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My own face looks larger than yours: A self-induced illusory size perception

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ABSTRACT

Size perception of visual objects is highly context dependent. Here we report a novel perceptual size illusion that the self-face, being a unique and distinctive self-referential stimulus, can enlarge its perceived size. By using a size discrimination paradigm, we found that the self-face was perceived as significantly larger than the other-face of the same size. This size overestimation effect was not due to the familiarity of the self-face, since it could be still observed when the self-face was directly compared with a famous face. More crucially, such illusion effect could be extended to a new cartoon face that was transiently associated with one's own face and could also exert further contextual influences on visual size perception of other objects. These findings together highlight the role of self-awareness in visual size perception and point to a special mechanism of size perception tuned to self-referential information.

1. Introduction

Size perception of visual objects is fundamental to a wide range of daily activities (e.g., grasping and picking up a cup). Yet, in some cases, object size is not perceived veridically, since several objective factors, such as retinal image size, distance, angle and contextual cues, can affect size perception leading to many well-known size illusions (Chen, Qiao, Wang, & Jiang, 2018; Kaufman & Kaufman, 2000; Massaro & Anderson, 1971; Newsome, 1972; Roberts, Harris, & Yates, 2005). For instance, an object surrounded by smaller items appears larger than an object of the same size surrounded by larger items (i.e., the Ebbinghaus illusion). Aside from such objective factors, size perception also highly depends on subjective factors. Converging evidence has shown that threatening information can modulate perceived size particularly when the information is relevant to the viewer (Chen, Yuan, Xu, Wang, & Jiang, 2016; Geuss, McCardell, & Stefanucci, 2016; Leibovich, Cohen, & Henik, 2016; Shiban et al., 2016; Vasey et al., 2012). For example, a spider but not a wasp appears larger to spider-phobic individuals (Leibovich et al., 2016). Moreover, acrophobic individuals tend to overestimate object size when looking down from a high place (Stefanucci & Proffitt, 2009; Teachman, Stefanucci, Clerkin, Cody, & Proffitt, 2008).

Not only the negative information, but also positively valenced stimuli can induce such size illusions. It has been demonstrated that powerless children were more likely to perceive coins as being larger than same-size discs (Bruner & Goodman, 1947; Dubois, Rucker, & Galinsky, 2010). Additionally, people perceive objects useful for reaching a goal as bigger when they are motivated (e.g., a glass of water when deprived of fluid or a golf hole when players performed better than expected) (Veltkamp, Aarts, & Custers, 2008; Witt, Linkenauger, Bakdash, & Proffitt, 2008). In the same vein, muffins look larger to food-primed dieters (Koningsbruggen, Stroebe, & Aarts, 2011). In general, the stimuli employed in these studies are all personally significant due to their relevance to the individuals' concerns or values, suggesting that self-relevance might play a crucial role in the observed size distortions. However, to date, there is still a lack of empirical evidence regarding whether the self-related stimulus itself, such as one's own face, can modulate visual size perception.

Contrary to other self-referential information, one's own face is essentially the most unique and distinctive stimulus that is not shared with other people (with the exception of identical twins), and hence its processing has been thought of as a more reliable marker of self-awareness (Devue & Bredart, 2011; Gallup, 1998; Kaufman & Kaufman, 2000). The specialty of self-face is reflected in more robust representations and prioritized processing relative to non-self faces, known as self-face advantage (Bortolon & Raffard, 2018). For instance, we are faster and more accurate at recognizing our own faces than other faces

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(both unfamiliar and familiar) (Keyes & Brady, 2010; Sui & Humphreys, 2013; Tong & Nakayama, 1999). This self-preferential processing occurs independent of face context and task demands and remains even when faces are subliminally presented (Geng, Zhang, Li, Tao, & Xu, 2012; Keyes, 2018). In addition, the self-face is particularly efficacious in grabbing attention in an automatic manner and even without conscious awareness (Liu, He, Rotsthein, & Sui, 2015; Wojcik, Nowicka, Bola, & Nowicka, 2019; Wojcik, Nowicka, Kotlewska, & Nowicka, 2017). The prioritization of self-face manifests also at the neural level showing stronger electrophysiological responses (e.g., N170, P300) and brain activations (e.g., the fusiform gyrus and the anterior cingulate) to the self-face as compared to the other-faces (Hu et al., 2016; Keyes, Reilly, & Foxe, 2010; Tacikowski & Nowicka, 2010). Inspired by the aforementioned findings, here we explored whether the observed self-face advantage can accentuate the perception of the self-face itself, leading to an expansion of its perceived visual size.

