Investigation of temporal changes of gaze locations during characteristic evaluation when viewing whole-body photos

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Abstract. We investigated how the observer's gaze locations temporally shift over the body parts of a subject in an image when the observer is tasked to evaluate the subject's characteristics. We also investigated how the temporal changes of the gaze locations vary when different characteristic words are contained in the tasks. Previous analytical studies did not consider time-series gaze locations, although they did determine that the initial location that the observer's gaze fixates on is the subject's face. In our analysis, we assigned characteristic evaluation tasks to observers and measured their gaze locations temporally while they viewed human images. We computed the distance from the observer's gaze location to the subject's body part at each time point and evaluated the temporal difference of the distances between the tasks. We found that the observer's gaze fixated on the face initially and shifted to the upper and lower body parts. We determined a common pattern of time-series signals of gaze locations among many participants and individual patterns among a few participants. Furthermore, we found that the temporal changes of the gaze locations became similar or dissimilar according to the characteristic words contained in the tasks.

Keywords: Gaze · Temporal change · Subject's characteristic.

1 Introduction

Interactions through displays, such as online presentations and parties, are becoming increasingly popular. In the future, it may be common to interact with others using large displays that show whole bodies (Fig. 1). These potential future online interactions will offer opportunities to gauge other people's characteristics through display images. In formal, real-world scenarios, it is essential to make a favorable impression on others, and this is likely to remain important in the online space. In this paper, we consider how observers alter their behavior when perceiving unfamiliar subjects' characteristics through display images in formal scenarios.

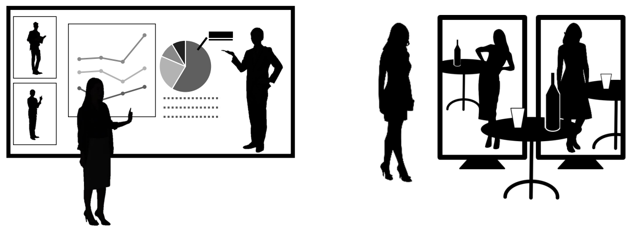

Fig. 1. Future interactions on large displays, in which people use their whole bodies. We consider that people hold online presentations and parties when far away from each other. Observers have more opportunities to perceive subjects' characteristics through images on large displays. In these opportunities, conveying the characteristic that the observers feel favorable is essential, as well as the interaction in real space.

In real-space interactions, observers obtain a large amount of information through vision when they evaluate the characteristics of other people [11, 2, 10, 13]. These visual functions play an important role when evaluating subjects' characteristics on display images. In this study, we consider gaze behavior as a visual function. Specifically, we consider the case in which observers direct their gaze to a subject's face, upper body, lower body, and other body parts.

In analytical studies [7, 14] in cognitive science, researchers investigated the initial gaze locations of observers performing characteristic evaluation tasks. These researchers reported that the gaze first fixates on subjects' faces in images. Based on this observation, we can assume that the face is an important cue in evaluating subjects' characteristics. However, in these analytical studies, the researchers did not investigate how gaze locations temporally shift over other body parts after the observer first looks at a face.

In this study, we investigated how the gaze locations of observers, who are tasked to evaluate characteristics, temporally shift over body parts after the observer first looks at a face. We also investigated whether the temporal changes of the gaze locations varied when the characteristic word included in the task changed. To achieve this, we displayed a stimulus image containing a subject on the display screen. We measured the time series of gaze locations of an observer looking at the stimulus image. We assigned observers the task of evaluating a characteristic word and asked them whether they considered the word to match the stimulus image. We calculated the distance from the body part of the subject in the image to the gaze location measured from the observer and evaluated the time-series signals of the distances. The experimental results demonstrated that the observer's gaze fixated on the face initially, and moved away from the face and variously to the upper and lower body parts as time passed. We found a common pattern of time-series signals of gaze locations among many participants and individual patterns among a small number of participants. We also found

