Perception, 2011, volume 40, pages 751 – 756

doi:10.1068/p7000

SHORT AND SWEET

Wobbling appearance of a face induced by doubled parts

Sayako Ueda, Akiyoshi Kitaoka¶, Tetsuo Suga

Faculty of Integrated Arts and Social Science, Japan Women's University, Nishi-ikuta 1-1-1, Tama-ku, Kawasaki-shi, Kanagawa-ken, Japan; e-mail: sueda@fc.jwu.ac.jp; ¶ Department of Psychology, Ritsumeikan University, Toji-in Kitamachi 56-1, Kita-ku, Kyoto-shi, Kyoto-fu, Japan

Received 19 April 2011, in revised form 15 June 2011

Abstract. An illusion produced by duplicating facial parts, which can cause an unstable feeling for many observers, was investigated. We examined factors that contribute to the unstable feeling. The results suggest that this illusion is specific to face perception, and the unstable feeling may be generated by difficulty in keeping attention directed to either of the duplicated facial parts.

Here we report a novel type of illusion that has recently been described (Martinez-Conde and Macknik 2010; Suga 2003) produced by duplicating facial parts (figure 1a). Such images produce an unstable feeling in many people, which may arise because of the special nature of facial processing (Martinez-Conde and Macknik 2010). If the viewer perceives only an object with four eyes and two mouths, the unstable feeling may not be generated. We call this phenomenon the 'wobbling-face' illusion. What factors contribute to the unstable feeling of this illusion, and is this illusion specific to faces? In the present study we examined these questions.

(a) (b)

Figure 1. [In colour online, see http://dx.doi.org/10.1068/p7000] Examples of (a) duplicated facial parts, (b) Hososhi.

Japan is an interesting venue for this research because the Japanese god Hososhi (方相氏), whose role is to protect the palace and graves of the royal family from demons or evil spirits, is always represented as a mask with four gold eyes (figure 1b). References to Hososhi appeared as early as 706 AD (Ueda 1988). The mask of Hososhi is similar to the wobbling-face. The purpose of Hososhi's duplicated eyes has never been determined; however, the familiarity of Japanese people with Hososhi may affect their response to this illusion.

In experiment 1, twenty Japanese women participated ($M = 19.1$ years, SD = 0.44 years). First, we tried to determine the nature of the unstable feeling of the wobbling-face. Stimuli were coloured photographs of a Japanese female model and a house in three conditions: (i) without duplication; (ii) with partial duplication (for face: eyes; for house: windows); and (iii) partial duplication with mirror-reversal (figure 2). These stimuli were prepared in inverted and upright orientations. Computer graphic techniques were used to control extraneous variables. Prior to the experiment, we showed participants two facial images of Barack Obama, the 44th president of the United States, one unmodified and the other in a wobbling-face representation that was featured in Martinez-Conde and Macknik (2010, page 38) as the screening test. We confirmed that participants could identify the difference between the two images and that an unstable feeling was generated for the wobbling-face image. It is possible that this screening test has exerted some promoting influence on the following experiment, but our study dealt with the cause of the unstable feeling of the wobbling-face. Therefore, this screening test was essential and we do not think that the possibility, if any, caused a serious problem affecting the conclusion of this study. Each trial began with a 500 ms visual cue (a crosshair) followed by the stimulus. Stimuli were presented in random order; participants saw each image once and were asked to state whether they experienced the unstable feeling and to explain their feeling about each image in detail. There was no time limit. If this phenomenon is specific to faces, we would expect that participants would experience the unstable feeling just for face images. Further, if the illusion is attributable to facial processing, we would expect that the feeling would decrease for inverted faces.