To probe this issue, the present study examined whether the self-face could modulate visual size perception by using a size discrimination task. In order to minimize the possibility that the size modulation effect of the self-face, if observed, may result from a mere familiarity effect instead of a genuine self-induced effect, we contrasted the self-face with both unfamiliar and familiar faces. To further eliminate potentially confounding differences (e.g., familiarity, perceptual properties) that might exist between the own and other faces, we also created the self-associated and other-associated cartoon faces, by adopting a novel associative matching paradigm adapted from a previous study (Sui, He, & Humphreys, 2012). Furthermore, we employed a modified Ebbinghaus illusion as a measurement tool to investigate whether the self-induced size illusion, if observed, can exert contextual influences on visual size perception of non-face objects.

2. Method

2.1. Participants

A total of 68 participants (34 females) whose ages ranged from 22 to 28 years took part in the study. 16 participants (8 females) were recruited in Experiment 1, 16 (8 females) in Experiment 2, 16 (7 females) in Experiment 3, and the remaining 20 (11 females) in Experiment 4. All participants were right-handed and had normal or corrected-to-normal vision, and gave written, informed consent in accordance with procedure and protocols approved by the institutional review board of the Institute of Psychology, Chinese Academy of Sciences. All participants were naïve to the purpose of the experiments. G*power (Version 3.1.9.4; Faul, Erdfelder, Buchner, & Lang, 2009; Faul, Erdfelder, Lang, & Buchner, 2007) analyses indicated that a sample size of at least 15 participants would afford 80% power to detect a medium-high advantage effect (Cohen's d = 0.8) induced by the self-face (Sui & Humphreys, 2013) and at least 19 participants would afford 80% power to detect a medium size illusion effect (Cohen's d = 0.68) in the task using the Ebbinghaus figure (Katsumata, 2019).

2.2. Stimuli

Stimuli were displayed using MATLAB (The MathWorks, Natick, MA) together with the Psychophysics Toolbox extensions (Brainard, 1997; Pelli, 1997). For all experiments, color, front view photograph of each participant' face with neutral expression was individually taken under constant artificial lighting using a digital camera before the experiment. The self-face image for one participant also served as the other-face image for another gender-matched participant. It was verified that participants were not familiar with the other-face prior to the experiment. In Experiment 2, two face images of Chinese celebrities (1 male and 1 female) were chosen from the internet for the famous face stimuli. All face images were converted to greyscale and cropped to remove external features (e.g., hair and ears) by using Photoshop CS6 software. These images were then mounted on an oval frame and resized to a dimension of 300 × 400 pixels. In order to control for low-level image properties, mean luminance and contrast were adjusted and matched across all images. Inverted counterparts were obtained by rotating the face images 180°. In Experiments 3 and 4, two different cartoon faces were created by Photoshop CS6 software. All stimuli were presented on a 22-ich LCD monitor, and the viewing distance was about 57 cm.

2.3. Procedure

2.3.1. Experiment 1

Participants were asked to perform a size discrimination task in Experiment 1 (Fig. 1). In each trial, two stimuli (an upright face and an inverted face) were used and sequentially presented for 600 ms, with a blank interval (600 ms) inserted between the displays of the two stimuli. To avoid potential interference effects, the centers of the two face stimuli randomly shifted within an area of 2.38° × 0.48° and the horizontal distance between them was at least 0.48°. One of the stimuli (the upright or the inverted face) was randomly selected as the standard size (a horizontal diameter of 135 pixels), and the size of the other stimulus could be 120, 125, 130, 135, 140, 145, or 150 pixels, resulting in a total of seven test conditions. In other words, the size difference of the two stimuli (upright vs. inverted) could be −15, −10, −5, 0, 5, 10, or 15 pixels. The presentation order of the two stimuli (first vs. second display) was randomized across trials. Participants were required to make a two-alternative forced choice to indicate, as accurately as possible, which stimulus (the first or the second) appeared larger regardless of what kind of stimuli was shown. Participants were explicitly told that neither the stimulus content nor its order was predictive of the stimulus size.

Each participant completed a total of 280 trials with 140 trials for the self-face category and the other-face category, respectively. The 140 trials comprised 20 trials in each of seven test conditions. The trials were presented in a randomized order for each participant.

2.3.2. Experiment 2

Experiment 2 followed the same design and procedure as in Experiment 1, except that the other-face image was replaced by the face image of a same-gender highly famous individual (Fig. 1). Participants were required to evaluate how familiar the famous face was by giving a score ranging from 1 (unfamiliar) to 7 (very familiar) following the size discrimination task. The results showed that they were quite familiar with the faces of both the male and female celebrities (6.857 and 6.625).

