Basic Recognition Mechanisms of Cloth Textures in Online Shopping

－ Involvement of Visual and Tactile Perception -

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Abstract: The main aim of this research is to elucidate the recognition mechanisms of cloth textures in online shopping. To understand these mechanisms, an investigation of two factors absent in in-store shopping is required. The first relates to the fact that a photographic image of a cloth on a display, which is defined by properties such as its size, resolution, and color reproduction, cannot represent all of the physical features of the actual cloth, such as its drape and fabric construction. The second concerns the cognitive effect of cloth texture judgment through visual perception alone. Tactile judgments based on visual–tactile memory perception can be very difficult; therefore, three experiments were carried out to investigate the identification accuracy of an observer's visual–tactile cloth judgment by comparing a photographic image of a cloth with the actual cloth. As a result, the following aspects were clarified: the judgment of cloth texture by using an actual cloth and its photographic image, differences in visual–tactile perception modality, and the involvement of visual–tactile perception in cloth texture judgment.

Key words: Cloth recognition mechanism, visual perception, tactile perception, actual cloth, photographic cloth image

1. Introduction

Many people now purchase clothes online by looking at digital images presented on a display. The amount of clothing and accessories purchased online is increasing every year [1]. However, online shoppers are sometimes disappointed that the color, texture, and tactile sensation of the actual cloth differ from what they expected. To solve this problem, investigating the mechanisms of cloth recognition on the basis of cross-modal linkage between vision and touch is important. In this study, the observer's accuracy of identification based on his/her visual–tactile response to the actual cloth and a photographic image of that cloth is investigated. This was accomplished by carrying out three fabric identification experiments: blind touch identification of an actual cloth after observing an image of the test cloth (i.e., a visual–tactile (V–T) experiment); visual identification of an actual cloth while observing an image of the test cloth (i.e., visual–visual (V–V) experiment); and tactile identification of a selected cloth after feeling a sample (i.e., tactile–tactile (T–T) experiment). Ten participants were recruited for these experiments. All possessed normal vision and were tested in each experiment. Eleven fabrics were selected as test cloths on the basis of their different characteristics. For each experiment, the percentage of correctly identified test cloths was calculated and then compared. The results indicated that the percentage of correct identifications in the V–V experiment was higher than that in the V–T experiment for most test cloths, and that the correlation between these indices was significant. The V–T experiment showed that subjects needed tactile information only for a few test cloths. In addition, the percentage of correct identifications in the T–T experiment was high. These results suggest that accuracy with regard to cross-modal linkage between visual–tactile perceptions is needed for recognizing these cloths.

2. Cloth Texture Recognition in Online Shopping and Experimental Methods

The process of cloth texture recognition differs between in-store and online shopping in two respects. The first is that in online shopping, shoppers observe a photographic image instead of the actual fabric. Cloth identification is achieved through perception of virtual information (Meaning_1: M1). The second is that online shoppers judge cloth textures based on visual perception alone (i.e., without tactile sensation). In such a case, visual and tactile perceptions are linked in memory (Meaning_2: M2). To explore these effects, three fabric identification experiments were performed. Cloth texture recognition in online shopping and the experimental methods are shown in Figure 1. In the first experiment, a cloth is identified by blind touch after observing its photographic image. This V–T experiment relates to both M1 and M2. In the second experiment, a cloth is identified by visual perception after observing its photographic image. This V–V experiment relates to M1. In the third experiment, a cloth is identified by tactile perception after touching a presented sample.

