

## **Vibration Tactile Foreign Language Learning: The Possibility of Embodied Instructional Media\***

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On the basis of two premises and embodied cognition theory, the vibration tactile learning is proposed as an effective method for foreign language learning. The premises are: the real nature of language is sound and the source of sound is vibration. According to embodied cognition theory, cognition is inherently connected to bodily sensation rather than metaphysical and independent. As a result, the vibration tactile learning is: people are able to learn foreign language better by listening to sound and experiencing its vibration through touch rather than solely listening to sound. The effectiveness of vibration tactile learning is tested with two instructional media theories: media comparison and media attribute. For the comparison, an experiment is conducted with control and experimental groups. The attributes of vibration tactile media are investigated in points of relationships with the learning process. The experiment results indicate a small effect on the increased mean score. Three kinds of relationships are found between the media attribute and learning process: enforced stimulus, facilitated pronunciation, and assimilation of resonance to sound patterns through touch. Finally, this paper proposes a new theoretical development for instructional media research: an embodied cognition based media research and development.

*Keywords: Instructional media, Embodied cognition, Tactile (haptic) perception, Foreign language learning*

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## Introduction

This paper has two main premises. First, the real nature of language is sound. That is, the essential quality of language is sound rather than letter. It is difficult to think of a real language without sound, even though it is possible to think of a language without letter. Every normal person, even illiterate who does not know letter, could comprehend the sound of their own language. Second, the origin of sound is vibration. There is no sound without vibration. Every sound has its vibration even though every vibration has not its sound. The sound is one part of many attributes of vibration. That is, every attribute of vibration is not converted into sound. Only some parts of vibration are converted to sound. So, when we only use our ears to receive sound, we are only receiving a part of the entire sound spectrum.

Humans are of multi-sensory beings. The five basic senses are visual, auditory, olfactory (smell), gustatory (taste), and tactile (touch). Usually, we sense sound with our ears. However, we do possess the ability to use our hands, one of tactile organs, to acquire sound vibrations as well. For example, we can feel sound vibrations if we place our fingers on the speaker holes of mp3 player and/or cellular phone. We can feel vocal vibrations when we put our fingers on our necks while speaking.

Considering the two premises above, and our ability to sense vibration through our hands, vibration tactile methodology is a logical proposal for foreign language learning. Using simple technology, vibration could be enforced for tactile sensing without increasing sound volume. Vibration speaker could generate the enforced vibration of sound. This device could be used as a kind of instructional media or learning aid in foreign language learning. Foreign language learners could touch the played sound itself with their hands not only listen to it with ears. The stimulus of vibration would facilitate foreign language learning.

The purpose of this paper is to propose vibration haptic language learning based on embodied cognition theory and analyze its effectiveness based on instructional

media theories: media comparison and media attribute.

## **Related Theories**

### **Embodied Cognition**

Lee (2010) wrote a narrative explanation about embodied cognition, that is, the extended mind. Cognition is not an abstract or internal process of the brain or mind alone, it is a kind of an action-oriented process combined with the body and environment. Cognitive process is grounded in bodily perception. Han (2011) introduced embodied cognition theory and a variety of studies on haptic technology based learning. The paper concludes that haptic feedback is effective in learning abstract physics concept. Many other papers report the positive effects of embodied cognition based learning (Ansorge, et. al. 2010; Atkinson, 2010; Louwerse & Jenuniaux, 2010;).

### **Instructional Media Theories**

Rha (1995) explored instructional media research. According to his investigation there are two main theories on instructional media: media comparison and media attribute research. Most instructional media research is on the effectiveness of media. However, effectiveness of instructional media is usually filled with controversy. Doubting about the usefulness of media comparison research, Lumsdaine (1963) advocated aptitude-treatment interaction research. On one side, Clark (1985) criticized media effectiveness itself. However, Salomon insisted media effectiveness with media attribute theory which is based on Goodman's symbol system theory.

## Vibration Haptic Language Learning

The vibration haptic learning in foreign language is as followed: people learn foreign language better by experiencing language through sound and vibration; rather than listening to sound alone. The instructional media, learning aid, is presented in Figure 1. Grasping the aid with hands, learners put their fingers or palm on the vibrator. Feeling the vibration with their hands and listening to contents with their ears, learners practice listening and speaking skills.

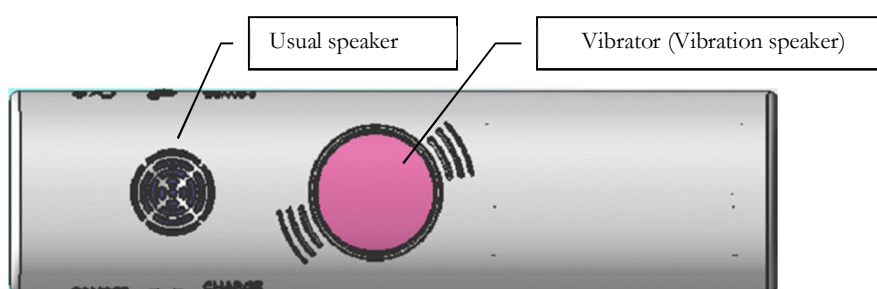


Figure 1. Design of Vibration Tactile Aid for Foreign Language Learning

## Research Questions

Hypothesis: Participants who practice listening with the vibration aid will see sharper increases in comprehension between the pre- and post- tests than those with no use of the vibration aid.

