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Effects of the Dynamic Presentation of Smile on the Evaluation of Various Impressions of Face

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We investigated whether dynamic presentation affects the perception of various impressions of smiling faces using computer-morphed animations of facial expressions. They comprised a combination of two types of presentation mode (static or dynamic) × two types of presentation time (longer or shorter) × two levels of smile intensity (slightly weaker or stronger than the original smile). In the emotional intensity rating task (experiment1), the main effect of the presentation mode was not observed. In the impression rating task (experiment2), five rating items — attractiveness, vitality, beauty, kindness, and sturdiness — were used to assess the various impressions. We found small and limited effects of the dynamic presentation in an interaction with the level of smile intensity, and the effects were found only in the rating items of attractiveness and beauty. These results are discussed focusing on the evaluation characteristics of the aesthetic impression of smiling faces.

Key words: perceived impression, smiling face, dynamic and static presentation

Introduction

Smiles play an important role in the facilitation of human communication. People smile frequently in their daily lives to express feelings such as friendliness and intimacy in human relationships as well as to express internal feelings of happiness and enjoyment. Smiles generally correlate with the positive impressions perceived in social human interaction. For instance, observers perceive a smiling person to be more attractive, sociable, and kind (Otta, Pereira, Delavati, Pimentel, & Pires, 1993; Yoshikawa, 1995) as compared to a non-smiling person. Moreover, the level of smile intensity is identified as an important factor in determining the degree of the impressions of the face. For instance, facial attractiveness increased up to a limit as a function of smile intensity, but began to decrease when the intensity was too strong (Ishi, Gyoba, & Kamachi, 2003).

However, most studies that investigate the smiling effect on the perceived impressions of a face have focused on the static image, despite the fact that in real human communication, faces are dynamic rather than static. Recent psychological studies have provided evidence that motion contributes to some aspects of face processing. They have demonstrated the effect of motion in the

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judging of gender (e.g., Hill & Johnston, 2001) and identity recognition (e.g., Hill & Johnston, 2001; Knappmeyer, Thornton, & Bühlhoff, 2003; Pike, Kemp, Nicola, Towel, & Phillips 1997). Further, other studies have examined the effect of the dynamic presentation of facial expressions on their identification and revealed that facial motion contributes to the processing of facial expression. They suggest that at least to some extent, the dynamic property is a useful cue in the recognition of specific emotions in facial expressions (Wehrle, Kaiser, Schmidt, & Scherer, 2000; Kamachi et al., 2001), especially those that are subtle and non-intense (Ambadar, Schooler, & Cohn, 2005).

Besides the recognition of emotions from facial expressions, does the dynamic presentation affect the perceived impressions of smiling face such as attractiveness? It is known that moving faces are rated as more attractive than static faces (Knappmeyer, Thornton, Etkoff, & Bühlhoff, 2002), and it is also reported that the attractiveness of static and dynamic faces were judged by different evaluative standards (Rubenstein, 2005). However, the role of motion on attractiveness and other various impressions of a smiling face still remains unclear.

In the present study, we aimed to examine whether the dynamic presentation of a smile affects the perceived impressions of the face relative to the static presentation. This was done by using morphed image sequences. We focused on one type of expression — the smile — which as described above, is closely associated with the impressions of face in social and interactive communication in human society. In addition to the presentation type, we also examined the effect of smile intensity and velocity of change. The former is spatial information and has been reported to be an important factor in the determination of the degree of the perceived impression of faces and emotional intensity (Ishi et al., 2003); the latter is regarded as temporal information that affects the perception of facial expressions (Kamachi et al., 2001; Sato & Yoshikawa, 2004) and that is unavailable in a static presentation.

