Title: Can the self become another? Investigating the effects of self-association with a new facial identity.

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Abstract

The mental representation of the self is a complex construct, comprising both conceptual information, and perceptual information regarding the body. Evidence suggests that both the conceptual self-representation and the bodily self-representation are malleable, and that these different aspects of the self are linked. Changes in bodily self-representation appear to affect how the self is conceptualised, but it is unclear whether the opposite relationship is also true: do changes to the conceptual self-representation affect how the physical self is perceived? First, we adopted a perceptual matching paradigm to establish an association between the self and an unfamiliar face (Experiment 1). Robust attentional and perceptual biases in the processing of this newly self-associated object suggested that the conceptual self-representation was extended to include it. Next, we measured whether the bodily self-representation had correspondingly changed to incorporate the new face (Experiment 2). Participants rated morphs between their own and the new-associated face according to how similar they were to the self, before and after performing the perceptual matching task. Changes to the conceptual self did not have an effect on the bodily self-representation. These results suggest that modulatory links between aspects of the mental self-representation are unidirectional, and flow in a bottom-up manner.

Keywords: *self, self-face, social cognition, self-concept, body representation*

Can the self become another? Investigating the effects of self-association with a new facial identity.

The mental representation of the self is a complex construct, containing both perceptual information (such as information regarding the physical appearance of the body, e.g. facial appearance), and conceptual information, which is comprised of varied semantic and episodic knowledge relevant to the self. Evidence from a variety of different research areas has shown that both the bodily self-representation (Tsakiris, 2008, 2010), and the conceptual self-representation, are malleable (Sui, He, & Humphreys, 2012). Importantly, different aspects of the self-representation appear to be linked. Changes in the bodily self-representation have been shown to elicit changes in the way the self is conceptualised (Banakou, Groten, & Slater, 2013) and to also elicit changes in social cognition (Maister, Slater, Sanchez-Vives, & Tsakiris, 2014). There is some evidence to suggest that the converse relationship is also true; that altering the self-concept can drive plasticity in the mental representation of one's body (Farmer, McKay, & Tsakiris, 2013). However, a modulatory link between the conceptual and the bodily self-representation, flowing in a top-down direction from conceptual to bodily self, has not been well evidenced.

It is well known that we show a processing bias for 'self-relevant' stimuli. This bias has been shown for stimuli relevant to the conceptual self-representation (e.g. one's own name or the name of one's hometown; Gray, Ambadi, Lowenthal, & Deldin, 2004, Bargh, 1982) and also stimuli relevant to the bodily self-representation (such as images of one's own face or body; Tong & Nakayama, 1999; Devue et al., 2007). An example of such a bias in the conceptual domain comes from a study using a dichotic listening task, in which participants are presented with two streams of auditory information, one in each ear, and attend to only one. Information in the unattended stream only enters conscious awareness when it contains words relating to the conceptual self-representation (Bargh, 1982). Similar effects are seen in the bodily domain; we are significantly faster to process images of our own face (Tong & Nakayama, 1999) and our own body (Devue et al., 2007) than we are to process those belonging to other highly familiar individuals. This bias remains even when the task does not require explicit identity-recognition (Sui & Han, 2007). Evidence suggests that the self-face is particularly effective in capturing attention; when presented as a distractor, it drastically slows response times despite the purposeful direction of attention elsewhere (Brédart, Delchambre, & Laureys, 2006).

Importantly, in a series of recent experiments, Sui, He, and Humphreys (2012) elegantly demonstrated the malleability of the conceptual self-representation. Participants first associated geometric shapes with labels for themselves, familiar or unfamiliar others, and then performed a perceptual matching task in which they judged whether subsequent label-shape pairings were correctly matched. Self-associated shapes benefitted from faster reaction times (RT) and increased accuracy, compared to both familiar and unfamiliar shape associations. The authors suggest that the self-associated shape was incorporated into the 'self-template', a rich and well developed schema of the self based on self-knowledge, enabling "fast same" responses (participants are faster to identify when two pieces of information are the same, rather than different; Krueger, 1978). In support of this interpretation, they found that neutral shapes which had been associated with the conceptual self activate brain regions involved in self-representation and self-attention (Sui, Rotshtein, & Humphreys, 2013), suggesting that the newly-associated shape has been incorporated into the conceptual self-representation. This incorporation into the conceptual self-representation may then lead to the extension of the self-processing bias to the newly associated information.