2.3.3. Experiment 3

Experiment 3 contained three stages: a pretest stage, an associative matching stage, and a posttest stage (Fig. 2). Participants completed a size discrimination task in both the pretest and posttest stages (Fig. 2B). The size discrimination task was similar to that of Experiment 1, with the only difference being that a self-associated cartoon face was directly contrasted with an other-associated cartoon face. The associative matching stage started with a learning procedure, in which the self-face and the other-face were presented on screen with their associative cartoon faces. The pairings of the real and the cartoon faces were counterbalanced across participants. Participants had 60 s to learn the two real-cartoon face pairings (self vs. other) before the perceptual matching task (Fig. 2A). During the perceptual matching task, a real-cartoon face pairing was presented for 100 ms. The real-cartoon face pairing either corresponded to a pairing seen by participants during the learning procedure (match trial) or was a novel pairing (mismatch trial). Participants were then required to judge whether the pairing was correct or not by pressing one of the two response buttons as quickly and accurately as possible within a 3000 ms time window. After this, visual feedback (correct or incorrect) was given on the screen for 500 ms. Participants performed 2 blocks of 120 trials following 60 practice trials. There were 60 trials in each condition (self-match, self-mismatch, other-match, other-mismatch). Trials were randomized for each participant.

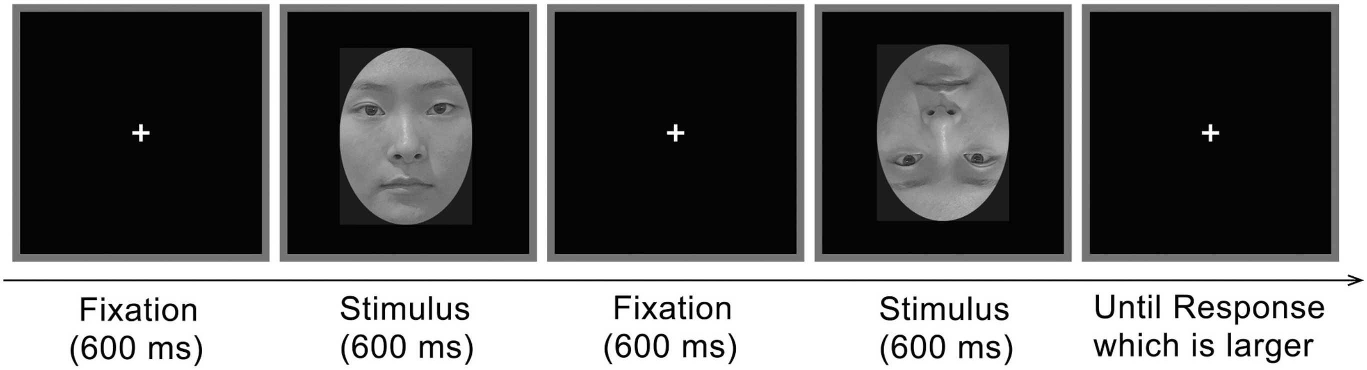

Fig. 1. Schematic representation of the size discrimination task. In Experiment 1, the size of the upright face (self-face or other-face) was compared with that of its inverted counterpart. Experiment 2 followed the same procedure as Experiment 1 except that the other-face was replaced by the famous face.

Participants were informed of the accuracy of their performance at the end of each block. Participants had to perform an additional block if the accuracy of the second block was below 90%. Actually, all participants performed well during the two blocks of the perceptual matching task, and none needed to complete an additional block.

2.3.4. Experiment 4

In the size discrimination task, the procedure was similar to that of Experiment 3 except that a grey ellipse surrounded by self-associated cartoon faces (self-context), which was presented for 1000 ms, was compared with a grey ellipse surrounded by other-associated cartoon faces (nonself-context) in the size discrimination task during the pretest and posttest stages (Fig. 2B). The grey ellipse was embedded in the contextual display of five evenly distributed cartoon faces (subtended $2.45^\circ \times 3.26^\circ$ in visual angle), and the distance between the ellipse and the surrounding faces was 0.56°. Participants performed the same associative matching task as in Experiment 3, and only three participants needed to complete one additional block.

3. Data analysis

For each participant under each test condition, we calculated the proportions of larger responses to the upright faces (Experiments 1 and 2), the self-associated cartoon faces (Experiment 3) or the grey ellipses surrounded by self-associated cartoon faces (Experiment 4), and fitted them with a Boltzmann sigmoid function: $F(x) = 1/(1 + \exp.[(x\text{-}x_0)/w])$.

The statistical analyses were conducted on the point of subjective equality (PSE, the point at which participants perceived the two stimuli as equal in terms of the visual size), which is estimated by the midpoint of the Boltzmann function. A PSE of 0 indicates a consistency between the perceived size and the physical size, and a negative PSE means that the upright face is perceived larger relative to the inverted counterpart (Experiments 1 and 2), whereas a positive PSE indicates the reverse (i.e., a size underestimation effect). Moreover, in Experiments 3 and 4, a negative shift of PSE reflects a size overestimation of the self-associated cartoon face as compared to the other-associated cartoon face (Experiment 3), and a positive change of PSE suggests a size underestimation of the grey ellipse surrounded by the self-associated cartoon faces relative to that surrounded by the other-associated cartoon faces (Experiment 4). In addition, the different limen (DL, half the interquartile range of the fitted function) was used to measure the size discrimination sensitivity.