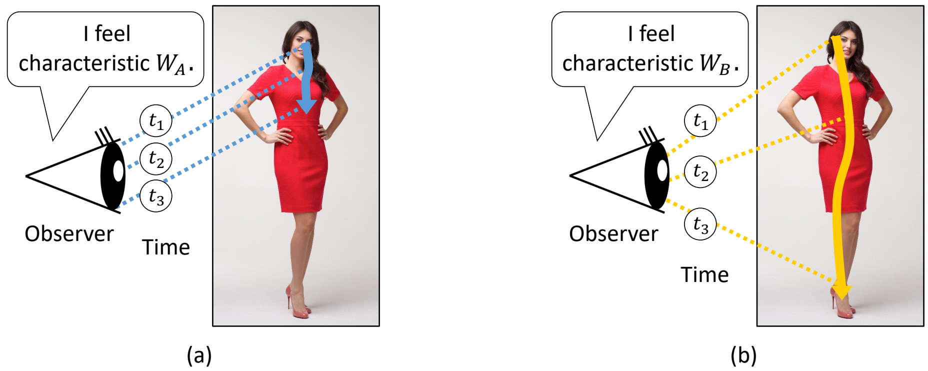

Fig. 2. We assumed that the gaze location of the observer shifted over the body parts of the subject in the image as time passed when the observer was tasked to evaluate characteristic words W_A and W_B.

that some of the characteristic words included in the tasks had similar time-series signals to the gaze locations, whereas others did not have those of the gaze locations.

2 Analysis of temporal changes of the gaze locations

2.1 Hypotheses

We formulated hypotheses to analyze the time-series signals of the gaze locations measured in the task of evaluating characteristics of human images as follows:

H1 : When the participants are tasked to evaluate the characteristics of subjects, the participants' gaze locations temporally shift from the faces of the subjects to other body parts.

H2 : When the characteristic words included in the task change, the time-series signals of the gaze locations described in Hypothesis H1 change.

In this study, we define the gaze location as the point where the gaze direction vector intersects the stimulus image on the display screen at a certain time.

First, we present a specific example (Fig. 2(a)) of what is expected for H1. We consider the case in which a task containing characteristic word W_A, such as gentle or intellectual, is assigned to a participant. We consider that the gaze first fixates on the subject's face, as described in [7, 14, 9, 1, 8, 15, 12]. Then the gaze location shifts from the face to other body parts, such as the chest, as time passes. When we assign a task with another characteristic word W_B, we consider the gaze locations to shift differently over time, as shown in Fig. 2(b). Second, we present a specific example of what is expected for H2. When we compare the time-series signals of the gaze locations between Figs. 2(a) and (b), we consider that the gaze location at each time point differs because of the difference in the characteristic words included in the tasks. To confirm these two hypotheses, we design an experimental method for measuring and analyzing gaze locations. We describe the details below.

2.2 Task

We explain the characteristic words contained in the task. We use characteristic words that often apply to formal scenarios in which many people share social conventions. Specifically, we target characteristic words used in formal scenarios, such as presentations and parties. Note that formal scenarios make people likely to hope to make a positive impression on another person; hence, we exclude words that express negative characteristics.

We had a free discussion to select the characteristic words that fit formal scenarios. As a result, we chose the following six characteristic words used in our analysis:

- Gentle
- Ambitious
- Unique
- Rich
- Intellectual
- Stylish

In our analysis, we assign observers the task of evaluating the characteristic words used in the formal scenario to measure the observers' gaze locations. The tasks are as follows:

T_1 : Do you feel the subject is gentle?
T_2 : Do you feel the subject is ambitious?
T_3 : Do you feel the subject is unique?
T_4 : Do you feel the subject is rich?
T_5 : Do you feel the subject is intellectual?
T_6 : Do you feel the subject is stylish?

We asked the participants to complete each task by answering yes or no in our analysis.

2.3 Stimulus images

We describe the details of the stimulus images observed by the participants. For each participant, we used 100 stimulus images containing subjects. Figure 3 shows a sample of the stimulus images used in our analysis. We only used images containing standing subjects, which are often encountered in formal scenarios, such as poster presentation areas and standing party receptions. The hands and feet were not aligned between the subjects. We assumed that the subject's body area was visible from head to toe and that the subject's face was close to the

Fig. 3. Sample of stimulus images used in our analysis.

front. We excluded sitting and supine postures. We used only one subject per stimulus image. We set the ratio of female to male subjects to 1:1, with 50 males and 50 females. We chose the subject's clothing to be appropriate for formal scenarios such as presentations and parties. We set the subject's facial expression to either smiling or neutral. We assumed that there was no background object in the stimulus image that was more prominent than the subject. We also assumed that there were no other objects in front of the subject. We resized the image to 972 pixels in height. We maintained the aspect ratio of the original image. The average size of the image width was 447.2±82.5 pixels. We collected images from the photo website[1].

