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The Impact of Phonetic Dissimilarity on the Perception of Foreign Accented Speech

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Abstract

Accented speech is more difficult to process for native listeners than is non-accented speech. Does perceptual dissimilarity affect only intelligibility, or are there other costs to processing? In two experiments, the intelligibility and time course of foreign accented speech (FAS) perception were investigated. Native English listeners heard single English words spoken by both native English speakers and non-native speakers (Mandarin or Russian). Listeners had to either compare the spoken utterance with a visual probe (Experiment 1), or repeat the word verbally (Experiment 2). An analysis indicates that both intelligibility and reaction time are, in part, functions of the similarity between the talker's utterance and the listener's representation of the word.

Introduction

In the air traffic control room, hospital emergency room, or university classroom, individuals with a wide range of language backgrounds must interact and communicate effectively with each other in a second language. The true impact of the accent onto human performance is largely unknown. Many studies have found that FAS is less intelligible than non-accented speech (NAS). But is this true of all words spoken by accented talkers, or just some?

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And, if a word *is* intelligible, does that imply that there is no processing cost associated with the accent?

The characteristics of an individual's accent are determined in part by the influence of the phonology of the individual's native language (L1) onto the phonology of the non-native language (L2; Flege 1995). Some L2 production will sound 'accented' because talkers produce L2 phonemes using the same articulation used in their L1 speech, and these words are potentially Confusable for L2 listeners. However, because two languages may have phonemes in common, some L2 production will be produced comparably to that of native talkers, and these words will by Non-Confusable to L2 listeners. The consequence of this is that intelligibility is a function not only of the linguistic background of the talker, but of the phonetic make-up of the word.
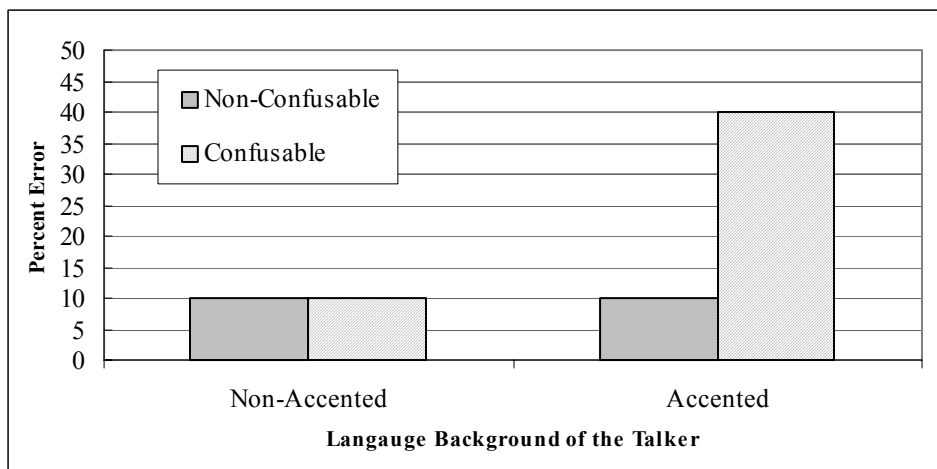
Figure 1: *Predicted intelligibility of Accented and Non-Accented talkers*

