



## Research Article

## A longitudinal study of individual differences in the acquisition of new vowel contrasts

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## ABSTRACT

This study explores how individuals' second language cue weighting strategies change over time and across different contrasts. The study investigates the developmental changes in perceptual cue weighting of two English vowel contrasts (/i/-ɪ/ and /ɛ/-/æ/) by adult and child Korean learners of English during their first year of immersion in Canada. Longitudinal results revealed that adult learners had an initial advantage in L2 perceptual acquisition over children at least for the /i/-ɪ/ contrast, but after one year some children showed greater improvements especially on the more difficult /ɛ/-/æ/ contrast. Both groups of Korean learners showed different acquisition patterns between the two vowel contrasts: they used both spectral and duration cues to distinguish /i/-ɪ/ but generally only duration to distinguish /ɛ/-/æ/. By examining cue weights over time, this study partially confirmed the hypothesized developmental stages for the acquisition of L2 vowels first proposed by Escudero (2000) for Spanish learners of English. However, some unpredicted patterns were also identified. Most importantly, the longitudinal results suggest that individual differences in cue weighting are not merely random variability in the learner's response patterns, but are systematically associated with the developmental trajectories of individual learners and those trajectories vary according to vowel contrast.

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## 1. Introduction

For a given language and sound contrast, listeners pay more attention to some acoustic dimensions over others and the relative importance of these cues in determining category identity is referred to as *cue weighting* (e.g., Francis, Kaganovich, & Driscoll-Huber, 2008; Holt & Lotto, 2006). During development, the acquisition of appropriate acoustic cue weights is essential for creating target-like phonetic and phonological categories and subsequently comprehending speech (Mayo, Scobbie, Hewlett, & Waters, 2003; Mayo & Turk, 2005; Nittrouer & Lowenstein, 2010). In research on second language (L2) speech perception, it is well established that learners often have difficulty with L2 contrasts because they initially rely on different acoustic cues than native (L1) listeners do. For example, in differentiating English tense and lax vowel contrasts, native English listeners rely predominantly on

spectral cues with vowel duration being secondary whereas Spanish L2 learners rely predominantly on vowel duration despite not having contrastive vowel length in their native language (Casillas, 2015; Escudero, 2000; Kondaurouva & Francis, 2008, 2010; Morrison, 2008). Spanish learners of Dutch also rely more heavily on duration than spectral differences for the Dutch /a:-/a/ contrast while native Dutch listeners rely mostly on spectral differences (Escudero, Benders, & Lipski, 2009; Lipski, Escudero, & Benders, 2012). Similarly, Japanese learners' difficulty in perceiving the English /i/-ɪ/ contrast has been attributed to their attending mostly to differences in second formant frequencies while native listeners are most sensitive to differences in the third formant (Iverson et al., 2003). Thus consistent mismatches have been identified in the use of acoustic cues by L2 listeners and L1 listeners. Of particular interest to the present study is how and to what extent these mismatches are resolved through the course of learning an L2. We take an individual differences approach using longitudinal data to investigate how individual L2 learners differ in their developmental trajectories over time.

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### 1.1. Individual differences in L2 speech acquisition

The previously cited works report on group level observations, which may mask significant individual variability in L2 speech learning (cf. Amengual, 2016a for bilingual individuals' perception and production of vowel contrasts; Darcy, Park, & Yang, 2015 for the relation between individual cognitive abilities and L2 phonological processing; Lengeris, 2009 for individual differences in L2 vowel processing in relation to L1 vowel processing; Schertz, Cho, Lotto, & Warner, 2015, 2016 for individual differences in cue weighting strategies; Sebastián-Gallés & Baus, 2005 for individual L2 learners' performance across different perceptual tasks). It has commonly been observed that some learners demonstrate some degree of native-like pronunciation while others are judged as less intelligible due to their foreign accent (Ioup, 2008). In L2 speech perception, previous research has found various sources for individual differences, with learners showing differences in cognitive abilities (Darcy et al., 2015), in perceptual training outcomes for L2 contrasts (Golestani & Zatorre, 2009; Perrachione, Lee, Ha, & Wong, 2011), and in degrees of sensitivity to L1 phonetic contrasts (Díaz, Baus, Escera, Costa, & Sebastián-Gallés, 2008). Cross-sectional studies of L2 learners' cue weights have also revealed distinct patterns of individual variability (Escudero, 2000; Kong & Edwards, 2015; Schertz et al., 2015, 2016; Wanrooij, Escudero, & Rajmakers, 2013) with some groups of learners coming closer to native-like performance than others. Consequently, some researchers have proposed that these groups reflect different developmental stages in the acquisition of L2 contrasts (Escudero, 2000; Morrison, 2008) although developmental changes in the weighting of acoustic-phonetic cues do not always reflect degree of experience with the target language (Escudero, 2000). The particular emphasis on individual differences in the present study is on the kind of individual differences that exist among learners in their cue weighting strategies, and how individuals differ in their developmental trajectories. We investigate this by tracking L2 perceptual cue weights for two English front vowel contrasts in two groups of Korean learners of English (adults and children) with very similar levels of exposure over the course of the first year of immersion in an L2-speaking environment.