There is also mounting evidence indicating that the bodily self-representation can be quickly and effectively altered. Bodily illusions demonstrate how multisensory integration can lead to changes in how one perceives one's own body. During the enfacement illusion a participant is stroked on the cheek while watching an unfamiliar face being stroked on the cheek in synchrony. Following a brief period of this interpersonal multisensory stimulation (IMS), participants reported an increase in perceived physical similarity between their own face and the other's face. This subjective experience is accompanied by objectively measured changes in the participants' abilities to discriminate between morphed images containing more or less of their own face or the other's face (Maister, Banissy, & Tsakiris, 2013; Mazzurega, Pavani, Paladino, & Schubert, 2011; Sforza, Bufalari, Haggard, & Aglioti, 2010; Tajadura-Jiménez, Grehl, & Tsakiris, 2012; Tsakiris, 2008).

Intriguingly, there is evidence to suggest that conceptual and bodily aspects of self-representation are closely linked. For example, changes in the way the body is represented, elicited by bodily illusions, can alter conceptual self-associations (Banakou et al., 2013; Maister et al., 2014; Paladino, Mazzurega, Pavani, & Schubert, 2010). Banakou et al. (2013) demonstrated that after embodying a child-sized body in a virtual reality environment, participants showed implicit associations between themselves and child-like concepts. In another study, Paladino et al. (2010) demonstrated that after experiencing IMS with an unfamiliar face, not only did participants report an increase in perceived physical similarity between themselves and the unfamiliar actor, but the IMS also led them to represent themselves as conceptually closer and more similar to the embodied other (see also Mazzurega et al., 2011). However, it remains unknown whether this link is bidirectional; can a change in conceptual self-representation lead to changes in the bodily self-representation?

Interestingly, recent evidence suggests that a bidirectional link may exist. Farmer, McKay and Tsakiris (2013) report an experiment in which the manipulated trustworthiness of an unfamiliar individual impacted upon perceived similarity between the participant's face and the unfamiliar face. Participants played a trust game with two unfamiliar individuals whose faces were shown on screen. One of the individuals was trustworthy, while the other always betrayed the participant's trust. Before and after the game, participants performed a self-other discrimination task using morphed images (the same task as used to measure the increased perceptual similarity after the enfacement illusion; Tajadura-Jiménez et al., 2012), to measure the perceived similarity between their own face and the faces of both players. Following the trust game, participants perceived their face to be more similar to the trustworthy individual than the untrustworthy player. Potentially this evidence suggests that altering the conceptual self-representation may have a modulatory effect on the bodily self-representation. Taken together with evidence from bodily illusions, these findings suggest that a bidirectional relationship exists between the conceptual and bodily self-representations; however, such a link has yet to be properly investigated.

We here exploit the simple paradigm reported by Sui et al. (2012) to investigate whether a bidirectional link between conceptual and bodily aspects of self exists. In this paradigm, they established a rapid association between the self and a previously neutral object. Robust attentional and perceptual biases in the processing of this newly self-associated object suggested that the conceptual self-representation was extended to include it. Our aims are two-fold; first, we aim to develop this paradigm to test whether an unfamiliar face, rather than shape, can be associated with the conceptual self-representation. We will therefore measure perceptual biases towards the newly self-associated face in order to assess whether it has truly acquired an association with the conceptual self-representation (Experiment 1). We will then measure if the bodily self-representation has correspondingly changed to incorporate the new face (Experiment 2). This will allow us to assess, using two simple and well-established paradigms, whether a change in the conceptual self-representation can lead to change in the bodily self-representation (i.e the mental representation of one's own face).

Experiment 1

Participants

Twenty participants (15 female, mean age 19.95 years, SD = 1.88) volunteered to take part in the study. All had normal or corrected-to-normal vision, and were right-handed. Informed consent was given by all participants before their participation, and the study was approved by Psychology Department Ethics Committee, Royal Holloway, University of London.

