Identification of Common Words for the Evaluation of Clothes’ Appearance and Tactile Sensation in Online Shopping
– An Indicator for Producing Images that Express Clothes’ Textures –

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Abstract: This study aimed to identify common words in order to evaluate the appearance and tactile sensation of clothes in online shopping. Initial data collection extracted 170 words, which three groups of observers evaluated for appropriateness by describing the look and feel of the clothing they encountered. These groups consisted of 13 female students majoring in fashion design (FFS), 13 male students majoring in engineering (EMS), and 13 female students majoring in subjects other than fashion design (OFFS). After comparing the results of the three groups, 66 terms for appearance and 76 expressions for tactile sensation were selected. Then, each group of observers sorted the words into clusters using the KJ Method. After comparing the clusters for each group, common terms were derived. Ultimately, the results produced 17 shared expressions (8 for appearance and 9 for tactile sensation).

Keywords: Tactile sensation of clothes, Appearance of clothes, Online shopping, KJ Method

1. INTRODUCTION

As broadband infrastructure and wireless technologies have advanced, the number of Internet users is approaching approximately one-third of the world’s population [1]. As Internet use has grown, online shopping has become increasingly prevalent. In particular, the online purchase volume of clothing and accessories has risen steadily [2]. Online shopping has many advantages over brick-and-mortar shopping. For example, consumers can shop at their preferred times, buy new products when they are first released, compare the characteristics of goods (such as prices), and shop without having to worry about being seen by others. However, online shopping also has some downsides, especially when buying clothes. For instance, consumers cannot immediately wear, see, or touch purchased clothing, which can result in the garments looking and feeling differently than the consumer envisioned.

The third drawback (touch) has been particularly important for online clothes shoppers.

Two approaches are necessary to resolve this issue. One is to determine a mechanism by which the consumer can use visual information to discern the textures of clothing. Afterward, this texture recognition method should be examined. In order to establish it, research must be conducted that analyzes the appearance and tactile sensation of clothes.

In terms of research on recognizing the texture of objects, the reports on the psychophysics experiments [3, 4] of Motoyoshi et al. are especially well known. These experiments showed that the statistical values reflected in the intensity histograms of computer-generated (CG) images influence the perception of the depicted object’s brilliance and transparency. This promising result revealed the relationship between the recognition of complex object textures and simple image statistics. However, identifying the feel of fabric requires the consumer to actually see it and touch it, an experience in which the relevant visual and tactile senses fuse into a single impression. The question arises as to whether the intricate process of discerning cloth texture can be replicated using simple statistics embedded in images of the fabric.

In order to explore this question, in our previous work [5] we conducted an experiment to determine the connection between the appearance of cloth in a picture and the tactile perception of the actual item. The results suggested a positive correlation between the rate of identifying the real cloth and its image with the statistical values embedded in the photo. It is thus possible to determine the texture of cloth, not only by seeing a picture of it, but also by analyzing the simple statistics contained in the image.

However, the outcomes of another study we conducted [6] showed that the type of cloth and observer’s performance (knowledge and experiences) influence how accurately
the observer distinguishes the texture, based on the actual object and its image. Since people recognize fabric based on many dimensional scales, an evaluative scale should be prepared to assist observers in discerning texture, and to identify two or more dimensions that can quantitatively assess it. Put another way, if the quality of images is adequate enough for users to evaluate fabric based on these scales, it becomes possible for users to correctly distinguish the texture.

The Kawabata Evaluation System (KES) is a well-known method for the multidimensional evaluation of cloth texture. This system developed by relating perceptions of handling fabric to its mechanical characteristics [7]. Kawabata et al. explained the relationship between 8 classifications of fabric handling (stiffness, anti-drape stiffness, smoothness, fullness and softness, crispness, scrooping feeling, flexible with soft feeling, and soft touch) and 16 measurement parameter items derived from 5 mechanical dimensions (tensile, shearing, bending, compression, and surface). As assessments of fabric handling are primarily connected with tactile impressions, the KES would seem useful for evaluating clothes by touch. However, the utility of KES when visually assessing clothing texture is uncertain. Moreover, ordinary users might not easily understand the KES’ specialized evaluation criteria.

