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3aSCa6. Phonetic convergence, communicative efficiency, and language distance
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Many English conversations across the globe today involve talkers with different language experiences. Here we show that, while language barriers challenge communicative efficiency, the detrimental effect of language distance may be mitigated by phonetic convergence. We analyzed a corpus of conversations in which talker pairs solved a spot-the-difference puzzle by verbally comparing two scenes only one of which was visible to each talker ("diapix" task). Language distance was varied by pairing talkers who either matched or mismatched in language background and in native/nonnative status relative to the target language. Communicative efficiency was measured by task-completion-time and word type-to-token ratio. Phonetic convergence was assessed by perceptual similarity tests in which listeners compared samples from one talker’s speech to samples from his/her partner's speech from either early or late portions of the conversation. In this test, greater similarity for late than early samples indicates convergence. Results showed a negative correlation between language distance and communicative efficiency, a negative correlation between language distance and phonetic convergence, and a mitigating effect of phonetic convergence on the negative correlation between language distance and communicative efficiency. This suggests that convergence may be an effective mechanism for overcoming the detrimental effects of a language barrier.

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Introduction

Many English conversations across the globe today involve talkers with different language experiences. On the one hand, variation in language background between conversation partners presents a barrier to communication. However, on the other hand, the need to overcome this barrier may encourage the conditions for speech accommodation. The purpose of the present work is to demonstrate that, while language barriers challenge communicative efficiency, the detrimental effect of language distance may be mitigated by phonetic convergence between speakers.

Talkers engaged in dialogue may differ in terms of their regional dialects, or they may come from different native language backgrounds in which case one or both talkers may be non-native talkers of the language being spoken (the target language). Furthermore, if both talkers are non-native talkers of the target language, then they may or may not come from a shared native language background. Each of these possible factors can thus define a point along a continuum of language distance between conversation partners as illustrated in Figure 1. Note that although the figure represents the points as approximately equidistant along the continuum, this is just for illustrative purposes. We have no metric that can establish exact relative distances, and we acknowledge that it is possible that even the relative ordering proposed in this figure may need adjustment. For example, it is possible that two native talkers of the target language from different regional dialects (N1-N2) may have less linguistic common ground than two non-native talkers from a shared native language background (NN1-NN1).

Figure 1. A language distance continuum. N = native talker of the target language. NN = non-native talker of the target language. Numbers refer to matched or mismatched regional dialect or native language for the native (N) and non-native (NN) talkers, respectively.

In the current study, language distance was varied by pairing talkers who either matched or mismatched in language background and in native/nonnative status relative to the target language. The talkers engaged in a task-oriented conversation, the recordings of which were used to assess communicative efficiency and phonetic convergence, with the overall goal of relating phonetic convergence, communicative efficiency, and language distance.

Methods and materials

Recordings for this study were taken from the Wildcat Corpus of Native and Foreign-Accented English (for details see http://groups.linguistics.northwestern.edu/speech_comm_group/wildcat/ and Van Engen et al., 2010). The corpus contains digitized recordings of scripted and unscripted speech productions from each of 84 talkers: 24 native speakers of English and 60 non-native speakers of English. Each participant read a set of scripted materials (words, sentences and a paragraph) in English and participated once in a task-oriented dialogue conducted in English. Native Korean speakers also read a set of scripted materials in Korean, and a subset of the Korean participants (n=8 out of 28 Korean participants) conducted the dialogue task in Korean.

The dialogue task, the “Diapix” task, is a spot-the-difference game involving a pair of pictures and a pair of participants. The two pictures represent the same scene, but there are ten differences between them. Six items are present in one picture but absent in the other (three items missing from each picture), and four items are slightly different in each of the pictures. Each participant is given one version of the scene and each participant
can only see his or her own scene. For the current study, all 38 English diapix conversations were analyzed with respect to communicative efficiency (see Table 1 below).

<table>
<thead>
<tr>
<th>Type</th>
<th>Task language</th>
<th>N (total=38)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>N1-N1</td>
<td>English</td>
<td>8</td>
<td>Both native talkers of American English</td>
</tr>
<tr>
<td>N-NN</td>
<td>English</td>
<td>8</td>
<td>One native talker of American English and one native talker of Korean (n=4); One native talker of American English and one native talker of Mandarin Chinese (n=4)</td>
</tr>
<tr>
<td>NN1-NN1</td>
<td>English</td>
<td>11</td>
<td>Two non-native talkers from the same native language background including Chinese (n=5 pairs), Turkish (n=1 pair), Korean (n=4 pairs), plus 1 pair in which the speakers each identified themselves as speakers of Indian English.</td>
</tr>
<tr>
<td>NN1-NN2</td>
<td>English</td>
<td>11</td>
<td>Two non-native talkers from different native language backgrounds including Chinese, Italian, Japanese, Korean, Macedonian, Persian, Russian Spanish, and Thai.</td>
</tr>
</tbody>
</table>

Table 1: Distribution of pairs across language distances for the initial communicative efficiency analysis.