4. Results

4.1. Size overestimation of self-face as compared to other-face

In order to eliminate the potential uncontrollable low-level perceptual differences between the self-face and the other-face, we first compared the size of the self-face (or the other-face) with that of its inverted counterpart and then contrasted the PSE in the self-face condition with that in the other-face condition to evaluate the size modulation effect of the self-face. In Experiment 1, one-sample *t*-test showed a significant positive PSE in the other-face condition (M = 1.20 pixels, $t(15) = 3.38$, $p < 0.01$, $d = 0.85$, 95% confidence interval (CI) for the mean difference = [0.44, 1.93], $BF_{10} = 22.75$, Fig. 3A), suggesting a size underestimation effect of the upright face stimuli compared with the inverted ones of identical physical size. This intriguing face size illusion has also been observed in previous studies (Araragi, Aotani, & Kitaoka, 2012; Walsh, Vormberg, Hannaford, & Longo, 2018). However, such illusion disappeared in the self-face condition (M = − 0.53 pixels, $t(15) = -1.07$, $p = 0.30$, $d = 0.27$, $BF_{10} = 0.14$, Fig. 3A), indicating that self-face processing can modulate the size underestimation of the upright faces. It is possible that self-related information processing leads to an overestimation of its perceived size, which might offset the underestimation effect of the upright face relative to its inverted counterpart. Indeed, paired-sample t-test revealed a significant decrease of PSE in the self-face condition as compared to the other-face condition (self-face vs. other-face: −0.53 pixels vs. 1.20 pixels, $t(15) = -4.58$, $p < 0.001$, $d = 1.15$, 95% CI for the mean difference = [− 2.50, − 0.91], $BF_{10} = 1.85 \times 10^2$, Fig. 3A, and see Fig. A1A for the panorama of the data), suggesting that the self-face was perceived larger than the other-face. Moreover, the participants' size discrimination sensitivity (i.e., DL) for the self-face condition did not significantly differ from that for the other-face condition (self-face vs. other-face: 1.64 pixels vs. 1.62 pixels, $t(15) = 0.18$, $p = 0.86$, $d = 0.04$, $BF_{10} = 0.26$). These findings together presented a novel case of visual size illusion induced by self-face.

4.2. Size overestimation of self-face as compared to famous face

However, it could be argued that the observed size illusion was due to the familiarity effect of the self-face compared with the other-face rather than the self-related information per se. To examine this possibility, we employed the famous faces that were also quite familiar to the participants in Experiment 2. Results showed a significant negative change of PSE in the self-face condition as compared to the famous face condition (self-face vs. famous face: − 0.33 pixels vs. 1.46 pixels, $t(15) = -3.21$, $p < 0.01$, $d = 0.80$, 95% CI for the mean difference = [− 2.97, − 0.60], $BF_{10} = 16.86$, Fig. 3B, and see Fig. A1B for the panorama of the data), suggesting that one's own face is perceived as larger than the famous face. Moreover, we found a significant positive PSE for the famous face condition (M = 1.46 pixels, $t(15) = 2.44$, $p = 0.03$, $d = 0.61$, 95% CI for the mean difference = [0.18, 2.74], $BF_{10} = 4.68$, Fig. 3B), which was not different from the PSE for the other-face obtained in Experiment 1 ($t(30) = -0.40$, $p = 0.69$, $d = 0.14$, $BF_{10} = 0.28$). Again, this size underestimation effect of the upright faces was not found in the self-face condition (M = − 0.33 pixels, $t(15) = -0.95$, $p =$