[1] https://www.photo-ac.com/

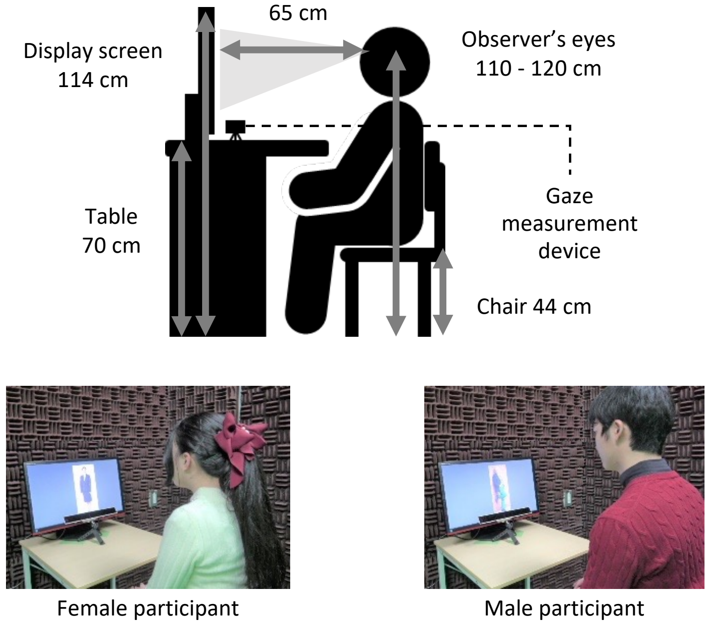

Fig. 4. Experimental settings for gaze measurement.

2.4 Settings

Twenty-four participants (12 males and 12 females, with an average age of 22.0±1.2 years old, Japanese students) participated in the study. We fully explained the disadvantages of gaze measurement to the participants and obtained their consent on a form. The participants and the subjects in the stimulus images were not directly acquainted with each other. During gaze measurement, we required the participants to complete all tasks $(T_1, \ldots, T_6)$. The procedure followed by the participants performing tasks is described in Section 2.5.

In this section, we describe the settings for our analysis. The participant was seated on a chair at a distance of 65 cm horizontally from the display screen. The height of the chair was 44 cm from the floor. The eye height of the participant was between 110 and 120 cm from the floor. We used the settings shown in Fig. 4 to measure the gaze locations of the participants. We displayed the stimulus image on the 24-inch display screen (AOC G2460PF, resolution 1920×1080 pixels, refresh rate 59.94 Hz) to measure the gaze locations. Figure 5 shows examples of the stimulus images on the display screen. We displayed the stimulus images at random locations on the screen to avoid center bias [3, 4]. We used Gazepoint GP3 HD as the gaze measurement device. The sampling rate of this device was 150 Hz. In practice, the interval of the measurement time of the gaze location

Fig. 5. Examples of stimulus images displayed on the screen.

varied. Thus, we resampled at 60 Hz to make the interval equal using bilinear interpolation.

As a preliminary experiment, we evaluated the gaze measurement error using these settings. We showed reference images containing six reference points with known locations to seven people on the screen. The average error from the reference points to the gaze locations was 71.4 ± 32.0 pixels.

2.5 Gaze measurement procedure

We used the following procedure to measure the gaze locations of the participants in our analysis.

P_1 : We randomly selected one participant for gaze measurement.
P_2 : We randomly set the order of tasks $(T_1, \ldots, T_6)$ to be assigned to the participant.
P_3 : We explained the task given to the participant, and the measurement procedure.
P_4 : We displayed a gray image on the screen for one second.
P_5 : We randomly selected one stimulus image from all the stimulus images, without overlap.
P_6 : We displayed the selected stimulus image on the screen for six seconds and recorded the time-series gaze locations of the participant.
P_7 : We displayed a black image on the screen for three seconds.
P_8 : We asked the participant to provide an answer for completing the task explained in P_3.
P_9 : We repeated the procedure from P_4 to P_8 until we used all the stimulus images.
P_{10} : We repeated the procedure from P_3 to P_9 until all tasks were completed according to the task order set in P_2.
P_{11} : We repeated the procedure from P_1 to P_{10} until all participants had completed the tasks.