We created the computer-morphed animations of the facial expressions that were used as stimuli. They comprised a combination of two types of presentation mode (static or dynamic) \times two types of presentation time (longer or shorter) \times two levels of smile intensity (slightly weaker or stronger than the original smile). In the dynamic presentation mode, the longer and shorter presentation times corresponded to slow and fast velocity, respectively. Two rating experiments were conducted by using these stimuli. In experiment1, the effect of the dynamic presentation of a smile on the perceived emotional intensity was examined, while in experiment2, the effect of the dynamic presentation of a smile on the perceived impressions of the face was tested.

Experiment 1: Emotional Intensity Rating

In experiment1, we aimed to examine whether the change in the presentation mode affects the perception of emotional intensity: Does dynamic presentation promote the perception of emotional intensity of a smiling face?

Method

Participants. Sixteen observers (11 males and 5 females, mean age = 20.38 years) participated in this intensity rating experiment. All the participants had normal or corrected-

normal vision.

Stimuli. Images of faces were selected from the ATR face database (See Kamachi et al., 2001) on the basis of the preliminary ratings. We used digitized facial images with happy and neutral expressions of eight different Japanese posers (aged 20-30 years, 4 females and 4 males). The facial images of each poser portraying a happy expression were used as smiling images that corresponded to 100% physical smile intensity, while the facial images of each poser with a neutral expression were used as neutral images that corresponded to 0% physical smile intensity. The pairs of smiling and neutral images across each poser were morphed by the FUTON system (Mukaida, et al., 2002) to create the interpolated and smile-exaggerated facial images.

The stimuli were prepared in the following manner. For each stimulus, one of the two types of presentation time was adopted: a longer presentation time and shorter presentation time. The number of frames for the longer presentation and shorter presentation was 31 and 7 (30 frames/sec) respectively, and thus, the total duration was approximately 1033 ms for the longer presentation and approximately 233 ms for the shorter presentation. In addition to the presentation time, one of the levels of smile intensity was provided to each stimulus: weaker (90%) smile intensity and stronger (120%) smile intensity. In the static presentation, a face with one of the smile intensities was displayed statically for 31 frames (longer presentation) or 7 frames (shorter presentation). In the dynamic presentation, morphed sequences were presented in succession, beginning from a neutral face to the face with a smile at one of the smile intensities (See Figure 1). It should be noted that there was an interaction between the smile intensity and velocity of change in the dynamic presentation.

Thus, we created 68 stimuli from eight posers that differed in presentation mode (2: static or dynamic) \times presentation time (2: longer or shorter) \times smile intensity (2: weaker or stronger).

Apparatus. Experiment program that was coded in C++ was run on a computer (TwoTop ViP Ex-P2600/800G). The rating scale and all the stimuli were presented on a 15-inch TFT color

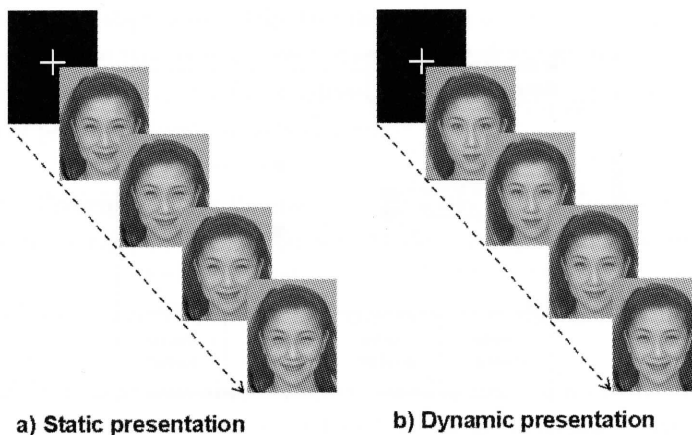


Figure 1. Stimulus presentation in two presentation modes: a) static presentation and b) dynamic presentation

monitor (IO DATA LCD-A152V) with a frame rate of 60.0 Hz and a resolution of 1024×768 pixels.