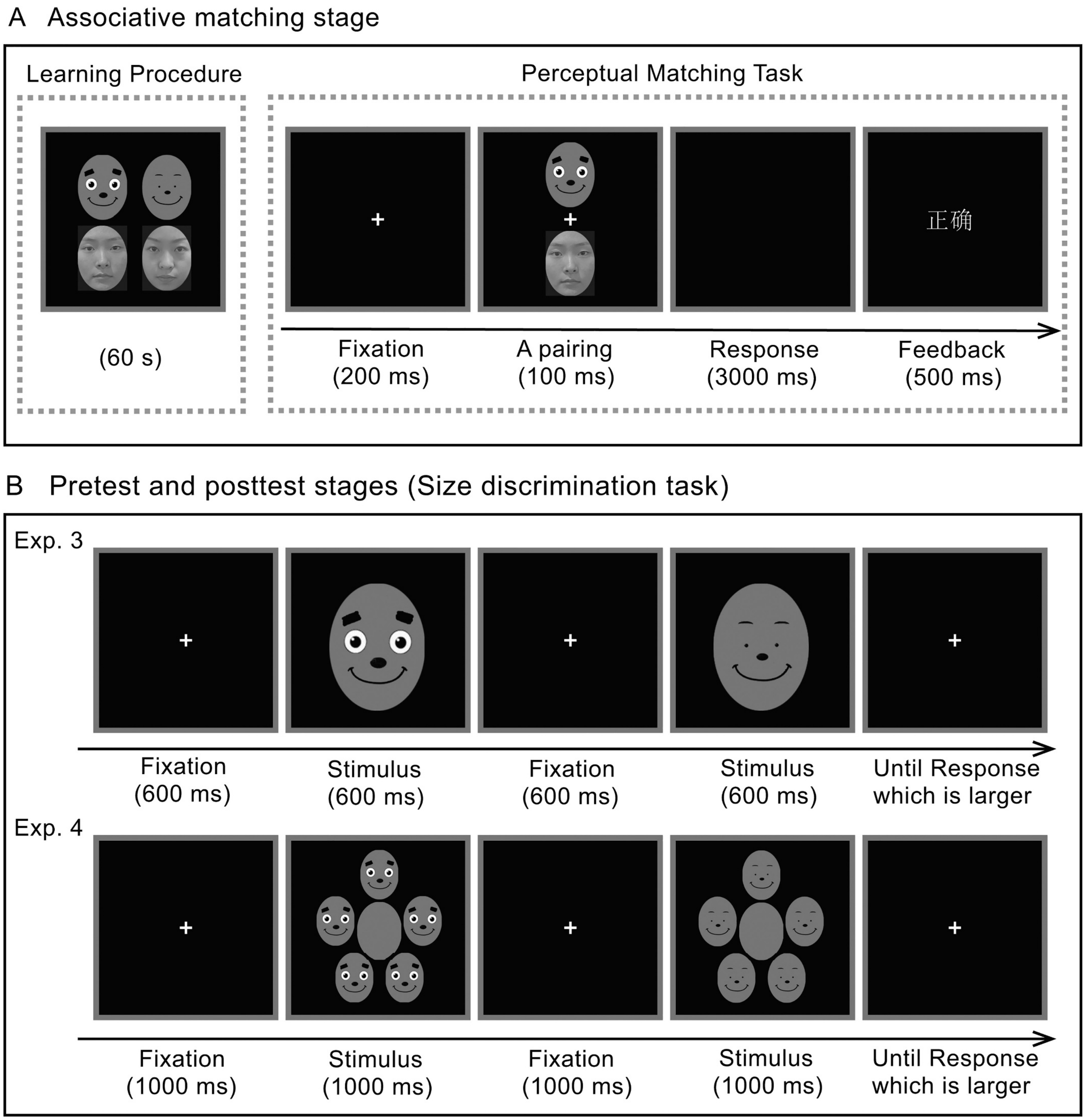

Fig. 2. Schematic representation of the experimental paradigm in Experiments 3 and 4. Both the two experiments contained three stages: a pretest stage, an associative matching stage, and a posttest stage. (A) Sample trial sequence from the associative matching stage in Experiments 3 and 4. Participants were first asked to learn the two real-cartoon face pairings presented on screen before the perceptual matching task. Immediately after this, participants had to judge whether the pairing was matched or not according to the prior learning procedure. Following the response, a visual feedback was given before the start of the next trial. (B) Sample trial sequences from the pretest and the posttest stages. In Experiment 3, the size of the self-associated cartoon face was directly contrasted with that of the other-associated cartoon face. While in Experiment 4, a grey ellipse surrounded by self-associated cartoon faces was compared with a grey ellipse surrounded by other-associated cartoon faces.

0.36, d = 0.24, $BF_{10} = 0.15$, Fig. 3B), replicating the finding in Experiment 1. In addition, the participants' size discrimination sensitivity (i.e., DL) for the self-face condition did not significantly differ from that for the famous face condition (self-face vs. famous face: 1.36 pixels vs. 1.48 pixels, $t\ (15) = -1.12$, $p = 0.28$, d = 0.28, $BF_{10} = 0.44$). Collectively, these converging findings of Experiment 1 and Experiment 2 clearly demonstrated a size overestimation illusion essentially caused by the self-referential property rather than the high familiarity of the own face.

4.3. *Size overestimation of self-associated cartoon face*

To further investigate the role of self-awareness in the observed visual size illusion, we adopted an associative matching paradigm to establish associations between the self-face and a cartoon face and be-

