

# Heightening fear response to horror video scenes by applying vibratory stimuli to upper bodies of viewers

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**Abstract**—We investigated the possibility of heightening the fear response to horror video scenes by applying vibratory stimuli to the upper bodies of the viewers. In earlier studies, such vibratory stimuli were demonstrated to increase basic emotions, including arousal and valence; however, their effects on the viewers’ response to scary experiences have yet to be studied. The participants of our study watched two types of horror video scenes with and without 1-s vibratory stimuli. The combinations of movies and vibratory conditions were randomized. After accounting for the effects of the videos, we observed that the subjective level of fear and skin conductance significantly increased when the participants experienced upper-body vibration when viewing horror scenes. The findings of the study can be exploited in developing emotionally appealing audio-visual contents.

## I. INTRODUCTION

Vibratory stimuli are applied to the upper bodies of viewers to heighten their emotional response to audio-visual content such as movies and games [1]–[3]. Prior researchers have investigated the effects of vibratory stimuli on the emotional response of viewers to various genres of audio-visual content. In these studies, physiological indices and subjective ratings were used to investigate the emotion levels induced by vibratory stimuli. Two types of questionnaire items are typically used in these studies. In one method, the quality of experience, such as realism and immersion, was the focus. In the other method, arousal and valence were rated as the elements of emotions based on the circumplex model of affect [4]. However, the effect of applying vibratory stimuli on the upper body on the fear response to videos has not been investigated.

In this study, this effect on the level of fear response to horror videos was examined. Skin conductance response on the hand was measured as the physiological index, and subjective fear was rated using a Likert scale. We investigated the effect of vibratory stimuli on the skin conductance response and subjective score of fear.

## II. EXPERIMENT

### A. Audio-visual contents

Two horror videos were used as the audio-visual content. Each video was approximately 2–3 min long and included a

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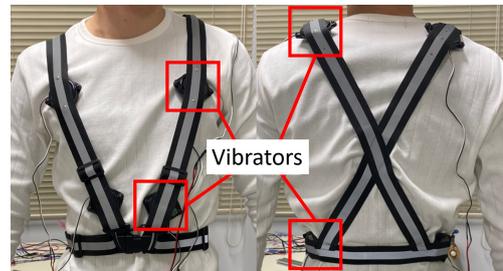


Fig. 1. Vibratory device adapted from [3].

scene where a monster appeared suddenly.

### B. Vibratory stimulus

Voice coil motors (Vp408, Acouve Laboratory, Inc., Japan) were used to present the vibratory stimuli. As shown in Fig. 1, they were attached to the left and right sides of the shoulders, chest, abdomen, and waist of the participants using a strap vest. The vibration started with the monster’s appearance and lasted for a second. The vibration amplitude was constant, and the frequency decreased linearly from 110 Hz to 20 Hz over a second. All the voice coil motors were actuated with the same vibration pattern simultaneously.

### C. Measurement of the fear response

We recorded the skin conductance response on the participants’ hands and their subjective rating of the fear elicited in them by appearance of the monster. The skin conductance increases with an increase in skin moisture, owing to sweating, which indicates intense emotions. The skin conductance generally starts rising within 1–2 s after the onset of the stimulus, peaks within 1–2 s, and then, tapers [5]. We analyzed the amount of increase from the commencement of the rise to the peak, which is generally called the amplitude. We used a measurement unit (AP-U030m II, Nihon Santeku Ltd., Japan) and an amplifier (MaP1720CA, Nihon Santeku Ltd., Japan) to record the skin conductance. After watching each video, the participants rated the level of fear elicited in them by the scenes of the monster’s appearance using a nine-grade questionnaire. Fear emotion is not elicited when only the vibratory stimulus is presented. Therefore, in the experiment, we did not measure the skin conductance and subjective evaluation in response to the vibratory stimulus alone.

#### D. Participants

The participants were 15 university students, who were unaware of the study objectives. They provided written informed consent.

#### E. Experiment tasks

The participants watched two horror videos. The vibratory stimulus was applied for one of these two videos. The change in skin conductance in response to the scene of the monster's appearance was recorded, and the participants rated the level of fear they experienced in reaction to the scene after each trial. Before each trial, the participants stayed in a resting state for several minutes until their skin conductance became steady. The order of the videos and the combinations of the video and vibration conditions for each participant were randomized.