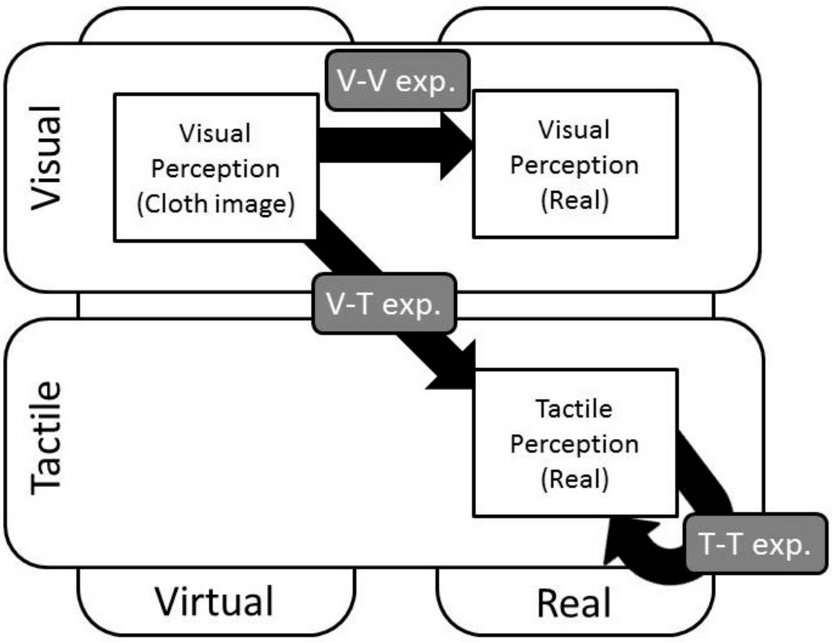

Figure 1. Cloth texture recognition in online shopping and experimental methods

3. Fabric Identification Experiment

3.1. Test cloths and stimuli

Eleven fabrics, mainly used for female formal dress, were selected as test cloths on the basis of their different characteristics. The following fabrics were used: silk lace, ox fabric, Indian-style material, chiffon crepe, velour, velvet, satin stretch, satin organdy, jacquard silk chiffon, silk satin, and satin back shantung. The fabrics were prepared and cut into 20 × 20 cm^2 pieces, as specified by JIS L 1096 [2]. A small square tag was attached to a corner of each piece to indicate its front surface. For photographic purposes, each fabric was cut into a circular piece (diameter: 40 cm). Four types of photograph were taken for each fabric by using a Nikon D50 digital camera with the following settings: exposure value, 13.9; shutter speed, 1/80 s; and aperture, F14. Three of the types involved a circular cloth draped over an acrylic cylinder. The cylinder heights were 1, 2, and 15 cm, respectively, and their diameters were 12 cm, in accordance with the drape tester [2]. The drape complexity levels of 1, 2, and 15 corresponded to the drape fabric shapes created by the acrylic cylinders of heights 1, 2, and 15 cm, respectively. The fourth type of photograph required the same camera configuration, with the circular cloth sample placed flat on a table. This type of picture displayed no fabric drape properties and was thus defined to have a drape complexity level of 0. Figures 2(a)–(d) show the four types of pictures, taking jacquard silk chiffon as an example. In total, 44 pictures served as the test images.

(a) Complexity level of 0 (b) Complexity level of 1 (c) Complexity level of 2 (d) Complexity level of 15

Figure 2. Pictures with different levels of drape complexity (sample fabric: jacquard silk chiffon)

3.2. Conditions of V–T, V–V, and T–T experiments

The experimental procedure differed slightly among the V–T, V–V, and T–T experiments. As noted above, the same 10 observers, all with normal vision, participated in the three experiments. First, an observer entered the experiment booth. Ambient light was provided by a fluorescent light fixture on the ceiling of the room. The horizontal and vertical illuminance values near the center of the display were about 523 and 230 lx, respectively. In the V–T and V–V experiments, observers saw a test image on the display and were then asked to select the actual cloth that corresponded to the image by touching and viewing (at complexity level 15), respectively, eleven actual cloth samples. The stimuli were presented on the 15.4-in display of a VAIO PCG-9S2N personal computer. The viewing distances between the observer's eyes and the display or the actual cloths were about 60 or 120 cm, respectively. Each observer was given as much time as needed to carry out the evaluation. To avoid comparison between successive images, a homogeneous gray plane (N5) was presented between each pair of experimental stimuli. The order of sessions in which the experimental stimuli or actual cloth samples were shown was randomized among test subjects. In the T–T experiment, observers first touched a presented cloth and were then asked to select the corresponding actual cloth. In addition, two cloth patterns were employed as presentation cloths. One pattern was constraint-free and was called "normal fabric." In the other pattern, called "restriction fabric," all factors other than the surface features were eliminated by attaching the cloths to a small square board. Therefore, when a normal fabric was shown, the correct cloth could be identified from the features of the whole fabric, whereas when a restriction fabric was shown, a cloth with a similar surface features could be incorrectly identified.

4. Results and Discussion

The percentage of correct identifications in the V–V and V–T experiments for each cloth is shown in Figure 3. For almost all cloths, this index was higher in the V–V experiment than in the V–T experiment. Moreover, the correlation coefficient between the percentage of correct identifications in the V–V and V–T experiments was as high as ~0.9. This suggests that visual information is very important for cloth texture recognition. However, the percentage of correct identifications in the V–V experiment is not that high despite the cloth identification by the same sense organ. One possible reason for this is that the view of a cloth image taken by a digital camera and then displayed on a monitor may differ from the view of an actual cloth. This difference in the presentation of real and virtual information remains to be worked out in the future. In addition, the difference in the percentage of correct identifications between the V–V and V–T experiments was high with jacquard silk chiffon, chiffon crepe, and velvet. For these cloths, visual identification is possible but tactile identification is quite difficult. These results indicate that some cloths have similar tactile properties to these cloths.