2.6 Body parts used in our analysis

The subjects in the stimulus images used in our analysis were in standing postures, as described in Section 2.3. The subjects' hands and feet were freely posi-

Fig. 6. (a) Body parts used for our analysis. (b) Examples of the body parts detected from the stimulus images.

tioned. When the subjects in the images were in various standing postures, the positions of the body parts differed between the stimulus images. Thus, we cannot directly compare the measured gaze locations between the stimulus images. We considered detecting body parts from the stimulus images and calculated the relative distances between the body parts and the gaze locations. We explain how we calculated the distance in Section 2.7.

In this section, we explain body parts $b \in \{b_1, \cdots, b_{12}\}$ in Figure 6(a) used in our analysis. We used 12 body parts: the nose in the center of the head region, the right and left shoulders in the torso region, the waist, two right and two left joints in the arms, and two right and two left joints in the feet. To detect the body parts of the subjects in the stimulus images, we used OpenPose [5]. Note that we excluded body parts with close distances between joints, such as palm joints and toe joints, and used only body parts with far distances between joints. Figure 6(b) shows examples of body parts detected in the stimulus images.

2.7 Calculation of the temporal changes of the gaze locations

In our analysis, we used the distance from the measured gaze location to the body part. We describe the method used to calculate the distance below. Suppose gaze location $\boldsymbol{x}(t, i, T, \mathcal{X})$ measured at time t when participant i observes stimulus

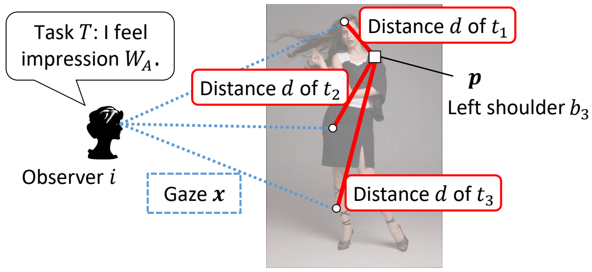

Fig. 7. Calculating distance $d(t, b_3, i, T, \mathcal{X})$ of time t between gaze location $\boldsymbol{x}(t, i, T, \mathcal{X})$ and left shoulder location $\boldsymbol{p}(b_3, \mathcal{X})$.

image $\mathcal{X}$ when task $T \in \{T_1, \cdots, T_6\}$ is given. Distance $d(t, b, i, T, \mathcal{X})$ from gaze location $\boldsymbol{x}(t, i, T, \mathcal{X})$ to location $\boldsymbol{p}(b, \mathcal{X})$ of body part b of the subject in the stimulus image is expressed as

$$d(t, b, i, T, \mathcal{X}) = \frac{\check{D}_{\mathcal{X}}}{D_{\mathcal{X}}} \|\boldsymbol{x}(t, i, T, \mathcal{X}) - \boldsymbol{p}(b, \mathcal{X})\|_2. \quad (1)$$

We use the L2 norm as the distance metric. Let $D_{\mathcal{X}}$ be the distance from the midpoint of the left and right shoulders to the waist point on each stimulus image, and let $\check{D}_{\mathcal{X}}$ be the average value of $D_{\mathcal{X}}$ computed from all the stimulus images. In our analysis, $\check{D}_{\mathcal{X}}$ was 250.0 pixels. As an example, the case of measuring distance $d(t, b_3, i, T, \mathcal{X})$ for left shoulder b_3 is shown in Fig. 7.

Next, using the set $\mathcal{S}$ containing all the stimulus images, we calculate the average distance for body part b at time t as

$$d(t, b, i, T) = \frac{1}{X} \sum_{\mathcal{X} \in \mathcal{S}} d(t, b, i, T, \mathcal{X}), \quad (2)$$

where X is the number of stimulus images. In our analysis, we measured the gaze location at 60 Hz for 6 sec; hence, the total number of gaze locations sampled in the procedure P_6 of Section 2.5 was 360. We had to pay attention to eye blinking, which often resulted in times when the gaze location was not measured. In this case, we did not include times that corresponded to blinking when we calculated the distance.

Finally, we refer to the time-series signal for which the values of distance $d(t, b, i, T)$ at each time point t were aligned in the time direction as the temporal change of the gaze locations.

