



Research Article

Perceptual subcategories within non-native English

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ABSTRACT

Listeners' ability to distinguish native from non-native speech has been robustly attested, but less is known about the nature of perceptual subcategories within non-native speech. This study examined American English-speaking listeners' abilities to perform auditory free classification by talker native language (L1) background on the basis of CV- and word-length excerpts of English productions by L1 American English, L1 Hindi, L1 Korean, L1 Mandarin, and L1 Spanish talkers. Results are examined in terms of classification accuracy and perceptual similarity, and the phonetic properties predicting listeners' classification responses are explored. Overall, L1 American English talkers were grouped together, as were L1 Hindi talkers. Talkers from L1 Korean and L1 Mandarin were perceptually similar to one another, although they did not comprise a single shared group. Deviation from native norms in VOT and in spectral and temporal properties of vowels predicted listeners' classification responses. These results suggest that listeners can use specific phonetic properties of the speech signal to group talkers on the basis of very little input, and that L1 Hindi talkers form a clear and consistent subcategory of non-native talkers for American English-speaking listeners.

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1. Introduction

When people speak, they communicate not only a linguistic message, but also information about themselves. Indexical information in the speech signal reveals personal characteristics including sex, age, and dialect membership (Abercrombie, 1967). Another attribute that may be exposed by indexical information is a talker's native speaker status. Sensitivity to the binary distinction between native and non-native speech has been evaluated by asking listeners whether a particular talker is a native or non-native speaker of the target language (Bond, Stockmal, & Markus, 2008; Flege, 1984; Park, 2013) or which of a pair of productions was said by a native speaker of the target language (Tsukada, 1998). Listeners are quite skilled at such judgments, and even short samples of speech, such as monosyllabic words (Park, 2013; Tsukada, 1998), segments (Flege, 1984), and 30-ms excerpts from stop consonants (Flege, 1984) convey indexical information relevant to this two-way division between native and non-native speech.

Whereas listeners' abilities to differentiate between the broad categories of native and non-native speakers are well-established in the literature, the perception of L1-based subcategories within the non-native speech category is less understood. That is, although listeners readily identify talkers as non-native speakers of a particular target language (Bond et al., 2008; Flege, 1984; Park, 2013; Tsukada, 1998), it is less clear whether they can distinguish, for example, Spanish-accented from Mandarin-accented varieties of the same language. Previous studies suggest that while listeners are to some extent aware of talker L1-based subcategories within non-native speech, certain L1 backgrounds may be difficult for them to tell apart. For instance, Derwing and Munro (1997) played English phrases for L1 Canadian English listeners and asked them to identify each accent as Cantonese, Japanese, Polish, or Spanish. On average, the listeners were 51.5% correct, but their responses revealed confusion between L1 Cantonese and L1 Japanese talkers, as well as between L1 Polish and L1 Spanish talkers. Similarly, Vieru, Boula de Mareuil, and Adda-Decker's (2011) L1 French listeners were 52% accurate in a forced-choice task in which they identified accents in 10-s excerpts of French speech as Arabic, English, German, Italian, Portuguese, or Spanish. Listeners' responses again exposed common confusions, in this case between L1 Italian and L1 Spanish talkers and between L1 English and L1 German talkers. In general, listeners can make somewhat accurate

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judgments about non-native talkers' L1 backgrounds, although they exhibit perceptual confusions among historically related and/or geographically close L1s.

Talker-based subcategories within non-native speech, to the extent that they are perceived, may considerably impact the process of communication. For instance, [Sumner, Kim, King, and McGowan \(2014\)](#) and [Kleinschmidt and Jaeger \(2015\)](#) proposed models of speech perception that involve simultaneous processing of linguistic information and social information about the talker. An open question about these and similar models pertains to the level of detail in the social information perceived, encoded, and used by the listener. Thus, in [Kleinschmidt and Jaeger's \(2015\)](#) model, the listener draws upon experience with “similar” talkers to interpret speech from an unfamiliar talker. However, whether all non-native talkers are “similar” to one another by virtue of being perceived as non-native, or whether listeners employ subcategories of non-native talkers (e.g., Spanish-accented, Mandarin-accented, etc.) to draw upon smaller, more relevant sets of prior experiences remains an open question.

