Appropriately performing hand gestures cueing phonetic features facilitates simultaneous speech imitation in an L2

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Abstract

This study investigates the effects of simultaneously performing hand gestures on the accuracy of pronunciation during L2 speech imitation focusing on the appropriateness of gesture performance. Fifty-five Catalan-speakers without any knowledge of Mandarin imitated Mandarin words contrasting only in aspiration. The target words containing the aspirated consonants were produced either with or without a fist-to-open-hand gesture cueing the air burst of the aspirated feature. The words were imitated twice in isolation (easy task) and then twice in pairs (difficult task). The accuracy of the participants' gesture performance and the accuracy of their simultaneous speech imitation were rated by three native speakers of Mandarin. The results revealed that only in the difficult task did participants who had appropriately performed the gestures obtain significantly higher pronunciation accuracy scores than those who had poorly performed the gestures or who did not perform any gesture at all. These results suggest that appropriately performing such hand gesture facilitates the pronunciation of words contrasting in aspiration in difficult tasks and that this online effect may have motivated the positive effects of gestures in the production of L2 aspirated plosives.

Index Terms: Gesture performance, speech production, aspirated plosives, L2 pronunciation training

1. Introduction

Previous research has shown that L2 learners' use of hand gestures together with speech can help the learning of L2 lexical tones (e.g., [1], [2]) and vowel length contrasts [3]. Especially when the training tasks are difficult for L2 learners, gestural training has been proven more effective than training without gestures [4]. However, little is known about the role played by producing hand gestures on simultaneous L2 speech production during the training phase. The assessment of this issue is important because it might well be that the simultaneous effects of gesture production on speech production are the root of the positive effects of performing gestures for L2 pronunciation training. To the best of our knowledge, only one study has ever evaluated this issue, and it showed that performing pitch gestures depicting the pitch contour of Mandarin lexical tones only played a moderate role in L2 speech imitation [5]. Moreover, to our knowledge, the potential effects of the appropriateness of learners' gesture performance have not yet been assessed.

We selected Mandarin plosives as target phonemes to train L1 Catalan speakers. Mandarin has three pairs of voiceless plosives, /p-pʰ, t-tʰ, k-kʰ/, which contrast in aspiration [6]. Since Catalan only has unaspirated plosives /p, t, k/ [7], we hypothesize that the aspiration would be a challenge for Catalan learners of Mandarin Chinese.

This study thus investigates the effects of (appropriately) performing a fist-to-open-hand gesture (mimicking a burst of air) while pronouncing words containing L2 novel aspirated and unaspirated consonants on pronunciation accuracy.

2. Method

2.1. Experimental procedure

During two different tasks, 55 Catalan speakers without any knowledge of Mandarin Chinese imitated four times six minimal pairs of dissyllabic words in Mandarin contrasting only in aspiration of the word-initial plosive consonants (e.g., *tuli* 'independence' vs. *tʰuli* 'figure'). Participants were randomly assigned to one of two conditions: (a) the Gesture (G) group ($n = 29$, 26 female), where two native Mandarin-speaking instructors uttered the target words with a fist-to-open-hand gesture cueing the aspirated feature (see Fig. 1) and participants had to imitate the target words while simultaneously performing the gestures, and (b) the No Gesture (NG) group ($n = 26$, 23 female) where the same instructors uttered the same words with no gesture and participants merely imitated the target words. Two levels of task complexity were included, namely, a less complex single-word imitation task and a more complex pair-of-words imitation task. In the single-word imitation task, the instructors uttered a single word each time and the participants had to imitate the word, while in the pair-of-words imitation task, the instructors uttered the words in minimal pairs and the participants had to imitate both words in a row. A total of 24 repetitions were performed for the single-word imitation task (e.g., 12 words × 2 repetitions) and 24 repetitions were performed for the pair-of-words imitation task (e.g., 12 words × 2 repetitions).

Each of the participants was videotaped during the whole experiment but no feedback was provided.

Figure 1: *Fist-to-open-hand gesture used for the aspirated feature of the plosive consonants in the G condition.*

2.2. Data coding

The participants' pronunciation accuracy and gesture accuracy (in the G condition) were assessed by three native speakers of Mandarin. Pronunciation accuracy was evaluated in a first round: raters listened to the audio track of each word and evaluated the pronunciation of the word on a scale from 1 'not accurate at all' to 9 'definitely accurate'. Then, in a second round, gesture accuracy was evaluated by the same raters on a scale from 1 'very bad' to 9 'very good'. In that case, both image and sound were accessible.

Interrater reliability was checked by means of Cronbach's α. The agreement among the three raters was excellent on the gesture accuracy scores ($\alpha = .93$) and good on the pronunciation accuracy scores ($\alpha = .81$). Depending on their mean gesture accuracy scores, participants in the G group were further divided into two subgroups by means of a Two-Step Cluster analysis, namely the well-performed gesture (WPG) group ($n = 14$) and the poorly-performed gesture (PPG) group ($n = 15$).

