A Multi-sensory Teaching of English Intonation using Vibrotactile Devices

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ABSTRACT

The ability to speak a foreign language is considered one of the most important skills in foreign language learning (L2). For L2 learners acquiring the intonation of a second language is one of the major difficulties. To address these difficulties, vibrotactile haptics feedback has been developed to teach intonation because intonation learning is a part of muscle and motor training. In this study, a multi-sensory teaching of intonation using two different vibrotactile devices was investigated. The vibrotactile devices were designed and developed to represent the intonation patterns of English. The two main goals of this study were (1) to increase awareness of English intonation patterns using the vibrotactile devices, and (2) to investigate the effect of the devices on intonation learning. A between-subjects experiment with two conditions (intensity and location) was conducted to evaluate the effect of the two different vibrotactile devices on intonation learning. Twelve participants were randomly and equally assigned into one of the conditions. The participants were asked to solve the multiple-choice questions during the experiment and were also given the pre-test and post-test questionnaire. The participants were video recorded during the experiment for further analysis. The results indicated some positive effects of a multi-sensory teaching of English intonation, especially when intensity was used. The proposed vibrotactile devices increased the participants' awareness of rhythm in English speech and were effective in teaching the intonation patterns of English.

Keywords: intonation, English, multi-sensory teaching, vibrotactile, haptics

INTRODUCTION

One of the most important skills in foreign language learning (L2) is the ability to speak the foreign language fluently. For L2 learners, speaking is more challenging than reading or listening, because acquiring the intonation of a foreign language is difficult. In this paper, two vibrotactile devices for displaying the intonation patterns of English are proposed. The proposed devices explicitly represent the intonation patterns of English, so that the learners of English can easily become aware of the intonation patterns in speech.

Intonation

Intonation is considered to be the most important element of spoken language. Using correct intonation patterns increases the intelligibility of speech because intonation conveys not only the meaning of speech, but also the speaker's attitude. Therefore, understanding and using correct intonation patterns are crucial in learning a foreign language.

Acquiring intonation of foreign languages seems to be a very difficult task for L2 learners. Leon and Martin (1972) described intonation as the most difficult element to learn. According to Lieberman (1967), it is difficult for adults to change intonation, because intonation is acquired in early childhood. Therefore, children can easily acquire native-like intonation of a foreign language. In addition, adult learners are accustomed to the intonation of their first language, and tend to apply the intonation patterns of their first language when they speak a second language (Ramirez Verdugo, 2006).

A multi-sensory approach

In this paper, a multi-sensory teaching of English intonation for L2 learners is proposed. In the present paper, multi-sensory refers to auditory and vibrotactile stimuli. The aim of the paper is (1) to increase the awareness of English intonation patterns using the vibrotactile devices, and (2) to investigate the effect of the devices on intonation learning. For vibrotactile representation of the intonation patterns of English, two different devices were developed. Among the five basic vibrotactile parameters (Jones et al. 2009), intensity and location were used in the experiment. One vibrotactile device modulated the intensity of vibration to represent the intonation patterns of English. The second device used spatial differences to represent the intonation patterns of English.

To enhance the perception of vibrotactile representation of intonation, the intonation patterns of English were simplified. The speeches were first analyzed using speech analyzer, and each sentence was divided into 3 pitch levels: low (150Hz or below), medium (150Hz ~ 225Hz) and high (225Hz or above).

METHOD

Participants

A total of 12 undergraduate students (Males: 6 vs. Females: 6) volunteered for this experiment. Their average age was 26.6 (S.D. = 4.1). They were randomly assigned into one of two experimental conditions.

Procedure

A between-subjects experiment was conducted to compare the effect of the two different types of vibration. Two conditions tested in the experiment were modulating intensity of vibration (Vibration type 1) and changing the location of vibration (Vibration type 2).

The experiment consisted of four steps: the pre-test survey, baseline test, main test, and the post-test survey. The pre-test survey was designed to collect general information about the participants, such as age and gender. The baseline test was conducted to evaluate the participants' English proficiency. After the participants completed the baseline test, the main test was conducted. The participants heard speeches during the both tests, and were asked to solve the multiple-choice questions about the intonation patterns of the speeches. Finally, a post-test questionnaire was given to the participants. The post-test questionnaire was designed to investigate participants' awareness of English intonation and effects of the proposed devices.

A total of 37 sentences from an English textbook were used in the experiment. Each sentence was categorized as easy, medium, and difficult depending on the length of the sentence.

Measurements

Three types of measurements (multiple-choice questions, survey, and video recordings) were used to evaluate the effect of the multi-sensory teaching of English intonation. Participants were asked to solve multiple-choice questions during the experiment. The problem set was used to assess participants' perception of intonation. The pre-test and post-test surveys were conducted to evaluate participants' awareness of English intonation patterns and overall satisfaction of the proposed devices. Finally, the participants were video recorded during the experiment for further analysis.

RESULTS

Results showed that there was no significant difference in overall accuracy between the two different types of vibrations. However, vibration type 1 generally showed positive improvement, whereas vibration type 2 showed a negative effect. Especially in case of medium difficulty level sentences, there was a significant difference as shown in Table 1. Improvement was calculated by subtracting the accuracy of the baseline test result from the accuracy of the main test result.