Procedure. The participants were seated in front of the monitor at a distance of approximately 60 cm from it. The stimuli were presented at the center of the monitor screen and measured 10.3 cm in height and 8.3 cm in width. The participants engaged in two rating sessions. In the first session, the rating was conducted for the stimuli of static neutral faces of eight posers with free viewing time. The participants were asked to rate the intensity of the happy emotion on a 9-point-scale that was presented below the stimuli on the monitor. In the second session, which was conducted immediately after the first, the rating for the all stimuli described in Stimuli section above were carried out. In this session, the fixation point was first presented, and once the trial began, it disappeared and the stimulus presentation lasted for approximately 1031 ms (for the longer presentation experimental condition) or approximately 233 ms (for the shorter presentation experimental condition). As soon as the presentation of the last frame ended, the image disappeared automatically. The participants were instructed to observe the stimulus carefully during the presentation, and then rate the face after the stimuli disappeared.

All the stimuli were presented in a random order across the participants, along with a 9-point-scale for the assessment of the emotional intensity in either session. The participants began the presentation by clicking the mouse button or pressing the space key on the keyboard. Each stimulus could be presented only once. Before the actual experiments, the participants were given a few practice trials with the static and dynamic stimuli.

Results

In order to investigate the effect of experimental factors (presentation mode, presentation time, and smile intensity) independent from the differences among the individual posers, the difference in the ratings between the individual neutral face (session1) and those of the smile stimuli of the poser (session2) was calculated for each participant. The difference scores are shown in Figure 2.

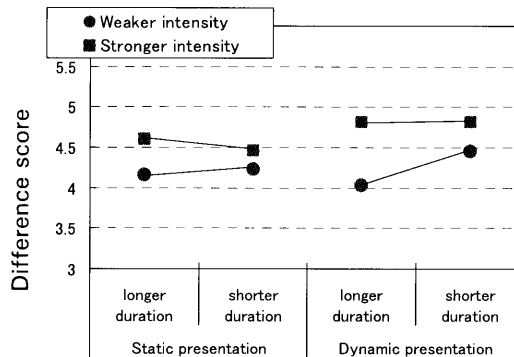


Figure 2. The results of emotional intensity rating

The data were collapsed across the posers, and then a 2 (presentation mode: static or dynamic) \times 2 (presentation time: longer or shorter) \times 2 (smile intensity: weaker or stronger) within-subjects ANOVA was conducted on the averaged scores. As a result, only significant main effect of smile intensity level ($F(1, 15) = 25.436, p < .01$) was observed, and a further examination revealed that the faces with stronger smile intensity were rated higher than that with weaker smile intensity. Further, there was a significant interaction of presentation time \times smile intensity ($F(1, 15) = 25.529, p < .01$), and a significant interaction of presentation mode \times smile intensity ($F(1, 15) = 9.52, p < .01$). However, further examination revealed only the simple effect of smile intensity in both interactions; the effect of dynamic presentation was not observed. The simple main effect of the dynamic presentation in the case of the weaker smile intensity ($F(1, 30) = 0.07, n.s.$), and the simple main effect of the dynamic presentation in the case of the stronger smile intensity ($F(1, 30) = 2.02, n.s.$) were both not significant.

Discussion

In experiment1, the main effect of the presentation mode in the intensity ratings of happy emotion was not observed, whereas the effect of manipulation of smile intensity was observed in both the presentation modes: smiles with stronger intensity were rated higher than those with weaker intensity independent of the presentation mode. Therefore, with regard to the intensity ratings of the happy emotion, the present results revealed the robust effect of the levels of smile intensity rather than the difference in presentation mode in the intensity ratings of the happy emotion. In the present experiment, the dynamic presentation did not promote the perception of emotional intensity. This might be because the substantial effect of intense smile intensity masked the subtle effect of motion, as pointed out by Ambadar et al. (2005).

Experiment2: Impression rating

In experiment2, we aimed to examine whether the dynamic presentation of a smile improved the perceived impressions of the face in comparison with the static presentation of the smile. If this is true, what type of impressions does motion affect? We used the same five rating items – attractiveness, vitality, beauty, kindness, and sturdiness – to individually assess the diverse aspects of perceived impressions of a face.