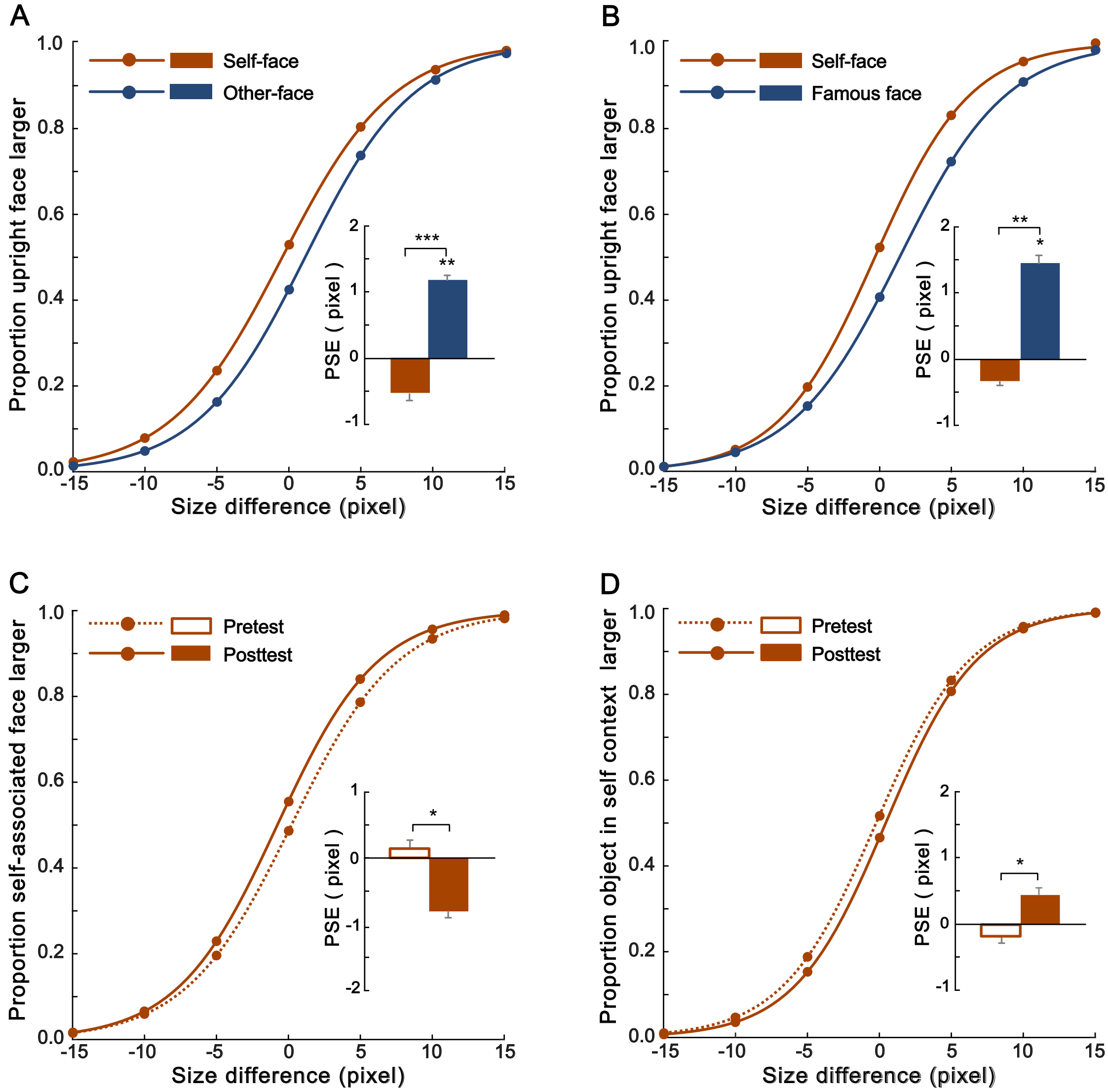

Fig. 3. Results from Experiments 1–4. (A) Proportion of responses in which observers reported the upright face as larger in size than its inverted counterpart, plotted as a function of the physical size difference between the two. Data are shown for the self-face (red curve) and the other-face (blue curve) conditions in Experiment 1. Inset shows the PSEs. (B) Data are shown for the self-face (red curve) and the famous face (blue curve) conditions in Experiment 2. (C) The graph shows the proportion of the "larger" responses to the self-associated cartoon face as a function of the difference between the sizes of the self-associated cartoon face and the other-associated cartoon face. The solid curve indicates the posttest condition and the dashed curve indicates the pretest condition. (D) Proportion of responses in which observers reported the grey ellipse embedded in the self-associated faces (self-context) as larger in size than that embedded in the other-associated faces (nonself-context) as a function of the physical size difference between the two was shown in the graph. Error bars: standard errors of the mean; ***$p < 0.001$. **$p < 0.01$, *$p < 0.05$. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

