The Universal Perceptual Model (UPM) of second language

Georgios P. Georgiou
Department of Languages and Literature, University of Nicosia, Cyprus
https://doi.org/10.36505/ExLing-2021/12/0026/000499

Abstract

Several speech models have been developed to examine second language (L2) speech patterns, considering that the acquisition of L2 sounds is often challenging for most learners. The Universal Perceptual Model (UPM) is a newly introduced model which provides predictions about the discrimination of L2 phone contrasts. In this paper, the central tenets and current evidence about the model's predictions are briefly discussed, while some revisions are also proposed. UPM predicted with success the discrimination accuracy of nonnative phone contrasts, indicating that it can be a useful L2 speech model. Future research should investigate further the predictability of the model.

Keywords: Universal Perceptual Model, second language, speech perception, assumptions

Introduction

Several speech acquisition models have been formed to predict the difficulties of learners in perceiving and producing the L2 phones. A newly established speech model, the *Universal Perceptual Model* (UPM) was firstly introduced in Georgiou (2021b). This model has been developed to inform and update the current theory of L2 acquisition and to provide more precise predictions about the ability of learners to discriminate challenging L2 segmental contrasts.

UPM is based on the *Functional Reorganization Hypothesis* (FRH) (Werker, 1995) which argues that although the discrimination of nonnative contrasts declines in adults, there is not a complete 'loss' of sensitivity as a result of L1 experience; instead, a functional reorganization occurs (Werker & Pegg, 1992). Thus, UPM supports that all possible human speech sounds have a mental correlate in the human brain from birth. In contrast, nonnative sounds are initially *inactive* and *disoriented* phonetic units which are activated upon L2 learning onset, and are oriented toward native productions as L2 experience increases. So, at the initial stage, the L2 productions do not match those of native speakers since the robust L1 phonological system works as a filter for L2 sounds (Trubestkoy, 1939)

UPM supports that the phonological space is filled with phonetic categories and there are not any mechanisms that lead to the formation of further phonetic categories as mental representations for each speech sound attested in every human language are available from birth prior to language experience.

The attainment of a native-like pronunciation is not impossible, according to UPM, as speech sounds are 'universal units' and can be activated and oriented toward L1 productions at any time of human life if some preconditions are met. Universal units are perceptual in nature, constraining the perception of phonetic categories extracted from the speech signal.

UPM predictions

UPM introduced three types of perceptual similarity of a single L2 phone to one or more L1 phones. These types include degrees of overlap. Degrees of overlap were firstly used by Faris et al. (2016) for uncategorized L2 phones (i.e., those that failed to reach a predefined categorization threshold). UPM denies the use of any categorization thresholds to form its predictions since different thresholds might affect the categorization type. According to their degree of overlap (see Figure 1), L2 phones might be:

(1) *non-overlapping*: identified in a different set of above-chance L1 categories,
(2) *partially overlapping*: to have at least one shared above-chance category
(3) *completely overlapping*: both nonnative phones are identified within the same above chance L1 category or set of L1 categories.

Above-chance categories are those selected more often than chance. Percentages are used to find the chance score; for example, if the script responses include 5 L1 categories, the chance score is 20%. *One-sample t-tests* are then employed to test whether the classification percentages of the L2 sounds in each L1 category are significantly different or not from the chance score; if $p < .05$, classification is more often than chance. Non-overlapping contrasts would be the easiest to distinguish followed by partially overlapping and completely overlapping contrasts. However, completely overlapping contrasts might be distinguished in the same manner as partially overlapping contrasts if the goodness-of-fit ratings (GOF) of the two classified phones differ from each other ($p < .05$).

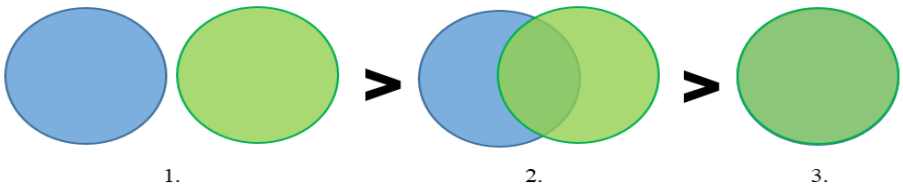

Figure 1: Overlapping degrees of UPM.

