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A new “fat face” illusion

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Abstract

We report a novel fat face illusion that when two identical images of the same face are aligned vertically, the face at the bottom appears ‘fatter’. This illusion emerged when the faces were shown upright, but not inverted, with the size of the illusion being 4%. When the faces were presented upside down, the illusion did not emerge. Also, when upright clocks were shown in the same vertically aligned fashion, we did not observe the illusion, indicating that the fat illusion does not generalize to every category of canonically upright objects with similar geometric shape as a face.

Thompson (2010) reported a fat face thin illusion that when next to an inverted face an upright face looks ‘fatter’ (see figure 1a). To explore this illusion further, we presented two identical upright faces vertically (see figure 1b); the lower face was consistently perceived to be fatter. Thus, what Thompson observed seems to be a face illusion that does not require one of the faces to be inverted and can be generalized to vertically aligned upright faces.

To verify our observations, we conducted three experiments. In experiment 1, we asked Chinese participants (N = 22, nine males, M_{age} = 20.9 years) to make a forced choice which of two vertically aligned faces was fatter. Stimuli were color photographs of 20 Chinese adults (10 males) in frontal pose, with white background (see figure 2 for an example). Expanding or compressing the width of each original face by 3% produced two altered versions to be used for the experiment, which were 103% and 97% of the original. On each trial, two images of the same individual were displayed at the top and bottom of a computer screen, aligned vertically. The two altered versions of the same face were paired with each other or itself, producing four combinations for the top and bottom images as shown in figure 2, and were presented in a random order. Half were identical in size (top = bottom), and half were different (top < bottom or top > bottom). Each pair was presented once to each participant. Participants were instructed to respond via key press which face was ‘fatter’ as accurately and rapidly as possible.

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Table 1 shows the means and SEs of the rates of the "bottom face is fatter" responses (henceforth referred to as bottom responses) for the three trial types. Comparing response rates to the expected rate, we found: (i) in the top < bottom condition, no significant difference ($t_{21} = -1.32$, $p = 0.201$), indicating that participants responded correctly that the bottom face was fatter; (ii) in the top = bottom condition, response rate was significantly higher than the expected rate ($t_{21} = 18.01$, $p < 0.001$), indicating that participants perceived the bottom face to be fatter than the top face even though they were identical (ie they showed a fat face illusion); (iii) in the top > bottom condition, response rate was also significantly higher than the expected rate ($t_{21} = 5.51$, $p < 0.001$), indicating that, although the top face was physically larger, participants still perceived the bottom one to be fatter, suggesting that the illusion was sufficiently strong to override the physical difference. Overall, the results showed that participants perceived the bottom face to be fatter than the top one when the two faces were identical or even when the top face was physically larger. These findings confirmed our observation that there exists a robust fat face illusion. Having established this illusion, we found the magnitude of it to be 4%.[(1)]

Stimulus inversion is known to disrupt the processing of faces (eg Freire et al 2000; Lee and Freire 1999; Thompson 1980). To investigate whether the fat face illusion could also be influenced by inversion, in experiment 2 we presented two identical vertically aligned faces upside down and asked a new group of adults ($N = 20$, twelve males, $M_{age} = 23.0$ years) to judge whether the bottom inverted face was fatter than the top one or vice versa. As shown in table 1, participants saw the inverted faces to be equal in size as they actually were ($t_{19} = 0.235$, $p = 0.817$). This finding suggests that the fat face illusion depends on the stimuli presented in their canonical orientation.

To further explore whether the illusion could be observed with any category of objects with a canonical upright orientation, we asked a new group of participants ($N = 17$, eight males, $M_{age} = 22.7$ years) in experiment 3 to judge whether the bottom clock of two identical vertically aligned clocks was fatter than the top one or vice versa. Clocks were chosen because they are a set of familiar objects with a canonical upright orientation. In addition, clocks share several other properties with faces such as being round and containing features (hands and time markers) that form meaningful configurations (telling time). Clocks have also been used in existing studies as comparison stimuli with faces (eg Hershler et al 2010). Photos of 20 clocks were used, with the size, resolution, and manipulations matching those of the face images from experiment 1 (see figure 3). As shown in table 1, when two identical vertically aligned clocks were shown, participants' response rate was not significantly different from the expected rate ($t_{16} = 0.12$, $p = 0.903$), indicating that they saw the clocks to be identical. Thus, when the upright faces were replaced with upright clocks, a fat illusion was not observed, suggesting that the illusion does not generalize to every category of objects that have an upright canonical orientation and physical properties similar to those of a face.