Method

Participants. Participants were 22 observers (10 males and 12 females, mean age = 21.5 years) who did not participate in experiment1. All the participants had normal or corrected-normal vision.

Stimuli and Apparatus. The stimuli and apparatus were the same as those employed in experiment1.

Selection of the items for assessing the impressions. The rating items for the assessment of the impressions of a smiling face were selected based on the previous study that investigated the relationship between the smile intensity and facial impressions (Ishi et al., 2003). The participants judged attractiveness and performed their impression rating using the semantic differential method independently. As a result of the factor analysis conducted on the data of impression

rating, the four types of impressions of smile-energy, mildness, beauty, and dominance, were extracted. In the present study, we used the four representative words for which the factor loading was the highest within the adjectives constructing each factor. Vitality (*genki-no-yosa* in Japanese) was chosen as representing the energy factor, kindness (*omoiyari* in Japanese) was chosen as representing the mildness factor, beauty (*utsukushi-sa* in Japanese) was chosen as representing the beauty factor, and sturdiness (*takumashi-sa* in Japanese) was chosen as representing the dominance factor. In addition to the four items for assessing impressions described above, the attractiveness (*miryoku-do* in Japanese) item was also used. In order to change the rating order of the items, three pre-determined combinations of the orders for five rating items were randomly assigned to all the participants.

Procedure

The procedure was the same as that in experiment1, except for the fact that the participants were asked to rate five items on a 7-point scale for the assessment of the impressions of the neutral face (session1) and smiling face (session2), which were presented to the right of the location where each stimulus appeared.

Results

Similar to experiment1, the difference in the ratings between the individual neutral face (session1) and the ratings of the smiling stimuli of each poser (session2) was calculated for each participant. The data were collapsed across the posers. For each word representing the assessment of the impressions, a 2 (presentation mode: static or dynamic) \times 2 (presentation time: longer or shorter) \times 2 (smile intensity: weaker or stronger) within-subjects ANOVA was conducted on the averaged scores. Results are as follows. With respect to attractiveness, a significant main effect of smile intensity level ($F(1, 21) = 6.674, p < .05$) and a significant interaction of presentation type \times presentation time \times smile intensity ($F(1, 21) = 11.621, p < .01$) was observed. For beauty, only a significant interaction of presentation mode \times smile intensity ($F(1, 21) = 8.096, p < .01$) was observed. For kindness, there was no main significant effect and interaction. For vitality, a significant main effect only of smile intensity was observed ($F(1, 21) = 20.002, p < .01$). For sturdiness, there was a significant main effect only of smile intensity ($F(1, 21) = 4.385, p < .01$).

Moreover, we found the interaction that related to the dynamic presentation only for the results of two rating items that described the evaluation of aesthetic impression of the smiling face-beauty and attractiveness. Therefore, the results pertaining to the latter are detailed below, and the results of further examinations of interactions are shown in Figure 3. For beauty, the simple main effect of smile intensity was found only in the dynamic presentation, and the dynamic face with a stronger smile intensity was rated as more beautiful than the dynamic face with a weaker smile intensity. On the other hand, for attractiveness, the simple-simple main effect of smile intensity was found only in the dynamic presentation for a longer presentation time. The dynamic face with a stronger smile intensity was rated as more attractive than that with a weaker smile intensity for a longer presentation time that is, at a fast velocity of change.

