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Not All Faces Are Processed Equally: Evidence for Featural Rather Than Holistic Processing of One's Own Face in a Face-Imaging Task

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The present work considers the mental imaging of faces, with a focus in own-face imaging. Experiments 1 and 3 demonstrated an own-face disadvantage, with slower generation of mental images of one's own face than of other familiar faces. In contrast, Experiment 2 demonstrated that mental images of facial parts are generated more quickly for one's own face. Finally, Experiment 4 established that a bias toward local processing is advantageous for one's own face, whereas a global-processing bias produces an enhanced own-face disadvantage. The results suggest that own-face imaging is more synchronized with retrieval of face features and less attuned to a face's holistic pattern than is imaging of other people's faces. The authors propose that the salient information for own and other face identification reflects, in part, differences in the purpose and experiences (expertise) generally associated with processing of own and other faces. Consistent with work examining the range of face processing, including other-race faces, our results suggest that not all faces receive the same holistic emphasis.

Keywords: face processing, cognition, processing of own face, feature–holistic processing, expertise

The goal of the present study was to explore a distinction between the processing of two classes of faces, both familiar. In particular, we wished to compare the processing of one's own face with the processing of other highly familiar faces. The idea that different classes of faces may be processed differently is widely accepted. For example, at least four findings suggested that familiar and unfamiliar faces are processed differently. First, a double dissociation has been observed in prosopagnosic patients charged with recognizing familiar and unfamiliar faces (e.g., Carlesimo & Caltagirone, 1995; Malone, Morris, Kay, & Levin, 1982; Takahashi, Kawamura, Hirayama, Shiota, & Isono, 1995; see also Warrington & James, 1967). Second, activation of different brain regions has been shown on presentation of familiar and unfamiliar faces (Andreasen et al., 1996; Henson et al., 2003). Third, when scanning familiar and unfamiliar faces, dissimilar patterns of eye movements have been observed in prosopagnosic patients (Rizzo, Hurtig, & Damasio, 1987). Finally, the pattern of evoked potentials varied for the processing of familiar and unfamiliar faces (e.g., Uhl, Lang, Spieth, & Deecke, 1990). In the current article, we focus on subdivisions within the class of familiar faces, specifically, one's own face as compared with other familiar faces.

In our study, we measured the time participants took to generate either a mental image of their own face or that of other highly familiar faces. The task of mental imaging is subjective, and as such, its use as a research tool could be questioned. However, a

rich research program has successfully used this task—despite its subjective nature—to uncover the structure of visual, long-term memory representations (e.g., Kosslyn, Ball, & Reiser, 1978; for reviews, see Kosslyn, 1980, 1994). Thus, whereas the final product of this task, indeed, is not subject to direct observation, its by-products—in particular, response latencies associated with performance—seem to be highly reliable and, as such, are useful in constraining theory. As we argue in this article, systematic analysis of performance in the face-imaging task can provide insight into processing of different classes of facial stimuli as a function of the difficulty involved in recalling information from long-term memory.

The motivation behind the comparison of own face and other familiar faces is driven by the notion that perceptual experience—which at its culmination turns into expertise—plays a critical role in the recognition and retrieval of objects, whether they are written words, objects, or faces (Gauthier & Tarr, 1997). We assume that the nature of the experience is a function of the goal to be obtained through the act of perception, with a different goal typically set for perceiving one's own face as compared with those of other familiar people. Indeed, the goal of processing another's face is most often to identify it (“who is this person?”), whereas the goal of processing one's own face is almost never identification but, rather, an inspection of individual facial features, such as in the act of grooming (see Tarr & Pinker, 1989). Under these assumptions, it would not be surprising to find evidence of qualitatively different processing for these two classes of face stimuli.

Stemming from the extensive experience that humans have with facial patterns, the face-recognition system has presumably been shaped to rely on more holistic processing (Gauthier, Curran, Curby, & Collins, 2003; Tanaka & Farah, 1993, 2003). By relying on holistic information, different individuals—all with similar features but different configurations—can be efficiently recognized. Indeed, it has been argued that the holistic processing of

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faces has an evolutionary advantage whereby rapid face recognition is essential for social survival (Farah, Rabinowitz, Quinn, & Liu, 2000).

However, the information likely to be stored about one's own face—from which a mental picture could be generated—would more appropriately capture the fragments of one's face that are salient reminders of how one generally regards one's own particular face. Therefore, the stored information used to generate mental images of one's own face would presumably rely more heavily on these readily available facial features than on a less available holistic representation. Theorizing in other perceptual domains suggests that generating an image of one's own face ought to be slower if the goal is an entire face image. Specifically, processing time is slower when local features and relationships must be integrated to achieve a whole pattern as compared with working off of an already compiled whole (Kimchi, 1994). Thus, if a whole configural pattern of one's own face is mediated by a process of integrating separable features, then own-face mental imaging should be slower relative to processing of faces that rely more on stored holistic patterns.

