Lexical Bias in Cross-Dialect Word Recognition in Noise

Lexical bias is a well-known factor affecting phonological categorization in spoken word recognition tasks. Ganong (1980) observed that listeners shifted their phonetic category boundary for /t/ vs. /d/ depending on the lexical status of the endpoint stimulus materials (e.g., *task* vs. *dask* or *tash* vs. *dash*) to produce more real word responses. The "Ganong effect," therefore, reflects an advantage for real word responses over nonword responses in lexical identification tasks (Fox, 1984; Pitt, 1995). Dialect variation has also been found to affect the perception of phonetic category boundaries. For example, Rakerd and Plichta (2003) found that listeners shifted their phonetic category boundary for /ɑ/ vs. /æ/ depending on the dialect of the preceding carrier phrase. For carrier phrases with fronted /ɑ/s, the boundary was shifted towards /æ/ relative to the boundary for carrier phrases with backed /ɑ/s.

The current study examined the interaction between lexical bias and dialect variation in a spoken word recognition task in noise. The stimulus materials were real English CVC words produced by three female talkers from each of two regional varieties of American English (North and Midland). A set of predicted phonological confusions was established for vowels based on previous descriptions of regional dialect variation in American English (e.g., Labov, Ash, & Boberg, 2006). For example, in the Northern dialect, /ɛ/ is lowered and backed and may be confusable with /æ/. In the Midland dialect, /ow/ is fronted and may be confusable with /ʊ/. To manipulate lexical bias in the current experiment, two sets of stimulus words were constructed. In the first set, the target words were selected so that the predicted phonological confusions resulted in real English words (word competitor condition). For example, all of the selected words containing /ɛ/ had a real minimal pair in English containing /æ/ (e.g., *bet* and *bat*). In the second set, the target words were selected so that the predicted phonological confusions did not result in real English words (nonword competitor condition). For example, none of the selected words containing /ɛ/ had a real minimal pair in English containing /æ/ (e.g., *chess* and **chass*). Each stimulus set included five words for each of 11 vowels in American English (i, ɪ, ej, ɛ, æ, ɑ, ɔ, ʌ, ow, ʊ, u). For the vowels for which no confusions were predicted (i, ej, u), the same words were used in both the word and nonword competitor conditions. The listeners heard each word mixed with speech shaped noise at a signal-to-noise ratio of +2 dB and responded by typing the words that they heard. Nineteen undergraduate linguistics students served as participants in the word competitor condition and 20 undergraduates served as participants in the nonword competitor condition. The residential history of the listeners was mixed, but most were lifetime residents of either the Midland (N=20) or the Northern (N=9) dialect.

The responses were scored for both correct word and correct vowel. Average word and vowel accuracy scores for each talker dialect in each condition are shown in Table 1. At the word level, performance was more accurate for the Northern talkers than the Midland talkers across both lexical conditions. However, at the vowel level, the effect of talker dialect was not significant in either condition, suggesting that while the Northern talkers were more intelligible overall, this intelligibility benefit may have been limited to consonants.

Table 1. Percent correct words and vowels in each condition for each talker dialect.

	Words		**Vowels**	
Condition	**Midland**	**North**	**Midland**	**North**
Word Competitor	63	67	81	82
Nonword Competitor	71	74	87	88

In addition, both word and vowel recognition performance were more accurate in the nonword competitor condition than the word competitor condition for both talker dialects, consistent with the Ganong effect. When the predicted phonological confusions were real words, listeners could respond with either the target word or the confusable minimal pair. When the predicted phonological confusions were not real words, however, the listeners exhibited a lexical bias and responded with the target word. This interpretation is further supported by an analysis comparing the responses to the words for which no phonological confusions were predicted and which were shared across the two conditions (i, ej, u) to the responses to the words for which phonological confusions were predicted and that differed across the two conditions (ɪ, ɛ, æ, ɑ, ɔ, ʌ, ow, ʊ). At both the word and vowel level, when the no phonological confusions were predicted, performance did not differ between the word and nonword competitor conditions. However, when phonological confusions were predicted, performance was significantly better in the nonword competitor condition than the word competitor condition at both the word and vowel levels, suggesting a lexical bias in the nonword competitor condition.

An examination of the responses to specific vowels further confirmed the Ganong effect and also revealed the role of dialect variation in eliciting this effect in natural speech. In the word competitor condition, /ɪ/ was misidentified as /ɛ/ and /ɛ/ was misidentified as /æ/ significantly more often than chance for the Northern talkers. This pattern of errors is consistent with the Northern dialect of American English, which includes backing and lowering of both /ɪ/ and /ɛ/. In addition, in the word competitor condition, /ow/ was misidentified as /ʊ/ significantly more often than chance for both the Midland and Northern talkers. This error pattern is consistent with back vowel fronting observed for women in both dialect regions. None of these error patterns were significant in the nonword competitor condition. Thus, predicted phonological confusions were observed in the word competitor condition, when an alternative real English word was available to the listeners as a possible response, but not in the nonword competitor condition, when a real English word was not available as a possible response.

Taken together, these results confirm a lexical bias in spoken word recognition. In addition, whereas previous studies of lexical bias have typically relied on synthetic acoustic continua (e.g., Fox, 1984; Ganong, 1980), the findings in the current study suggest that lexical bias can also be observed for more naturally occurring variability. In particular, vowel variation in American English leads to continuous acoustic-phonetic variability across dialects that is similar to the acoustic continua produced in the laboratory and used for studying category boundaries, and it is exactly these continua of naturally-occurring variation that elicited the effects of lexical bias in the current study.

References

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