# TACTILE SENSATIONS INDUCED BY IMAGES OF CLOTHES WITH MOTION PARALLAX

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## ABSTRACT

In recent years, the number of Internet users has been increasing and this is due to the spread of information communication devices. Approximately 80% of the Japanese population uses the internet. Furthermore, over 90% of companies uses the Internet, with the number of companies offering electronic commerce (e-commerce) services increasing each year. However, since 2009, the number of such companies has not progressed. According to a report, the principal reason that consumers cited for not using e-commerce was that they "want to purchase products after seeing the real product." In the current study, proper attention was given to clothes, which had a high sales share in e-commerce. The differences in the visually-induced tactile sensation between users seeing real clothes, compared to when they saw images of clothes are investigated. The current study also proposed techniques, for image editing and presentation, to reduce these differences. 9 thin sweaters were used as an experimental stimulus. Images of the clothes with motion parallax was developed using an application software on a tablet-type device. The participants evaluated the tactile sensation evoked by each stimulus on 11 items with adjective pairs. Findings revealed that the presentation of images with motion parallax evoked visually-induced tactile sensations that were like those evoked when they saw a real sweater. The perceptions of fluffiness, irregularity, and roughness, in particular, were better in the motion parallax condition.

*Keywords*: *Motion parallax, Tactile sensation, Clothes, E-commerce, Semantic differential*

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## 1. INTRODUCTION

In recent years, the number of internet users have been increasing owing to the spread of information communication devices. According to a report by the Ministry of Internal Affairs and Communications(http://www.soumu.go.jp/johotsusintokei/whitepaper/ja/h28/html/nc252110.html) , approximately 80% of the Japanese population use the internet. It is mainly used for email, weather forecasts, and electronic commerce (e-commerce), at rates of 79.6%, 60.0%, and 58.7%, respectively. In addition to that, over 90% of companies use the internet, with increasing numbers of companies offering e-commerce services each year. However, since 2009, the number of such companies has plateaued, as consumers feel that purchasing using e-commerce is associated with a greater risk, than purchasing in real stores. Thus, it is necessary to reduce the risk to expand e-commerce.

The risk in e-commerce includes risk associated with perception. In previous studies conducted by Matsuda (2014) & Morimoto (2014), that focused on clothes, which sold better on an e-commerce platform (http://www.meti.go.jp/policy/it_policy/statistics/outlook/h28report2.pdf), and revealed differences between visual-induced tactile sensation of users who could feel the real shirt, in comparison to those who viewed images on a LCD display monitor. The still images could not transfer the tactile sensations to the observers. Thus, we proposed image processing methods to evoke similar tactile sensations to the images to those evoked in users with access to real clothes. However, further improvement was required since the efficiency was insufficient.

Kobayashi et al. reported that when participants saw some objects in an LCD display monitor with 3-D glasses, the binocular parallax due to the 3-D glasses was effective in reproducing feelings of tactile (Kobayashi, 2010). However, since they are special equipment, 3-D glasses are not popular among daily life. In addition to binocular parallax, however, motion parallax also exists. Motion parallax is the relative difference produced by the motion of the object image on the retina; it allows the perception of depth in humans. When watching motion pictures, this depth cue is used unconsciously. No special equipment is required. In 2015, Fyuse (https://Fyuse/) was released as an application software to acquire images with motion parallax and display them. It also works on Android and iOS platforms, allowing users to easily capture and display images with a sense of greater depth.

In the current study, differences in the visually-induced tactile sensation between users who saw the real clothes and those who viewed the images of clothes with motion parallax are investigated. The purpose of this study was to propose techniques for image editing and presentation to reduce those differences.

## 2. METHOD

### 2.1. Participants

A total of 16 university students (8 female and 8 male students), aged 20–27 years (average: 22.9 years), participated in the current study.