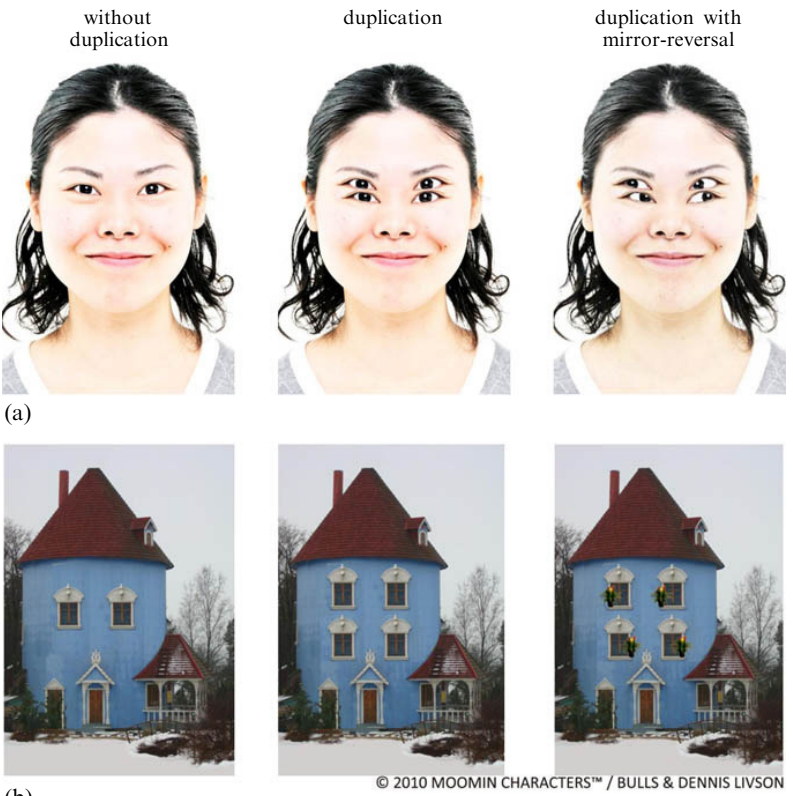


Figure 2. [In colour online.] Stimuli for experiment 1: (a) face images; (b) house images.

The proportions of participants who experienced the unstable feeling for each image are summarised in figure 3, which showed that significantly more participants reported the feeling for face images than for house images ($\chi^2_1 = 158.53$, $p < 0.01$) and for upright images than for inverted images ($\chi^2_1 = 3.87$, $p < 0.05$). Moreover, duplicated images gave significantly more unstable feeling than those without duplication ($\chi^2_1 = 29.09$, $p < 0.01$) and with duplication with mirror-reversal ($\chi^2_1 = 4.56$, $p < 0.05$). Therefore, we think that the wobbling-face illusion may be specific to faces and is attributable to facial processing.

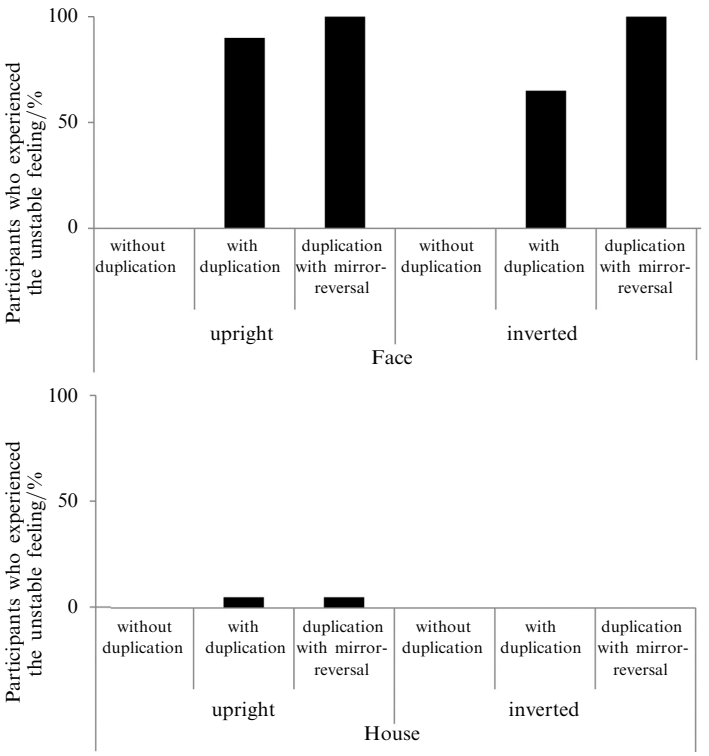


Figure 3. Proportions of participants who experienced the unstable feeling in experiment 1.

