

# Vibration to upper body manipulates joyful experience while viewing emotional scenes

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**Abstract**—Vibration stimulation to the upper body enhances the subjective experience during viewing audio-visual content. However, the reported types of enhanced experience vary among previous studies. In this study, we investigated the types of experiences that were enhanced or diminished by vibratory stimuli to the upper body. In an experiment involving seven participants, eight hugging scenes were viewed, each of which evoked different impressions. For some randomly selected videos, participants were presented vibratory stimuli. After viewing the videos, participants scored the hugging scenes using ten adjectives. Vibration affected the feeling of joy for three out of eight videos. A hug scene of a father and his son after a long separation felt more joyful with the vibration. A hug scene of a family during a hospital stay due to illness felt less joyful with the vibration. The results will provide an effective way to enhance the experience of audio-visual contents using vibratory stimuli.

**Index Terms**—affective, experience, emotion, vibration

## I. INTRODUCTION

Vibration stimulation has been used in many studies to enhance the experience of audiovisual content [1]–[5]. Lemmens et al. [1] and Karafotias et al. [2] improved immersion and realism by using a jacket with a vibrator attached to provide vibratory stimulation to a viewer's upper body during video viewing. However, there is a dispersion among previous studies in the types of emotions and feelings that the vibratory stimuli can enhance.

In this study, as shown in Fig. 1, we investigated the types of feelings that could be changed by vibratory stimuli to the upper body while watching a hug scene. Hug scenes can cause a variety of impressions and feelings, including joy and sadness [6]. Thus, we can examine the effects of vibration on various kinds of subjective experiences under the same experimental condition, whereas earlier studies targeted limited types of impressions and feelings.

## II. METHODS

### A. Participants and ethical statement

Seven university students (two females, mean age: 24.9), who were unaware of the purpose of the experiment, participated in the study. All participants provided written informed consent in advance.

This study was approved by the institutional review board of Hino Campus, Tokyo Metropolitan University (H22-014).

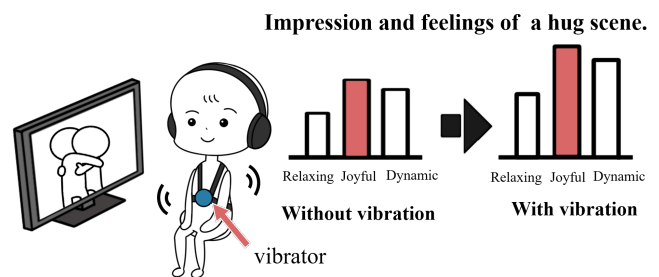


Fig. 1. Vibration to the upper body to manipulate the impressions of hugging scenes.

### B. Apparatus

Videos were played on a 21-inch display placed 60 cm away from the participant's head. Sounds were played through headphones. Vibrations were presented by two voice coil motors (Vp604, Acouve Laboratory, Inc., Japan) through a vest to firmly contact each of the vibrators at the epigastric fossa and T5 vertebrae.

### C. Audio visual contents: hug scenes

In the experiment, participants watched eight hug scenes as stimuli that would evoke a variety of positive and negative impressions. For example, they included a video in which a dog jumped into its owner and one in which two friends conciliated and hugged each other. These eight videos were selected from the literature [6] as part of their psychophysical, affective, and evaluative impressions were prominent. Each video lasted five to 21 s.

### D. Vibratory stimuli to upper body

A 50 Hz vibration was ignited at the start of a hug scene and lasted for two seconds. The amplitude of vibratory stimuli gradually increased, reaching a maximum after one second, and then decreased. The control frequency was 1 kHz.

### E. Adjective attributes used to evaluate hug scenes

Ogura et al. [6] selected 36 adjective attributes to rate the impressions of hug scenes. They were subsequently classified into three categories, i.e., psychophysical, affective, and evaluative, referring to [7], [8], and principal components were computed for each category. We used a representative adjective for each of the ten components. Ten adjectives were *joyful*,

TABLE I  
TEN ADJECTIVE ATTRIBUTES AND THEIR CATEGORIES.