tween the other-face and another cartoon face in Experiment 3. In the perceptual matching task, the overall accuracy was very high (94.19%), suggesting that participants indeed learned the associations between the real and the cartoon faces. Additionally, the performance of the matching task indexed by combining accuracy and RT (ACC/RT) was better for the self-association condition than for the other-association condition (self vs. other: 1.19 vs. 1.06, t (15) = 4.92, $P < 0.001$, d = 1.23, 95% CI for the mean difference = [0.07, 0.19], $BF_{10} = 3.32 \times 10^2$), reflecting a self-association advantage over other-association. Following the associative matching task, the posttest showed a significant negative shift of PSE compared to that in the pretest (pretest vs. posttest: 0.15 pixels vs. − 0.88 pixels, t (15) = 2.54, $p = 0.02$, d = 0.64, 95% CI for the mean difference = [0.17, 1.89], $BF_{10} = 5.55$, Fig. 3C, and see Fig. A1C for the panorama of the data), showing a size overestimation illusion of the cartoon face newly associated with one's own face. Moreover, this size illusion could not be due to the change of the participants' size discrimination sensitivity, as their difference limens (i.e., DL) remained unchanged before and after the associative matching task (pretest vs. posttest: 1.52 pixels vs. 1.45 pixels, t (15) = 0.56, $p = 0.58$, d = 0.14, $BF_{10} = 0.29$). More intriguingly, the self-association advantage index (calculated using the difference of the association performance obtained in the self-face condition versus that in the other-face condition, $\frac{ACC_{self}}{RT_{self}} - \frac{ACC_{other}}{RT_{other}}$) was positively correlated to the magnitude of size overestimation effect (calculated using the difference of PSE obtained in the pretest versus that in the posttest, ($PSE_{pretest} - PSE_{posttest}$) ($r = 0.50$, $p = 0.04$), suggesting the role of self-advantage in the modulation of visual size perception.

4.4. Size underestimation of object in self-context

Finally, we explored the potential contextual influences of such self-induced size illusion on the visual size perception of non-face objects in

Experiment 4. Participants again showed high accuracy in the perceptual matching task (92.65%) and a reliable self-association advantage (self vs. other: 1.14 vs. 0.93, t (19) = 6.57, $p < 0.001$, d = 1.47, 95% CI for the mean difference = [0.14, 0.27], $BF_{10} = 1.44 \times 10^4$). Importantly, paired-sample *t*-test showed a significant positive shift of PSE in the posttest as compared to the pretest (pretest vs. posttest: − 0.19 pixels vs. 0.48 pixels, t (19) = − 2.34, $p = 0.03$, d = 0.52, 95% CI for the mean difference = [− 1.26, − 0.07], $BF_{10} = 4.01$, Fig. 3D, and see Fig. A1D for the panorama of the data), reflecting a size underestimation effect for the objects embedded in the self-associated stimuli (i.e., an Ebbinghaus-like illusion). In other words, the self-associated cartoon faces could enlarge their perceived size and thus led to a size-contrast illusion whereby the central object surrounded by the self-associated stimuli was perceived as smaller than that surrounded by the other-associated stimuli. Again, no change of DLs was observed before and after the matching task (pretest vs. posttest: 1.36 pixels vs. 1.23 pixels, t (19) = 1.46, $p = 0.16$, d = 0.33, $BF_{10} = 0.58$). In sum, these findings together with those obtained from Experiments 1–3 demonstrated that self-referential processing could drive the size illusion and further exert contextual influences on visual size perception of non-face objects.

5. Discussion

The own face bears unique importance for our identity and our sense of self (Devue & Bredart, 2011; Rochat, Broesch, & Jayne, 2012). Correspondingly, self-face demonstrates an advantage relative to other faces in terms of perception and attention (Bortolon & Raffard, 2018; Rochat et al., 2012; Sui & Rotshtein, 2019; Tong & Nakayama, 1999). The present study reported a novel case of self-face advantage: self-face processing could enlarge its perceived size. Specifically, compared with a stranger's face of the same size, the self-face was perceived as significantly larger. This size overestimation effect might not be accounted for by the familiarity effect, as it persisted even when the self-face was contrasted with a familiar face (i.e., a famous face). One thing to note is that although famous faces have usually been adopted as the control stimuli in previous studies (Geng et al., 2012; Keenan, Nelson, O'Connor, & Pascual-Leone, 2001; Tacikowski, Jednorog, Marchewka, & Nowicka, 2011), it is difficult to completely exclude the familiarity effect of self-face as compared to famous faces. Therefore, we employed an associative matching paradigm to further eliminate the potential familiarity effect. The self-associated cartoon face and the other-associated cartoon face were counterbalanced and equally unfamiliar to observers, but the former still exhibited a similar size overestimation effect. More importantly, the observed size illusion induced by the self-associated cartoon face can further exert contextual influences on visual size perception of non-face objects. In sum, these findings together demonstrated that self-awareness per se could perceptually accentuate relevant face stimuli, leading to a self-induced visual size illusion.