Of these 38 diapix conversations, 12 were selected for further investigation of phonetic convergence. In addition, the 4 diapix conversations conducted in Korean were included in the phonetic convergence assessment. Table 2 shows the distribution of diapix conversations selected for phonetic convergence analyses. For additional details see Kim, Horton, and Bradlow (2011).

<table>
<thead>
<tr>
<th>Type</th>
<th>Task language</th>
<th>N (total=16)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>N1-N1</td>
<td>Korean</td>
<td>2</td>
<td>Same native language (Korean) and same regional dialects</td>
</tr>
<tr>
<td>N1-N2</td>
<td>Korean</td>
<td>2</td>
<td>Same native language (Korean) but different regional dialects</td>
</tr>
<tr>
<td>N1-N1</td>
<td>English</td>
<td>2</td>
<td>Same native language (American English) and same regional dialects</td>
</tr>
<tr>
<td>N1-N2</td>
<td>English</td>
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<td>8</td>
<td>One native talker of American English and one native talker of Korean (n=4); One native talker of American English and one native talker of Mandarin Chinese (n=4)</td>
</tr>
</tbody>
</table>

Table 2: Distribution of pairs across language distances for the phonetic convergence assessment. Note that all of the English conversations in this table are also represented in Table 1 above.

Communicative efficiency was measured by task-completion-time (shorter time = greater efficiency) and word type-to-token ratio (greater ratio = less repetition = greater efficiency). Phonetic convergence was assessed by XAB perceptual similarity tests in which independent groups of listeners (n=161) compared samples from one talker’s speech (X) to samples from his/her partner’s speech extracted from either early or late (A or B, counterbalanced) portions of the conversation. Listeners were asked to indicate which sample (A or B) was more similar to the model sample (X). The critical measure of this test is % late selection. Convergence is indicated by a % late selection rate that exceeds chance (50%). Native listeners of English performed these convergence judgment tests for the English conversations. Native listeners of Korean were recruited for judgments of the Korean conversations. In addition, an independent group of 20 native English listeners provided accentedness ratings of the 8 non-native talkers included in the N-NN diapix conversations on a scale of 1 (native accented) to 9 (heavily foreign-accented).

Results

Results of the communicative efficiency assessment of the 38 diapix conversations in Table 1 showed the following pattern of results (for full details and statistics see Van Engen et al., 2010).
1. The N-N (native + native) pairs performed the task in the shortest amount of time and had the greatest word type-to-token ratios.

2. The N-NN (native + non-native) pairs and the NN1-NN1 (non-native + non-native from the same native language background) were not significantly different in terms of task completion time and word type-to-token ratio, but both were significantly less efficient than the N-N pairs (as noted in 1 above).

3. The NN1-NN2 (non-native + non-native from different native language backgrounds) pairs tended toward the low-efficiency end of the scale for both task duration and word type-to-token ratio. These results indicate that communicative efficiency is negatively related to language distance as indicated in Figure 1.

Results of the phonetic convergence assessment of the 16 diapix conversations in Table 2 showed the following pattern of results (for full details and statistics see Kim et al., 2011).

1. The N1-N1 (same native language and same dialect) pairs showed a significantly higher likelihood of phonetic convergence than either the N1-N2 (same native language but different dialect) pairs or the N-NN (different native language) pairs.

2. The N1-N2 and N-NN pairs did not show a difference in likelihood of phonetic convergence.

3. There was a hint (without statistical significance) that convergence of the non-native talker to the native talker was more likely in diapix conversations that involved a non-native talker with a moderate, rather than extreme, accentedness rating.

These results indicate that, like communicative efficiency, phonetic convergence is negatively related to language distance as indicated in Figure 1.

Finally, in order to more fully understand the consequence for communication of language distance, we performed a combined analysis of the communicative efficiency data (Van Engen et al., 2010) and the phonetic convergence data (Kim et al., 2011) for the diapix conversations shown in Table 2. This analysis specifically tested within this data set if there is a mitigating effect of phonetic convergence on the negative correlation between language distance and communicative efficiency. Results of this analysis showed the following.

1. Language distance decreased communicative efficiency in terms of task completion time and type-to-token ratio. This establishes the validity of the main finding of Van Engen et al. (2010) in the subset of data for which we also have phonetic convergence data.

2. There is a significant interaction between language distance and rate of phonetic convergence such that the negative impact of language distance on communicative efficiency, in terms of both task completion time and type-to-token ratio, is mitigated by the rate of phonetic convergence.

Thus these findings indicate that pairs of talkers who exhibit a relatively high rate of phonetic convergence achieved greater communicative efficiency than similarly distant pairs (in terms of language distance as indicated in Figure 1 above) who exhibited relatively low rates of phonetic convergence (or even tended towards phonetic divergence).

Conclusion

Even though language distance creates a communication barrier, phonetic convergence may be an effective mechanism for overcoming the detrimental effects of a language barrier. A remaining challenge is to identify precise linguistic, cultural and situational factors that promote phonetic convergence even amongst talkers who must bridge a great language distance.

References