To place this investigation in a larger context, one might consider the investigations into own-race bias in face recognition. In brief, recognition of faces of those from another race is generally poorer than that of faces among one's own race (e.g., Meissner & Brigham, 2001). A variety of cognitive explanations have focused on the possibility that as compared with other-race faces, own-race faces are processed more holistically, giving a high premium to configural relationships (Rhodes, Tan, Brake, & Taylor, 1989; Sangrigoli & de Schonen, 2004). In contrast, faces of those from other races receive less configural analysis. Levin (2000) and Levin and Angelone (2002) have made a case that the goal of own-race face perception is typically identification, thereby leading to a high level of individuation of this class of faces. In contrast, the goal of other-race face perception may more likely be race classification, resulting in an absence of individuation for this class of faces as a result of the lack of expectation that further interactions with that person will take place. Thus, the act of perception with the different classes of faces is postulated to evolve in response to the purpose, or goal, which is to be attained through experience with the different classes of faces.

If configural and holistic analysis is at the core of own-race face recognition as a means of individuating frequently encountered others (Michel, Rossion, Han, Chung, & Caldara, 2006), then it is of interest to explore whether the broad holistic analysis that dominates processing of faces from one's own race applies equally well to processing of the frequently encountered own face, for which the processing goals are entirely different. We suggest that it cannot. Instead, we predict that in comparison with other familiar faces, one needs relatively little configural information about one's own face, for there are almost no occasions that require one to individuate one's own face for the purpose of identification. Note that other differences exist between the information that may be stored regarding one's own face and others' faces (e.g., one's own face is typically perceived in mirror-transformed views; see General Discussion for other possible candidates). Whereas we are not discounting the importance of other such differences, the focus of the present investigation—as an initial venture into own-face processing—is directed toward whether the difference between holistic and featural information may provide a partial account for

differential processing of own and other faces, if indeed such differential processing can be demonstrated.

Support for holistic processing of faces—without consideration of own-face recognition—is extensive. Although, object recognition is generally mediated by embedded parts (Biederman, 1987; Tanaka & Farah, 1993), face recognition is more dependent on holistic analysis (e.g., Tanaka & Farah, 1993). Thus, although object parts (e.g., house doors) were recognized equally well as upright whole objects-, inverted whole objects, or in isolation, by contrast, face parts (e.g., nose) were best recognized within upright faces (e.g., Farah, 2000). Additionally, Palermo and Rhodes (2002) found that when an upright face served as a target, participants were able to match (same-different) flanking faces more easily when the flanking faces were inverted than when they were upright. Presumably, less interference occurred when the targets and flankers shared fewer holistic-processing resources. Indeed, Farah, Wilson, Drain, and Tanaka (1998) postulated that face recognition is a “special” form of pattern recognition in that “it involves relatively little part decomposition” (p. 484). Moreover, in a comprehensive review of the empirical evidence, McKone, Martini, and Nakayama (2003) concluded that that holistic processing of faces often proceeds without any part decomposition. Finally, face recognition based on an undifferentiated whole may be so fundamental to face processing that it begins at a very early age (as early as 4 years of age; Pellicano & Rhodes, 2003).

Although face recognition seems to rely primarily on holistic processing, the neuropsychological literature supports a dissociation between own and other face recognition. Thus, Turk et al. (2002) tested a split-brain patient, who viewed a series of morphed photos that ranged from 0% self (and 100% familiar) to 100% self (and 0% other) and judged whether the photo was of oneself or of a familiar other. Results indicated a double dissociation. The participant's left hemisphere showed a bias toward recognizing morphed faces as self, whereas his right hemisphere was biased toward the familiar other (for further neuropsychological evidence, see Conway & Pleydell-Pearce, 2000; Keenan, Nelson, O'Connor, & Pascual-Leone, 2001).

Further evidence of the dissociation between one's own face and others' faces comes from cognitively intact individuals. Kircher et al. (2000) investigated the functional anatomy of processing self-relevant information by tracing localized magnetic resonance imaging signals as participants judged (a) the familiarity of photos morphing a stranger's face and their own face and (b) the familiarity of photos morphing a stranger's face and their partner's face. Results showed that the left fusiform gyrus was activated for the faces that included one's own face but not for faces that included the highly familiar partner's face.

Behavioral evidence has also suggested that own-face processing may be different from that of other faces. Face recognition appears dependent on the angle of view (Bruce, Valentine, & Baddeley, 1987). Troje and Kersten (1999) found a frontal advantage for one's own face, with frontal views increasing identification more for one's own face than for other familiar faces. Laeng and Rouw (2001) observed that the optimal viewing condition for other faces was 22.5°, whereas own-face viewing showed a significant frontal advantage (but see Tong & Nakayama, 1999). Recently, Brédart, Delchambre, and Laureys (2006) compared the impact on foveal word processing of flanking faces and found that own-face flanks had a more deleterious effect than did other-face

flanks when flanking faces were incongruent with names appearing in the foveal region. It was not clear as to why own-face flankers were stronger distractions, but the findings suggested that processing of one's own and other faces rely on different long-term representations.