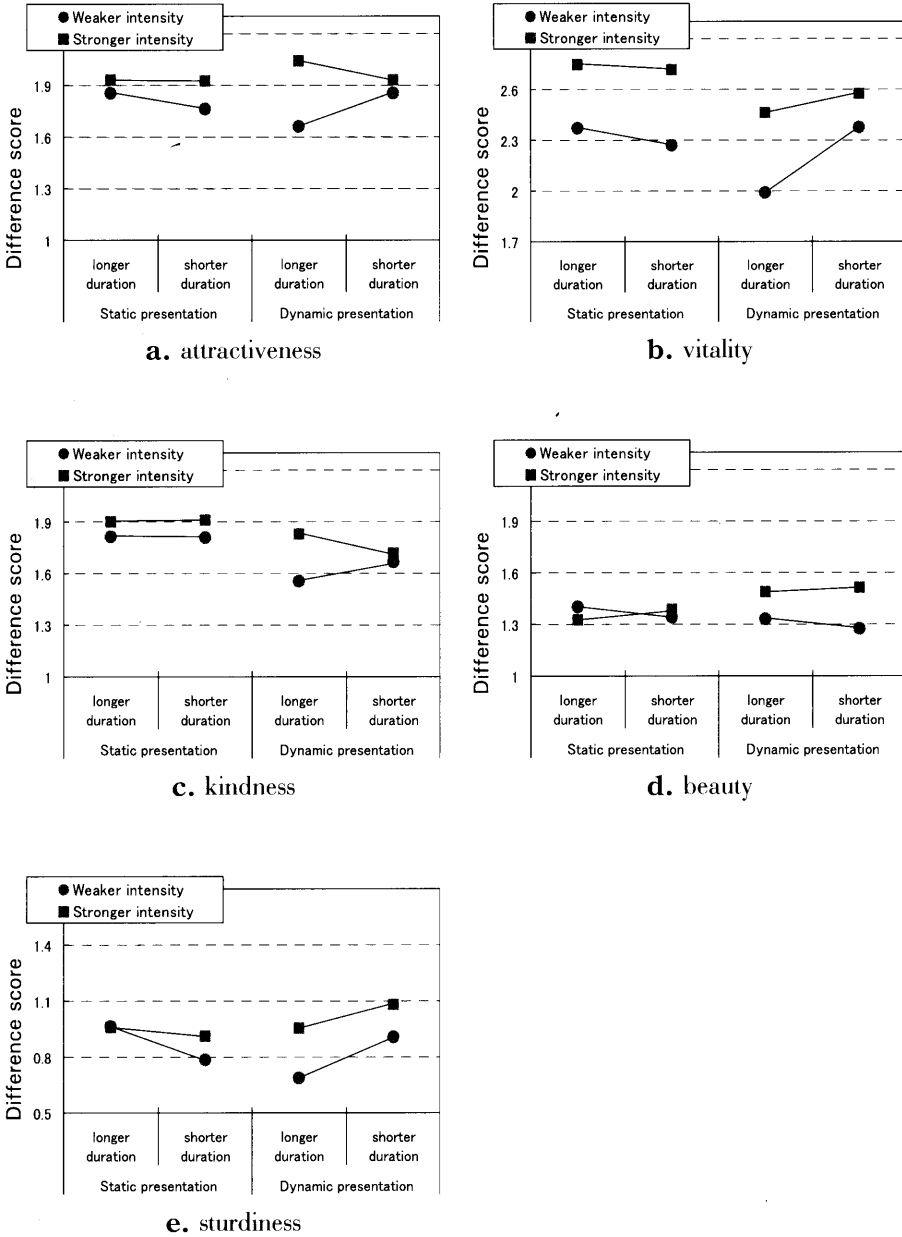


Figure 3. The results of impression rating of attractiveness, beauty, kindness, vitality, and sturdiness

Discussion

In experiment2, no main effect of the presentation mode was observed in the ratings across all of the rating items. The effect of the presentation mode was observed in an interaction with the level of smile intensity only in the evaluation of aesthetic impressions rated by the items of beauty and attractiveness for a smiling face. The obtained effects in these items were consistent with Knappmeyer et al. (2002), who have reported that the manner in which a face moves influences its perceived attractiveness. However, the lack of a significant difference between the static presentation and the dynamic presentation in the present study revealed that motion did not produce a beneficial direct effect on the impression ratings. Our results showed the relatively small but firm effect of motion in the evaluation of a smiling face. The smile with stronger intensity was rated as more beautiful and more attractive than that with weaker intensity only in the dynamic presentation, and not in the static presentation. In contrast, in the static presentation, we did not find any difference between a weaker smile intensity and stronger smile intensity in the ratings across all the rating items.