In contrast, the Fabric Kansei Cluster (FKC), a multi-dimensional evaluation of cloth textures proposed by Sakita et al. [8, 9], arose from the fashion industry. Employing eight material axes, the FKC is associated with the recognition of visual properties with tactile ones, and can be used to assess clothing texture. However, these evaluation scales were based on the experiences of people in the fashion industry, and were not acquired based on systematic experimental results. Furthermore, since the FKC does not distinguish the appearance of clothing from its physical sensation, it is hard to obtain separate quantitative evaluation results for the clothing’s look and feel.

This research aims to develop an evaluative scale that will become an indicator for producing images, which makes it possible for users to correctly discern the feel of clothing in online shopping. Based on systematic experimental research, various observers identified evaluation words that describe the appearance and tactile impressions of clothes; these words will form an evaluative scale that can be used in the future for general purposes.

First, evaluation words relevant to the look and feel of clothing were collected, and their evaluative appropriateness was examined. Then, different groups of observers clustered these terms. Finally, common evaluation words for appearance and touch were established by studying the similarities between the expressions across groups. As a result, eight common terms for appearance and nine for tactile sensation were chosen.

2. INVESTIGATING, COLLECTING, AND ASSESSING EVALUATION WORDS

2.1 Investigating and Collecting Evaluation Words

Words for gauging the look and feel of clothes were comprehensively collected [10-16] from domestic and international academic journals. As a result, about 84 terms for appearance, 55 for tactile sensation, and 95 to describe both were collected. The removal of overlapping and duplicated words yielded a total of 170 expressions for assessing the appearance and tactile impressions of clothes.

2.2 Assessing the Appropriateness of Evaluation Words

To assess the evaluative appropriateness of the 170 expressions, 2 questionnaire surveys were conducted: one to gauge their suitability for rating appearance, and the other to see if they were apt for judging tactile sensation. These questionnaires were given to 3 groups of observers, comprising a total of 39 experimental subjects: 13 male students majoring in engineering (EMS), 13 female students majoring in fashion design (FFS), and 13 female students majoring in fields other than fashion design (OFFS), respectively. The 170 words were presented at random on the evaluation sheet and assessed on a 5-point scale (0–4) of suitability (Figure 1). Table 1 displays the results. These observers were employed mainly because the study needed to use evaluation words identified by various participants. First, the FFS group that had cloth’s

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**Figure 1**: Five-point evaluation scale to measure the suitability of the 170 words
knowledge and experience and the EMS group that did not have such a background were employed. Next, because the EMS and FFS groups each consisted of males and females, the OFFS group was used to differentiate between the participants’ knowledge of cloth and experience with it based on gender.

According to the assessment results for suitability in terms of evaluating appearance, approximately equal shares of the FFS group rated the words 1–4 (respectively), with slightly fewer giving a 0. In comparison, roughly half the EMS group gave the words a 1 or 2, while the OFFS group assigned more 0s than the other groups. The outcomes reveal that the FFS group assigned the most 4 ratings, followed by OFFS and EMS (respectively), with FFS giving approximately twice as many 4 ratings as EMS.

Figure 2 compares each group’s ratings of suitability for the words that describe appearance. These cross-comparisons indicate the degree to which observers with different knowledge and experiences will interpret evaluation words to have the same meaning. Here, “R” is the correlation coefficient, and the dotted line represents the average rating of appropriateness (2.1 in FFS, 1.8 in EMS, 1.8 in OFFS) in each group of observers. The correlation coefficients in Figures 2 (a)–(c) are high, with each exceeding 0.84. Thus, there is no significant difference among the three groups in their interpretations of the terms for appearance.

Based on these contrasts, the evaluation words for appearance were extracted under a condition where the overall rating of appropriateness mutually exceeded each observer group’s mean rating of suitability. In Figures 2 (a)–(c), these words are represented in the right upper quadrant. As a result, 66 evaluation words for appearance were derived.

The same analysis was conducted for the suitability of tactile impressions. With regards to the appropriateness of touch, Table 1 shows that roughly half of the FFS group assigned ratings of 3 and 4, while a high proportion of the
EMS and OFFS groups gave a 0. As with the category of appearance, FFS gave the most 4 ratings, followed by OFFS and EMS, with FFS assigning approximately three times more 4s than EMS.