Stimuli and Tasks

We used an adapted version of Sui et al. (2012)'s shape-label matching paradigm with unfamiliar faces in place of neutral geometric shapes. Three gender-matched unfamiliar faces, with non-facial features removed, were converted to greyscale and used in the face-label matching task. The faces were presented above a fixation cross, with an identity label presented below. Three identity labels were used: 'Self', 'Friend', and 'Stranger', following Sui et al. (2012). During the task participants were required to judge whether briefly-presented face-label pairings were correct, or incorrect. The task was run on Presentation (NeuroBehavioural Systems).

Procedure

The experiment started with a learning phase, in which all three unfamiliar faces were presented on screen with their matching identity labels written below each one (face-label pairings were counterbalanced across participants). Participants were told that each of the three faces belonged to themselves, their closest friend, or a stranger. Participants had 60 seconds to learn the face-label pairings before starting the matching task. During the matching task, a fixation cross was presented at the beginning of each trial for 400ms, followed by a face-label pairing for 200ms. The face-label pairing either corresponded to a pairing seen by participants during the learning phase (match trial), or was a novel pairing (mismatch trial). Participants were then required to judge whether the pairing was correct or incorrect based on what they had learnt during the learning phase. Following presentation of the face-label pairing, participants had 1000ms to respond, using one of two buttons (one for correct, one for incorrect), as quickly and as accurately as possible. Visual feedback for the participant's response was then presented following each trial (correct or incorrect), lasting 500ms. The task lasted a maximum of 15 minutes and was split into three blocks of 120 trials, with 12 practice trials before the first block. At the end of each block participants received visual feedback detailing the accuracy of their performance in the preceding block. Each identity label was presented an equal number of times, with an equal number of match and mismatch pairings, such that there were 60 trials in each condition (self-match, self-mismatch, friend-match, friend-mismatch, stranger-match, stranger-mismatch). Trials were randomised for each participant. This procedure is illustrated in Figure 1.

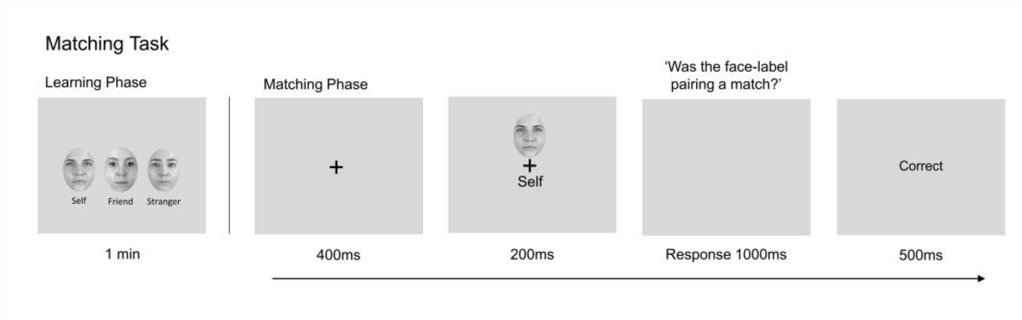

Figure 1: A visual representation of the Matching Task. In the Learning Phase all three unfamiliar faces and identity labels (self, friend and stranger) are presented on screen for 1 min. In the Matching Phase, each trial starts with a fixation cross (400ms), followed by a face-label pair (200ms), after which the participant has 1000ms to respond. Following the response, visual feedback is presented for 500ms before the start of the next trial.

Results

Before analysis, data were cleaned within-subjects, by excluding responses outside 2SD of each trial-type mean.

Accuracy on the matching task was assessed using a signal detection approach. D', reflecting perceptual sensitivity to each face, was calculated by combining performance in each face identity condition across both match and mismatch trials. A repeated measures ANOVA with a within-subjects factor of Face Identity (Self vs. Friend vs. Stranger) was run on d' scores. There was a significant main effect of Face Identity, F (2, 38) = 4.96, p = .012, η^2 = .21, reflecting larger d' scores for self-associations than both other identity associations (p = .007), while there was no difference between friend and stranger associations (p = .18).