When the confusable word *is* intelligible, is there still a perceptual cost involved? If there is, perhaps measuring reaction time (RT) will reflect it: Confusable words will require more time for a correct response, compared to Non-Confusable. This has been termed *comprehensibility* (Munro and Derwing, 1995).
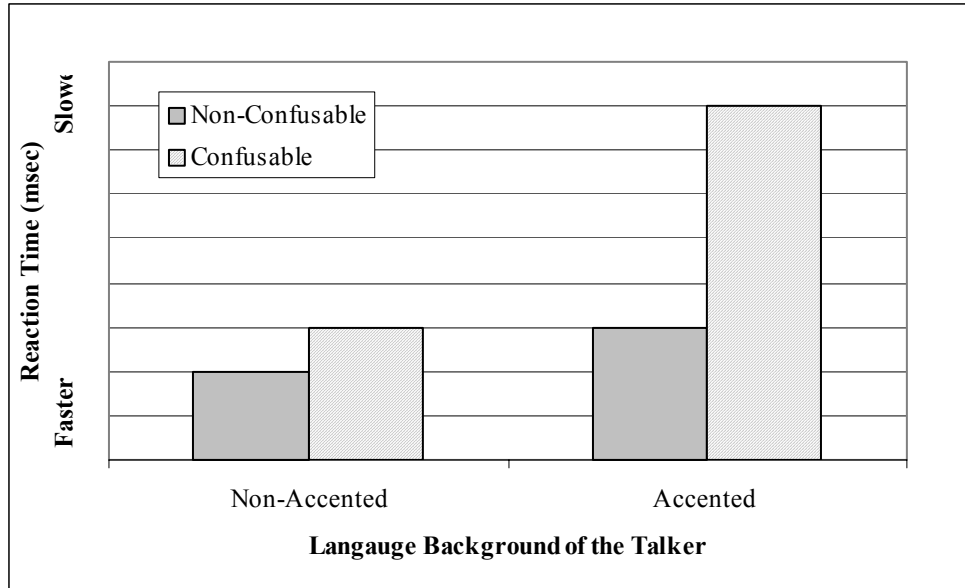
**Figure 2:** *Predicted comprehensibility of Accented and Non-Accented talkers*

Experiment 1: Cross-Modal Matching

Task	Same/Different response to visual prime and auditory target
Independent Variables	Language Background (Accented, Non-Accented)
	Prime/Target Relationship (see Table 1)
Dependent Variables	Percent Error and Reaction Time
Stimulus Materials	180 real English monosyllabic words (see Rogers, 1997)
Talkers	5 male English talkers from Central Ohio
	5 male accented talkers (L1: Russian or Mandarin)
Listeners	Eighty (80) Native English speaking Ohio State Undergraduates
	Normal Speech/Hearing - little experience with accented speech

Prime Type:	What they saw on the screen:		What they heard:	# Trials
Same (Control)	"tap"	/tæp/	/tæp/	90
Confusable	"tab"	/tæb/	/tæp/	30
Non-Confusable	"tack"	/tæk/	/tæp/	30
Dissimilar (Control)	"fell"	/fɛl/	/tæp/	30

Table 1: *Prime/Target Relationship in Cross-Modal Matching Task*

Method
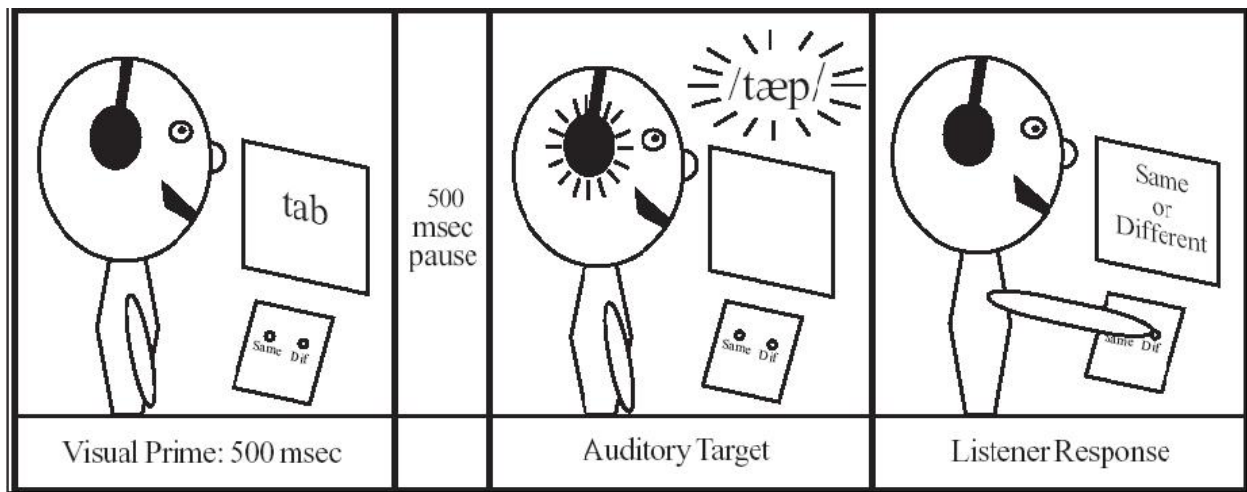
Figure 3: *Cross-Modal Matching Task sequence*

Results

♦ There were significant main effects in accuracy for both Accent and Prime/Target relationship variables. Errors in discrimination were more common when the uttered word was accented. In the Non-Confusable prime condition, the accent effect was small (~3%), while in the Confusable prime condition it was substantial (~16%). Figure 4 summarizes these results.