As with the category of appearance, Figure 3 presents the extent to which the groups of observers agree on the appropriateness of the fabric’s look. As in Figure 2, in Figure 3, “R” is the correlation coefficient, and the dotted line shows the average value (2.4 in FFS, 1.7 in EMS, 1.8 in OFFS) of the degree of suitability in each group of observers. The correlation coefficients in Figures 3 (a)-(c) are high, with each surpassing 0.86. With that said, agreement between groups was not as uniform here. Specifically, the distribution in Figure 3 (a) is slightly skewed toward the FFS group. Overall, however, no significant difference was found among the three groups in their interpretations of words for tactile sensation.

Using the same analytical methods discussed in relation to Figure 2, 76 evaluation words were obtained for describing tactile sensation.

3. CLUSTERING EVALUATION WORDS USING THE KJ METHOD

Of the original 170 terms, 142 were selected for further analysis based on appropriateness: 66 for appearance and 76 for touch. Since the pool of words was still fairly large, it was difficult to use them to assess clothing texture in online shopping. Thus, each group of observers further classified the evaluation words into about ten clusters, and common clusters between groups were analyzed with the view that these terms would become the final evaluation scales. The three groups of observers (each comprised of 13 people) aggregated the terms using the renowned Kawakita Jiro (KJ) Method [17], which identifies commonalities and achieves consensus. By comparing the expressions shared by the three groups, new evaluation words with more common features could be identified.

The above process was carried out separately for expressions that described appearance and touch. Two steps were required: in the first, some very similar evaluation words were placed together. In the second phase, these terms were further condensed into about 10 words for each group of observers (for appearance and tactile sensation). Table 2 displays a summary of the expressions that represent each evaluation word identified by the groups.

Regarding the evaluation words for appearance in Table 2(a), FFS seemed to classify terms based on clear, clothing-related concepts such as seasons, textures, occasions, prices, tastes, colors, and shapes. Since the
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OFFS results are similar to those of the FFS group, it is thought that these evaluation words were assembled according to the same concepts. In contrast, the EMS group showed a tendency to summarize the evaluation words using binary terms (e.g., thin/thick), although it seems the EMS group essentially clustered their terms according to the same patterns as the other two groups.

Conversely, the evaluation words for tactile sensation (Table 2(b)) appeared to aggregate according to the features of each group. For example, the FFS group focused on material textures such as thickness, hardness, smoothness, and elasticity, reflecting their greater knowledge of and experience with cloth. However, the OFFS participants tended to focus on words related to seasons and prices, showing less of an interest in fabric and a greater tendency towards polysemy. In addition, similar to the category of appearance, the EMS group once again tended to classify words according to binaries.

In order to find common evaluation words among the groups, the KJ Method was used to compare the identified evaluation words (Figures 4 and 5). In these figures, connections between expressions indicate points of commonality between groups, while words without relationships did not repeat across multiple groups. As shown in Figure 4, 8 shared evaluation words that describe appearance were derived: thin, thick, casual, formal, good impression, bad impression, soft, and vivid. Similarly, as shown in Figure 5, 7 common words for tactile sensation were obtained: thin, thick, flat, rustic, crisp, soft, and stretchy.

Next, the relationship between these shared expressions and the KES texture evaluation scale was examined. The KES texture evaluation scale has eight words related to the feeling of fabric: stiffness, anti-drape stiffness, smoothness, fullness and softness, crispness, scrooping feeling, flexibility with soft feeling, and soft touch. While none of these expressions are the same, it is possible to say that the three most common words for touch—soft, crispness, and smooth—have a similar meaning.

Table 2: Evaluation words for (a) appearance and (b) tactile sensation (for each group of observers)

(a) Evaluation words to describe appearance

<table>
<thead>
<tr>
<th>Evaluation words</th>
<th>FFS</th>
<th>EMS</th>
<th>OFFS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suitable in winter</td>
<td>Suitable in winter</td>
<td>Thin/thick</td>
<td>Suitable in winter</td>
</tr>
<tr>
<td>Suitable in summer</td>
<td>Casual</td>
<td>Casual</td>
<td>Suitable in summer</td>
</tr>
<tr>
<td>Casual</td>
<td>Premium</td>
<td>Formal</td>
<td>Casual</td>
</tr>
<tr>
<td>Formal</td>
<td>Classic</td>
<td>Fancy</td>
<td>Good impression</td>
</tr>
<tr>
<td>Fancy</td>
<td>Dislike</td>
<td>Elegant</td>
<td>Bad impression</td>
</tr>
<tr>
<td>Elegant</td>
<td>Soft</td>
<td>Soft/hard</td>
<td>Soft</td>
</tr>
<tr>
<td>Soft/hard</td>
<td>Unique</td>
<td>Brilliant</td>
<td>Vivid</td>
</tr>
<tr>
<td>Unique</td>
<td>Like</td>
<td>Likable</td>
<td></td>
</tr>
<tr>
<td>Like</td>
<td>Youthful</td>
<td></td>
<td></td>
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</tbody>
</table>