3 Experimental results

3.1 Analysis of the average temporal changes of the gaze locations

We investigated hypothesis H1 described in Section 2.1 by computing the average temporal changes of the gaze location using distance $d(t, b)$ of time t between

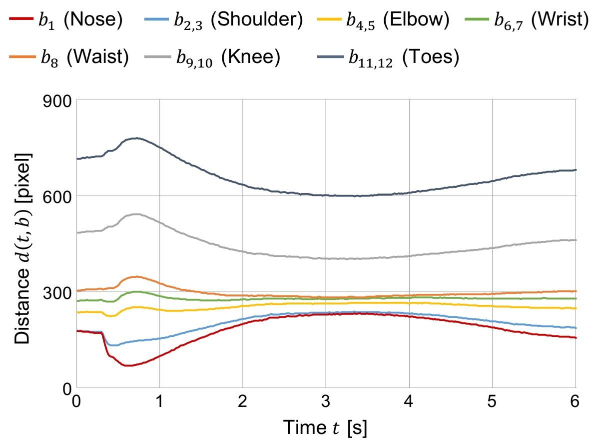

Fig. 8. Average temporal changes of the gaze location for each body part b. Average distance $d(t, b)$ at each time point t was computed from the results for all tasks and participants.

the measured gaze and each body part b as follows:

$$d(t, b) = \frac{1}{6I} \sum_{T \in \mathcal{T}} \sum_{i \in \mathcal{I}} d(t, b, i, T), \tag{3}$$

where $d(t, b, i, T)$ is the distance in Eq. (2), $\mathcal{T}$ is the set of tasks $\{T_1, \cdots, T_6\}$, I is the number of participants, and $\mathcal{I}$ is the set containing all participants.

Before evaluating distance $d(t, b)$, we checked distance $d(t, b, i, T)$ calculated from the symmetrical body parts. Differences in the distance were minimal between the right and left shoulders, between the right and left elbows, between the right and left wrists, between the right and left knees, and between the right and left toes. Thus, we averaged the distances between the left and right body parts for symmetrical cases. In our analysis, to calculate the distance, we used the following body parts: shoulder $B_{2,3}$, elbow $B_{4,5}$, wrist $B_{6,7}$, knee $B_{9,10}$, and toes $B_{11,12}$.

Figure 8 shows the average temporal changes of the gaze location using distance $d(t, b)$ for each body part b. The vertical axis represents the magnitude of the value of $d(t, b)$. If this magnitude is small, the gaze location is close to the body part location on average. The horizontal axis represents time t when the gaze location was measured.

Between $t = 0$ sec and 0.3 sec, there was a period when the average distance was almost unchanged. We consider that the participants' brains worked to respond in some way to the stimulus image in this period. After $t = 0.3$ sec, the average distance for the nose b_1 continually became smaller, reaching a minimum distance at 0.6 sec. We consider that the participants shifted their gaze to the subject shown at a random position on the display screen and started to observe the subject's face. This result shows the same tendency as the results in previous analytical studies [7, 14]. After $t = 0.6$ sec, the average distance for the nose b_1 tended to increase toward 3.1 sec, and this increase gradually became smaller. By contrast, the average distance for the toes $b_{11,12}$ tended to decrease, and this decrease gradually became smaller. We did not determine any particular body part for which the average distance was extremely small in this period. Between $t = 3.1$ sec and 6 sec, the average distance for the nose b_1 gradually decreased, and conversely, the average distance for the toes $b_{11,12}$ gradually increased.

We summarize the results of our analysis of hypothesis H1. The participants not only looked at the face at all times but also observed other body parts in addition to the face after first looking at it. However, we cannot say that the body part where the gaze fixated was common among the participants or stimulus images. We confirmed that the gaze locations variously shifted to upper and lower body parts over time.

3.2 Temporal changes of the gaze locations of each participant

We evaluated the temporal changes of the gaze locations of each participant. We computed distance $d(t, b, i)$ of participant i as

$$d(t, b, i) = \frac{1}{6} \sum_{T \in \mathcal{T}} d(t, b, i, T), \tag{4}$$

where $d(t, b, i, T)$ is the distance in Eq. (2) for each task T and $\mathcal{T}$ is the set of tasks $\{T_1, \cdots, T_6\}$. We used seven body parts b as follows: nose, shoulders, elbows, wrists, waist, knees, and toes.