♦ There were significant main effects in RT for Accent and Prime/Target relationship (Figure 5). Responses to accented words were slower than to non-accented words, and the Confusable relationship elicited slower responses than the Non-Confusable. However, there was no interaction; the accent effect was the same in both Confusable and Non-Confusable conditions.
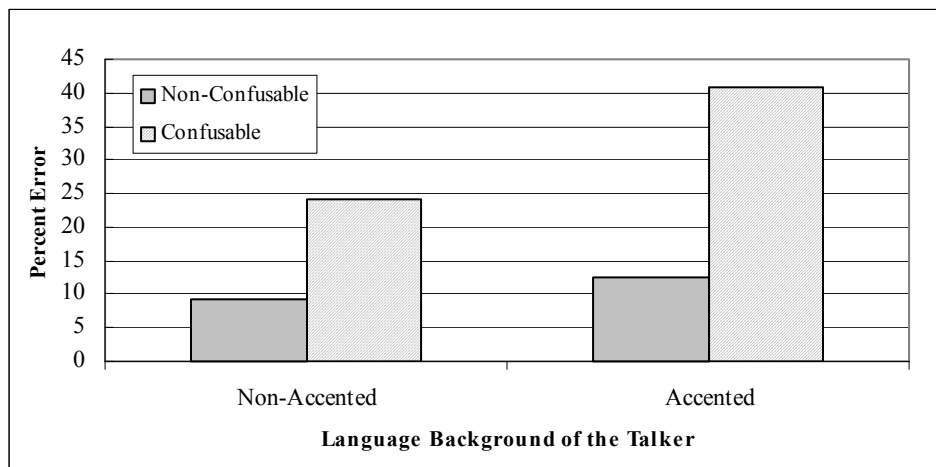
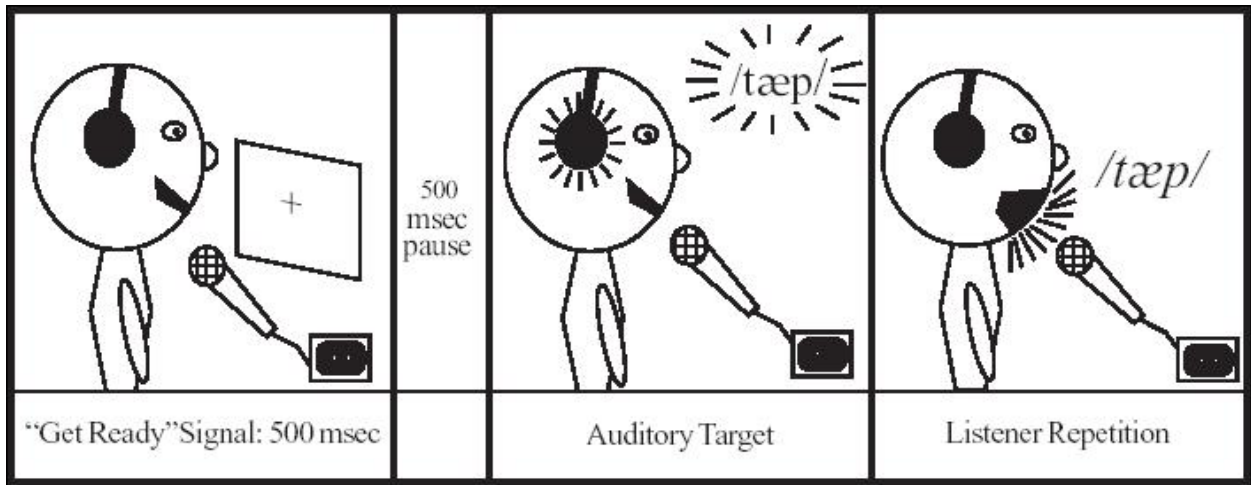
Figure 4: *Summary of error results from Experiment 1*
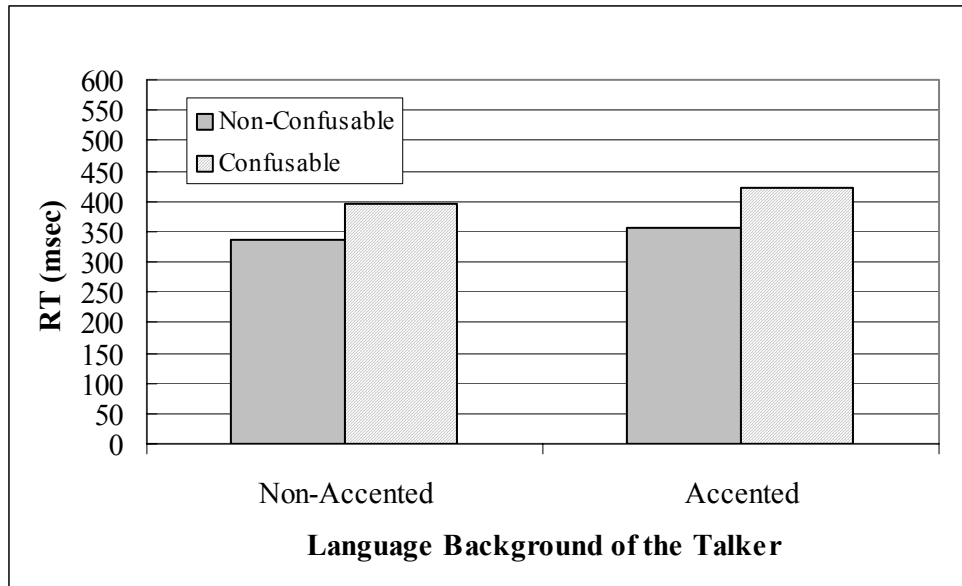
Figure 5: *Summary of RT results from Experiment 1 - Correct responses only*