The most common feedback of participants who experienced the feeling for duplicated face images included: "I couldn't perceive a four-eyed woman" and "I was not sure which should be focused on, the upper eyes or the lower ones". Two participants who did not experience the feeling reported that they were able to perceive a four-eyed woman. The most common feedback of participants who experienced the feeling for the facial image that was duplicated in mirror-reversal was: "I couldn't detect her gaze direction" and "I detected either averted-right-eyed or averted-left-eyed". These reports suggest that the wobbling face might have induced rivalry of attention between the doubled facial parts. The participants' attention might have been directed to only one pair of eyes rather than to four eyes at once. To investigate this idea, we performed an additional experiment using the same participants.

In experiment 2, the duplicated parts of each stimulus were changed in size or shape in order to change impressions with pairs of parts. For the face image, the duplicated lower eyes were changed into bigger eyes. Bigger and lower-placed eyes are characteristic of babyish face (Enlow 1982). For the house image, the duplicated lower windows were given Japanese characteristics (figure 4). These stimuli were prepared in upright and inverted orientations. Each trial began with a 500 ms visual cue followed by the stimulus.

(a) (b)

Figure 4. [In colour online.] Stimuli for experiment 2: (a) face image; (b) house image.

Stimuli were presented in random order. Participants saw each image once and were asked to judge whether they could form a single impression of each image with attention to all four parts at once. Those who did so were regarded to have experienced no illusion. Then, they were asked to rate their impression of each image: for face images they rated the model's age, and for house images they rated their cultural impression on a 7-point scale, from −3 (strongly Japanese-style) to +3 (strongly Western-style). In the next step, those who failed to form a single impression for each image made up of four parts were asked to observe the same images again and to rate their impressions of the upper parts or of the lower parts separately: for face images they rated the model's age of upper eyes and lower eyes, and for house images they rated their cultural impression of upper windows and lower windows. There was no time limit. If attention limitations caused participants to choose only one pair of eyes at a time from the four eyes, we would expect that few participants would be able to rate age with attention to all four eyes at once, and rated age may differ for upper eyes and lower eyes. Moreover, if the illusion is attributable to facial processing, we would expect that age ratings with attention to four eyes at once would be easier for the inverted face.

The proportions of participants who formed a single impression of each image as they attended to four parts at once are summarised in figure 5. Significantly fewer

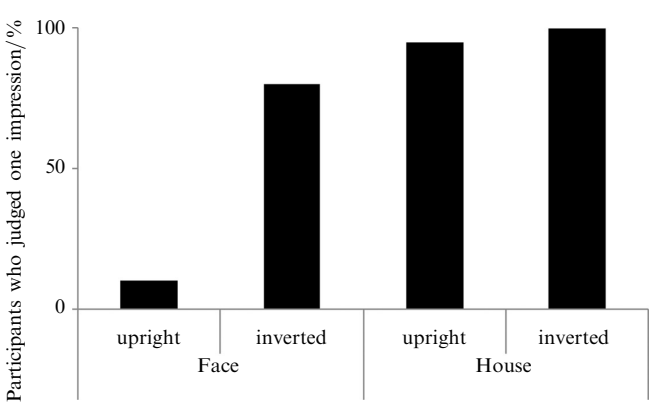


Figure 5. Proportions of participants who formed a single impression of each image as they attended to four parts at once. There was a face-inversion effect.

