

## Lexical bias in second language sibilant perception: The role of language proficiency and phonotactic context

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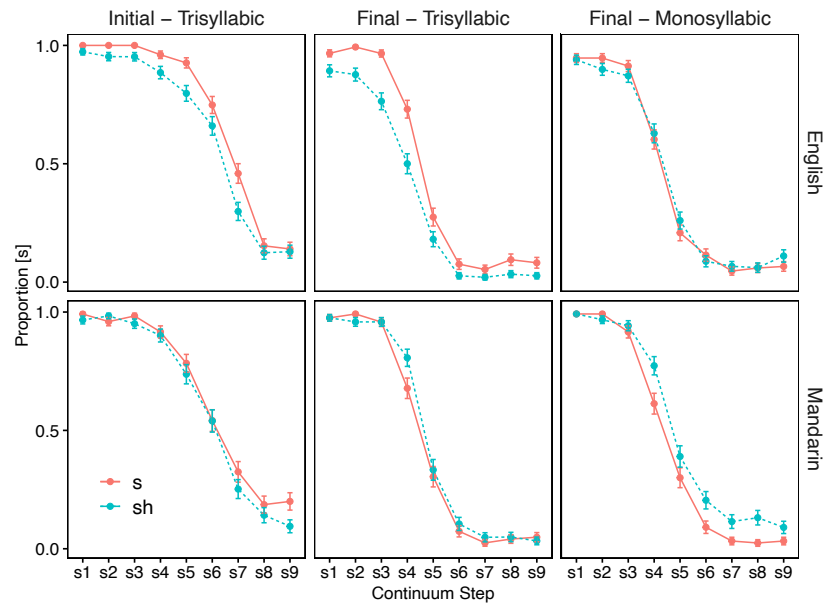
Successful perception typically arises from the integration of bottom-up sensory processes with top-down *a priori* knowledge.<sup>1-3</sup> Native listeners use lexical knowledge to guide identification of ambiguous phonemes.<sup>4,5</sup> Proficient L2 listeners also show lexical bias effects but only when coarticulatory phonetic cues match; less proficient L2 listeners do not.<sup>6</sup> Here, we examined how L1 phonology influences the use of an L2 lexicon during ambiguous phoneme identification. We investigated how the position of an ambiguous [s~ʃ] in a word modulates lexical bias in L2 English listeners. Specifically, we tested native English listeners versus native Mandarin listeners, since Mandarin does not contain the phoneme [ʃ], and [s] only occurs in syllable onsets.<sup>7</sup>

**Predictions:** If L2 listeners have difficulty leveraging the lexicon during ambiguous phoneme identification, we expect less lexical bias for Mandarin compared to English listeners. Moreover, if the L1 phonology plays a specific role in affecting these biases, we expect more “s” responses in words where the ambiguous phonemes are in syllable onsets. Furthermore, if increased proficiency facilitates use of the L2 lexicon, then only more proficient listeners will show lexical bias. In sum, top-down lexical context will not be enough to support differential identification of a non-contrastive pair in the L1 or a phoneme that does not occur in a particular position in the L1.