Questionnaire: What is the attributes of the vibration tactile aid which facilitate learning? And how do they work for learning?

## Research Design & Methods

### Experimental Research

Participants: Undergraduate students who attend TOEIC courses in a University  
Contents of testing and learning: The second part of actual TOEIC listening comprehension test, 30 questions

Experimental tool: Vibration speaker devices which play sound for mp3, cassette player, etc.

Experimental design:

Groups	Pre-test	Treatment	Post-test
Control	Test without the aid	Practice-tests (2 repeat tests) without the aid	Test without the aid
Experimental	Test without the aid	Practice-tests (2 repeat tests) with the aid	Test with the aid

Independent variables: Listening practice with the vibration aid

Dependent variables: Increased scores between pre- and post-test of the listening test

## Results

### Analysis of Effectiveness based on Media Comparison Theory

The results of the experiment are presented in Table 1. The increased scores between pre- and post-test are compared. Before the experiment, I actually intended to compare the two post-test scores of control and experimental groups. I supposed that I could infer the effectiveness of using the vibration learning aid through the t-test for the post-test mean scores. However, the post-test mean score

(20) of control group was higher than the post-test mean score (17.45) of the experimental group. Not only was the post-test score higher but also the pre-test score (about 19) of the control group was much higher than the pre-test score (about 16) of the experimental group (one point per each question, total 30 points for 30 questions). This case is natural in even random sampling.

At this point, it is not meaningful to compare both post-test scores. Instead, it is more meaningful to compare the increased scores because the main purpose of this paper is not to measure the effectiveness, rather to search for the possibility of a vibration tactile learning method. The difference of increased scores is 0.45. That is, participants who practice listening with the vibration tactile aid had more of an increase in listening comprehension between the pre- and post- tests than those with no use of the vibration tactile aid. There seems to be some effectiveness in the descriptive statistics even if it could not be significant in the inferential statistics.

**Table 1. Comparison of Increased Scores**

Groups	Increased scores between pre- and post-test	Mean	SD	n
Control	+2 +1 +1 -1 +4 +2 0 0 +1 +1	1.00	1.76	10
Experimental	-2 +5 -2 +2 +2 +4 +2 +2 0 +1 +1	1.45	2.30	11

**Analysis of Effectiveness based on Media Attribute Theory**

It is not difficult to understand that it is better to use both auditory and tactile organs over auditory-only organs in spoken language learning. This hypothesis is similar to Mayer’s (2009) multimedia learning; “People learn better from words and pictures than from words alone.” Likewise, people can learn better from listening and touching sound than from listening alone. The content of words (verbal information) is just similar to the pictures (nonverbal information) in multimedia learning. However, in vibration tactile learning, people listen and touch the exact

same one (sound). Multimedia learning could be traced to Paivio's (1986) dual coding theory; people learn better from processing verbal and nonverbal (imagery) than by verbal processing alone. However, how about more than dual? Is there only the imagery in the nonverbal? Are there only words and pictures in the multimedia? Humans are multi-sensory beings. Embodied cognition is not only limited to seeing or listening. The tactile or kinesthetic could be more important in embodied cognition.

Returning to the main points, what is the attribute of tactile learning media which makes learning effective? How does it work with cognitive processes of learning? The main attribute of vibration tactile learning and its media is to have learners touch sound vibrations. There are three kinds of relationships between touching sound vibrations and learning foreign language.

First, the stimulus of languages is diversified and reinforced through vibration. Second, pronunciation (articulation), which is a production of vibration, is facilitated by touching the same vibration. Third, the learner's disposition (body and mind) are assimilated to a language pattern through vibration stimulus in spoken language learning.

The third relationship is especially important. Every language has its own unique sound pattern, that is, a vibration pattern. Learning foreign language is a process of adaptation and assimilation to the pattern. In a way, spoken language communication is a process of resonance and sympathy between speakers through the assimilation. This resonance or sympathy is manifested when the two counterparts are similar to each other in characteristics, that is, disposition of body and mind. The assimilation or change of the disposition can be facilitated through touching vibrations in spoken sound because the body and mind interacts with each other according to embodied cognition.