participants formed a single impression for the upright facial image than for the inverted facial image ($\chi^2_1 = 24.67$, $p < 0.01$). The mean ratings of face images are summarised in figure 6. They were submitted to a repeated-measures ANOVA with two factors: orientation (upright and inverted) and parts (four eyes, upper eyes, and lower eyes). There was a significant main effect of parts ($F_{2,56} = 8.32$, MSE = 20.74, $p < 0.01$). Multiple comparisons of ratings showed that rated ages were significantly different for attention to upper eyes and attention to lower eyes ($p < 0.05$). This result suggests that participants who saw this illusion attended to either of the pairs at one time. Moreover, when those who had no illusory experience observed the four-eyed face and rated its age, the rated one was younger than for the upper eyes alone and older than for the lower eyes alone ($p < 0.05$). It is suggested that for the no-illusion participants the rated age was averaged between the two pairs of eyes.

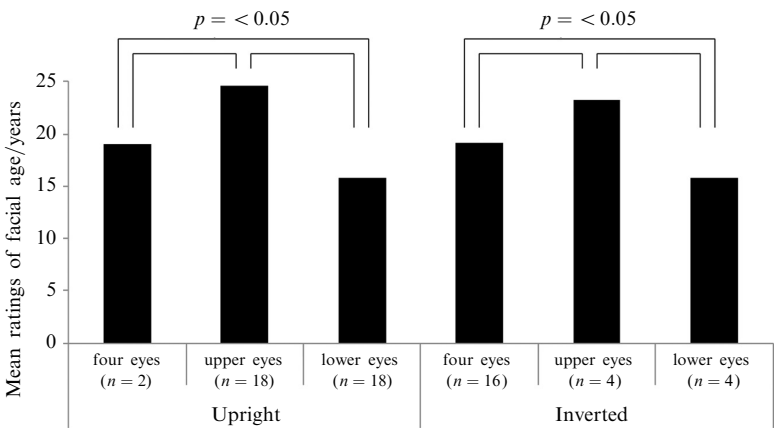
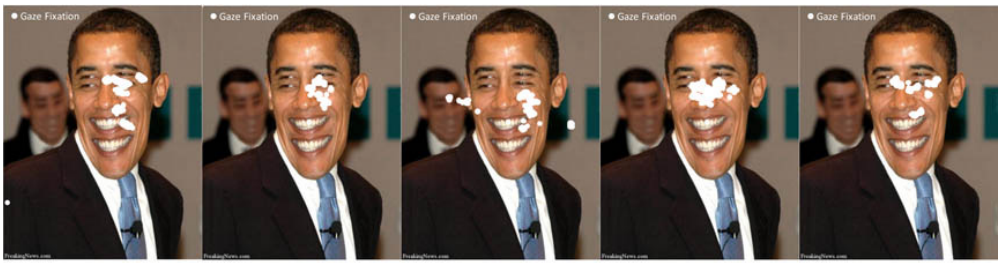
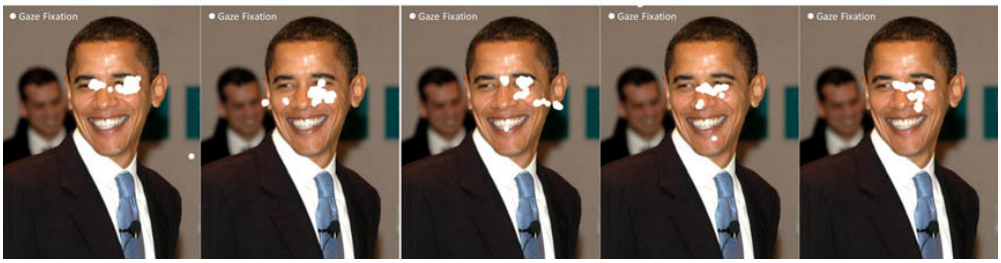


Figure 6. Mean ratings of facial age. The term 'four eyes' indicates the age-estimation data for those who had no illusory experience for the duplicated face. The term 'upper eyes' ('lower eyes') indicates the age-estimation data for those who had illusory experience and rated the upper eyes (lower eyes). As a result, the estimated ages for the upper eyes were significantly greater than for the lower ones. Moreover, the estimated ages for 'four eyes' were intermediate between those for the 'upper' and 'lower' eyes.

