Effect of Advance Elevation of Physiological Activities on Emotionally Appealing Jump-performance Scene of Figure Skating

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***Abstract*—This study investigated whether the intensity of emotional arousal can be magnified by presenting vibratory stimuli to upper body before emotionally appealing scenes of sports videos. To test this possibility, we gave vibratory stimuli to the thoracoabdominal part of participants while they watched competitive figure skating videos. The vibrations were introduced at two time points—just before the jump performance scene and right at the moment the jump occurred. The former increased the viewers' physiological activities, that is, skin conductance responses; however, no clear effects were observed on subjective excitement. In contrast, the vibratory stimuli at the moment of the jump had a definite effect on physiological and subjective responses. Thus, the effects of stimuli presented before emotionally appealing scenes are inconclusive in case of figure skating videos. In contrast, the before-scene stimuli was found to be effective for horror videos in an earlier study. Thus, the effects may depend on the type of emotions evoked by videos.**

***Index Terms*—emotion, vibratory stimuli, audio-visual contents**

I. Introduction

Vibratory stimuli increase emotional experiences evoked while watching videos [1]–[5]. It is not necessary for such vibratory stimuli to coincide in time with the emotional scenes in the videos [6]. Makioka et al. demonstrated that vibratory stimuli presented before fear-evoking scenes in horror videos made the scenes appear scarier [6]. Although the mechanism is not clear, it is possible that the viewer's physiological activity was enhanced by vibration presented in advance ("preceding vibration") and the feeling elicited by the subsequent scene was magnified. Thus far, the influence of preceding vibration was studied using horror videos [6]. Hence, by employing exciting sports videos in this study, the effects of physiological activation before emotionally appealing scenes can be generalized.

II. Methods

A. Apparatus

We used a voice coil motor (Vp604, Acouve Laboratory, Inc., Japan) to stimulate the thoracoabdominal section of the body. The voice coil motor was placed in contact with the participant's epigastric fossa through a vest, as shown in Fig. 1. A similar apparatus was used in our earlier study [6].

The skin conductance response was measured using AP-U030m II (Nihon Suntech, Japan) and a condition amplifier

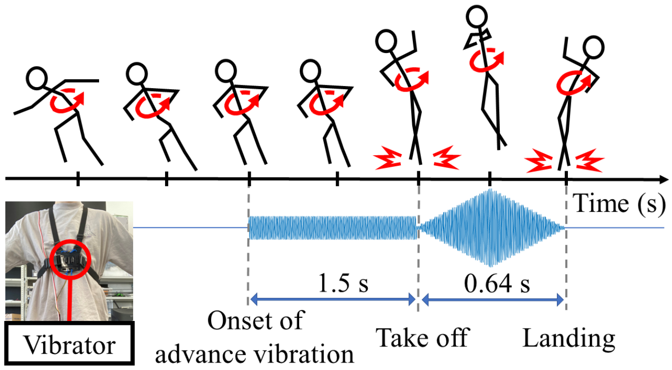

Fig. 1. Stimulus timing and waveform. Adopted from [1], [6].

(MaPI720CA, Nihon Suntech, Japan). Electrodes were placed on the ventral surface of the second and third fingers of the participant's non-dominant hand.

Audiovisual stimuli were played using a signage player (BrightSign/HD220, BrightSign, Inc., CA). The movie was played using a 21-inch monitor, and the distance between the monitor and the participant's eyes was 60 cm. Audio was presented through headphones connected to the monitor.

The voice coil motor, skin conductance response meter, and signage player were connected to a DAQ device (NI USB-6211, National Instrument Corp., TX) and controlled synchronously by Data Acquisition Toolbox of Matlab (Mathworks, Inc., MA).

B. Audio-visual and vibratory stimuli

A total of eight competition videos of different figure skaters, four males and four females, were used as audiovisual stimuli. The videos were played from the beginning of the performance until the completion of the first jump. All videos lasted 30–40 s.

As shown in Fig. 1, two types of sinusoidal vibratory stimuli were used, that is, preceding and main vibration. The main vibration was presented when the competitor jumped and lasted 640 ms. The amplitude was modulated along the triangular waveform, reaching a peak over 320 ms from zero amplitude, then decreasing from peak to zero over 320 ms. The preceding vibration, whose amplitude was one-third that of the main vibration, was presented just before the jump and lasted 1.5 s. The durations of these stimuli were chosen by referring to the previous study [1] to fit the scene of the competitor's jump.

C. Procedures

There were four types of vibration conditions: no vibration, only preceding vibration before the jump, only main vibration during the jump scene, and the combined condition of preceding and main vibration. The combination and order of the four vibration conditions and videos were randomized for each participant. Participants experienced each condition twice, for a total of eight videos. Participants watched the videos while wearing the vests in all stimulus conditions. Thus, they were not aware of the stimulus conditions in advance. After viewing each video, the participants reported the intensity of their excitement at the jump scene on a 9-point Likert scale.

D. Participants

Seven university students (three females) in their 20s who were unaware of the purpose of the experiment participated in the experiment. All participants provided written informed consent before the experiment. This experiment was approved by the institutional review board of Hino Campus, Tokyo Metropolitan University (H23-11).

E. Analysis

The amplitudes of skin conductance response and subjective evaluation scores were compared across stimulus conditions. The amplitude of the skin conductance response was defined as the difference between the value immediately before its rising and the subsequent local maximum. Both values were standardized within individuals (z-score). Two-way analysis of variance was then applied to them to investigate the effects of the preceding vibration and main vibration during the jump performance.