To summarize, we have reported a novel fat face illusion that, when identical images of the same face are aligned vertically, the bottom face appears 4% fatter. This illusion emerges

[(1)]We measured the magnitude of the illusion for upright faces with 30 additional Chinese participants (17 males, $M_{age} = 22.6$ years), by varying the size of the top face and pairing it with one particular bottom face. Participants judged which face was fatter to determine their point of subjective equality (PSE). For each face, we produced 21 variants by changing width to a different extent from 95% to 115% of the original photo's width, with the step at 1%. Then we used the original photo as the bottom face and each variant as the top face. The rest of the procedure was identical to that of experiment 1. As the top face width changed from 95% to 115% of the bottom face width, the mean bottom response rate changed gradually from nearly 100% to 50% to almost 0%. For each participant, we chose the pair for which the response rate was closest to 50% and took the top face width as the particpant's point of subjective equality (PSE). The mean PSE was 104.08 (SE = 0.339), which was significantly larger than the point of objective equality (100) ($t_{29} = 12.04$, $p < 0.001$). Thus, the PSE for the top face to be perceived the same as the bottom one is approximately 104%, which indicates that the magnitude of the fat face illusion is about 4%.

when the faces are shown upright, but not with inversion. When the objects are from a perceptually similar category, eg clocks, the illusion is not observed. Investigations are needed to examine whether there exist categories of non-face objects that show similar illusions. Studies are also needed to show whether visual expertise alone (Bukach et al 2006), but not faces in particular, can produce the illusion. Finally, additional studies are needed to explore the linkages between the fat face illusion and the classic illusion discovered by Jastrow (1891). In the Jastrow case, when two identical trapezoid shapes are vertically aligned, the bottom shape looks bigger. However, unlike the fat face illusion, the same illusory perception continues when the trapezoids are inverted. It is thus unclear whether the fat face illusion is a face-specific illusion or a specific case of the Jastrow illusion. Results from such studies along with those from the present study will ultimately elucidate the factors that engender the fat face illusion and its underlying perceptual mechanisms.

Acknowledgments

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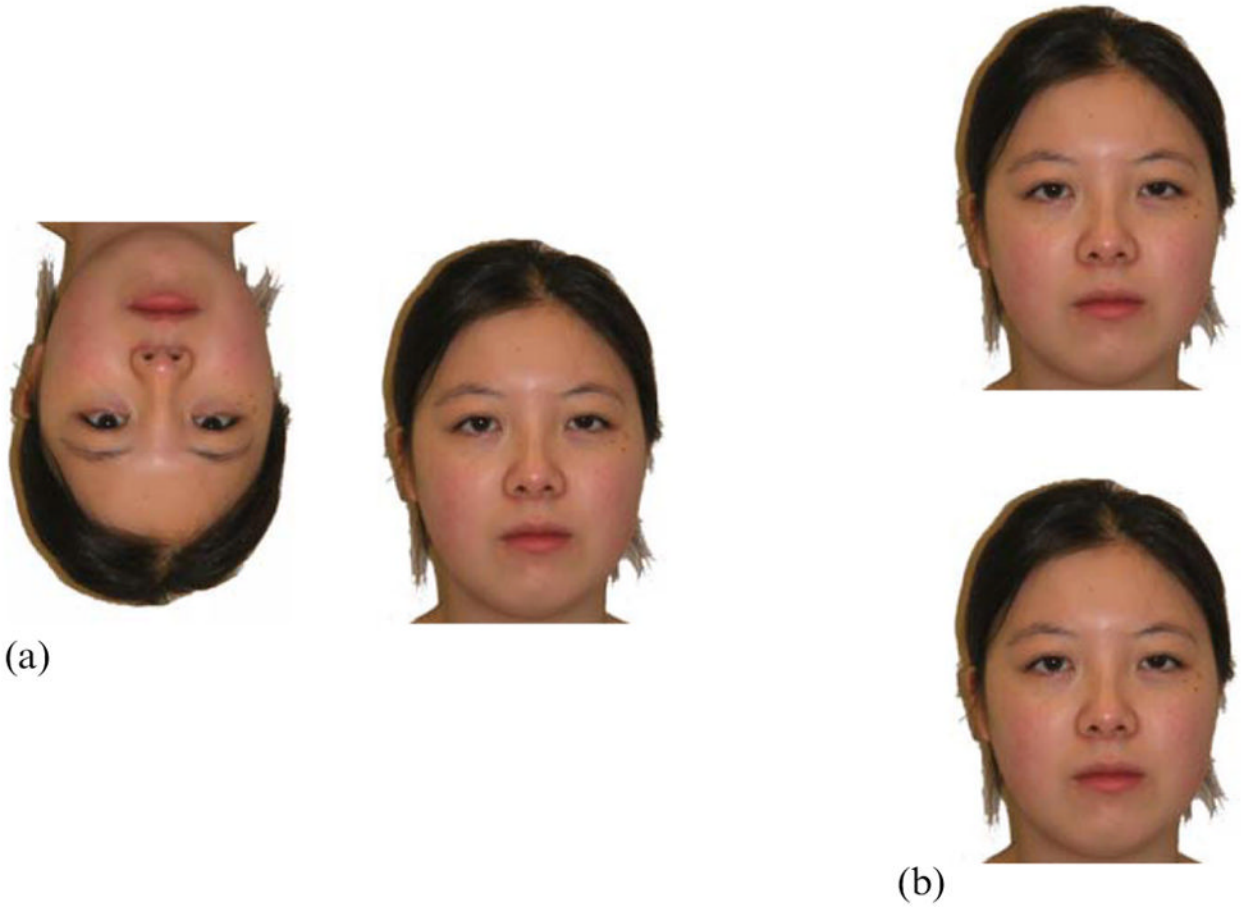