### **Analysis of Effectiveness based on Cognitive Load Theory**

Now I could not help asking the question, "What is this tactile or haptic learning

method and the embodied cognition concerned with cognitive load theory? Does this learning method make the learner's cognitive load higher or lower? It could be answered simply. It could make cognitive load somewhat low because learners use the additional tactile sense and receive additional vibration stimulus which are the sources of sound. The dual coding theory could be a backup for this answer. On the other hand, the cognitive load could be higher because the additional information, the vibration stimulus, could not be discriminated meaningfully by the learners. Here, I have another question; "How much can humans understand vibrations meaningfully?" This question reminds me of Helen Keller, who was a famous author and lecturer even though she was deaf and blind. How could someone with her disabilities learn and become a lecturer? One of her learning methods was that Anne Sullivan, her teacher, taught her to communicate by spelling words into her hand. Another method was Tadoma in which the deafblind person places their thumb on the speaker's lips and their fingers on the cheeks and throats. She could feel the movement of the lips and breaths as well as the vibrations of the vocal cords. Her sense of touch became extremely subtle through practice. It could be said that there is high probability that learners could understand and discriminate the vibrations of sound to some extent depending on their training and development of tactile sense, and eventually the cognitive load is lowered for better learning.

In addition, out of concern for clarity, I'd like to point out that there could be some fallacy in the above simple questions and answers concerned regarding cognitive load. A learner's cognitive load could be classified into three parts depending on factors that cause it; intrinsic cognitive load, extraneous cognitive load, and germane cognitive load (Jung, Jung, & Kim, 2012). Then, various factors of tactile learning could have effects on each of three parts in different ways. For a more reasonable explanation the analysis should be done in each of three parts separately. Actually, the effect of cognitive load to learning should be dealt in the point of mental efficiency also (Ryu & Lim, 2010). I expect to discuss these topics deeply in future research.



## Analysis of Effectiveness based on Embodied Cognition

The proverb “A sound mind in a sound body” supports the embodied cognition theory that body and mind are not separate things. In another proverb, “A picture is worth a thousand words,” we could draw inference that “an actual object is worth a thousand pictures.” The actual (real) object could be felt and understood better through cross-modal senses including touch. We can say, “Seeing is believing, but touching is knowing.”

Touch is not only sensed through hands. Skin, which includes hands, is the somatosensory organ. There are two kinds of skin: hairy and glabrous. Hairy skin covers most of the body and has invisible hairs, while glabrous skin is found on the smooth surfaces like toes and fingers. Generally speaking, glabrous skin is more complex and sensitive than hairy skin. According to a two-point thresholds experiment, fingers are the most sensitive parts. The sensory homunculus on the somatosensory cortex shows that fingers and lips represents very large parts, which points to fingers’ highest tactile acuity (Foley, & Matlin, 2010; Goldstein, 2002; 2010).

The Tadoma method is used for the communication with a deaf blind person. Various researches have reported the effectiveness of Tadoma method in speech perceive and production (Chomsky, 1986; Fowler & Dekle, 1991). Alcon, the inventor of Tadoma, wrote in her paper, “He was surprised on how the speech pattern of the sound vibrations through the fingers can transmit useful information to the brain.” (Alcon, 1945).

Even if learners could have much difficulty in understanding the vibration of sound consciously, unconsciously it could be very helpful for learning. The cross modal senses of sound could work for foreign language learning in a motivational or emotional aspect. Considering various factors including cognitive load and embodied cognition, logically and theoretically there could be profound implications and great potential in tactile (haptic) sense of vibration for foreign

language learning.

## **Discussion and Conclusion**

This paper introduces a new method with a new media in foreign language learning. The effectiveness of the method was analyzed based on both media comparison and media attribute theories. According to the media comparison experiment, there was some effectiveness in the increased mean score even though it could not be significant. It is unreasonable to expect some effectiveness with such limited testing. Also, the sample size was too small. This experiment was a kind of pilot test to explore the possibility of new instructional media. Moreover, considering that the experiment results could vary in media comparison research, it is not reasonable to say conclusively that there is no significant effect in vibration tactile learning. One of most important factors discovered in this experiment is that there are individual differences in the increased scores. Some participants had decreased scores on the post test in spite of practice. It could be supposed that some participants have negative attitudes toward unfamiliar media, and lose their concentration due to test repetition. For this reason, the total increase was weak in mean scores influencing the experimental result.

Based on media attribute and embodied cognition theories, I have discovered three types of relationships between media and learning. First of all, it is the most important of the assimilation of learner's disposition to the pattern of sound or vibration of the target language. This process is explained with resonance theory. Everything has its own vibration property: free vibration or natural frequency. If the natural vibration is similar, resonance occurs (Fry, 1979). In order to resonate with the conversation partner or the sound of target language, learners instinctively assimilate themselves, adjust their 'own vibration property' or their disposition, to the pattern of sound or vibration. This learning process could be facilitated through touching vibrations. To this point, the exact name of the vibration tactile (haptic)

learning would be ‘resonance tactile learning’, or ‘sympathetic touch learning’.

Finishing this paper, I’d like to respond to the ‘directions for future research on instructional media’ (Rha, 1995). The ‘new theory development’ would be a ‘embodied cognition based media’ as I have started it in this paper. As he said, it is akin to a media-driven method and decision-oriented research rather than a media-independent and conclusion-oriented one.

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