

# Subjective Scores and Gaze Distribution in Personality Evaluations: Effect of Subjects' Clothing on Observers' Impressions of Them

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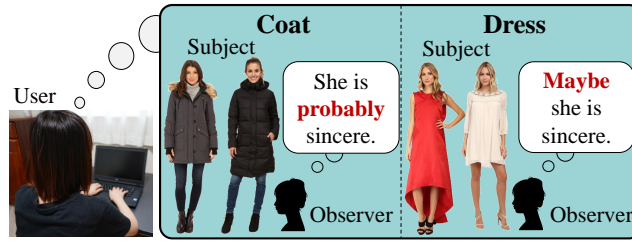
**Abstract.** The clothing that coworkers and others wear in the workplace affects our evaluations of them, including what personality traits we ascribe to them. In this study, we sought to determine whether observers' subjective impressions of a subject's sincerity and nervousness vary depending on the subject's clothing, and the extent to which observers look at subjects' clothing while making those assessments. We measured subjective scores for sincerity and nervousness as components of personality traits perceived by observers. Specifically, we displayed stimulus images containing subjects wearing several types of clothing and measured observers' subjective scores and gaze distributions. The experimental results indicated that the subjects' clothing strongly affected the observers' subjective assessments of the subjects' sincerity and nervousness. We also confirmed that the observers gazed at both the subjects' clothing and head regions.

**Keywords:** Clothing · Personality evaluations · Subjective scores · Gaze.

## 1 Introduction

In online-interaction interfaces, observers frequently form positive impressions of subjects in images displayed on screens, and also form unconscious impressions of those subjects. In particular, observers' impressions are strongly affected by the subjects' clothing (e.g., a woman's dress) [7]. Consider a female shopper exploring an apparel shopping website to purchase clothing to wear at the office. Figure 1 shows that she is concerned about what impression her clothing will give to observers; here, we consider that she is imagining herself wearing what the subjects in the images are wearing. In this paper, we report on our study on how observers perceive subjects wearing office-style clothing. We assumed that the observers were unfamiliar with the subjects.

We consider that the most important impressions will vary depending on individual contexts; however, many relevant impressions are formed in interpersonal



**Fig. 1.** A user buying clothes is concerned about what impression they will give to observers.

relationships. For example, physical appearance is relevant to the impressions that are formed of employees who interact with the public face-to-face, such as retail clerks or ushers at trade shows. In contrast, personality traits such as sincerity and nervousness are relevant to the impressions that are formed of engineers in IT companies or of human resource personnel. In this study, we considered observers' impressions of others' personality traits in an office workplace. More specifically, we investigated sincerity and nervousness as components of one of the Big Five personality traits, conscientiousness and neuroticism [6]. The Big Five are the most commonly used basic personality traits.

Our aim was to quantitatively measure a subjective sincerity score and a subjective nervousness score from Japanese participants. Perceptions of others' sincerity and nervousness vary depending on various subjective elements, such as their hairstyle, facial expressions, and clothing. In this study, we focus on subjects who are wearing clothing for working in an office. In one study [5], it was reported that work clothing affects perceived personality traits. However, those authors used only a text-based questionnaire for analysis. No researcher has yet examined whether what people are wearing in images affects others' impressions of them. To partially close this research gap, we investigated the following hypothesis in the present study:

**Main hypothesis ( $H_m$ ):** Observers' subjective scores for a subject's sincerity and nervousness will vary depending on what the subject is wearing.

Furthermore, we investigated whether observers viewed subjects' clothes while making their assessments. It is generally well-known that an observer's gaze tends to fixate on the subject's head for a long duration [2]. On the basis of this knowledge, then, we investigated the following hypothesis:

**Sub hypothesis ( $H_s$ ):** Observers will gaze at a subject's clothing as well as their head while making assessments about the subject's sincerity and nervousness.

Experimental results showed that both hypotheses  $H_m$  and  $H_s$  were supported. We confirmed that the subjects' clothing strongly affected the observers' subjective assessments of the subjects' sincerity and nervousness. We also confirmed



**Fig. 2.** The clothing categories of coat  $C_c$ , dress  $C_d$ , and sleepwear  $C_s$  used in our investigation.

that the observers gazed at both the subject’s clothing and head regions while making their assessments.