To investigate the effect of Face Identity on RT, a repeated-measures ANOVA was run with factors of Face Identity and Match-type. There was a main effect of Match-type, F (1, 19) = 89.90, p < .001, η^2 = .83, reflecting faster RTs for matched pairs relative to mismatched pairs (p < .001). There was also an interaction between Identity and Matching Judgment, F (2, 38) = 34.34, p < .001, η^2 = .75.

To investigate the interaction, analysis was run separately on matched and mismatched pairs. For mismatched pairs, there was a significant effect of Face Identity on RTs, F (2, 38) = 5.77, p = .006, η^2 = .40. Self mismatched pairs (i.e. those featuring the self-associated face, but either a 'friend' or 'stranger' label) benefitted from faster RTs than both Friend and Stranger mismatched pairs (p = .002). Friend and Stranger pairs did not differ (p = .54). For matched pairs, Face Identity also had a significant effect on RTs, F (2, 38) = 10.01, p = .001, η^2 = .57. Self-associations elicited faster responses than other association types (p < .001), whereas friend and stranger associations did not differ (p = .997). The data are visualised in Figure 2.

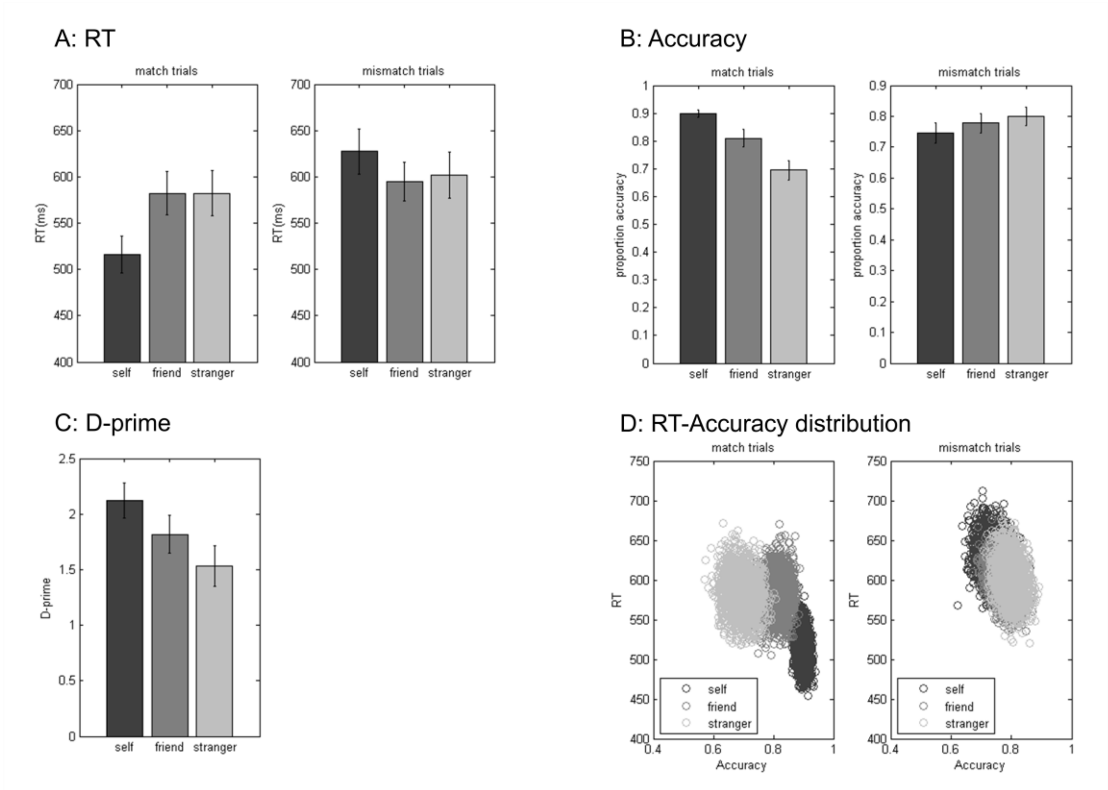

Figure 2: Behavioural results from the Matching Task. Mean RTs (A), accuracy (B) and D-prime (C) to self, friend and stranger-associated faces for match trials (face and label were correctly matched) and mismatch trials (the label presented did not match the face). Error bars represent standard error. D shows the bootstrapped sample means (resampling with replacement repeated for 2000 samples) for match and mismatch trials. RTs are represented on the y-axis with accuracy on the x-axis. A bootstrapping procedure combining accuracy and RT was adopted to examine the distribution characteristics of each trial type (see Sui et al., 2012).