#### F. Analysis

We analyzed the skin conductance amplitude and subjective score in the questionnaire, which were normalized using arithmetic means between the two trials for each participant. Three participants were excluded from the skin conductance analysis because their conductance did not respond to audio-visual and vibratory stimuli. In the experiment, the participants watched two different videos, one of which was presented with vibrations. Therefore, it was necessary to eliminate the effect of the videos from the skin conductance amplitudes and questionnaire ratings to investigate the effect of the vibratory stimulus. We modeled the skin conductance amplitude and subjective score for each trial as the linear summation of the effect of vibration and that of the video as follows.

$$y = a_{\text{vib}}x_{\text{vib}} + a_{\text{video}}x_{\text{video}} + \text{constant} \quad (1)$$

where the first and second terms represent the effects of the vibration and video, respectively.  $x_{\text{vib}}$  was one, when the vibration was present; otherwise, it was zero.  $x_{\text{video}}$  was one when the participant watched Video 1 and zero when the participant watched Video 2. Thus,  $a_{\text{vib}}$  was the increase in the skin conductance amplitude or questionnaire rating owing to the vibratory stimulus.  $a_{\text{video}}$  was the increase when watching Video 1, compared with Video 2. The model parameters were calculated using the least-squares method, with the objective variable being either the skin conductance amplitude or subjective score. We determined the effects of the vibration and video by testing whether  $a_{\text{vib}}$  and  $a_{\text{video}}$  were significantly different from zero in the  $t$ -test.

### III. RESULTS

There was a moderate correlation between the skin conductance amplitude and subjective score ( $r = 0.627$ ,  $p = 0.001$ ). Fig. 2 shows the values of  $a_{\text{vib}}$  and  $a_{\text{video}}$  in (1). For both the skin conductance amplitude and subjective score,  $a_{\text{vib}}$  was greater than zero (skin conductance amplitude:  $p = 0.007$  and subjective score:  $p = 0.006$ ). The vibratory stimulus increased the skin conductance response and subjective fear elicited by the horror scenes.  $a_{\text{video}}$  was greater than zero in the skin conductance model ( $p = 0.003$ ), unlike in the

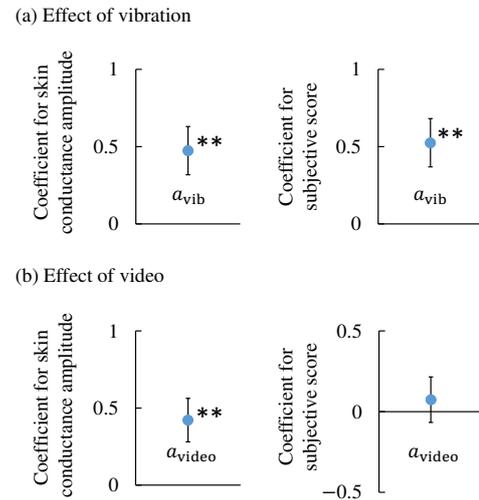


Fig. 2. Value and standard error of  $a_{\text{vib}}$  and  $a_{\text{video}}$  in the model of skin conductance amplitude and subjective score (\*\*:  $p < 0.01$ ).

subjective score model ( $p = 0.605$ ). In other words, the skin conductance response to Video 1 was stronger compared to Video 2. However, the subjective score was the same for both videos.

### IV. DISCUSSION

The vibratory stimuli increased both the skin conductance amplitude and subjective score, indicating that the fear response to the horror videos was heightened. The study engendered an interesting question. Why was the skin conductance response to Video 1 stronger, although both videos were rated as equally scary? The answer may be found in the introspective reports provided by the participants, which indicated that most participants were more startled by the monster's appearance in Video 1. The skin conductance response to the startling monster appearance scene in Video 1 might have been stronger. In other words, although Video 1 might not have been scarier than Video 2, it was more startling.

### V. CONCLUSION

We investigated the possibility of heightening the fear response to horror videos by applying vibratory stimuli to the upper bodies of viewers. The vibratory stimuli increased the skin conductance amplitude and subjective score, indicating heightened fear. This effect can be utilized to enhance emotional reaction to horror movies, video games, and other audio-visual content. In the future, more horror videos should be examined in experiments to obtain more general conclusions.

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