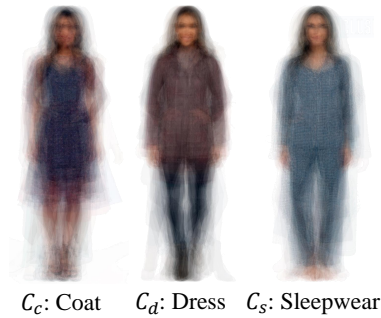
## 2 Methods for measuring subjective scores and gaze distributions during personality evaluations

### 2.1 Stimulus images

To investigate the hypotheses  $H_m$  and  $H_s$ , we selected stimulus images from a multiview clothing (MVC) dataset [9]. The MVC dataset consists of 161,260 images comprising 264 clothing category labels, such as button-up shirts, polos, tank tops, swimwear, and sweaters. Each stimulus image contained a person wearing clothing from one of the clothing categories, and was labeled accordingly (e.g., “tops and coats”). We selected only images of women in which the entire body was included. Furthermore, we selected only clothing category labels belonging to whole-body items such as dresses and coats, and eliminated categories containing exclusively upper- or lower-body items (e.g., tops or bottoms). The following labels were assigned to the clothing categories:

**Clothing category  $C_c$ :** Coat,  
**Clothing category  $C_d$ :** Dress,  
**Clothing category  $C_s$ :** Sleepwear.

Figure 2 shows examples of stimulus images for coat  $C_c$ , dress  $C_d$ , and sleepwear  $C_s$ . The reasons for selecting these clothing categories are described below. We



**Fig. 3.** Average calculated from the stimulus images for each clothing category.

used coats  $C_c$  that are frequently worn when commuting to workplaces such as IT companies and to jobs such as human resources in Japan, where observers' impressions of personality traits are particularly important. We used a dress  $C_d$  typical of those worn by sales clerks at workplaces such as retail department stores and trade shows, where a person's appearance is especially salient. We used sleepwear  $C_s$  as a simple comparison with the other clothing categories.

We resized the height of all the stimulus images to 960 pixels while maintaining the aspect ratio of the original MVC dataset images. To control the experimental conditions, we used only the frontal orientation of the subject's body. Furthermore, each subject appeared in multiple images and wore different clothes in each. The number of stimulus images for each clothing category was 24 and the total number of stimulus images was 72. We checked the alignment of all the images using the average image computed from all the stimulus images. Figure 3 shows the averaged stimulus images for each clothing category. The positions of the face and torso were deemed to be in rough alignment, while the positions of the wrist and toes were not in alignment.

## 2.2 Personality traits

We selected the adjectives to represent personality traits in the present study by referencing existing analytical studies [1, 10] that employed the Big Five personality traits. These traits are categorized as [6]: openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism. Table 1 lists the adjectives that represent the factors of each of the Big Five personality traits.

To detect differences in subjective scores, we used the contrasting categories of conscientiousness and neuroticism. Conscientiousness indicates a tendency toward responsibility, diligence, and seriousness, all of which are strongly associated with the workplace and specifically that found in many IT companies and in departments such as human resources. In contrast, neuroticism indicates a tendency toward strong stress tolerance, another feature associated with the workplace.

**Table 1.** Examples of adjectives representing the Big Five personality traits.

Trait	Adjectives
Openness to experience	Curious, Creative, Imaginative, Smart
Conscientiousness	<b>Sincere</b> , Diligent, Conscientious, Cautious
Extraversion	Fun, Active, Enthusiastic, Social
Agreeableness	Friendly, Generous, Kind, Forgiving
Neuroticism	<b>Nervous</b> , Emotional, Impulsive, Stressful

Finally, we selected the following adjectives to represent conscientiousness and neuroticism, respectively.

- (a): Sincere
- (b): Nervous

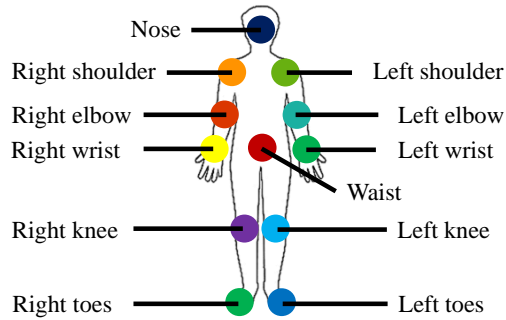
### 2.3 Body-part attention probability for analyzing gaze distribution

To investigate the sub hypothesis  $H_s$ , we measured the body-part attention probability [8] to validate where the observer’s gaze fixated. The body-part attention probability indicated how long an observer viewed which of the subject’s body parts in the stimulus image during gaze measurement. This allowed us to directly compare the body-part attention probabilities among all the stimulus images, which contained a variety of subject postures. For example, even though the subjects’ hand postures differed among the stimulus images (e.g., the hand is in the pocket or the hand is raised), we could quickly check whether observers’ gazes frequently fixated on the hands by viewing the values of the body-part attention probabilities.