Figure 1.
[In color online, see http://dx.doi.org/10.1068/p6906] (a) Thompson's (2010) fat face thin illusion where the upright face appears fatter. (b) The fat face illusion where the bottom image appears fatter.

Figure 2.
[In color online.] Vertically aligned face pairs of one individual face (sizes 1 and 2 were 103% and 97% of the original face, respectively).

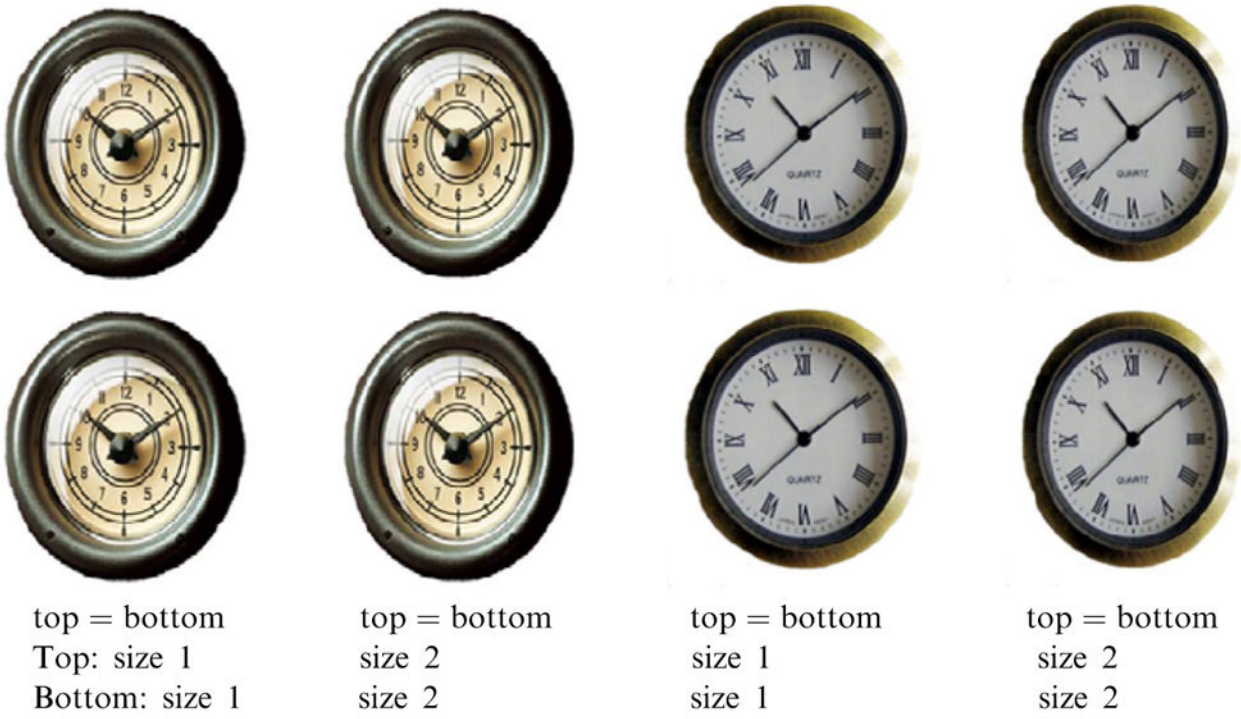

Figure 3.
[In color online.] Sample clock stimuli (sizes 1 and 2 were 103% and 97% of the original clocks, respectively).

Table 1

Means and SEs of the rates of the “bottom is fatter” responses in experiments 1, 2, and 3

Experiment	Object	Actual image size	“Bottom is fatter” response rate/%	Expected rate/%
1	face upright	top > bottom	17.7 (3.2)	0.0
		top = bottom	86.4 (2.0)	50.0
		top < bottom	98.2 (1.4)	100.0
2	face inverted	top = bottom	49.3 (3.2)	50.0
3	clock upright	top = bottom	49.6 (3.3)	50.0