The apparent support for differences in the processing of one's own as compared with other faces comes, by and large, from research involving facial recognition. To support our prediction that own-face processing is qualitatively different from that of other familiar faces, we used a face-imaging task. In this task, participants were required to generate a mental image either of one's own face or of other people's faces. Because the generation of a mental image requires using preexisting representations in long-term memory, this exercise can provide a window into the characteristics of these representations. In addition, because face imaging does not require having to present the physical nominal stimulus, it was a natural candidate for our investigation, allowing for the study of both participants' own face and other familiar faces, with familial relationship to participants serving as control stimuli.

We argue that similar differences to those that have been documented using face recognition would be found with the face-imaging task. This argument is based on converging evidence suggesting that the tasks of perceptual recognition and mental imaging utilize common representations, perhaps even in overlapping parts of the brain. Thus, Farah (1988), along with Kosslyn, Thompson, Kim, and Alpert (1995), have reported that visual mental imaging engages a shared representation with higher visual perception. A variety of other studies, testing both objects and faces, reached similar conclusions (e.g., Ishai & Sagi, 1995; Kosslyn et al., 1995; but see Behrmann, Winocur, & Moscovitch, 1992). Indeed, O'Craven and Kanwisher (2000) observed significant overlap in the regions activated for the perception and the mental imaging of famous faces. Statistical maps of activated regions showed remarkable similarity for perception and imaging tasks (see also Ganis, Thompson, & Kosslyn, 2004). These authors concluded that the most plausible account of overlapping activations is that generating mental images and perceptual recognition reflect common representations and/or analysis. Finally, Bryant (1991) used multidimensional scaling and clustering techniques to show that participants used the same general features to make ratings when using pictures as when using mental imagery. Therefore, theorizing regarding both the more holistic representation of familiar faces and the significance of experience in guiding facial recognition ought to apply to mental imaging.

Assuming that the experience with own-face analysis is likely to favor features over holistic representation and that feature integration takes time to produce a whole pattern (Healy, 1994; Kimchi, 1994), we predicted that the time to generate an image of one's own face from long-term storage would differ from that of generating an image of other familiar faces. Moreover, we wished to uncover the nature of the most readily available information stored in long-term memory for one's own face and other familiar faces by varying the target images. Specifically, in Experiment 1, we asked participants to generate target images of whole face. We predicted that participants' own face would be imaged more slowly owing to their presumed reliance on a less well-integrated whole. Indeed, an own-face disadvantage was found. Of course, it is possible that own-face mental imaging could be slower for a

variety of other reasons (see the General Discussion for other plausible candidates). Therefore, in an effort to more specifically determine whether the most accessible stored information of one's own face is more featural, in Experiment 2 we asked participants to generate target images in which facial features were prioritized. The own-face disadvantage was either eliminated or reversed. Experiment 3 was a replication of the own-face disadvantage found in Experiment 1, implemented with a modified procedure. Finally, in Experiment 4, we determined whether differences in orientation toward whole or feature processing had a differential effect on mental imaging of participants' own face and other familiar faces. To this end, prior to the actual imaging task, we manipulated the processing orientation of participants toward either the whole or the components. This was accomplished by showing participants a series of single large letters (e.g., "H," henceforth, the global level) composed of small letters that were different from the large letter (e.g., many "R"s, henceforth, the local level; Navon, 1977). Processing orientation was manipulated by asking participants either to identify the global patterns (i.e., orientation to whole) or to identify the local letters (i.e., orientation to components). As detailed in the results, we found that processing orientation affected the processing advantage of generating an image for another's face as compared with one's own face.

Experiment 1

In Experiment 1, we compared mental imaging of one's own face with that of other familiar faces. As a control to one's own face, we included celebrity faces (e.g., Ishai, Haxby, & Ungerleider, 2002) as well as faces of family and friends of our participants. It is unclear which familiar face should serve as the best comparison for one's own face. When a face is generated, deeper semantic associates are doubtless generated along with it. The semantic associates available for family and friends are probably best equated to that of one's own face. Still, it could be argued that because of the exposure in the mass media and tabloids, the plethora of information available on celebrities far exceeds that of most acquaintances, even close family members, and is equal only to the information available on one's own life. Because there is little cost associated with generating mental images regarding family and friends—faces that in a recognition task would be very difficult to obtain—we asked participants to image, in addition to their own face and faces of celebrities, faces of friends and of close family members.

On the basis of pilot data, we found that an own-face disadvantage in generation times could be obtained even with crude measurement, using a stopwatch. Therefore, to highlight the possible robustness of our findings, we used this procedure (for a computerized version of the task, see Experiment 3) with the justification that if such a crude procedure yields consistent results, it would bolster the robustness of our effect.

Method

Participants. Twenty-four Union College students were paid \$3 for participating in the experiment.

Materials and design. The 15 to-be-imaged items included objects and people whose faces, as revealed by preliminary testing, were familiar to the participants. The objects were the following:

teacup, elephant, red car, and leather chair. Four categories of faces included celebrities, close friends, family members, and own face. The celebrities were Tom Cruise, Barbara Streisand, Jack Nicholson, and Marilyn Monroe. Family members were mother and father.