To calculate the gaze attention probability, we used the procedure proposed by Kinoshita et al. [8]. Figure 4 shows the body parts used in our gaze analysis. We included 12 body parts: the nose of the face region, the left and right shoulders, the waist of the torso region, the left and right elbows, the left and right wrists, the left and right knees, and the left and right toes. All the body parts except the nose comprised the clothing region. Figure 5 shows examples of 12 body parts automatically detected by OpenPose [4].

### 2.4 Experimental conditions

Twenty-four observers (13 men, 11 women; average age 21.9 years) participated in our experiment. We fully explained the limitations of gaze measurement to the participants and obtained their written consent. Figure 6 shows the experimental setting. The observer was seated at 65 cm from the display, and then adjusted the chair height so that their eye level was 110–120 cm above the ground while seated. The display size was 24 inches (resolution: 1920×1080 pixels, size: 53 cm × 30 cm). We used a Gazepoint GP3 HD eye tracker device to measure eye movement. The sampling rate was 150 Hz, and the angular resolution was



**Fig. 4.** The 12 body parts included in our gaze analysis. We used the nose of the face region, the left and right shoulders, the waist of the torso region, the left and right elbows, the left and right wrists, the left and right knees, and the left and right toes.



**Fig. 5.** Examples of 12 body parts detected in the stimulus images for each subject's clothing category  $C_c$ ,  $C_d$ , and  $C_s$ .

between 0.5 and 1.0 degrees. We displayed the stimulus image at a random position on the screen to avoid center bias [3]. Each observer viewed 24 stimulus images, selected randomly from the repository of 72 stimulus images.

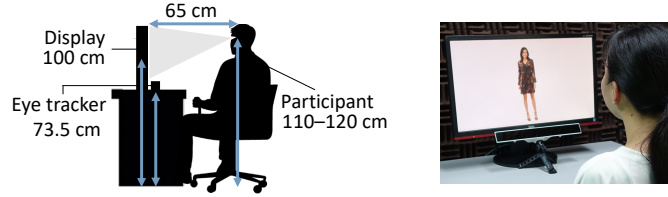
## 2.5 Procedure for measuring observers' subjective scores

The observers were asked the following questions for each stimulus image:

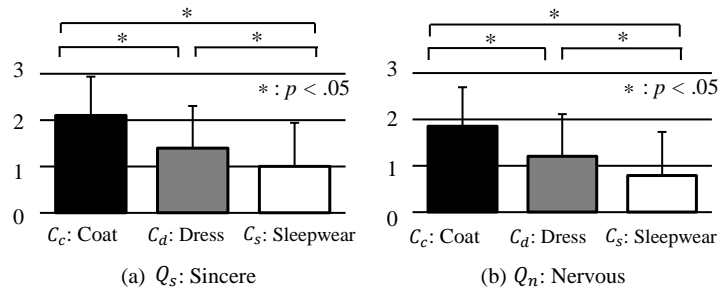
$Q_s$ : How sincere do you perceive the subject to be?

$Q_n$ : How nervous do you perceive the subject to be?

The observers gave their subjective rating for each image on a 4-point scale, ranging from 0 to 3. The higher the score, the more sincere or nervous the observer perceived the subject to be. We used the following procedure to measure observers' scores for the questions.



**Fig. 6.** Experimental setting. Twenty-four observers participated in our experiment. We used a screen to display the stimulus images. To measure gaze distribution, we used a gaze measurement device with a 150-Hz sampling rate.



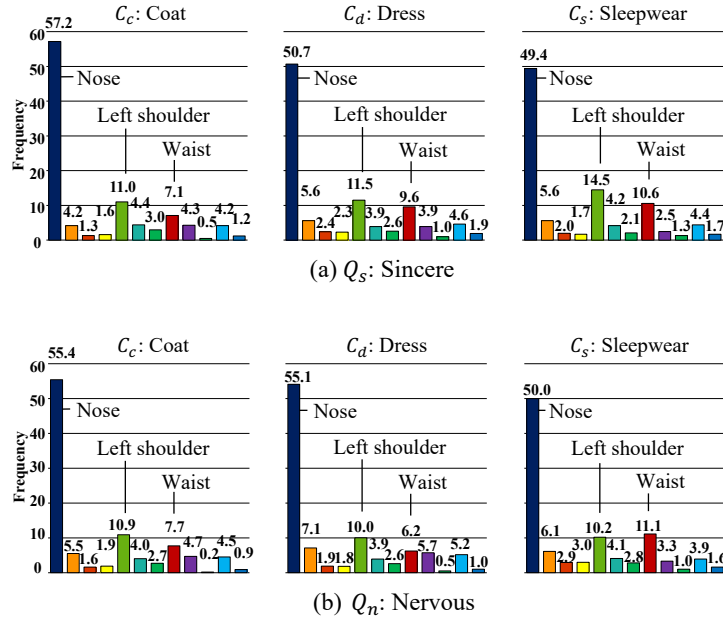
**Fig. 7.** Subjective scores relating to the main hypothesis  $H_m$ . In (a), we asked the question  $Q_s$  to measure perceived sincerity. In (b), we asked the question  $Q_n$  to measure perceived nervousness. We confirmed that the subjects' clothing ( $C_c$ ,  $C_d$ , and  $C_s$ ) strongly affected the observers' subjective assessments of their sincerity and nervousness.