### 2.2. Stimulus

Nine types of thin sweaters were prepared for the experiment (Figure 1), and were photographed as still images and images with motion parallax. Images with motion parallax were captured using Fyuse in a dark room, under two white fluorescent lamps, which were focused on the diagonal upper front of the sweater (Figure 2). When the images were captured using Fyuse, the iPad air was located at a distance of 113 cm from the sweater. Furthermore, the PC camera platform was rotated from -30° left to 30° right of the iPad, at the same distance from the sweater. The brightness of the real sweaters and the images on the iPad were then measured using a luminance meter (KONICA MINOLTA, CHROMA METER CS-200). The brightness of the images was manipulated to match the brightness of the real sweater.

| Sweater | Material | Number of experiment sample image and color | | |
|---|---|---|---|---|
| | | 1(white) | 2(gray) | 3(black) |
| A | Cashmere 100% |  |  |  |
| B | Wool 100% |  |  |  |
| C | Wool 100% |  |  |  |

Figure 1: Image of the sweaters that were used in the current experiment

### 2.3. Procedure

Each participant evaluated the tactile sensation induced by the stimuli using a seven-point scale in a dark room under the same white fluorescent lamps that were used to capture images. The following four presentation conditions were used: 1) seeing a still image of a sweater; 2) seeing images of a sweater with motion parallax, which were acquired using Fyuse; 3) seeing a real sweater, and 4) touching a real sweater. The following 11 tactile items were evaluated: smooth-rough, uneven-even, coarse-fine grained, itchy-not itchy, slick-not slick, cool to touch-not cool to touch, warm-cold, heavy-light, wet-dry, hard-soft, and elastic-not elastic.

During conditions 1 and 2, the distance between the participant and the iPad air was approximately 50 cm. During condition 2, the participant used their finger motion touching the image of the sweater. During condition 3, participants observed the stimulus from the same position as the camera when it captured the images (Figure 3). The order that the stimuli were presented in was randomised.

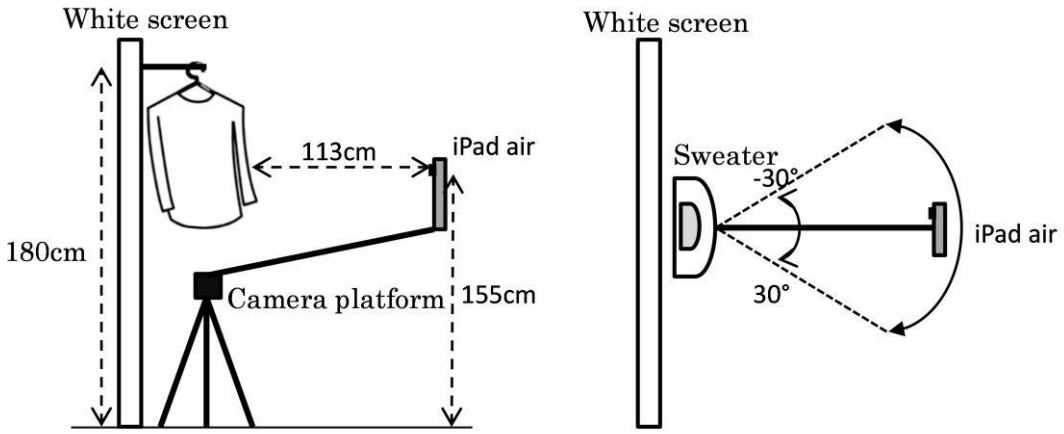


Figure 2: Environment used to capture the images using Fyuse

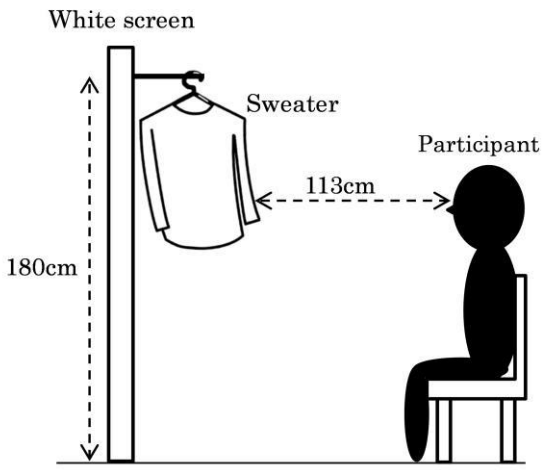


Figure 3: Experimental condition 3

## 3. RESULT

Figure 4 shows the semantic differential profiles during conditions 1 (seeing a still image), 2 (seeing images with motion parallax), 3 (seeing a real sweater), and 4 (touching a sweater). A two-factor analysis of variance (1st: tactile sensation word pairs, 2nd: presentation conditions) was conducted for each sweater (Figure 1, a total of nine sweaters).