The order of the 15 stimuli was randomized, with the constraint that items from the same category not appear consecutively. The same list of items was presented three times to each participant, in a different order across trials. The design included item category (own face, friend face, family face, famous face, and object) and trial (first, second, third), both manipulated within participant.

Procedure. Individually tested participants were instructed to image whole faces and objects as quickly as possible and to make sure images were clear before responding. They were warned that the images might not be of equal clarity but were asked to generate a clear image quickly. Before the experiment began, the experimenter practiced reading each name at a constant pace and for the same total time. Prior to testing, each participant practiced the imaging task with a different set of familiar faces and objects from that used in the actual experiment. For both the practice and target trials, participants tapped a table once the image was formed.

Timing of a trial began when the experimenter completed reading aloud the name of the to-be-imaged item. An assistant, who was unaware of the experimental hypotheses or of the various conditions, recorded participants' response times (RTs) with a stopwatch.

Results and Discussion

Imaging times were averaged across participants and are displayed in Table 1. Object RTs, though displayed, were not included in the reported analyses for any of the experiments. Table 1 revealed that imaging of one's own face was slower than that of other faces and that the own-face disadvantage persisted across all three trials. For this and subsequent analyses, all hypotheses were treated as two-tailed.

An analysis of variance (ANOVA) yielded significant main effects of trial, $F(2, 46) = 19.02$, $MSE = 0.99$, $\eta_p^2 = 0.45$, and face category, $F(3, 69) = 14.49$, $MSE = 0.83$, $\eta_p^2 = 0.39$, $ps < .01$. The interaction, $F(6, 138) = 4.85$, $MSE = 0.31$, $\eta_p^2 = 0.17$, was also significant, $p < .01$. A pairwise comparison performed with Bonferroni adjustment for multiple comparisons determined that across trials, mental imaging of famous faces was slower than that for friend and family faces ($p < .02$), and, more importantly, imaging of participants' own face was slower than that of each of

the other three face categories ($p < .02$). Thus, the results established an own-face disadvantage in the imaging of whole faces.

Recently, Ishai et al. (2002) asked participants to image celebrity faces. Because imaging latencies were not the focus of that investigation, the performance of only eight pilot participants was timed. Still, the mental-imaging times for famous faces in our experiment were considerably slower than those observed by Ishai et al. Most likely, the difference in overall RT was due to the use of only celebrity faces in the Ishai et al. study, whereas all categories (objects and the different types of familiar faces) were presented in random order in the present study.

The results of our first experiment provided initial support for the notion that own-face imaging is qualitatively different from other-face imaging. A possible alternative interpretation for the results is that the longer time needed to generate own-face images may have been mediated by a subjective demand imposed by participants on themselves to generate a clearer image of themselves than of others, a process that would be accompanied by longer image-generation times. Sharper own-face images, as compared with other-face images, might therefore account for the own-face disadvantage. This possibility was addressed later in Experiments 3 and 4, where clarity measures were taken in addition to latency measures. However, we first sought support for the notion that the own-face disadvantage was mediated by featural processing of one's own face.

Experiment 2

Experiment 2 tested whether the disadvantage for one's own face observed in Experiment 1 could be eliminated or reversed when imaging instructions shifted the focus to local features (e.g., eyebrow width) and the positioning of local features (e.g., distances between facial parts; Leder, Candrian, Huber, & Bruce, 2001).

Method

The method for this experiment approximated that of Experiment 1. However, instead of whole faces, participants now imaged facial features or their positions within the face, including distance between eyes, head shape, eyebrow thickness, and nose-to-mouth distance. Features were imaged for Julia Roberts (high famous), Christian Slater (moderate famous), Vanilla Ice (low famous), mother's face (family), friend's face, and own face. Relative fame was assessed through an independent sampling of participants not involved in the imaging task. Prior to imaging features for a particular face, the to-be-imaged feature was named. Subsequently, the experimenter—who was unaware of the experimental hypothesis—recited the names at an even pace. Participants imaged that feature for the succession of faces. RTs were again recorded by a naive assistant.

The order of both the sequence of features and the faces for each feature was randomized across participants. To ensure that the required feature was imaged, participants were instructed to perform a judgment or drawing task based on the imaged feature. Thus, following the imaging, participants had to perform one of the following: either to immediately select the correct facial shape from a set of shapes; to place an eye on a chart at the proper distance from a second eye; to mark where lips were located below

Table 1
Mean Imaging Times in Seconds (With Standard Errors) for the Different Categories of Stimuli Across the Three Image-Generation Trials

Item category	Trial 1	Trial 2	Trial 3	Item mean
Own face	3.55 (.56)	2.30 (.25)	2.21 (.29)	2.69
Family face	1.97 (.24)	1.79 (.19)	1.56 (.18)	1.77
Friend face	2.25 (.21)	1.84 (.14)	1.57 (.15)	1.89
Famous face	2.67 (.24)	1.94 (.17)	1.70 (.17)	2.10
Object	2.16 (.17)	1.69 (.13)	1.41 (.10)	1.75
Trial mean	2.52	1.91	1.69	

a nose; or to trace the thickness of eyebrows with a pencil. In each case, participants were instructed to work from the mental image they had generated in response to the aforementioned name. This procedure is akin to the widely used practice of asking readers comprehension questions following the reading of a passage to ensure that the reader is trying to comprehend the text while the experimenter's real interest lies in factors pertaining to the perceptual qualities of the passage (see Koriatic & Greenberg, 1994). Latency for the mental images was computed on the basis of the respondent's time to tap the table on each trial and was recorded before the feature judgment task was performed. Eighteen students were paid \$3 to participate.