Experiment 2: Word Repetition

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Task	Spoken repetition of Auditory targets
Independent Variables	Talker language Background (Accented, Non-Accented)
	Note: All words were Confusable
Dependent Variables	Percent Error and Reaction Time
Stimulus Materials	Same as Experiment 1
Talkers	Same as Experiment 1
Listeners	Forty Native English speaking Ohio State Undergraduates
	Normal Speech/Hearing - little experience with accented speech

Method

Participants heard each sentence via headphones, and repeated it verbally. The experimenter transcribed the utterance.
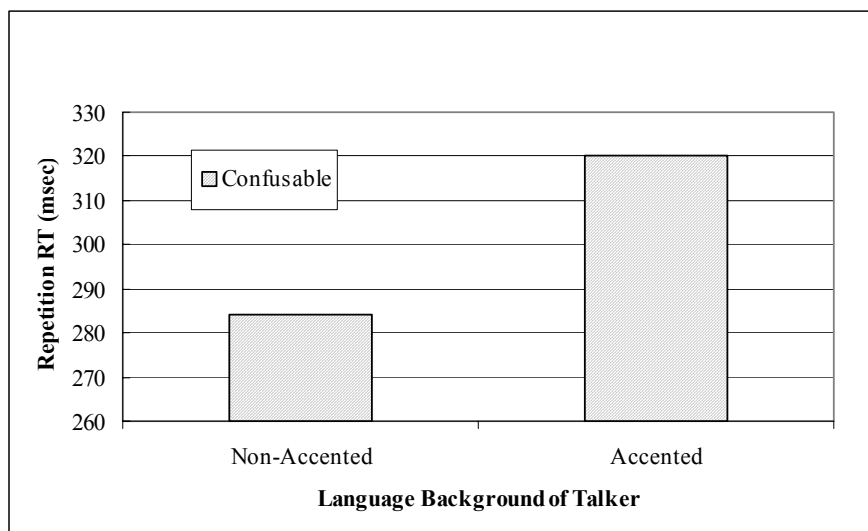
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Figure 6: *Word Repetition Sequence*

Results

♦ As in Experiment 1, accuracy errors were most prevalent with FAS (Figure 7).