For all sweaters, the interaction between two factors were significant. A-1: $F(30, 450)=4.738$, $MSe=1.566$, $p<.001$. A-2: $F(30, 450)=3.836$, $MSe=1.513$, $p<.001$. A-3: $F(10, 150)=33.132$, $MSe=3.898$, $p<.001$. B-1: $F(30, 450)=4.823$, $MSe=1.292$, $p<.001$. B-2: $F(30, 450)=1.862$, $MSe=1.165$, $p=.004$. B-3: $F(30, 450)=2.883$, $MSe=1.590$, $p<.001$. C-1: $F(30, 450)=2.719$, $MSe=1.193$, $p<.001$. C-2: $F(30, 450)=2.609$, $MSe=1.264$, $p<.001$. C-3: $F(30, 450)=3.930$, $MSe=1.333$, $p<.001$.

The analysis of the simple main effect demonstrated significant effects of the following items during the presentation conditions: smooth–rough (A-1,2,3, B-1,3, C-2,3), uneven–even (A-1, B-1,3, c-3), coarse–fine grained (A-1,3, B-1,3), itchy–not itchy (A-1,2,3, B-1,3, C-1,2,3), slick–not slick (B-1,3, C-3), cool to touch–not cool to touch (A-1, C-1,3), warm–cold (A-1, C-3), heavy–light (A-1, B-1,2,3, C-1,2,3), hard–soft (A-2, B-1,2, C-2,3), and elastic–not elastic (A-2).

The results of a multiple comparison using the Bonferroni method (with a significance level of $p<.05$), demonstrated significant differences between conditions 1 and 3 for the following: A-1: smooth–rough, uneven–even, coarse–fine grained, itchy–not itchy, cool to touch–not cool to touch, warm–cold, heavy–light; A-2: smooth–rough, uneven–even; A-3: smooth–rough; B-3: uneven–even, slick–not slick, heavy–light; C-1: itchy–not itchy, C-2: smooth–rough, itchy–not itchy; and C-3: hard–soft. This result indicated that visually-induced tactile sensations during condition 1 was significantly different from those induced during condition 3.

Further, the following items did not show any significant differences between conditions 2 and 3: A-1: uneven–even, itchy–not itchy, cool to touch–not cool to touch, heavy–light; A-2: nothing; A-3: smooth–rough; B-3: uneven–even, coarse–fine grained, slick–not slick, heavy– light; C-1: itchy–not itchy; C-2: smooth–rough, itchy–not itchy; and C-3: nothing. This result indicated that the tactile sensations that were visually induced during condition 2 that was close to those induced during condition 3.

Conversely, the results of the multiple comparison showed significant difference between conditions 3 and 4 as follows: A-1: coarse–fine grained, itchy–not itchy; B-1: hard–soft; B-2: heavy–light; B-3: uneven–even, itchy–not itchy, heavy–light; C-2: heavy–light; and C-3: cool to touch–not cool to touch. The following items did not show any significant differences between conditions 2 and 4: A-1: coarse–fine grained, itchy–not itchy; B-1: hard–soft; B-2: nothing; B-3: uneven–even, itchy–not itchy, heavy–light; C-2: nothing; and C-3: cool to touch–not cool to touch. This result indicated that the tactile sensations that were visually induced during condition 2 were closer to those elicited during condition 4.