Experiment 1 Discussion

In Experiment 1, we measured the effects of associating an unfamiliar face with the self on perceptual processing. Our results showed a clear perceptual prioritisation effect towards the unfamiliar face after only a brief period of self-association, which manifested itself in faster reaction times, higher accuracy and increased perceptual sensitivity to the self-associated face over faces associated with a friend or stranger. The pattern of results closely mirrored those reported by Sui et al. (2012), in an analogous task using neutral shapes instead of faces. This suggests that the conceptual self-representation can be rapidly extended to incorporate an unfamiliar face, and that correspondingly, perceptual and attentional processing of that face is prioritised as ‘self-relevant’.

Experiment 2

Following the successful inclusion of a previously unfamiliar face into the conceptual self-representation in Experiment 1, we aimed to investigate whether this inclusion would alter the mental representation of one’s own face. Therefore, Experiment 2 followed the same procedure as Experiment 1, with the addition of a self-recognition task before and after the matching task. In the self-recognition task participants rated how similar morphed images between their own face and the self-associated face were to their own face (Sforza et al., 2010). The pre-association self-recognition task acted as a baseline measure of self-recognition, and we looked for changes from baseline in the post-matching-task self-recognition task. We controlled for effects due to mere exposure to the self-associated face by including a control condition in which participants rated morphs between their own face and the stranger-associated face.

Participants

28 new participants (26 female, mean age 20.07 years, SD 1.12) were recruited for the second experiment. All had normal or corrected-to-normal vision, and were right-handed. Informed consent was given by all participants before their participation, and the study was approved by Psychology Department Ethics Committee, Royal Holloway, University of London.

Stimuli and Tasks

Matching Task. The stimuli for the matching task were exactly the same as those used in Experiment 1.

Self-recognition Task. A photograph of each participant's face with a neutral expression was taken, flipped horizontally (so as to reflect the orientation of their face that they would commonly see in a mirror) and converted to greyscale. All non-facial features were removed using an oval template. Two sets of morphed face images were created for each participant by morphing the participant's face separately with the self-associated and stranger-associated faces from the matching task. Fifty morphed images were created for each set, representing 2% steps from the participant's face to the self/stranger face (see Figure 3). During the self-recognition task, each of the 100 images was presented once, and participants rated how similar they perceived the face to their own.

Procedure

Participants performed the self-recognition task first (lasting for approximately 8-10 minutes), followed by the matching task (lasting approximately 10 minutes), and lastly the self-recognition task again. The procedure for the matching task was the same as in Experiment 1, except that the trial count was reduced to 240 (three blocks of 80 trials).

Self-recognition task. Each trial of the self-recognition task began with a central fixation cross, presented for 500-1500ms. One of the 100 morphed face images was then presented for 2000ms, replaced by a sliding scale consisting of a vertical line marked with 100 at the top and 0 at the bottom. Participants used a mouse to rate on the scale how much the presented face resembled their own face. Participants had as much time as they required to give their response, but were encouraged to go with their initial instincts about the photos and respond quickly. Images from both morphing sets ('self' and 'stranger') were intermixed and presented in a randomised order. The procedure and example stimuli are presented in Figure 3.

