

The Perceptual Assimilation Model (PAM/PAM-L2) revisited: How experience resolves both phonological contrasts and phonetic details in non-native speech perception

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According to the Perceptual Assimilation Model [1], native as well as non-native speech perception are shaped by experience with the articulatory-phonetic properties of native language (L1) phonemes. Research findings on adults' discrimination accuracy for non-native phonological contrasts has generally conformed to PAM's predictions, which are based on the perceivers' perceptual assimilation of the contrasting phonemes to their L1 phonological categories. PAM's extension to adult L2 learning (PAM-L2) [2] predicts the likelihood of establishing a new L2 category based on learners' L1 perceptual assimilation of that L2 phoneme at the initial stage of L2 acquisition, relative to their assimilation of contrasting L2 phonemes. We use this opportunity to refine PAM/PAM-L2 in light of subsequent research that has prompted further theoretical considerations.

We discuss the following three insights we have gained from those theoretical considerations, and their consequences for refining PAM/PAM-L2:

1) ***The range of choices perceivers make in perceptual assimilations is informative.*** PAM originally proposed that non-native phonemes are perceptually assimilated to L1 phonological categories as Categorized or Uncategorized (or rarely are Non-Assimilated, i.e., heard as non-speech rather than as phonological elements). However, actual assimilations of a non-native phoneme are generally not restricted to a single L1 phoneme for Categorized cases, nor are they typically randomly distributed across L1 phonemes for Uncategorized cases. Assimilations of a given non-native phoneme can also be split between two or three L1 phonemes [3]. Thus, in many cases non-native phonemes are perceived as consistent with more than one L1 category. Faris et al. [3] focused on Uncategorized cases, but in our revised PAM/PAM-L2 we now take into account the full range of L1 assimilation responses to a non-native phoneme, regardless of whether it is deemed Categorized or Uncategorized.

2) ***Discrimination is modulated by perceived phonological overlap.*** Insight 1) carries key implications for PAM discrimination predictions. Consider a pair of contrasting non-native phonemes, each of which has elicited its own set of L1 response categories. Comparing the two response sets could reveal that there are no L1 categories in common (*non-overlapping*), or instead that all categories are in common (*completely overlapping*), or even that only some categories are in common (*partially overlapping*). PAM's discrimination predictions should be modulated by the amount of perceived phonological overlap between a given pair of contrasting non-native phonemes, such that accuracy levels will be higher for non-overlapping (N) than for partially overlapping (P) and lowest for completely overlapping (O), i.e., $N > P > O$. This pattern should hold within each type of pairwise assimilation pattern (*Contrast Classification*) described in the original PAM. The predicted pattern for degrees of perceived phonological overlap has been observed in a number of cross-language speech perception studies [4–6].

3) ***Experience with L1 phonetic variation shapes speech perception.*** The observed variation in categorization responses to a given non-native phoneme has led us to take into account sociophonetic evidence that recognition of L1 lexical items across token variation (phonological constancy [7]) is affected by sensitivity to phonetic variations that reflect talker characteristics (indexical information) [8]. L1 experience tunes not only the perception of L1 phonemes and contrasts, but also, importantly, the ability to distinguish phonologically relevant from indexically relevant phonetic variation. Non-native perceivers will initially rely on their L1 experience to attribute phonological versus indexical causes to non-native token variation.

This may result in misperception of some phonetic variations as only indexically relevant, i.e., phonologically constant instead of phonologically distinctive, possibly yielding a Single-Category Contrast Classification. Conversely, some indexical variations may be misperceived as phonologically relevant. That is, varying tokens of a non-native phoneme may be assimilated to different sets of L1 phonemes, thus contributing to the perceptual patterns that led to Insights 1) and 2). Thus, whereas PAM/PAM-L2 focused on phonological distinctiveness, we now recognize that phonological constancy across indexical variation is equally important. Both need to be retuned for efficient L2 speech perception and word learning. Indeed, L2 lexical training with indexical variation across talkers and accents enhances word learning and generalization [9].

We conclude by discussing how these insights might help refine PAM-L2 predictions for L2 phoneme acquisition and lexical acquisition, and outline some potential directions for future research and theoretical development.

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