- $P_1$ : We randomly selected one observer.
- $P_2$ : We set the question as either  $Q_s$  or  $Q_n$ .
- $P_3$ : We randomly selected one stimulus image.
- $P_4$ : We displayed a gray image presented on the screen for 2 seconds.
- $P_5$ : We displayed the stimulus image for 8 seconds while measuring the gaze movement.
- $P_6$ : We displayed a black image for 3 seconds, and the observer answered the question verbally.
- $P_7$ : We repeated the procedure  $P_3$  to  $P_6$  for 24 stimulus images.
- $P_8$ : We repeated the procedure  $P_2$  to  $P_7$  for the total number of observers.

### 3 Experimental results

#### 3.1 Results for the main hypothesis $H_m$

Figure 7 shows the subjective scores for the main hypothesis  $H_m$ . In this figure, (a) shows the results for sincere  $Q_s$  and (b) shows the results for nervous  $Q_n$ . It is clear that the subjective scores for coat  $C_c$  were highest and those for sleepwear



**Fig. 8.** Body-part attention probability (%) for clothing categories  $C_c$ ,  $C_d$ , and  $C_s$ . In (a), we asked the question  $Q_s$  to measure perceived sincerity; in (b), we asked the question  $Q_n$  to measure perceived nervousness. All the body parts except for the nose corresponded to the clothing region. Observers viewed both the subjects’ head regions and clothing regions.

$C_s$  were lowest for both questions  $Q_s$  and  $Q_n$ . Furthermore, the subjective scores for coat  $C_c$  in (a) and (b) were higher than the neutral score of 1.5. Additionally, the subjective scores for dress  $C_d$  and sleepwear  $C_s$  were lower than the neutral score of 1.5.

Next, we checked for significant differences in the subjective scores between the clothing categories,  $C_c$ ,  $C_d$ , and  $C_s$ , using the Steel-Dwass test for multiple comparisons. Results showed significant differences ( $p < .05$ ) in subjective scores among all the clothing categories for both questions  $Q_s$  and  $Q_n$ . We confirmed that the subjects’ clothing strongly affected the observers’ subjective assessments of their sincerity and nervousness. The results indicated that the observers perceived the subjects as more sincere and nervous when the subjects wore coats rather than dresses and sleepwear.

### 3.2 Results for the sub hypothesis $H_s$

Figure 8 shows the results of the body-part attention probability analysis. As described in Section 2.3, the region containing all the body parts except for the nose corresponds to the clothing region. The observers’ gazes were fixed





**Fig. 9.** Examples of the stimulus images used in the additional evaluation.

on the subjects' head region (i.e., containing the nose) for the most prolonged time duration, and on the subjects' clothing regions for the remaining time. We observed this same tendency for all clothing categories. From these results, we can confirm that the observers gazed at both the subjects' clothing and head regions. Therefore, we believe that  $H_s$  is supported.