We applied hierarchical clustering to visualize the temporal change patterns of the gaze location. First, we computed distance $d(t, b, i)$ using Eq.(4) at body part b for time t for each participant i by averaging the distances for all stimulus images and all tasks. Next, we generated a matrix with $d(t, b, i)$ elements for each participant. The size of the matrix was 360×7. Each matrix corresponded to a specific participant. We used the Frobenius norm as the distance metric between matrices. We set the number of clusters to four.

We applied hierarchical clustering to the temporal changes of the gaze locations of 24 participants and found that 17 belonged to cluster 1, 3 to cluster 2, 2 to cluster 3, and 2 to cluster 4. Figure 9 shows the representative temporal change of the gaze location for one participant in each cluster. The vertical axis represents the magnitude of $d(t, b, i)$. A small value indicates that the gaze location was close to the location of body part b. In the figure, we show the temporal changes of gaze location for one of the participants of the pair with the smallest norm in each cluster. Figure 9(a) shows the temporal change of the gaze location in cluster 1, which included most participants. In this cluster, participants not only looked at the face at all times but also observed other body parts after first looking at the face. The remaining clusters are shown in Figs. 9(b)–(d). Although the number of participants that belonged to the cluster was small, each cluster demonstrated an individual pattern of temporal change of gaze location.

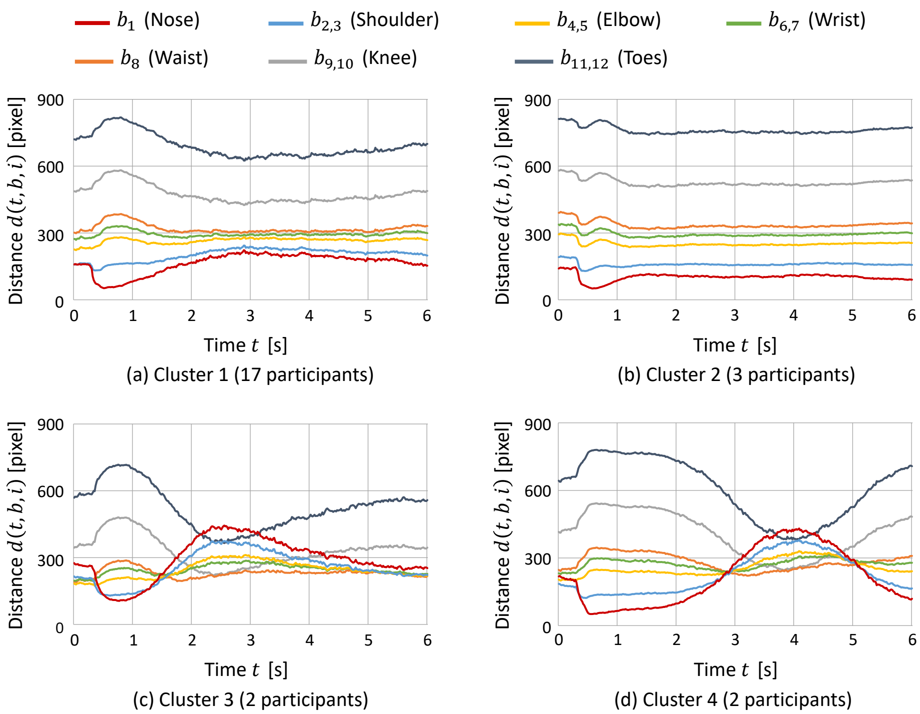

Fig. 9. Temporal changes of gaze locations $d(t, b, i)$ for representative participant i. We performed hierarchical clustering using all participants.

In cluster 2, the participants' gaze first gathered at the nose and continued to stay near the face. In clusters 3 and 4, the participants shifted their gaze more to the lower part of the body, such as the feet, compared with the results in cluster 1. From these results, we believe that there was a common pattern of temporal change of gaze location among many participants and individual patterns among a small number of participants.

