

# Chilly Chair: Facilitating an Emotional Feeling with Artificial Piloerection

Shogo Fukushima

The University of Electro-Communications  
JSPS Research Fellow  
1-5-1 Chofugaoka Chofu, TOKYO, JAPAN  
[shogo@kaji-lab.jp](mailto:shogo@kaji-lab.jp)

Hiroyuki Kajimoto

The University of Electro-Communications  
Japan Science and Technology Agency  
1-5-1 Chofugaoka Chofu, TOKYO, JAPAN  
[kajimoto@hc.ucc.ac.jp](mailto:kajimoto@hc.ucc.ac.jp)



**Figure 1.** (a) Principle of a prototype device, (b) Forearm hair behavior with electrostatic force, (c) Schematic view of the Chilly Chair, (d) Surprised expression on a participant when both audio stimulation and piloerection were presented.

## 1. Introduction

In audio-visual entertainment such as listening to music, game playing, and viewing movies, people frequently seek a richer experience. However the improvement in experience that can be obtained by improving audio and visual quality is reaching its limit.

Adding haptic stimulation to entertainment is a promising step to enrich these experiences and has been attempted in a number of studies such as in a vibration headphone [Koss Corporation], vibration-embedded chair [Israr et al. 2010], and jacket-shaped tactile display [Lemmens et al. 2009]. These tactile interfaces improve the reality of entertainment by transferring various cues from the contents onto the body. In contrast, we present a novel approach that directly facilitates the emotional feeling evoked by the content, using haptic technologies. We speculated that the quantity of emotional feeling evoked by the content is one of the most critical factors in determining the quality of the entertainment.

To enhance the emotional feeling with haptic technologies, we focus on piloerection, which is a type of involuntary emotional reaction. According to James Lange theory, emotional feeling is experienced as a result of physiological change in the body induced by the autonomic nervous system. Damasio et al. also predicted that emotional feeling is evoked by the insula cortex that represents particular bodily reactions such as the sensations of butterflies in the stomach and goose bumps [Damasio et al. 2000]. Our hypothesis is that not only is piloerection an emotional “reaction”, but it can also work as an emotional “input” that enhances the emotional feeling itself.

## 2. Principle and verification

We developed a prototype device that raises forearm hairs using an electrostatic force (Figure 1(a)). An acrylic plate with a copper electrode and a crude rubber sheet attached was bent along the forearm. The electrode was connected to a high voltage source (HJPQ-30P1, Matsusada Precision Inc), and the forearm was connected to the ground. When a high voltage (0~20 kV) is applied to the electrode, the acrylic plate is polarized and the forearm hair is attracted to the acrylic plate by the electrostatic force (Figure 1(b)).

We carried out a psychophysical experiment with the prototype device, to verify our hypothesis that a feeling of surprise (one of the emotions that relate to piloerection) was enhanced by piloerection of the participant’s body hair synchronized with the subjective feeling of surprise. To surprise the participants, we used an audio warning alarm. Two conditions were prepared: one with only audio stimulation, and the other with both audio stimulation and piloerection. We compared the two conditions by means of a questionnaire, asking the participant to quantify the amount of surprise they felt, and by observing the skin conductance reaction (SCR), which is known to vary with the activation of the sympathetic nervous system. From the results, both the amount of subjective surprise and the SCR value increased significantly when piloerection was added to the audio emotional stimulation [Fukushima et al. 2012].

## 3. Chilly Chair

Based on these observations, we constructed the “Chilly Chair”, a chair type piloerection control system that raises the hairs on the back and forearms (Figure 1(c)). Contrary to our previous experiments, we first measured the SCR value and controlled the piloerection accordingly. Consequently we established that the Chilly Chair can be applied not only to audio-visual entertainment, but also to non-computational entertainment such as reading books and dreaming while asleep.

## Reference

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