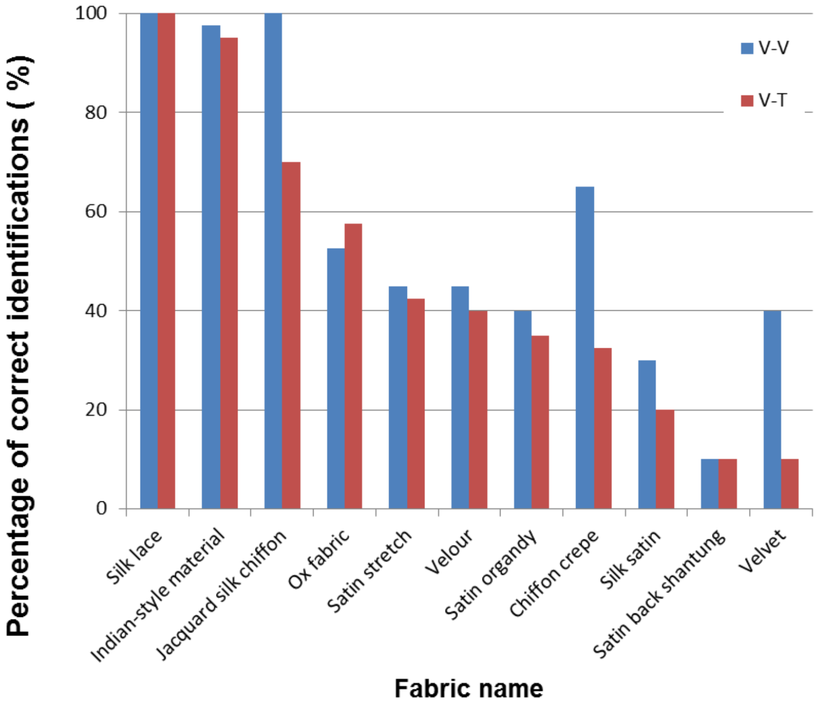

Figure 3. Percentage of correct identifications in V–V and V–T experiments

Figure 4 shows the percentage of correct identifications for each cloth under normal and restriction fabric conditions. Under the normal fabric condition, this index is very high with an average value of about 87%. Under the restriction fabric condition, the percentage of correct identifications is lower than that under the normal fabric condition for almost all cloths, with an average restriction fabric value of about 67%. Therefore, restricting factors other than surface features severely hinders the tactile judgment of cloth. These results suggest that tactile sensation is very important in cloth texture recognition. Additionally, the percentage of correct identifications in the T–T experiment is high for chiffon crepe and velvet. For these fabrics, the percentage of correct identifications differs greatly between the V–V and V–T experiments. These results suggest that accuracy with regard to cross-modal linkage between visual–tactile perceptions is needed for the recognition of these cloths.

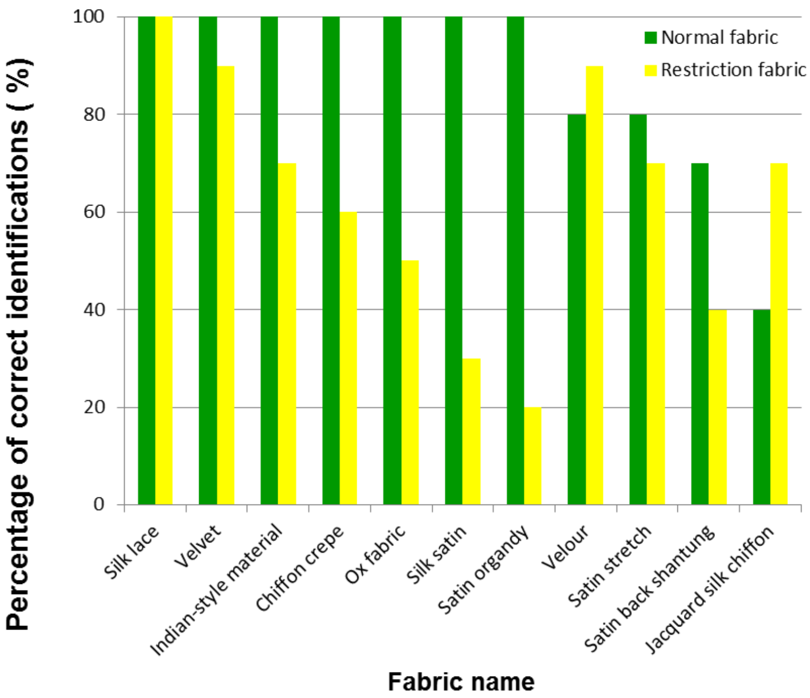

Figure 4. Percentage of correct identifications for normal and restriction fabrics in T–T experiment

5. Conclusions

To investigate basic recognition mechanisms of cloth textures in online shopping, three fabric identification experiments were carried out: visual–tactile (V–T), visual–visual (V–V), and tactile–tactile (T–T). The results indicated that the percentage of correct identifications in the V–V experiment was higher than that in the V–T experiment for most test cloths, and that the correlation between these indices was significant. The V–T experiment clearly showed that subjects needed tactile information for only a few test cloths. In addition, the percentage of correct identifications in the T–T experiment was high. These results suggest that accuracy with regard to cross-modal linkage between visual–tactile perceptions is needed for recognition of these cloths. The results of the T–T experiment showed that the restriction of factors other than surface features can adversely affect the tactile judgment of cloth. These results suggest that tactile sensation is an important element in cloth texture recognition.

Acknowledgements

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References

[1] http://www.soumu.go.jp/johotsusintokei/whitepaper/ja/h23/index.html.

[2] JIS L 1096 (1999), 8.