3.3 Comparison of the temporal changes of the gaze locations between characteristic words

We investigated hypothesis H2 described in Section 2.1 by visualizing the differences in the temporal change of the gaze locations between tasks containing different characteristic words. In this analysis, we focused on the body part of the nose b_1. We computed distance $d(t, b_1, T)$ for each task $T \in \{T_1, \dots, T_6\}$ as

$$d(t, b_1, T) = \frac{1}{I} \sum_{i \in \mathcal{I}} d(t, b_1, i, T), \quad (5)$$

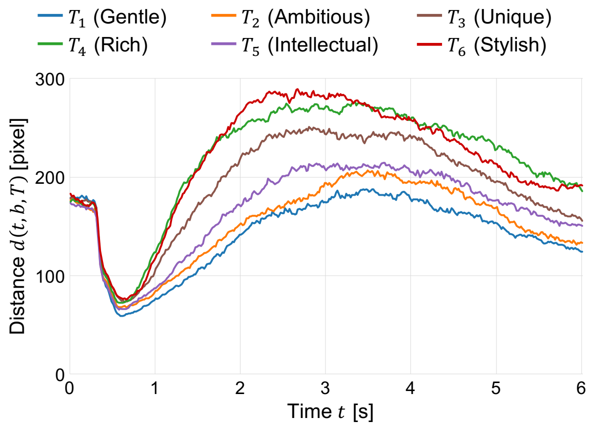

Fig. 10. Visualization of the temporal changes of the gaze locations $d(t, b_1, T)$ for each task $T \in \{T_1, \ldots, T_6\}$ of each characteristic word. We computed these temporal changes for the body part of the nose b_1.

Table 1. We computed the distance matrix between the task vectors using the temporal changes of the gaze locations $d(t, b_1, T)$. T_1: Gentle, T_2: Ambitious, T_3: Unique, T_4: Rich, T_5: Intellectual, T_6: Stylish.

	T_1	T_2	T_3	T_4	T_5	T_6
T_1	0	254.5	1040.2	1548.1	512.9	1562.6
T_2	254.5	0	823.2	1325.5	302.6	1348.8
T_3	1040.2	823.2	0	536.5	547.7	537.3
T_4	1548.1	1325.5	536.5	0	1049.8	218.8
T_5	512.9	302.6	547.7	1049.8	0	1070.4
T_6	1562.6	1348.8	537.3	218.8	1070.4	0

where $d(t, b_1, i, T)$ is the distance in Eq. (2), I is the number of participants, and $\mathcal{I}$ is the set containing all participants. Figure 10 shows the time-series signals of distance $d(t, b_1, T)$. Between $t = 0$ sec and 0.6 sec, the distances were almost common among all tasks. Between 0.6 sec and 6 sec, the distances increased and decreased over time for all tasks. Additionally, there were differences in the timing of the increase and decrease among the tasks. The experimental results demonstrated that the tendency was similar in all tasks; that is, the gaze locations approached the nose first and then left. We found that the timing of the gaze shift after the participant looked at the nose differed between tasks.

We further investigated the differences in the temporal changes of the gaze locations. We generated a task vector for each task's $d(t, b_1, T)$ values, arranged in ascending order at time t. We calculated the distance matrix between the task vectors using the L2 norm. Table 1 shows the distance matrix between

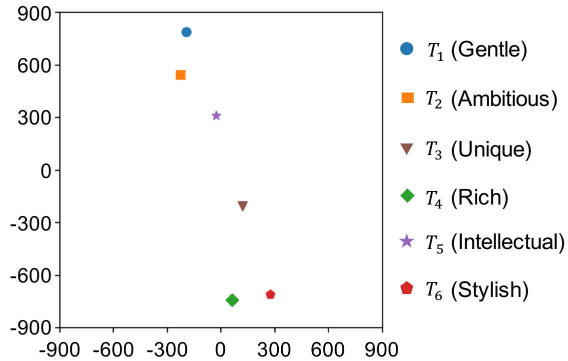

Fig. 11. Results of placing each temporal change of the gaze location for each characteristic word on a two-dimensional plane. We calculated metric MDS using the distance matrix of the task vector.

the task vectors. We applied the metric multidimensional scaling (MDS) [6] to the distance matrix and placed the task vectors on a two-dimensional plane, as shown in Fig. 11. The distance between gentle T_1 and ambitious T_2 was small, which indicates that the temporal changes of the gaze locations were similar to each other. Similarly, the distance between rich T_4 and stylish T_6 was small, which indicates that the temporal changes of the gaze locations were similar to each other. T_1 and T_2 were placed further away from T_4 and T_6, which indicates that the temporal changes of the gaze locations were not similar. In particular, the distance between T_1 and T_6 was the largest. For the unique T_3, there was nothing placed particularly close to it. The intellectual T_5 was placed close to T_2. From the results of our analysis into hypothesis H2, we found that there were words with similar and dissimilar temporal changes of the gaze locations among the characteristic words included in the tasks. This suggests that changes in characteristic words probably cause differences in the temporal changes of the gaze locations.