Revised predictions

The predictions of UPM need some clarifications and extensions. For instance, the discrimination of two L2 phones without above-chance responses might be poor to excellent depending on the phonetic similarity of the two L2 phones. This similarity can be estimated by comparing the basic articulatory characteristics of the phones (e.g., place and manner of articulation and voicing for consonants, and height, backness, and lip rounding for vowels). In contrast, the discrimination of one L2 phone that includes at least one above-chance response and another L2 phone without below chance responses might be very good-to-excellent since learners perceive some similarity to one phone and one or more L1 phones and no similarity to the other L1 phone (Faris et al., 2018).
Also, above-chance categories should be considered only i. those of which the classification percentage differs significantly from the chance score and ii. those of which the classification percentage is equal or more than the chance score. So, for example, as it can be seen in Table 1, although the 4% classification of the Italian [ɛ] in the Cypriot Greek [i] differed significantly from the 20% chance score ($p < .05$), this response is not above-chance since it is below the chance score. In partially overlapping contrasts, the discrimination might depend on how close the one L2 phone is to the common L1 response of the other L2 phone. For example, if one L2 phone is above chance with a 100% classification score in an x L1 phone, and one other L2 phone is above chance with 70% in an x L1 phone and 30% in a y L1 phone, these phones will be discriminated less accurately than if one L2 phone is above chance with 100% classification score in an x L1 phone, and one other L2 phone is above chance with 60% in an x L1 phone and 40% in a y L1 phone.

Current evidence

Fifteen Cypriot Greek learners of Italian participated in two psychoacoustic tasks in which they were asked to classify L2 Italian vowels (in [bV] context) in their L1 phonological system, and to discriminate pairs of Italian vowels ([i—e], [e—ɛ], [ɔ—o], [o—u]). Another 10 Italian speakers participated as the control group (see Georgiou, 2021b).
The results of the classification task are shown in Table 1. The discrimination task showed that [i – e] and [e – ɛ] (partially overlapping contrasts) had 67% and 76% correct responses respectively, [ɔ – o] (non-overlapping) had 81% correct responses, and [o – u] (completely overlapping) had 52% correct responses. The analysis has been conducted in R with the use of mixed-effect models. It was found that [o – u] significantly differed from all vowel contrasts ([ɔ – o]: $\beta = -29.07$, $SE = 4.02$, $t = -7.234$, $p = < .0001$; [i – e]: $\beta = 15.60$, $SE = 4.02$, $t = 3.883$, $p = .0054$; [e – ɛ]: $\beta = 24.00$, $SE = 4.02$, $t = 5.973$, $p = < .0001$). The [i – e] contrast significantly differed from [ɔ – o] ($\beta = -13.47$, $SE = 4.02$, $t = -3.352$, $p = .0270$).

Table 1: Classification of the Italian vowels in the Cypriot Greek phonetic categories (%). The parentheses show the GOF (Georgiou, 2021b).

	Cypriot Greek vowels				
Italian vowels	[i]	[e]	[a]	[o]	[u]
[i]	**100** (4.27)				
[e]	**47** (3.14)	**53** (4.18)			
[ɛ]	4 (3.05)	**96** (4.52)			
[a]			**100** (4.68)		
[o]				19 (3.19)	**81** (4.1)
[ɔ]				**97** (4.32)	3 (3.9)
[u]				9 (4.23)	**91** (4.21)

Bold represents above-chance responses > 20%, $p < .05$.

Conclusions

UPM successfully predicted the discriminability of the vowel contrasts, yielding that the non-overlapping contrast had the best discrimination followed by the partially overlapping and the completely overlapping contrasts. Future empirical research should aim at testing the predictions of the model in (a) a context where the L2 is widely spoken, (b) speakers with an L1 other than Greek and/or with a different L2, (c) consonantal contrasts, (d) diphthongs, (e) varying contexts (e.g., target phone in initial, final position), and (f) learners with advanced proficiency in the L2.

References

Faris, M. M., Best, C. T., Tyler, M. D. 2016. An examination of the different ways that non-native phones may be perceptually assimilated as uncategorized. Journal of the Acoustical Society of America 139, 1, EL1-EL5.

Faris, M. M., Best, C. T., Tyler, M. D. 2018. Discrimination of uncategorised non-native vowel contrasts is modulated by perceived overlap with native phonological categories. Journal of Phonetics 70, 1-19.

Georgiou, G. P. 2021b. Toward a new model for speech perception: The Universal Perceptual Model (UPM) of Second Language. Cognitive Processing 22(2), 277-289.

Trubetzkoy, N. 1939. Grundzüge der Phonologie. Göttingen: van der Hoeck & Ruprecht. Translated 1969 by Christine Baltaxe as Principles of Phonology. Berkeley and Los Angeles, University of California Press.

Werker, J. F. 1995. Exploring developmental changes in cross-language speech perception. In Gleitman, L.R., Liberman, M. (eds.), An invitation to cognitive science. Language: An invitation to cognitive science, 87–106. The MIT Press.

Werker, J. F., Pegg, J. E. 1992. Infant speech perception and phonological acquisition. In Ferguson, L. M. C., Stoel-Gammon, C. (eds.), Phonological Development: Models, Research, and Implications. York, Parkton, MD.