A similar phenomenon of visual size illusion has been observed with objects conveying high importance to the viewer in previous studies (e.g., coins for powerless children) (Dubois et al., 2010; Koningsbruggen et al., 2011; Leibovich et al., 2016; Veltkamp et al., 2008). It has been well documented that subjective importance and physical size are inextricably linked (Dubois et al., 2010; Luna, Nogueira, & Albuquerque, 2019; Veltkamp et al., 2008). However, it has not yet been tested whether self-face bearing unique importance can, like the behaviorally important objects, alter perception of physical size. A recent study showed that the self-advantage effect could be modulated by the physical size of the stimuli, suggesting a close association between self and size perception (Sui & Humphreys, 2015). Here, we went a step further by employing self-face stimuli in a size discrimination task and demonstrated that self-face could indeed affect its perceived size. This self-induced size overestimation effect resonates well with a wealth of previous research showing that self-face stimuli enjoy privileged processing in the visual system (Alzueta, Melcon, Poch, & Capilla, 2019; Geng et al., 2012; Sui & Humphreys, 2017). This also adds to the literature on self-advantage effect by demonstrating that self-face processing can impinge on basic perceptual processes and as a result can enlarge its perceived size relative to others' faces.

More importantly, the self-face induced size overestimation effect could be extended to an inconsequential cartoon face that was newly associated with the self-face stimulus. During the associative matching procedure, we found a clear perceptual prioritization effect towards the self-associated cartoon face, which parallels recent findings obtained in an analogous task using self-label instead of self-face (Reuther & Chakravarthi, 2017; Sui et al., 2012; Wozniak, Kourtis, & Knoblich, 2018). In contrast to prior work of self-prioritization using very familiar self-related stimuli (e.g., one's own face or name) (Bortolon & Raffard, 2018; Cunningham & Turk, 2017), the novel use of the self-associated cartoon face could overcome potential confounds from stimulus familiarity and complexity. Going beyond this, here we showed that, following transient associative learning, the cartoon face linked with the self-face could inflate its perceived size as well. Remarkably, the magnitude of this size overestimation effect could be well predicted by the self-association advantage index, indicating that self-advantage effect can subsequently modulate visual size perception. Furthermore, this self-induced size illusion could also be measured indirectly by using a modified version of the Ebbinghaus illusion with self- or other-associated cartoon faces as surrounding stimuli. We found a reliable Ebbinghaus-like illusion: an inner object surrounded by self-associated cartoon faces appeared to be smaller than an identical object surrounded by other-associated cartoon faces. It is conceivable that the self-associated cartoon faces were perceived as larger and thus induced a size underestimation effect of the inner object. Together, our findings demonstrated that self-advantage could lead to distorted perception of size, highlighting the role of self-awareness in modulating visual size perception.

This self-induced size illusion is presumably mediated by the visual attentional system. It has been demonstrated that the allocation of attention to a visual stimulus can increase its perceived size (Anton-Erxleben, Henrich, & Treue, 2007; Choi & Chong, 2020; Kirsch, Heitling, & Kunde, 2018). Additionally, there is mounting evidence that self-relevant signals always bias the attentional system (Macrae, Visokomogilski, Golubickis, & Sahraie, 2018; Tacikowski & Nowicka, 2010; Zhao, Uono, Li, Yoshimura, & Toichi, 2018). It is therefore possible that self-referential information might enhance attention to a greater extent than nonself-related information, thus leading to a larger perceived size of the self-relevant stimuli. From a functional perspective, the observed self-induced size illusion may be an adaptive strategy to cope with important information in the environment. It has been documented that stimuli with larger size tend to be more prominent and easier to capture attention, thereby facilitating their detection in the complex visual scenes (Nah, Neppi-Modona, Strother, Behrmann, & Shomstein, 2018; Proulx & Matthieu, 2010; Wolfe, 2017). Hence, perceiving self-referential stimuli as larger might in fact reflect potential processing advantages, which is also in line with previous findings on the self-prioritization effect (Bortolon & Raffard, 2018; Cunningham & Turk, 2017; Sui & Rotshtein, 2019).

Notably, we also found an intriguing face-inversion-related size illusion, that is, a size underestimation effect of the upright faces compared with the inverted counterparts. This size illusion has been reported in prior research (Araragi et al., 2012; Walsh et al., 2018). However, the shape of the outline of the upright face was different from that of the inverted face in these studies. Here, we adopted oval faces and thus made it better controlled for the outer contour of the faces. Our results repeated and extended the previously observed face size illusion by directly illustrating that the face inversion rather than the contour difference accounted for the size underestimation effect. More importantly, this size underestimation effect was maintained in the famous face condition but disappeared in the self-face condition, suggesting that self-specific processing can modulate the face-inversion-related size illusion. These findings together demonstrated that the self-face induced overestimation effect could offset the underestimation effect of the upright faces and provided evidence for the specificity of self-face processing as compared to that of other-faces (both unfamiliar and familiar) from a visual size perception perspective.

In conclusion, we report a novel perceptual illusion that self-face can enlarge its perceived size. Moreover, this size overestimation effect can be extended to the self-associated cartoon face and further exert contextual influences on visual size perception of other objects. Our findings together point to a special mechanism of size perception tuned to self-referential information and provide new evidence for the self-advantage effect. Visual size appears to expand when observers are confronted with self-referential signals.

Declaration of Competing Interest

None.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.cognition.2021.104718.

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