One might point out possibilities that the unstable feeling of the wobbling-face should be attributed to a simple motion illusion: that static patterns are moved across observer's peripheral visual field such as The Pinna Illusion (Pinna and Brelstaff 2000) or eye-movement instabilities (Kuriki et al 2008), rather than the rivalry of attention between doubled facial parts. But, as regards the possibility of motion illusion, when the lower head is slowly moved, the unstable feeling of the wobbling-face appears unchanged. Therefore, we suggest the unstable feeling does not reflect this type of motion illusion. In order to examine the possibility of eye-movement instabilities, we briefly examined eye movements when five participants who reported illusory feeling were observing the wobbling-face image and the normal-face image of US President Barack Obama for 5 s longer (figure 7). There was no special eye movement shifting back and forth between the duplicated parts. We tried to compare the displacement of gaze on images every 20 ms, and the effects of task (the wobbling-face image and the normal-face image) on this measure were analysed with a Mann–Whitney's U test. There were no significant image differences in eye movements (the wobbling-face: 1.93 pixels/20 ms, SD = 0.40 pixels/20 ms; the normal-face: 1.68 pixels/20 ms, SD = 0.21 pixels/20 ms, $p > 0.10$). Therefore, we suggest that the unstable feeling should reflect not eye-movement instabilities but some perceptual or cognitive processes such as the rivalry of attention between doubled facial parts.



(a)



(b)

Figure 7. [In colour online.] Eye-gaze patterns: (a) the wobbling-face image; (b) the normal-face image.

We suggest that the rivalry of attention between doubled facial parts in the wobbling-face illusion might be attributable to a limit in the number of facial parts that can be processed at once. How can we explain this limit? There is the possibility that schematic face-like patterns, known from the study of the newborn face-preference phenomenon (eg Fantz 1963), might be involved. Schematic facial patterns are constructed from facial parts found in normal faces: two eyebrows, two eyes, one nose, and one mouth. If facial processing is assumed to be biased to attend to these internal facial templates in order to detect normal faces, responses should be strong to one of the duplicated facial parts. This might also be why this illusion is specific to the face. The wobbling-face illusion can be attributed to facial processing. So, participants who saw this illusion attended to only one pair of eyes and experienced the unstable feeling just for duplicated faces. Therefore, the wobbling-face illusion may be interpreted as a kind of ambiguous figure similar to the Necker cube, in which the perspective of a shape suddenly switches in the mind of the observer to another, equally valid possibility. However, in the wobbling face, the switch may occur more quickly. This illusion could therefore be regarded as a new, frequently reversing, type of ambiguous figure.

References

Enlow D H, 1982 *Handbook of Facial Growth* 2nd edition (Philadelphia, PA: Saunders)
Fantz R L, 1963 "Pattern vision in newborn infants" *Science* **40** 296 – 297
Kuriki I, Ashida H, Murakami I, Kitaoka A, 2008 "Functional brain imaging of the Rotating Snakes illusion by fMRI" *Journal of Vision* **8**(10):16, 1 – 10
Martinez-Conde S, Macknik S L, 2010 "The eyes have it" *Scientific American Mind* **20**(1) 36 – 41
Pinna B, Brelstaff G J, 2000 "A new visual illusion of relative motion" *Vision Research* **40** 2091 – 2096
Suga T, 2003 *Three Types of Temperament* (Kyoto: Kitaoji-Shobo) [in Japanese]
Ueda S, 1988 "Hososhi no shoso" [Various aspects of Hososhi] *Bulletin of the Kashihara Archaeological Institute* **10** 345 – 377 [in Japanese]

ISSN 0301-0066 (print) ISSN 1468-4233 (electronic)

PERCEPTION
VOLUME 40 2011

www.perceptionweb.com