Table 1. The improvement (represented in percentage) regarding the two vibration types

Sentence Difficulty	Easy	Medium	Hard	Overall
Vibration Type 1	M = 8.33 S.D. = 0.21	M = 5.55 S.D. = 17.21	M = 7.14 S.D. = 25.15	M = 6.86 S.D. = 12.57
Vibration Type 2	M = -4.16 S.D. = 10.20	M = -11.11 S.D. = 13.60	M = -2.38 S.D. = 21.02	M = -5.88 S.D. = 13.92
	t(7.4) = -1.34 p = 0.21	t(9.5) = -1.86 p = 0.09*	t(9.7) = -0.71 p = 0.49	t(9.9) = -1.66 p = 0.12

The post-test survey revealed that the vibration type 1 was more effective in intonation awareness, feeling the rhythm of the sentences, and listening than the vibration type 2, but the difference was not significant. Figure 1 displays the result of the post-test survey.

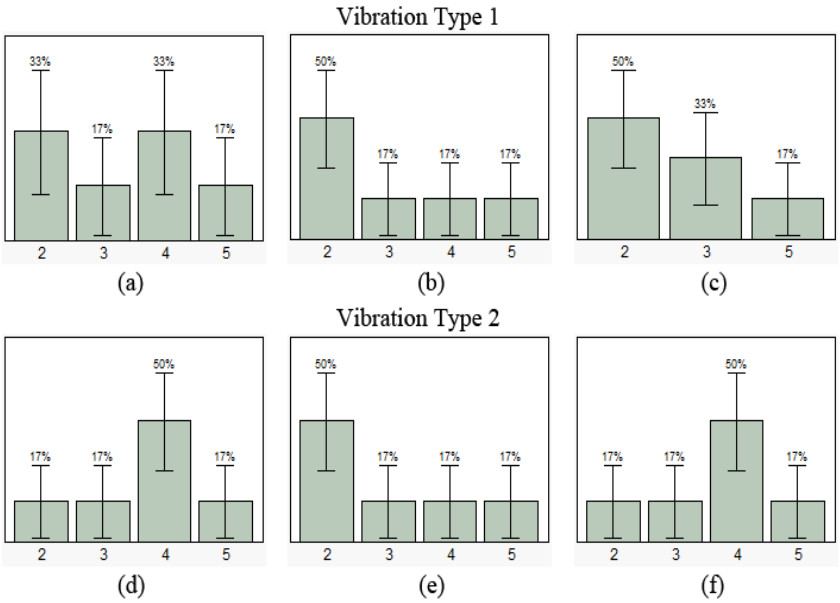

Figure 1. (a), (d) the effect on intonation awareness. (b), (e) the effect on feeling rhythm. (c), (f) the effect on listening, Scale: 1: very likely, 2: likely, 3: neutral, 4: unlikely, 5: very unlikely

DISCUSSION

The results indicated that the modulating the intensity of vibration according to the pitch of speech (vibration type 1) helped the participants to become aware of intonation patterns, and was turned out to be effective in learning intonation. The reason why the vibration type 2 elicited the negative effects might be divided attention. None of the participants who experienced vibration type 1 reported that their attention was divided or disrupted. However, 67% of the participants who experienced the vibration type 2 reported that their attention was divided and disrupted. This might be due to the difficulties in discriminating different vibrations: they had difficulty in identifying the location of vibration, whereas the other 33% of the participants had difficulty in identifying the intensity of vibration.

The results of the present study showed that vibrotactile stimulus could represent the intonation patterns, especially by modulating intensity of vibration. Therefore the proposed vibrotactile device is expected to help learners of English acquire the intonation patterns of English. The device could be integrated into existing commercial English teaching software to increase user experience. In addition, the proposed vibrotactile device could be employed in English teaching robots. Unlike computers, robots usually provide physical interfaces, so the vibrotactile device could be embedded within robots. Finally, the vibrotactile device could be developed further to teach other aspects of spoken language, such as word or sentence stress.

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REFERENCES

Auer, E. T., Bernstein, L. E., & Coulter, D. C. (1998). Temporal and spatio-temporal vibrotactile displays for voice fundamental frequency: An initial evaluation of a new vibrotactile speech perception aid with normal-hearing and hearing-impaired individuals, *Journal of the Acoustical Society of America*, 104

Boothroyd A. (1985). A wearable tactile intonation display for the deaf. *IEEE Transactions on Acoustics, Speech and Signal Processing,* 33

Cook, A. (2000*). American accent training (book and audio CD, 2nd edition).* Barron's Educational series

Jones, L. A., Kunkel, J., & Piateski, E. (2009). Vibrotactile pattern recognition on the arm and back. *Perception*, 38, 52–68.

Leon, P., & Martin, P. (1972). Applied linguistics and the teaching of intonation, *Modern Language Journal*, 56, 3

Levis, J. (2008). Computer technology in teaching and researching pronunciation, *Annual Review of Applied Linguistics*, vol. 27, pp. 184-202

Lieberman, P. (1967). *Intonation, perception and language*. Cambridge, MA:MIT Press.

Oh, S., Jang, Y., Lee, Y. (2001). On the problems of English intonation representation in English textbook, *Speech Sciences*, 4, 8.

Ramirez Verdugo, D. (2006). A study of intonation awareness and learning in non-native speakers of English. *Language Awareness*, 15(3), 141-159.

Seferoglu, G. (2005). Improving students' pronunciation through accent reduction software. *British Journal of Educational Technology*, 36(2), 303-316.

Spaai, G., & Hermes, D. (1993). A visual display for teaching intonation. *CALICO Journal* 10(3), 19-30.

van Lier, L. (2004). *The ecology and semiotics of language learning: A sociocultural perspective.* Boston: Kluwer Academic.