(b) Evaluation words for tactile sensation

<table>
<thead>
<tr>
<th>Evaluation words</th>
<th>FFS</th>
<th>EMS</th>
<th>OFFS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warm</td>
<td>Thin</td>
<td>Weight</td>
<td>Winter</td>
</tr>
<tr>
<td>Thin</td>
<td>Smooth</td>
<td>Rough/smooth</td>
<td>Smooth</td>
</tr>
<tr>
<td>Smooth</td>
<td>Rough</td>
<td>Comfortable</td>
<td>Uncomfortable</td>
</tr>
<tr>
<td>Rough</td>
<td>Crisp</td>
<td>Springy</td>
<td>Crisp</td>
</tr>
<tr>
<td>Crisp</td>
<td>Comfortable</td>
<td>Soft/hard</td>
<td>Soft</td>
</tr>
<tr>
<td>Comfortable</td>
<td>Stretchy</td>
<td>Stretchy</td>
<td>Comfortable</td>
</tr>
<tr>
<td>Stretchy</td>
<td>Flexible</td>
<td>Flexible</td>
<td></td>
</tr>
<tr>
<td>Flexible</td>
<td>Moist</td>
<td>Dry/wet</td>
<td>Bilowing</td>
</tr>
<tr>
<td>Moist</td>
<td>Uncomfortable</td>
<td>Premium</td>
<td>Premium</td>
</tr>
</tbody>
</table>

Figure 4: Common evaluation words to describe appearance

Figure 5: Common words for tactile sensation
The relationship between these common terms and the experimentally acquired FKC material axes was also considered. The material axes are: thin, thick, flat, rustic, soft, crisp, dry, and wet. Despite that only three (thin, thick, soft) were reflected in the common words for appearance, six axes (thin, thick, flat, rustic, soft, crisp) manifested in the shared terms for tactile sensation. This suggests that the FKC material axes are especially useful for assessing the feel of clothes.

It is notable that dry and wet were not extracted from the analyzed data. These attributes were chosen as FKC material axes based on fashion designers’ experiences, and Sukigara et al. [18] highlights the importance of attributes in their report on the Shittori feeling of cloth. While the FKC axes of dry and wet appeared in various forms in the terms listed in Table 2, they were not extracted for several reasons. Firstly, these axes were sometimes clustered with words that have different meanings. FFS grouped them with rough, comfortable, and moist, while EMS classified them in binary categories such as rough/smooth, and dry/wet, and OFFS associated them with summer and uncomfortable. Another reason is that dry and wet have different meanings depending on whether they refer to appearance or touch. Since these meanings change according to the observer, they were thought to vary in terms of appropriateness.

Similarly, although the extracted term stretchy is not an FKC material axis, it refers to clothing function. While this word might not be very important in the fashion world, it is extremely relevant to the general consumer.

4. CONCLUSION

This research ultimately aims to establish a method of presenting images that enables users to correctly recognize the appearance and texture of clothes when shopping online. To that end, it is important to produce images for online shopping that express the texture of clothes. This research identified terms for the look and feel of clothing that various users can generally employ. These terms serve as an evaluative scale, which in turn acts as an indicator for producing images. Words that describe the appearance and tactile sensation of clothes were obtained from academic journals, assessed for their appropriateness by appraising clothes, and classified by different groups of observers. Finally, the most common terms for visual and tactile evaluation were pinpointed by studying the similarities between them. As a result, eight shared expressions for appearance and nine for tactile impression were derived.

Ultimately, 17 common terms were obtained. There were eight for appearance: thin, thick, casual, formal, good impression, bad impression, soft, and vivid. There were nine for tactile sensation: thin, thick, flat, rustic, crisp, soft, dry, wet, and stretchy.

Research is currently being conducted on the production of images, with a focus on evaluation words that have been derived. In addition, assessments of these words by observers, and the effectiveness of producing pictures related to them are being shown [19, 20]. By applying these findings to future research, we hope to conduct an online shopping experiment that uses the evaluation scales for clothing texture obtained in this study.

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