Studies of adaptation to non-native speech provide indirect evidence about the role of non-native talker similarity in speech perception. [Bradlow and Bent \(2008\)](#) showed that exposure to English productions by multiple L1 Mandarin talkers helped listeners better understand a new L1 Mandarin talker, but not a new L1 Slovak talker. Further, [Baese-Berk, Bradlow, and Wright \(2013\)](#) showed that exposure to English productions by talkers from a variety of L1s (Hindi, Korean, Mandarin, Romanian, and Thai) helped listeners better understand both a new L1 Mandarin talker and a new L1 Slovak talker. The results obtained by [Baese-Berk et al. \(2013\)](#) suggest that the “non-native speech” category is important to listeners, in that experience with a variety of non-native talkers benefits the comprehension of other non-native talkers, regardless of whether a talker's specific L1 background has been encountered previously. However, the results described by [Bradlow and Bent \(2008\)](#) suggest that listeners may also rely on L1-based subcategories within this non-native category, because exposure to a single subcategory does not benefit the comprehension of talkers from other subcategories. Overall, listeners may evaluate similarity among talkers at either the more general non-native category level or at the more specific L1-based subcategory level, depending on the task presented and the talkers encountered.

Crucially for this interpretation of [Bradlow and Bent's \(2008\)](#) findings, for L1 Mandarin and L1 Slovak talkers to fall into different L1-based perceptual subcategories, listeners must be skilled at discriminating talkers' L1s. However, from the work by [Derwing and Munro \(1997\)](#) and [Vieru et al. \(2011\)](#), it is known that listeners misidentify talkers' L1s roughly half the time when choosing from a relatively short list of possible responses. Thus, perceptual subcategories within non-native speech require further investigation before their impact on speech processing can be fully understood. The overarching goal of the present work was to explore the nature of listeners' subcategories within non-native speech, including the perceptual similarity structure among talkers' L1 backgrounds and the phonetic properties that define the L1-based subcategories.

1.1. Objectives of the current study

The first objective of the current study was to explore the perceptual similarity structure of different L1 backgrounds within non-native speech. While forced-choice tasks like those conducted by [Derwing and Munro \(1997\)](#) and [Vieru et al. \(2011\)](#) represent one approach to addressing this objective, the labels offered by the experimenters in these tasks impose an inherent limitation on listeners' responses, which may not optimally reflect their perceptual subcategories. Listeners can only choose the correct label if they are at least somewhat familiar with the named L1 background, which may underestimate their perceptual skills; they may be capable of recognizing that two talkers belong to the same L1-based subcategory without being able to explicitly identify that background, or even without having heard such speech previously. Thus, with a forced-choice design, when performance for a particular L1 background is low, it is not clear whether the talkers did not meet listeners' expectations for the correct label, or whether the listeners were unfamiliar with speakers characterized by the correct label and thus unable to reliably assign the label to talkers. In addition, the presence of labels may induce listeners to attend primarily to more stereotyped properties of some accents, and ignore sources of phonetic variation which are less familiar or less salient.

To obtain perceptual responses about the subcategories of non-native speech without introducing these biases, a free classification task can be used. In free classification tasks, listeners create their own perceptual categories, which may be more or less fine-grained than the divisions known to the experimenter ([Clopper, 2008](#)). Auditory free classification tasks have been used to investigate listeners' perceptions of regional dialect variation in the United States ([Clopper & Bradlow, 2008, 2009](#); [Clopper & Pisoni, 2007](#)) and perceptions of similarity across different languages ([Bradlow, Clopper, Smiljanic, & Walter, 2010](#)). Auditory free classification was also used by [Atagi and Bent \(2013\)](#) to study perceptual subcategories within non-native English. In their study, L1 American English listeners were instructed to group talkers by general similarity or by perceived L1 background on the basis of sentences. With the latter set of instructions, listeners were nearly perfect at grouping together L1 American English talkers, and were generally least accurate for L1 French talkers; performance on L1 German, L1 Japanese, L1 Korean, L1 Mandarin, and L1 Spanish talkers was intermediate. These results thus provided strong evidence for the general non-native category, and weaker evidence for specific L1-based subcategories. Degree of talker accentedness was found to correlate with one dimension of a multi-dimensional scaling (MDS) model of the perceptual responses, suggesting that listeners were comparing the speech samples they heard against their expectations for native speech.

In the present work, as the subcategories themselves were the objects of study, a free classification task rather than a forced-choice task was used to provide the listeners with full control over the representation of the perceptual space. With a free classification task, perceived similarity among individual talkers and among L1 backgrounds can be explored by evaluating listeners' grouping responses. Although this approach is similar to the approach used by [Atagi and Bent \(2013\)](#), the present study differed substantially from theirs in two ways. First, the present study included non-native English productions from L1 Hindi talkers, an L1

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