♦ There was a main effect of RT; responses to accented words were ~38 msec slower than those to non-accented (Figure 8).
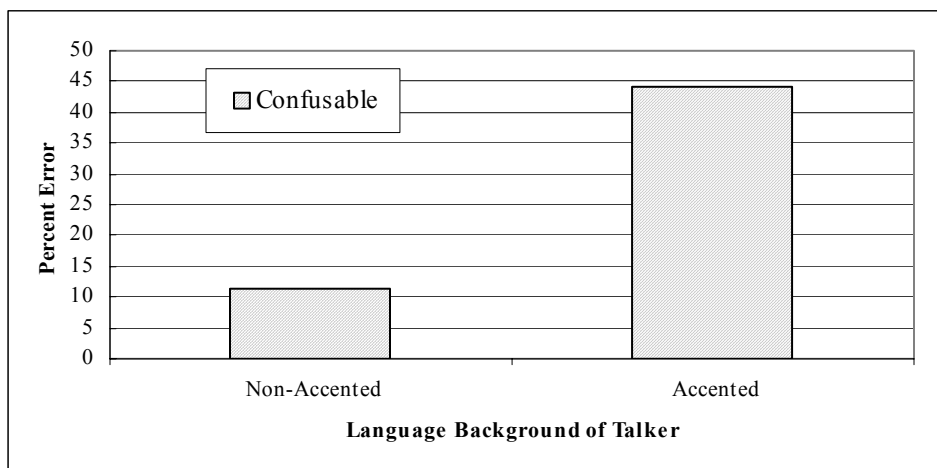
Figure 7: *Summary of error results from Experiment 2*

Figure 8: *Summary of RT results from Experiment 2 - Correct Responses*

Conclusions

Major Points

♦ *Accented speech is less intelligible than non-accented speech.* Thus was true for both Mandarin and Russian accented words, and occurred in both the Cross-Modal Matching task and the Word repetition task

♦ *Intelligibility is affected by the L1/L2 phonetic relationship.* The intelligibility gap is largest when the L2 utterances contain phonemes that are produced non-normally because of the influence of the talker's L1 (Flege, 1995). This is illustrated in the accuracy results of the Cross-Modal Matching task; performance in the Confusable condition was far worse for FAS than for NAS

♦ *Even when a word is intelligible, processing is affected by accent.* The processing cost associated with FAS is not paid in lower intelligibility alone. Comprehensibility, or perceptual effort, is higher when an utterance is accented. This is demonstrated in the RT results of Experiment 2. Correct repetitions of accented words are slower than repetitions of non-accented words.

Discussion

Situations in which individuals with different linguistic backgrounds need to communicate effectively are becoming the norm rather than the exception. While it is simple to say that an accent makes speech processing more difficult, this does not adequately describe the impact of accent on perception. The two experiments described here indicate that situations in which intelligibility will be impacted by a specific accent can be predicted by capitalizing on the L1/L2 relationship. Words which contain phonemes that are produced non-normally are less likely to be intelligible.

The impact of accent on comprehensibility have only begun to be explored. The results of the Word Repetition task indicate that a 30-50 msec processing delay can be attributed to the presence of an accent. This has implications for models of lexical access; word activation may be a function of the similarity between the accented utterance and the non-accented cognitive representation of the word.

Outside of the laboratory, comprehensibility differences may directly impact word comprehension, which in turn affects the overall performance of listeners. If there is also noise is in the environment, or if the listener is completing other tasks, even intelligible speech may pose a problem for communication.

Future Manipulations

♦ Repeat Word Repetition task with words that do not contain confusable phonemes for a given accent.

♦ Explore comprehensibility by examining speech in noise, performance in competing tasks, and the effects of training.

♦ Examine the importance of lowered comprehensibility in complex, real-world environments, such as air traffic control, education, or medical transcription.

Works Cited

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Acknowledgements

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