3. Results

Fig. 2 shows the mean Pronunciation Accuracy Scores across the two tasks (single-word imitation and pair-of-words imitation) and across the three Gesture Performance Groups (WPG, PPG, and NG). A GLMM analysis was conducted with mean Pronunciation Accuracy Score as dependent variable and Gesture Performance (NG, PPG, and WPG), Task Complexity (Easy and Difficult) as well as their interaction as independent variables. Participants, raters, and items were set as random factors. *T*-test was applied for the pairwise post-hoc comparisons adjusted by the Sequential Bonferroni method. A significant main effect of Task Complexity was obtained, $F(1, 7914) = 64.36$, $p < .001$, revealing that participants obtained higher mean Pronunciation Accuracy Scores in the easy task than in the difficult task (*contrast estimate* = 0.18, $p < .001$). A significant main effect of Gesture Performance ($F(2, 7914) = 3.16$, $p = .043$) indicated that participants' gesture performance had an impact on their pronunciation accuracy, with WPG outperforming PPG (*contrast estimate* = 0.39, $p = .036$). Moreover, a significant two-way interaction of Task Complexity × Gesture Performance, $F(2, 7914) = 34.63$, $p < .001$, indicated that the effects of gesture performance differed significantly depending on Task Complexity. Post-hoc pairwise comparisons revealed that in the difficult task the WPG group outperformed the PPG group (*contrast estimate* = 0.49, $p = .006$) and the NG group (*contrast estimate* = 0.43, $p = .006$). However, there was no significant difference between the PPG group and the NG group (*contrast estimate* = 0.06, $p = .673$). By contrast, no significant differences were found between the three groups in the easy task.

4. Conclusions

These results suggest that appropriately performing the fist-to-open-hand gesture while imitating L2 words featuring aspiration helps to better pronounce these words online. The positive effects of such hand gesture on simultaneous speech production might help to learn the production of L2 aspirated plosives [8]. From a methodological point of view, the results also show that it is important to control for gesture accuracy during training when investigating the role of producing hand gestures in L2 pronunciation learning. Crucially, the current study suggests that in multimodal pronunciation teaching

teachers should pay attention to the learners' appropriateness of gesture performance, especially when doing complex tasks.
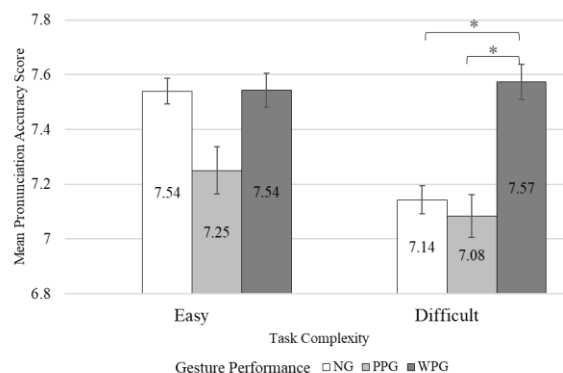

Figure 2: *Mean Pronunciation Accuracy Score across the tasks and groups. Numbers on the bars represent the mean score. Error bars indicate 95% confidence interval. Asterisks mark significant contrasts.*

6. References

[1] F. Baills, N. Suárez-González, S. González-Fuente, and P. Prieto, "Observing and producing pitch gestures facilitates the learning of Mandarin Chinese tones and words," *Stud. Second Lang. Acquis.*, vol. 41, no. 1, pp. 33–58, 2019, doi: 10.1017/S0272263118000074.

[2] L. M. Morett and L. Y. Chang, "Emphasising sound and meaning: pitch gestures enhance Mandarin lexical tone acquisition," *Lang. Cogn. Neurosci.*, vol. 30, no. 3, pp. 347–353, 2015, doi: 10.1080/23273798.2014.923105.

[3] P. Li, F. Baills, and P. Prieto, "Observing and producing durational hand gestures facilitates the pronunciation of novel vowel-length contrasts," *Stud. Second Lang. Acquis.*, pp. 1–25, 2020, doi: 10.1017/S0272263120000054.

[4] D. Gluhareva and P. Prieto, "Training with rhythmic beat gestures benefits L2 pronunciation in discourse-demanding situations," *Lang. Teach. Res.*, vol. 21, no. 5, pp. 609–631, 2017, doi: 10.1177/1362168816651463.

[5] A. Zheng, Y. Hirata, and S. D. Kelly, "Exploring the effects of imitating hand gestures and head nods on L1 and L2 Mandarin tone production," *J. Speech, Lang. Hear. Res.*, vol. 61, no. 9, pp. 2179–2195, 2018, doi: 10.1044/2018_JSLHR-S-17-0481.

[6] S. Duanmu, *The Phonology of Standard Mandarin*. Oxford, UK: Oxford University Press, 2007.

[7] M. W. Wheeler, *The Phonology of Catalan*. New York, NY: Oxford University Press, 2005.

[8] X. Xi, P. Li, F. Baills, and P. Prieto, "Hand gestures facilitate the acquisition of novel phonemic contrasts when they appropriately mimic target phonetic features," *J. Speech, Lang. Hear. Res.*, to be published.