Layer	Adjective	Description
Evaluative	Joyful	I feel a joy.
	Reassuring	I feel peaceful, calm, and free from anxiety.
Affective	Reliable	I feel that people trust each other.
	Enjoyable	The hug is enjoyable and fun.
	Possessive	One of the hugging people appears to monopolize the other.
	Relaxing	The hug scene relieves and unwinds my tension.
Psycho-physical	Dynamic	The hugging motion is not still and dynamic.
	Embracive	One put their arms around the other.
	Forcible	It appears that one hugs the other without his/her consent.
	Mannish	I feel the hug is powerful and manly.

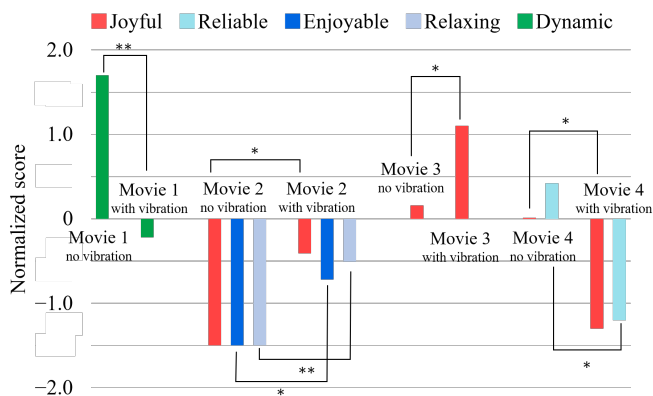


Fig. 2. Changes in the impression of hug scenes caused by vibratory stimuli. \* and \*\* indicate significant differences at  $p < 0.05$  and  $0.01$ , respectively.

*reassuring, reliable, enjoyable, possessive, relaxing, dynamic, embracive, forcible, and mannish.* Table I lists the descriptions that were presented to the participants.

#### F. Procedures

Of the eight hug scenes that each participant watched, three to five were presented with vibratory stimuli. The order of the hug scenes and the presence or absence of vibratory stimuli were randomized and counterbalanced among the participants. Three or four participants viewed each video with the vibration presented. After watching each video, the participants rated each of the ten adjectives on a nine-point scale from one (hardly agree) to nine (largely agree). A One-minute interval was set before viewing another video.

#### G. Data analysis

The scores assigned to the adjectives were standardized using z-scores within individual participants. For each video, we compared the mean scores between trials with and without the vibratory stimuli using a *t*-test. For the multiple tests, *p* values were not adjusted.

### III. RESULT

As shown in Fig. 2, for Movie 1, a hug scene of a son and his mother, the scores for *dynamic* decreased by the vibration.

For Movie 2, where an ape and a lady hug each other, the scores for *joyful*, *enjoyable*, and *relaxing* increased by the vibration. For Movie 3, a hug scene of a son and his father, the scores for *joyful* increased by the vibration. For Movie 4, a hug scene of a daughter and her mother, the scores of *joyful* and *reliable* decreased with the vibration.

### IV. DISCUSSION

Several scores of impressions in four of the eight hug-scene videos were changed through the presentation of vibration to the viewer. The vibratory stimuli may have a significant impact on the joy experienced from viewing hugging scenes as the *joyful* scores were influenced by the vibration for three out of the eight scenes. For example, in Movie 2, a hug between an ape and a lady, the score for *joyful* that was negative was neutralized by the vibration. In Movie 3, in which a father who was separated from his family because of his military duty met his son, the scores for *joyful* also increased. The joy of their reunion might have been more strongly evaluated by the participants in the presence of the vibration. Meanwhile, in Movie 4, showing a hug scene between a mother coming out of a hospital and her daughter, the *joyful* score was reduced by the vibration. The participants may have been more sympathetic to the daughter's concern for her ailing mother.

Thus, the effect of the vibratory stimuli may depend on the video content and may amplify or suppress joyful feelings. On the other hand, the videos used in the experiment were short, ranging from 5 to 12 s, and it is unclear whether the effect can be confirmed when applied to relatively long content such as movies. Nonetheless, it should be noted that the experiments involved a small number of participants with similar cultural backgrounds. The study requires a larger number of participants for the result to be generalized.

### V. CONCLUSION

We investigated the types of impressions that were influenced by the provision of vibratory stimuli to the upper body during the experience of audiovisual content. The vibratory stimuli affect *joyful*, which was the overall evaluation for the hugging scene. Depending on the context of the scenes, the sense of joy was either enhanced or suppressed. For more general conclusions, a larger number of participants should be tested in the future.

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