits on such transfer, in both perception and production [4-6]. Instead, L2 learners' pronunciation of particular phonemic categories appears to largely emerge word-by-word, rather than category-by-category [7].

Previous research in this area has typically explored a small number of training contexts and, likewise, tested the generalizability of learning to a small number of new contexts. The present study is more extensive in scope, and aims to uncover whether transferability of learning to new contexts is indeed the exception, or relatively commonplace.

2 Method

The data reported here come from a larger study examining the impact of High Variability Phonetic Training (HVPT) on L2 speech. HVPT trains learners to perceive target sounds produced by multiple talkers in multiple phonetic contexts, under the assumption that variability promotes category development (see [4-5] for a detailed overview).

2.1 Participants

Fifteen volunteer participants (five male; ten female) were learning English as a Foreign Language in Bogotá, Colombia (*M* age = 31; range 20-60). All were taking drip-feed English language classes (limited to 1-3 hours per week) and spoke English at a beginner (n=8) or intermediate (n=7) proficiency level. None had previously lived in an English speaking environment. All reported normal hearing.

2.2 Training procedure

Participants were trained to identify ten English vowels (/i/, /ɪ/, /e/, /ɛ/, /æ/, /ɒ/, /ʌ/, /o/, /ʊ/ and /u/ embedded in CV (consonant + vowel) and CVC (consonant + vowel + consonant) syllables, using a customizable researcher mode of the free web-based pronunciation training application, English Accent Coach [8]. This HVPT application employs 30 distinct voices (15 male;15 female) to present each vowel in CV or CVC combinations. Learners must click on the International Phonetic Alphabet (IPA) symbol for the vowel they perceive and are given immediate auditory and visual feedback; when they make an incorrect choice, they hear a buzz and see the correct symbol highlighted in red. They must click on the correct symbol in order to continue (see [8] for details).

Participants completed 40 sessions over a two-month period, but never more than two sessions in a given day (see Table 1 for a detailed breakdown of sessions). The first four sessions introduced learners to IPA symbols, and comprised 50-100 items each. The remaining 36 sessions trained learners to perceive the ten target vowels in CV and CVC syllables, and comprised 200 items each (see [4-6] for a rationale for using open syllables).

Table 1: Training contexts for each of 40 sessions.

Session numbers	Phonetic context in which ten English vowels were embedded
1-4 (phonetic symbol familiarization)	/h + V/
5-9, 39-40	/h + V/
10, 17	/b,d,g + V/
11, 18	/p,t,k + V/
12, 19	/v, ð, z + V/
13, 20	/f, θ, s + V/
14,21	/n, m + V/
15, 22	/ ʃ, tʃ, dʒ + V/
16, 23	/l, ɹ, j, w + V/
24, 27, 30, 33	/b, d, g, p, t, k + VC/
25, 28, 31, 34	/v, ð, z, f, θ, s + VC/
26, 29, 32, 35	/l, ɹ, j, w, m, n + VC/
36, 37, 38	All CVCs

The primary training context was /hV/. Not only was this context trained and tested during the first five sessions, it was also tested again during the final two sessions to determine if the intervening 30 training sessions, which incorporated all English consonantal contexts (with the exception of /ʒV/), resulted in any further improvement in the /hV/ context. All other contexts, grouped by manner and/or voicing features (e.g., voiced stops, followed by voiceless stops, followed by voiced fricatives, etc.), were trained at least twice in order to measure improvement over time, both between and within phonetic contexts.

2.3 Predictions

The extensive quantity of perceptual training in this study, and the incorporation of all English consonantal contexts, allows us to answer the question of whether perceptual learning of L2 English vowels proceeds in a primarily context independent or primarily context dependent manner. If the former, we should expect that the

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perception of English vowels should develop in a relatively linear fashion, largely uninterrupted by changes in the phonetic contexts in which the vowel is taught. Conversely, if learning occurs in a context dependent manner, we should see the learners' vowel identification (ID) scores return to near baseline each time the consonantal contexts changes. Finally, it is possible that category learning progresses somewhere between context independency and dependency, resulting in some weak evidence of transfer of learning as contexts change.

3 Results

Figure 1 provides a clear indication that for vowels in /hV/ syllables, learning is context dependent. While a clear linear improvement in mean ID scores across initial /hV/ sessions 5 to 9 is evident, when a new context was introduced in session 10, the mean ID scores returned to baseline. Furthermore, from sessions 10 to 16, during which time the training contexts changed session-by-session, no impact on ID scores is seen across any contexts.

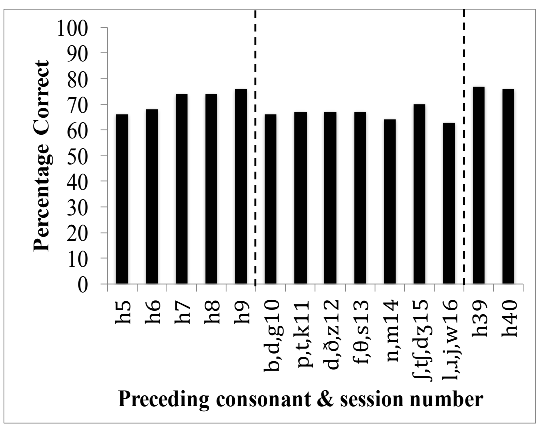

Figure 1: Average correct vowel identification scores for sessions 5-16 and 39-40. Dotted lines indicate change in phonetic context.

Bonferroni-adjusted paired samples t-tests revealed that while mean ID scores for vowels in the primary /hV/ context significantly improved from session 5 to 9, t(14)= 5.3298, $p<.001$, no further improvement occurred from session 9 to 39, t(14)=2.0603, $p=.06$, despite learners receiving 30 intervening training sessions focussing on the same vowels, albeit in different phonetic environments.

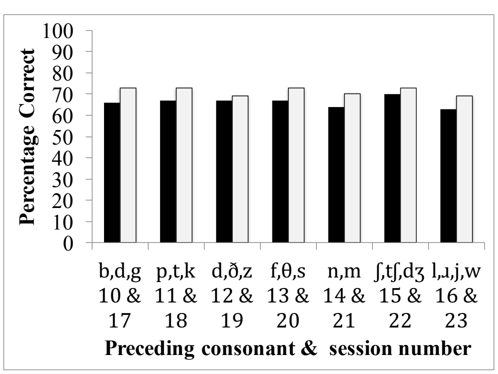

Figure 2: Average correct vowel identification scores for sessions where the same contexts were trained twice, one week apart.

Figure 2 further illustrates context dependency in L2 vowel category learning, comparing mean vowel ID scores within the same contexts over time. For example, ID scores for vowels in /b,d,g +V/ contexts at sessions 10 and 17 are shown to improve over time, and the same pattern is evident for each of the other six contexts illustrated, as well as for those contexts repeated during sessions 24-35 (see Table 1). Only those contexts repeated during sessions 36-38 showed no improvement. For these sessions, vowels were presented in all possible CVC contexts, not just subsets restricted to related phonetic contexts. As such, the overwhelming amount of variation may have made learning difficult.

4 Conclusion

The results of this study provide little support for the belief that L2 vowel category learning proceeds in a context independent manner. Rather, it provides evidence that L2 categories must be learned context-by-context, or perhaps word-by-word (see [7]), with little if any knowledge transfer from one phonetic context to the next. It should be noted that this study trained learners using phonetic contexts that were clustered together in terms of voice and manner properties. It may be the case that training in /bV/ contexts, for example, can transfer to /dV/ or /gV/ contexts, both of which also begin with voiced stops. Since these contexts were all trained simultaneously, this remains unresolved.

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