4 Conclusions

We investigated how observers temporally view the body parts of subjects in images when they are assigned a task to evaluate characteristics. We also investigated whether the temporal changes of the gaze locations differed when the characteristic words in the task changed. We calculated the distance from the body part of the subject in the image to the measured gaze location. We compared the time-series signals of the calculated distance. From the experimental results, we confirmed that the observer's gaze initially fixated on the face, then moved away from the face and variously shifted to the upper and lower body parts as time passed. We also confirmed a common pattern of temporal change of gaze locations among many participants and individual patterns among a small number of participants. Furthermore, we determined characteristic words with similar and dissimilar temporal changes of the gaze locations.

In future work, we will analyze the temporal changes of the gaze locations measured using various characteristic words. We will also expand our analysis to various subjects' appearances, such as age, body shape, and race, in the stimulus images.

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References

1. Bareket, O., Shnabel, N., Abeles, D., Gervais, S., Yuval-Greenberg, S.: Evidence for an association between men's spontaneous objectifying gazing behavior and their endorsement of objectifying attitudes toward women. Sex Roles pp. 245–256 (2018)
2. Bente, G., Donaghy, W.C., Suwelack, D.: Sex differences in body movement and visual attention: An integrated analysis of movement and gaze in mixed-sex dyads. Journal of Nonverbal Behavior (22), 31–58 (1998)
3. Bindemann, M.: Scene and screen center bias early eye movements in scene viewing. Vision Research **50**(23), 2577–2587 (2010)
4. Buswell, G.T.: How people look at pictures: A study of the psychology of perception of art. University of Chicago Press (1935)
5. Cao, Z., Hidalgo, G., Simon, T., Wei, S.E., Sheikh, Y.: Openpose: Realtime multi-person 2d pose estimation using part affinity fields. IEEE Transactions on Pattern Analysis and Machine Intelligence **43**(1), 172–186 (2021)
6. Cox, M., Cox, T.: Multidimensional scaling. Part of the Handbook of Data Visualization, Springer pp. 315–347 (2008)
7. Gervais, S.J., Holland, A.M., Dodd, M.D.: My eyes are up here: The nature of the objectifying gaze toward women. Sex Roles **69**, 557–570 (2013)
8. Hollett, R.C., Morgan, H., Chen, N.T.M., Gignac, G.E.: Female characters from adult-only video games elicit a sexually objectifying gaze in both men and women. Sex Roles **83**, 29–42 (2020)
9. Kinoshita, K., Inoue, M., Nishiyama, M., Iwai, Y.: Body-part attention probability for measuring gaze during impression word evaluation. In: Proceedings of 23rd International Conference on Human-Computer Interaction, CCIS 1420. pp. 105–112 (2021)
10. Mason, M.F., Tatkow, E.P., Macrae, C.N.: The look of love: gaze shifts and person perception. Psychological Science (3), 236–239 (2005)
11. Mehrabian, A.: Silent messages: Implicit Communication of Emotions and Attitudes. Wadsworth Publishing Company (1971)
12. Nishiyama, M., Matsumoto, R., Yoshimura, H., Iwai, Y.: Extracting discriminative features using task-oriented gaze maps measured from observers for personal attribute classification. Pattern Recognition Letters **112**, 241–248 (2018)

13. Pfeiffer, U.J., Vogeley, K., Schilbach, L.: From gaze cueing to dual eye-tracking: Novel approaches to investigate the neural correlates of gaze in social interaction. Neuroscience & Biobehavioral Reviews **37**(10), 2516–2528 (2013)
14. Philippe, B., Gervais, S.J., Holland, A.M., Dodd, M.D.: When do people "check out" male bodies? appearance-focus increases the objectifying gaze toward men. Psychology of Men and Masculinity **19**(3), 484–489 (2018)
15. Riemer, A.R., Haikalis, M., Franz, M.R., Dodd, M.D., Dilillo, D., Gervais, S.J.: Beauty is in the eye of the beer holder: An initial investigation of the effects of alcohol, attractiveness, warmth, and competence on the objectifying gaze in men. Sex Roles **79**, 449–463 (2018)