Such an influence of the dynamic presentation in relation to the manipulated smile intensity, which was found in the evaluation of aesthetic impressions, enabled us to conclude that the function of motion would be to differentiate and reflect the subtle effect of the difference of the level of smile intensity on the aesthetic evaluation of a smiling face. In other words, the motion might increase the sensitivity of configural changes composed by facial features depending on the level of smile intensity; this is assumed to contribute to the evaluation specific to aesthetic impression of face.

Next, we focused on the difference due to the presentation time. We did not obtain consistent results between the items assessing the aesthetic aspects of a smiling face. For the ratings of beauty, the effect of dynamic presentation was found only in the case of the longer presentation time (that is, a slow velocity of change), while its effect was found only in the shorter presentation (that is, a fast velocity of change) for the ratings of attractiveness. Previous studies that investigated the perception of facial expression have revealed contradicting results. A happy expression has been reported to be occasionally associated with a fast movement (Kamachi et al., 2001, Sato et al., 2004), and occasionally with a longer duration (Pollick, Hill, Calder, & Peterson, 2003). Further examination is required to determine the characteristics and effective temporal information such as the velocity of change affecting the evaluation of an aesthetic impression.

General Discussion

In the emotional intensity rating task (experiment1), we observed a stronger effect of the manipulated level of smile intensity, but did not observe a remarkable effect of presentation mode. On the other hand, in the impression rating task (experiment2), the effect of the dynamic presentation was found in an interaction with the level of smile intensity specific to in the evaluation of an aesthetic impression such as attractiveness and beauty; this indicated that the difference of the level of smile intensity was reflected in the aesthetic evaluation for a smiling face only in the dynamic presentation, and not in the static presentation.

The overall results of experiment1 and experiment2 showed that the effect of the dynamic presentation on the evaluation of the aesthetic impressions of a smiling face did not occur simply because of the promoted perception of emotional intensity. This suggested the following possibilities. First, the dynamic presentation of a smiling face would enhance the processing of a facial feature or the configuration characterized by the level of smile intensity, which would be related to aesthetic evaluation, but not to the perceived intensity of happy emotion. Second, the motion itself would function as a modifier specific to the evaluation of the aesthetic impression of smiling faces. Emotion is pointed out as a relevant cue in the perception of attractiveness in dynamic faces (Rubenstein, 2005): however, in the present study, the perceived intensity of happy emotion in static faces did not appear to be influenced by the context of the evaluation of the aesthetic impression of smiling faces.

Next, we discuss the points that contradict the findings by Ishi et al. (2003), who discovered an inverted U-shape change in the perceived facial attractiveness as a function of the levels of manipulated smile intensity. In the present study, there was no difference in the attractiveness between the smiles at weaker intensity and stronger intensity in the case of static presentation, and the smile with stronger intensity was higher than that with weaker intensity in the case of dynamic presentation. The different procedure for the assessment of attractiveness might cause this contrasting fact in static presentation. Ishi et al. (2003) used the method of rank order, where observers made a relative judgment of the images with variant smile intensity, including neutral faces at a time, whereas the current study used the rating task with a 7-point-scale in which observers saw and rated the images with weaker smile intensity (90%) or stronger smile intensity (90%) that were presented serially one by one.

Finally, the dynamic properties of a face are so complex that the aspects of face processing they influence and the manner in which they function is still unclear. However, in conclusion we found the effect of dynamic presentation in an interaction with the level of smile intensity in the case of rating items of beauty and attractiveness; this suggests that at least the evaluation of the aesthetic impression of a smiling face was associated with the facial motion in some way.

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