Results and Discussion

Imaging times were averaged across participants and are displayed in Table 2. Examination of the results portrayed a trend different from that found in Experiment 1. Own-face images averaged across features were faster than all but family faces, to which latency was about equal. In fact, for two categories of features, own-image features were generated fastest. An ANOVA confirmed the main effects of face category, $F(5, 85) = 18.72$, $MSE = 4.57$, $p < .001$, $\eta_p^2 = 0.52$, and feature, $F(3, 51) = 4.04$, $MSE = 6.23$, $p < .02$, $\eta_p^2 = 0.19$, but showed no interaction.

Next, we compared participants' own face against all other faces across all features combined. Individual comparisons of participants' own face with every other face showed that across all features, only family face showed no difference ($p < .05$). Family face and own face had comparable imaging times. Note that in Experiment 1, when asked to image whole faces, participants' own face was imaged significantly slower than family face ($p < .02$). Therefore, it seems that for all face categories, the instructions to image features changed the default processing from holistic to featural, and either eliminated (family) or reversed (other categories) the previous own-face disadvantage. Still, mental imaging of family faces allowed for greater flexibility in processing than did imaging of other faces, thereby yielding RTs to own face more comparable to those of family faces. Taken together, the results confirmed our hypothesis that own-face imaging was more compatible with facial features than was holistic processing. The trend appeared to be consistent both for features and for the positioning of features within the face.

It is noteworthy that Ishai et al. (2002) also included a condition in which participants were asked to generate an image of a facial

feature. Thus, participants were instructed to generate clear, vivid images of a face and then were asked, for example, whether the face had thick lips or a big nose. Ishai et al. reported that latencies in this condition were not significantly different from those in the condition where no question was asked regarding individual features, a condition most similar to that of Experiment 1. How can this be reconciled with our finding that feature imaging (Experiment 2) was considerably slower than whole-face imaging (Experiment 1)?

The clearest difference between these studies is that only in our study were participants asked to directly image features. In Ishai et al. (2002), in contrast, the entire face was first imaged, and only once imaged, was a yes–no response required regarding the feature. Despite this critical difference, however, the pattern of performance at a descriptive level was identical in both studies, with slower RTs occurring in the feature condition than in the whole-face condition. Indeed, the absence of a significant effect reported by Ishai et al. most likely reflects the low power of their analysis, which used the data from only eight pilot-study participants.

Experiment 3

Experiment 3 was designed to provide a computer-based replication of the own-face mental imaging effect. The use of the stopwatch method in Experiments 1 and 2 highlighted the robustness of the effect, showing that it could be found even in unfavorable conditions that include large variability. Still, a computer-based replication can better demonstrate the true magnitude of the effect, with noise decreased to a minimum. Additionally, in Experiment 3, participants were also asked to rate the clarity of their images. This was undertaken to ensure that RT differences between the different image categories could not be attributed to a trade-off between speed and clarity of the image.

Method

A total of 18 Tel-Aviv University students participated in the experiment for monetary compensation. Each participant was administered two trials of three to-be-imaged faces, which included his or her own face and that of each of the participant's parents. Face category (own, father, mother) and trial (first, second) were manipulated within participant. The words "your own face," "your father's face," and "your mother's face," as well as three other names for the practice trials ("your sibling" and two celebrities),

Table 2
Mean Imaging Times in Seconds (With Standard Errors) as a Function of Face Category and Feature

Face category	Feature				Item mean
	Eye distance	Nose–mouth distance	Eyebrow thickness	Head shape	
Own	2.60 (.32)	3.47 (.61)	2.11 (.26)	2.33 (.35)	2.64
Family	2.71 (.33)	2.80 (.26)	2.59 (.27)	2.22 (.19)	2.58
Friend	3.29 (.39)	3.93 (.56)	2.98 (.33)	2.55 (.17)	3.19
High famous	4.12 (.46)	3.99 (.47)	3.32 (.42)	3.32 (.49)	3.69
Moderate famous	5.17 (.65)	5.25 (.77)	4.89 (.65)	4.07 (.54)	4.85
Low famous	5.17 (.81)	5.93 (.60)	5.29 (.69)	4.03 (.61)	5.10

were recorded on the computer. Trials were then presented by auditory presentation of the face stimulus to be imaged.

The study began with presentation of the three practice images, followed by two trials of the three test faces. In each trial, the to-be-imaged names were counterbalanced such that each name appeared only once and across participants each name appeared an equal number of times as first, second, or third in order.