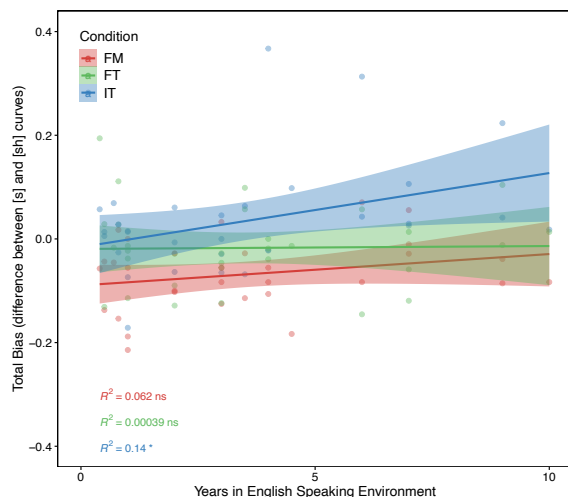
**Methods:** Sixty-nine listeners (n = 38 native English, n = 31 native Mandarin) took part in a two-alternative forced choice task: They responded whether they heard [s] or [ʃ]. Our Mandarin listeners lived in an English-speaking environment and reported greater daily English usage than previously tested L2 listeners with different L1s.<sup>6</sup> Twenty-four English words were selected to represent three experimental conditions: Initial Trisyllabic (e.g., [s]anity, IT), Final Trisyllabic (e.g., aboli[ʃ], FT), and Final Monosyllabic (e.g., wi[ʃ], FM) words. Sibilants were replaced with one of nine synthesized sibilants in a nine-step [s~ʃ] continuum. The sounds were mixed to different volume proportions (Step 1: 100% [s], 0% [ʃ]; Step 9: 0% [s], 100% [ʃ]) to create the continuum.<sup>8</sup>

**Results:** Figure 1 presents the results of the identification task. We ran a linear mixed effects model with a logit link function<sup>9</sup> on the proportion of “s” responses. Fixed effects included Group (Mandarin, English), Condition (IT, FT, FM), Word-type ([s]-words, [ʃ]-words) and Continuum, and their interactions. A maximal random effects structure was used<sup>10</sup> and pairwise comparisons on the model output were conducted. We observed a Group × Condition × Word-type interaction ( $\beta = -2.15$ , SE = 0.92,  $z = -2.35$ ,  $p < 0.05$ ). English listeners showed a lexical bias effect in the IT ( $\chi^2(1) = 10.9$ ,  $p < 0.01$ ) and FT conditions ( $\chi^2(1) = 7.3$ ,  $p < 0.05$ ). Mandarin listeners only showed an effect in the FM condition ( $\chi^2(1) = 9.3$ ,  $p < 0.05$ ), but the bias was in the opposite direction (i.e., more “s” responses for [ʃ]-words). They did, however, show a greater proportion of [s] responses in both Word-types in the IT condition ([s]: IT-FT: ( $\chi^2(1) = 46.9$ ,  $p < 0.001$ ), IT-FM: ( $\chi^2(1) = 52.3$ ,  $p < 0.001$ ; [ʃ]: IT-FT: ( $\chi^2(1) = 26.8$ ,  $p < 0.001$ , IT-FM: ( $\chi^2(1) = 16.8$ ,  $p < 0.001$ ). For the Mandarin listeners, we found a positive correlation between the amount of lexical bias (i.e., difference between [s] and [ʃ] curves) and the number of years spent in an English-speaking environment ( $R^2 = 0.14$ ,  $p < 0.05$ ) in the IT condition only (see Figure 2).

**Discussion:** Only L1 English listeners showed a lexical bias effect and only in trisyllabic items. L2 listeners were unable to utilize lexical knowledge during ambiguous phoneme identification, consistent with previous findings.<sup>6</sup> The sigmoidal shape of the identification curves for the Mandarin listeners suggest that they were identifying the non-native [ʃ] as distinct from the native [s]. It is possible that the non-native [ʃ] was perceived as the native [ɛ].<sup>11,12</sup> In addition, more “s” responses were observed in the IT condition, which is the only licensed environment for [s] in Mandarin. This was also the only condition in which greater time spent in an English-speaking environment enhanced the use of lexical knowledge. These results demonstrate how language proficiency and aspects of the L2 modulate the use of lexical information to drive identification.



**Figure 1.** Mean identification response functions across listeners to the nine-step [s]-[ʃ] continuum. Error bars represent the standard error of the mean.



**Figure 2.** Correlations between years spent in an English-speaking environment with lexical bias, i.e., difference between [s] and [ʃ] curves. Shaded regions represent the 95% Confidence Interval of the model fit.

## References

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