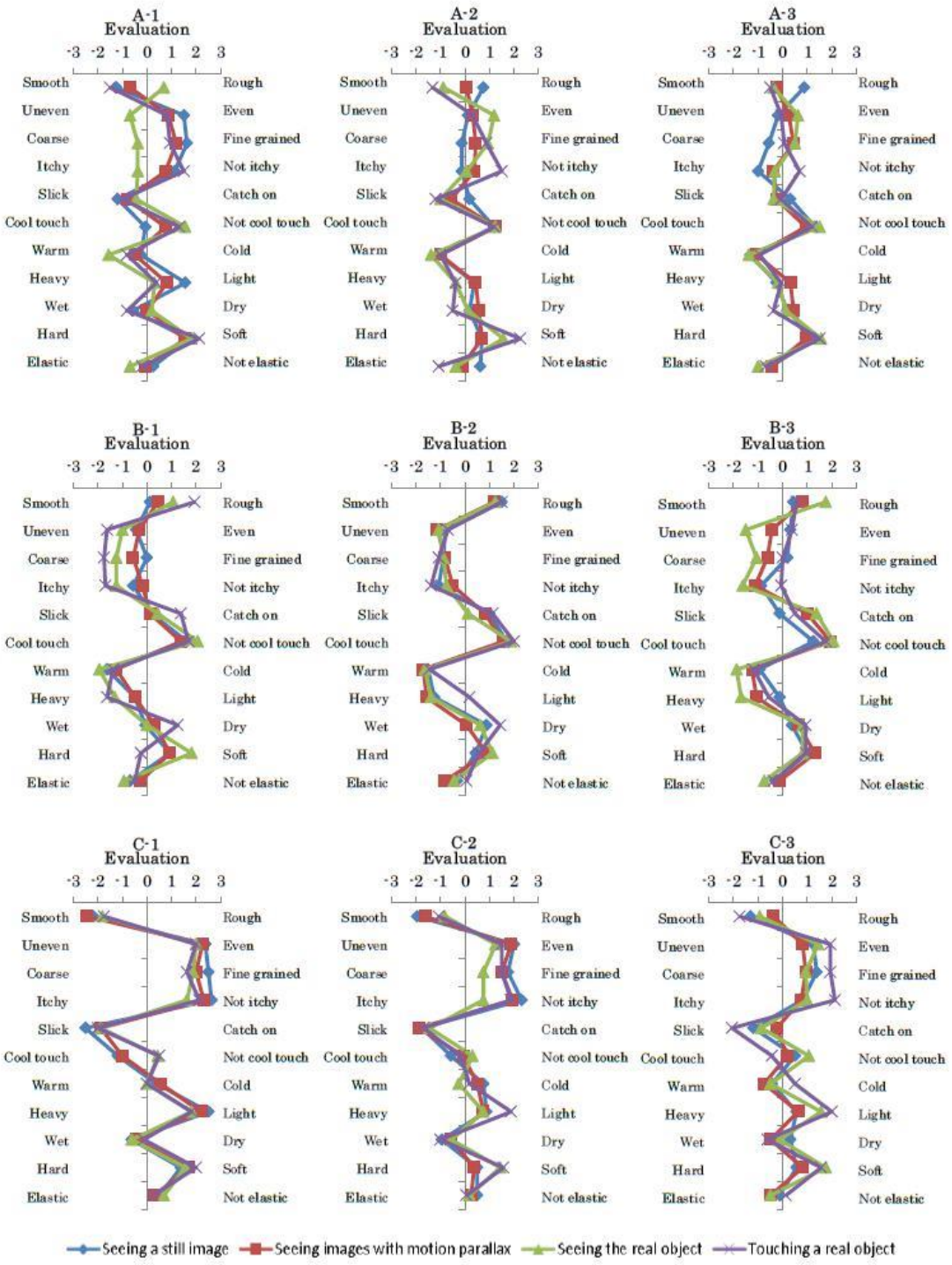


Figure 4: Semantic differential profile for each sweater

## 4. DISCUSSION

The data suggested that the tactile sensation that were visually induced with images with motion parallax were closer to those induced by real sweaters, instead of still images. In particular, the tactile sensations of fluffiness, irregularity, and roughness were very close. Since motion parallax increases depth sensation, sensations of toughness and irregularity during the condition with motion parallax is similar to those elicited in real life.

The data also suggested several differences in the tactile sensations that were visually induced when the sweater was seen, compared to when it was touched. The tactile sensations elicited by wool was especially hard to elicit using visual stimuli alone. However, images with motion parallax accurately improved these visually-induced tactile sensations. Participants are seen to observe images with motion parallax more carefully than the real sweater.

From the above discussion, techniques for displaying images with motion parallax to reduce differences in the tactile sensations that are elicited is proposed.

## 5. CONCLUSIONS

The differences in the visually-induced tactile sensations between when participants saw real clothes, compared to when they saw images of the clothes alone were analysed. The findings revealed that the presentation of images with motion parallax evoked tactile sensations, which were like those that were visually induced when they saw a real sweater. The perception of fluffiness, irregularity, and roughness was better in the motion parallax condition.

The use of Fyuse limited the resolution and photography conditions in the current study. Moreover, some noise and flicker were included in the experimental stimuli. Thus, further study is needed to evaluate the efficiency of image resolution.

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