Prior to the presentation of each name, an asterisk appeared for 500 ms, immediately followed by a stimulus name, which was sounded through the headphones. Imaging instructions were identical to those of Experiment 1. Participants were instructed to create a clear image of the face and to press the space bar once a clear image was formed. Timing was measured from the offset of the sounded name until the space bar was pressed. Subsequently, participants rated the clarity of the imaged face by pressing a key from 1 (*least clear*) through 5 (*most clear*). The screen then turned blank for 2,000 ms until the asterisk for the next name was presented.

Results and Discussion

Table 3 presents the RT and clarity ratings for the first and second trials. Examination of the data revealed a pattern identical to that found in Experiment 1. In both trials, RTs were slower and were rated less clear for participants' own face than for a parent's face. A two-way ANOVA for the RT data, with face category (own, father, mother) and trial (first, second) as within-participant variables, found face category to be significant, $F(2, 34) = 30.51$, $MSE = 308,502$, $p < .0001$, $\eta_p^2 = .64$. Trial showed a marginal effect, $F(1, 17) = 3.94$, $MSE = 20,504$, $p = .06$, $\eta_p^2 = .19$, suggesting faster performance in the second trial than in the first. The Trial \times Face category interaction was not significant, $F(2, 34) = 1.44$, $MSE = 56,002$, $p > .10$, $\eta_p^2 = .08$. A planned comparison of the face-category effect, comparing participants' own face with father's face and with mother's face, revealed a

significant effect, $F(1, 17) = 41.41$, $MSE = 454,582$, $p < .001$, $\eta_p^2 = .71$, establishing that imaging times were slower for participants' own face than for a parent's face. Post hoc Tukey analysis showed a significant difference between own face and father's face ($p < .001$) and between own face and mother's face ($p < .001$).

Likewise, for the clarity data, face category was found to be significant, $F(2, 34) = 6.57$, $MSE = 0.36$, $p < .005$, $\eta_p^2 = .28$. Both trial and the Trial \times Face category interaction were not significant (both F s < 1). A planned comparison of the face category effect was significant, $F(1, 17) = 8.26$, $MSE = 0.57$, $p = .01$, $\eta_p^2 = .33$, establishing that clarity rating of participants' own face was lower than that of a parent's face. Post hoc Tukey analysis showed a significant difference between own face and father's face ($p < .01$) and between own face and mother's face ($p < .01$). Critically, the slower imaging times found for participants' own face could not be attributed to the generation of clearer faces. On the contrary, the own-face disadvantage was revealed not only in the RT data but also in the clarity ratings.

Experiment 3 demonstrated that the own-face disadvantage could be replicated with a computer-based procedure and a response mechanism controlled by the respondent. Generating an image of one's own face was significantly slower than generating an image of the face of each of one's parents. This effect persisted for the first and second trials and could not be attributed to a speed-clarity trade-off. Finally, the face category effect accounted for an impressive 71% of variability in generation times. Taken together with the effectiveness of the manipulations across the previous three experiments (despite their more crude procedures), the present findings provide consistent support for differential processing of one's own and other faces in the image-generation task.

Experiment 4

We have interpreted the own-face disadvantage (Experiments 1 and 3) as mediated by featural processing of one's own face. This result was supported by an own-face advantage for the imaging of local feature positioning (Experiment 2). In the current experiment, we wished to provide even stronger evidence for the role of featural processing of one's own face by directly manipulating the type of processing that the different face categories undergo. By manipulating the type of processing, we wished to systematically affect the imaging times of participants' own face as compared with those of other familiar faces.

Our manipulation was based on a recent study by Macrae and Lewis (2002). These researchers biased participants' processing toward either local or global processing prior to their performance of a face-recognition memory task. Participants who were oriented toward local features performed worse in the recognition task than did controls, who spent 10 min completing the unrelated filler task of reading a passage from a novel. In contrast, participants oriented toward global features improved their ability to recognize faces as compared with the controls. Weston and Perfect (2005) used the same biasing task with split faces and also found that a local-processing bias leads to more local, feature-oriented processing of faces.

In the current experiment, we used the local-global manipulation to investigate own-face processing. Presumably, a bias toward local processing would be compatible with own-face processing

Table 3
Mean Imaging Time in Milliseconds (With Standard Errors) and Clarity Ratings (and Standard Errors) for First and Second Trials as a Function of Face Category With Computer-Based Presentation

Measure	Response time (SE)	Clarity rating (SE) ^a
First trial		
Face category		
Own	2,942 (620)	4.28 (.75)
Father	1,964 (761)	4.72 (.46)
Mother	1,992 (755)	4.67 (.49)
Own-face imaging effect ^b	964	0.415
Second trial		
Face category		
Own	2,782 (710)	4.33 (.77)
Father	1,989 (766)	4.78 (.43)
Mother	1,963 (626)	4.83 (.38)
Own-face imaging effect ^b	806	0.475

^a Clarity ratings were measured on a subjective scale ranging from 1 to 5 (with 5 representing highest clarity). ^b The own-face imaging effect was calculated as the absolute value difference between participants' own face and the mean of father's and mother's faces.

expertise and, hence, would be advantageous for processing one's own face. In contrast, a global bias would be more consistent with other-face expertise, thereby yielding an own-face disadvantage. To ensure the robustness of our findings and to complement the earlier procedures, we returned to the stopwatch procedure that was used in Experiments 1 and 2. As in Experiment 3, participants were asked to rate the clarity of their images to ensure that RT differences, if found, could not be attributed to a trade-off between speed and clarity of the image.