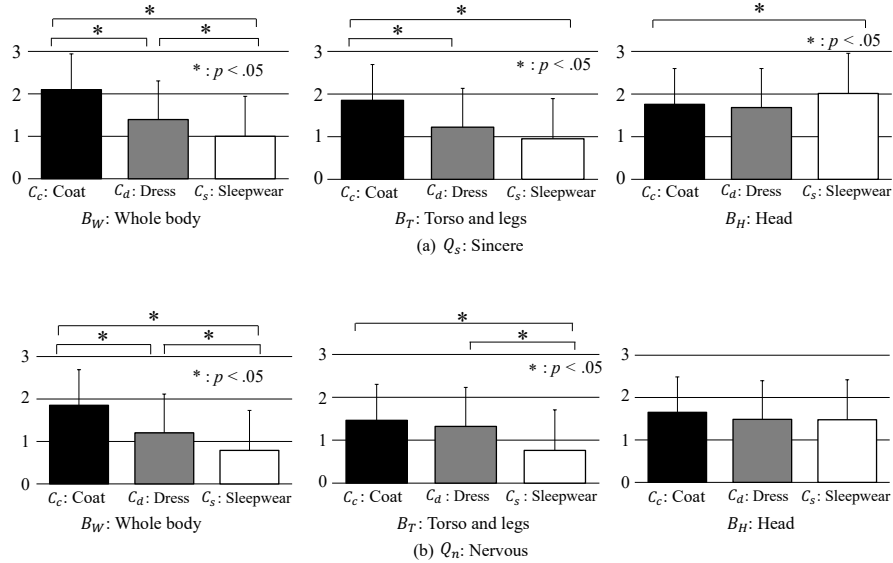
#### 4 Additional evaluation

We further evaluated observers' responses to conditions in which the subjects' head regions (where observers' gazes fixate the longest) and clothing regions were alternately either visible or not visible. We set the stimulus image conditions as

$B_W$ : Whole body,  
 $B_T$ : Torso and legs,  
 $B_H$ : Head.

Figure 9 shows the examples of the stimulus images. In condition  $B_W$  of (a) in this figure, the subject's whole body is visible, the same condition as that shown in Figure 2. In condition  $B_T$  of (b), the top 20% of the stimulus image is obscured with the background color. In condition  $B_H$  of (c), the lower 80% of the stimulus image is obscured with the background color. The experimental conditions, except for the stimulus images, were the same as those described in Section 2.

Figure 10 shows the results for the subjective assessments of the whole body  $B_W$ , the torso and legs  $B_T$ , and the head  $B_H$  for both questions (i.e., regarding perceived sincerity  $Q_s$  and perceived nervousness  $Q_n$ ). Note that the results for  $B_W$  shown in this figure are the same as those shown in Figure 7. A comparison of whole body  $B_W$  and torso and legs  $B_T$  showed that the ranking order of the subjective scores for coat  $C_c$ , dress  $C_d$ , and sleepwear  $C_s$  was the same. By contrast, a comparison of whole body  $B_W$  and head  $B_H$  showed that the ranking order of the subjective scores for clothing categories  $C_c$ ,  $C_d$ , and  $C_s$  differed. For questions about perceptions of sincerity  $Q_s$  when torso and legs  $B_T$



**Fig. 10.** Subjective scores for the stimulus image conditions of whole body  $B_W$ , torso and legs  $B_T$ , and head  $B_H$  used in the additional evaluation. In (a), we asked the question  $Q_s$  to measure perceived sincerity. In (b), we asked the question  $Q_n$  to measure perceived nervousness. All three clothing categories,  $C_c$ ,  $C_d$ , and  $C_s$ , were used. By comparing this figure with Figure 10, we could conclude that the stimulus images containing the subject’s torso and legs, which represent the clothing region, significantly affected the observer’s subjective scores compared with those containing only the subject’s head region.

was displayed, the subjective score for coat  $C_c$  exceeded the neutral score of 1.5. For questions about perceptions of nervousness  $Q_n$  when torso and legs  $B_T$  was displayed, the subjective scores for  $C_c$ ,  $C_d$ , and  $C_s$  did not exceed the neutral score of 1.5. For questions about perceptions of sincerity  $Q_s$  when head  $B_H$  was displayed, the subjective scores for  $C_c$ ,  $C_d$ , and  $C_s$  were higher than the neutral score of 1.5. For questions about perceptions of nervousness  $Q_n$  when head  $B_H$  was displayed, the subjective scores for  $C_c$ ,  $C_d$ , and  $C_s$  were close to the neutral score. These results illustrate that the stimulus images containing the subject’s torso and legs, which represented the clothing region, significantly affected the observers’ subjective scores compared with those containing only the subject’s head region.

## 5 Conclusions

In this study, we investigated the influence on observers of the type of clothing being worn by subjects in digitally presented stimulus images. More specifically, observers rated their subjective impressions of the subjects’ personality traits

in response to images showing subjects wearing a coat, a dress, or sleepwear. Both the main hypothesis  $H_m$  and the sub hypothesis  $H_s$ , respectively, were supported: observers' perceptions of a subject's sincerity and nervousness varied depending on what the subject was wearing, and observers gazed at both the clothing and the face of the subjects while making their assessments.

In future work, we will expand our investigation by using more adjectives that represent the Big Five personality traits, and using more clothing categories.

## Acknowledgment

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