A male participant was excluded from the analysis of skin conductance because no responses were recorded due to his skin condition.

III. Results

Fig. 2 (a) shows the mean and standard errors of the standardized amplitudes of the skin conductance response for each stimulus condition. Two-way analysis of variance for skin conductance responses indicated the main effect of preceding vibration ($F(1, 44) = 16.1$, $p < 0.001$) and the main effect of the main vibration ($F(1, 44) = 20.61$, $p < 0.001$). No interaction between the two main effects was found ($F(1, 44) = 0.01$, $p = 0.92$).

Fig. 2 (b) shows the mean and standard errors of the standardized subjective evaluation scores for each stimulus condition. Two-way analysis of variance for the subjective evaluation scores indicated the main effect of vibration at jump performance scenes ($F(1, 52) = 32.1$, $p < 0.01$). There was no main effect of preceding vibration ($F(1, 52) = 0.23$, $p = 0.64$), and no interaction between the two factors were found ($F(1, 52) = 1.14$, $p = 0.29$).

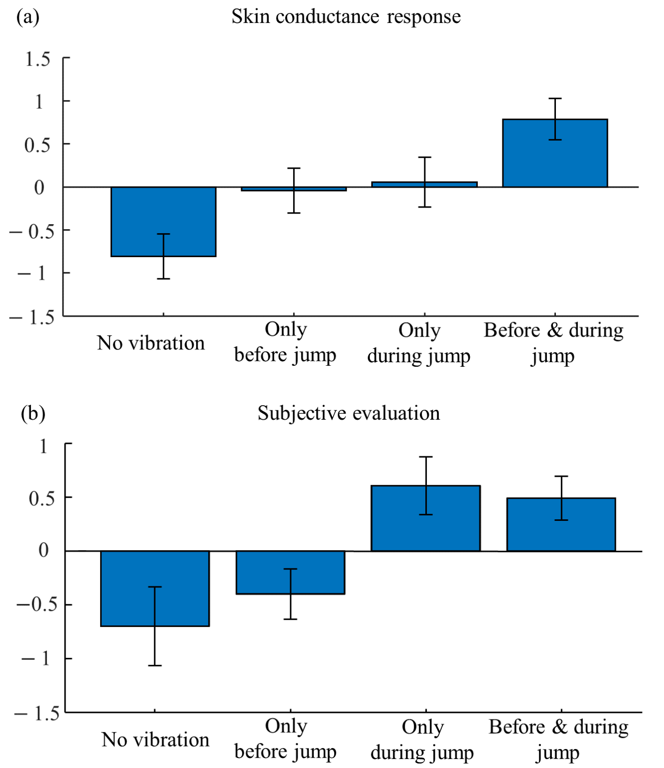

Fig. 2. Means and standard errors of (a) skin conductance responses and (b) subjective evaluation.

IV. Discussion

The effect of preceding vibratory stimuli given before the emotionally arousing jump performance scene in the figure skating videos increased the amplitude of the skin conductance response during the jump performance scene; however, no effect was found in the participants' subjective reports, and the effect of the preceding vibration on their emotions was inconclusive. On the other hand, the main vibration at the jump performance scene exhibited a clear effect on the skin conductance response and sense of excitement. An earlier study using horror videos [6] showed the effects of preceding vibratory stimuli on subjective fear but such effects were not confirmed in this study using figure skating videos. The reasons for this discrepancy are unclear. The intervals between the advance and main vibrations were different between this study and [6], which makes it difficult to directly compare the results of the two studies. Previous studies have rarely used preceding vibration, and their design methods have yet to be established. It is possible that we would reach different conclusions after redesigning the preceding vibration.

References

[1] I. Tara, S. Okamoto, Y. Akiyama, Y. Yamada, and H. Ozeki, "Timing of vibratory stimuli to the upper body for enhancing fear and excitement of audio-visual content," *International Journal of Affective Engineering*, vol. 22, no. 2, pp. 105–113, 2023.

[2] Y. Kosuge, Y. Ogura, and S. Okamoto, "Vibration to upper body manipulates joyful experience while viewing emotional scenes," in *Proceedings of IEEE Global Conference on Consumer Electronics*, 2023.

[3] P. Lemmens, F. Crompvoets, D. Brokken, J. Van Den Eerenbeemd, and G.-J. de Vries, “A body-conforming tactile jacket to enrich movie viewing,” in *Proceedings of IEEE World Haptics 2009-Third Joint EuroHaptics Conference and Symposium on Haptic Interfaces for Virtual Environment and Teleoperator Systems*, 2009, pp. 7–12.

[4] I. Tara, S. Okamoto, Y. Akiyama, and Y. Yamada, “Heightening fear response to horror video scenes by applying vibratory stimuli to upper bodies of viewers,” in *IEEE Global Conference on Life Sciences and Technologies*, 2022, pp. 254–256.

[5] M. Kim, S. Lee, and S. Choi, “Saliency-driven real-time video-to-tactile translation,” *IEEE Transactions on Haptics*, vol. 7, no. 3, pp. 394–404, 2013.

[6] T. Makioka, S. Okamoto, and I. Tara, “Fear magnified by vibratory stimuli to the upper-body at predictive horror scenes,” in *IEEE Global Conference on Consumer Electronics*, 2022, pp. 570–572.