Method

The global–local orientation task (Macrae & Lewis, 2002; Navon, 1977) was used as a between-participants variable. Face category (own, mother) was manipulated within participant.

For the Navon task, a set of 50 index cards was used, with each card consisting of a single large letter (e.g., “H,” henceforth, the global level) composed of small letters that were different from the large letter (e.g., many “R”s, henceforth, the local level). Each of the 50 cards had a unique combination of large and small letters. The index cards were presented for the global–local orientation. For the orientation task, participants were asked to flip through the deck of cards for 10 min. Randomly assigned participants were asked either to identify the global patterns (half of the participants) or to identify the local letters (the remaining half). Participants flipped the through cards, saying each letter before turning to the next card. The experimenter monitored performance to ensure that the participants were following instructions. When no cards were remaining, participants continued naming from the beginning of the deck until 10 min had elapsed.

Following the orientation task, participants from either orientation imaged both their own face and their mother's face, with order balanced across participants. To ensure that there was no speed–clarity trade-off, we obtained clarity ratings, on a scale ranging from 1 (*least clear*) to 5 (*most clear*) from participants immediately after they indicated that the image was formed. The assistant who recorded RTs was unaware of the hypothesis or conditions. A total of 48 Tel Aviv University students were included.

Results and Discussion

Imaging times were averaged across participants in the two orienting conditions and are displayed in Table 4. Examination of the results revealed an interesting interaction for the imaging data, with faster own-face imaging following local orientation relative to global orientation and the reverse pattern in response to instruc-

tions to image mother's face. An ANOVA on the RT data verified a main effect of face category, $F(1, 46) = 4.8$, $MSE = 0.7$, $p < .05$, $\eta_p^2 = 0.09$, as well as the critical interaction, $F(1, 46) = 46.6$, $MSE = 6.67$, $p < .001$, $\eta_p^2 = 0.5$. Orienting task did not reach significance ($F < 1$). A Tukey least significant difference test found that differences between participants' own face and other (family) face were significant for comparisons in the global ($p < .001$) and local ($p < .025$) conditions. These findings clearly indicate that processing orientation affected the processing of own and other faces in an opposite manner.

Clarity data indicated that the imaging results did not reflect a speed–clarity trade-off, as faster images were reported to be the clearest. The interaction for clarity data was also significant, $F(1, 46) = 5.71$, $MSE = 0.41$, $p < .05$, $\eta_p^2 = 0.11$. Thus, although own-face images were reported to be clearer when imaging followed the local orienting task, they were reported as less clear following the global orienting task. This finding is inconsistent with the notion that a more stringent criterion was used for generating participants' own face as compared with other faces and that this more stringent criterion mediated the slower generation times observed for participants' own face. Instead, when whole faces served as target images, their slower generation times seem to be a genuine effect.

General Discussion

Three basic findings emerged from the studies reported in this article. First, imaging of one's own face was reliably slower than imaging of other familiar faces (Experiments 1 and 3). Second, imaging of parts of one's own face were reliably faster than imaging of other familiar faces (Experiment 2). Third, and most striking, biasing participants' processing toward global processing resulted in an enhanced own-face disadvantage in imaging times, whereas biasing processing toward local processing reversed the effect such that an own-face advantage was found (Experiment 4).

It is noteworthy that the imaging speed for participants' own face relative to that of other familiar faces changed as a function of task goal (whole face, Experiments 1 and 3 vs. face parts, Experiment 2). Had participants simply held off declaring that an own-face image was sufficiently clear before responding, thereby suggesting that a criterion change mediated the slower latencies observed for participants' own face, then the aforementioned interactions and changing patterns would have been most unlikely. It would be unreasonable that in the more holistic mode, images of participants' own face would be slowly generated because the clarity criterion was more stringent. If that were the case, then when feature processing was targeted, the criterion for own-face clarity would suddenly be relaxed. The possibility of a changing criterion was also undermined by the reversal of mental imaging patterns as a function of processing orientation (local vs. global, Experiment 4) although relative clarity judgments remained consistent across orientations.