### 1.2. Developmental trajectories of L2 speech acquisition

The majority of previous research in L2 speech acquisition has employed cross-sectional comparisons of different variables such as age, length of residence (LOR), and L2 use to investigate the developmental process (Flege & MacKay, 2004). Cross-sectional studies alone, however, might not suffice to provide clear insight into some aspects of the development of language over time. Most importantly, cross-sectional studies cannot tell us if individuals who behave differently from one another are progressing through different stages or following different developmental paths. In contrast, examining developmental trajectories and individual differences along the way could be highly informative because it could shed light on whether large differences in starting states and end states of acquisition are related.

The present study complements and extends previous cross-sectional studies by adopting a longitudinal approach to examining developmental changes in perceptual cue weighting. It has been observed that the field of second language acquisition suffers from a lack of longitudinal research (Ortega & Iberri-Shea, 2005) even though L2 developmental processes can be best captured by longitudinal studies. Only a few previous studies have reported the longitudinal development of L2 speech learning, such as the perception and production of English /l/ and /ɫ/ by Japanese learners of English (Aoyama, Flege, Guion-Anderson, Akahane-Yamada, & Yamada, 2004), the production of English vowels by Japanese learners of English (Oh et al., 2011), and the perception and production of English vowels by native Koreans (Tsukada et al., 2005). The findings of Tsukada et al. (2005) showed that there were no significant effects of LOR on Korean speakers' performance on English vowel perception and production over a period of approximately one year. However, their study included Koreans who had already been in the US for more than two years at the onset of the study. It is likely that most of the participants in their study were no longer in the earliest stages of L2 acquisition when learning is presumably most rapid, and thus it may have been difficult to observe developmental changes and significant effects of LOR within a year. The present study was designed to address this by tracking recent arrivals during their first year of residence in an L2 environment. Thus, we study learners from the early stages of exposure to native speaker input in an English-speaking environment and track their developmental trajectories for a considerable period of time.

A handful of studies have hypothesized stage-like development in the perceptual weighting patterns of L2 learners (Escudero, 2000; Morrison, 2008). Escudero (2000) proposed four hypothetical stages in the development of a new /i/-ɪ/ contrast by native Spanish learners of English. The proposed sequence is that, initially, naïve Spanish learners are not able to identify tokens of /i/ versus /ɪ/, thereby showing a no-contrast pattern. At the next stage, the contrast is distinguished exclusively by duration information present in the input. Then, learners use both duration and spectral information but still give priority to duration cues. At the final stage, learners show English-like use of both spectral and duration cues with primary weighting appropriately placed on spectral cues. Although a developmental sequence was hypothesized in Escudero's (2000) work, this stage-like development was inferred from cross-sectional patterns. The present study investigates whether L2 learners progress through specific developmental stages, as hypothesized by Escudero (2000), using longitudinal data. In the present study, we extend the hypothesized developmental stages—developed by Escudero (2000) for native Spanish listeners—to learners with a different native language background (i.e., Korean learners of English). We expect that Korean learners of English will show similar developmental patterns since both Korean and Spanish learners of English encounter similar difficulties in acquiring the tense and lax vowel contrasts in English (Flege, Bohn, & Jang, 1997) and both must acquire these new vowel contrasts from a smaller vowel inventory in their L1.

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