The present outcomes fit well with a diverse set of findings found in the face recognition literature. Although several neurological (e.g., Kircher et al., 2000, 2001; Turk et al., 2002) and cognitive (e.g., Troje & Kersten, 1999) dissociations have revealed differences in the processing of one's own face as compared with other faces, our study offers a suggested mechanism contributing to these dissociations. Specifically, own-face generation may ac-

Table 4
Mean Imaging Times in Seconds and Clarity Ratings (With Standard Errors) as a Function of Face Category and Orientating Task

Face category	Orientating task			
	Imaging time		Clarity rating	
	Local SE	Global SE	Local SE	Global SE
Own	2.65 (.30)	3.69 (.53)	4.71 (.13)	4.29 (.16)
Family	3.44 (.27)	2.15 (.41)	4.29 (.13)	4.50 (.15)

tivate different representations and processes—more feature oriented and less holistic in nature than does generation of images of other faces.

In general, however, our results maintain compatibility with the holistic position advocated by Farah et al. (1998) for the case of processing the faces of others. It is interesting to note that Ishai et al. (2002) found that following the generation of famous face images, questions that oriented a respondent's attention to a face feature (e.g., "thick lips") resulted in increased brain activity in the right intraparietal sulcus and the right inferior frontal gyrus relative to when attention was directed to the whole face. Presumably, it is possible that stored own-face representations that prioritize face parts would also trigger different retrieval pathways than representations of those faces for which configural or whole-face attributes are prioritized.

Halberstadt (2003) biased participants by emotional labeling of faces during encoding. Later, participants were asked to judge which of a string of emotional renditions of faces matched the original face. These emotional labels altered initial target encoding in the direction of foil faces where features reflected the original emotional label. Moreover, the pattern was not observed for inverted faces for which holistic processing was disrupted. Additionally, Yovel, Reville, and Mineka (2005) determined that personality traits, in particular obsessive-compulsive qualities, can shape whether one focuses on the details or global patterns, indicating considerable cognitive control in object processing. Schooler (2002) suggested that talking about a face precipitates a shift toward feature-based processing, that is, language descriptors can disrupt usual holistic processing. Thus, one could speculate about another interpretation of the present findings for which it is assumed that one's own face may implicitly engage a form of verbal mediated processing that draws more heavily on features than holistic analysis.

According to some (e.g., Gauthier & Tarr, 1997), expertise affects object recognition in the direction of more holistic processing and representation (alternatively, see Tanaka, Curran, & Sheinberg, 2005). Certainly, on the surface, the present findings seem at odds with that contention. Yet, if it is assumed that expertise builds with experience to provide the most efficient goal-directed behavior (identification of other faces and scrutiny of own-face particulars), then it makes sense that own-face processing would center on local facial attributes, as that information is more compatible with behaviors associated with own-face analysis. Thus, as with other-race face processing (Michel et al., 2006), the present findings suggest that there is a limit to the generalizability of holistic face processing.

The present findings are meant to stimulate consideration of own-face processing, which heretofore had not received much attention. Thus, the findings were not meant to exclude other possible contributing factors of face processing that could also distinguish one's own face and other faces. One alternative candidate, as noted above, is verbal mediation. Another candidate is personal relevance (see Kircher et al., 2000). However, the contrast of Experiments 1 and 3 (generating a complete face) with Experiment 2 (generating face parts) and the findings of Experiment 4 (biasing of processing by orienting task) make it clear that at least one consideration regarding the mental-imaging task (and face perception as well, e.g., O'Craven & Kanwisher, 2000) for

one's own face and other faces is that information extracted from long-term storage for these two categories of faces differs.

Thus far, we have accounted for the feature-based nature of own-face processing on the basis of the goals of perception. That is, whereas the goal of own-face processing is primarily analysis of facial properties, as in grooming, that of other-face processing is primarily identification. An additional account may be that one's own face is seen either mirror reversed (in a mirror) or nonreversed (in photos), whereas others' faces are almost never seen reversed. Mirror reversal should presumably only hurt configural information, given that most, if not all, faces are slightly asymmetrical in nature. It could be argued, therefore, that it may be difficult to create a stable configural representation for one's own face because the configural information is variable as compared with that of other facial stimuli.

A caveat to the present understanding is that these trends are specific to face mental imaging, in which information is accessed from long-term storage. Ishai et al. (2002) determined that in a famous-face mental-imaging task involving long-term memory, akin to the task used here, brain activity was significantly different from that observed when the identical faces were imaged after they had been recently memorized (short-term storage). As in our study, participants were asked to generate mental images in response to a name. The patterns in brain activity observed in Ishai et al. caution that the differences observed in the current study between participants' own face and other faces apply specifically to tasks that involve mental images generated from long-term representations. Thus, whether the relative advantages and disadvantages for one's own face hold for retrieval of short-term images or in recognition tasks remains an open question. We speculate that processing of stored information about one's own face could be altered by task demands and the memory systems drawn into the process. Regardless, it is apparent that own-face processing moves along more efficiently against a baseline of other categories of familiar faces when face features are emphasized and when the task involves recall.

Finally, the present findings also serve as a reminder that face imaging, central to such tasks as eyewitness retrieval, is likely to vary in response to the goals and biases encouraged by the inquiry. Indeed, much effort is currently being devoted to understanding the accuracy and processes used by witnesses to retrieve (and most often recall) useful face information in helping investigative teams capture a witnessed individual (Wells, Memon, & Penrod, 2006).

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