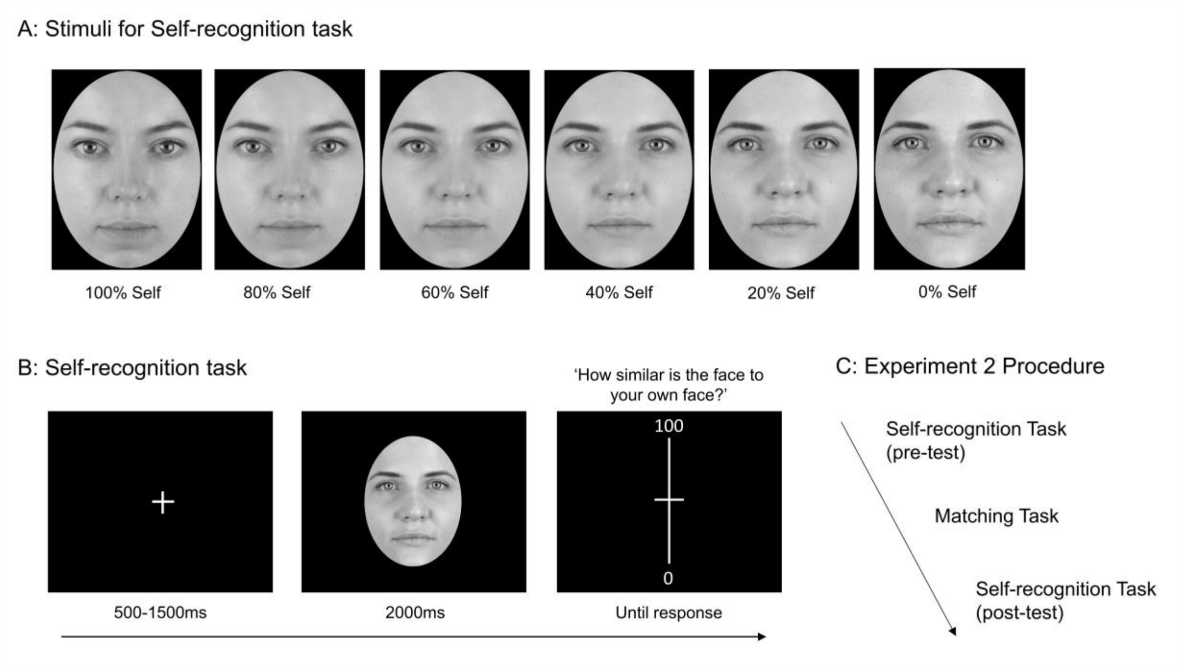

Figure 3: The experimental design and procedure for Experiment 2. A shows an example of the morphed-face stimuli used in the self-recognition task. Personalised morphs were created for each participant, morphing their own face with the self-associated and stranger-associated faces. B shows a trial from the self-recognition task: a random interstimulus interval (ISI) with fixation cross is presented for 500-1500ms, followed by the presentation of one of the morphed images for 2000ms. The sliding response scale then appears until participants make their response. C shows the procedure for Experiment 2: participants complete the self-recognition, followed by the matching task from Experiment 1, and lastly the self-recognition task again.

Results

First we analysed performance on the matching task. Mean RTs and accuracy performance for each trial type are visualised in Figure 4.

D' was calculated according to a signal detection analysis. It was entered into a repeated-measures ANOVA with the within-subjects factor of Face Identity (Self vs. Friend vs. Stranger). There was a significant main effect of Identity, F (2, 52) = 3.574, p = .035, η^2

= .12. Self-associations benefited from a larger d' than both friend and stranger associations (p = .026). There was no difference between friend and stranger associations (p = .411).

Next, RT was analysed with factors of Face Identity and Match-type. There was a main effect of Identity, F (2, 52) = 3.68, p = .03, η^2 = .12 reflecting faster RTs to self-associations relative to friend and stranger associations (p = .018). There was also a main effect of Match-type, F (1, 26) = 105.76, p < .001, η^2 = .80, reflecting faster RTs for matched pairs relative to mismatched pairs (p < .001). The interaction between Identity and Matching Judgment was also significant, F (2, 52) = 11.34, p < .001, η^2 = .30. We then ran analyses separately for matched and mismatched trials. There was no effect of Face Identity for mismatched trials, F (2, 42) = .36, p = .70, η^2 = .01. However, for Matched trials, Face Identity had a significant effect on RTs, F (2, 52) = 8.54, p = .001, η^2 = .25. Self-associations showed faster RTs than both friend and stranger associations (p = .002). Friend and stranger associations did not significantly differ (p = .172). The pattern of results is illustrated in Figure 4.

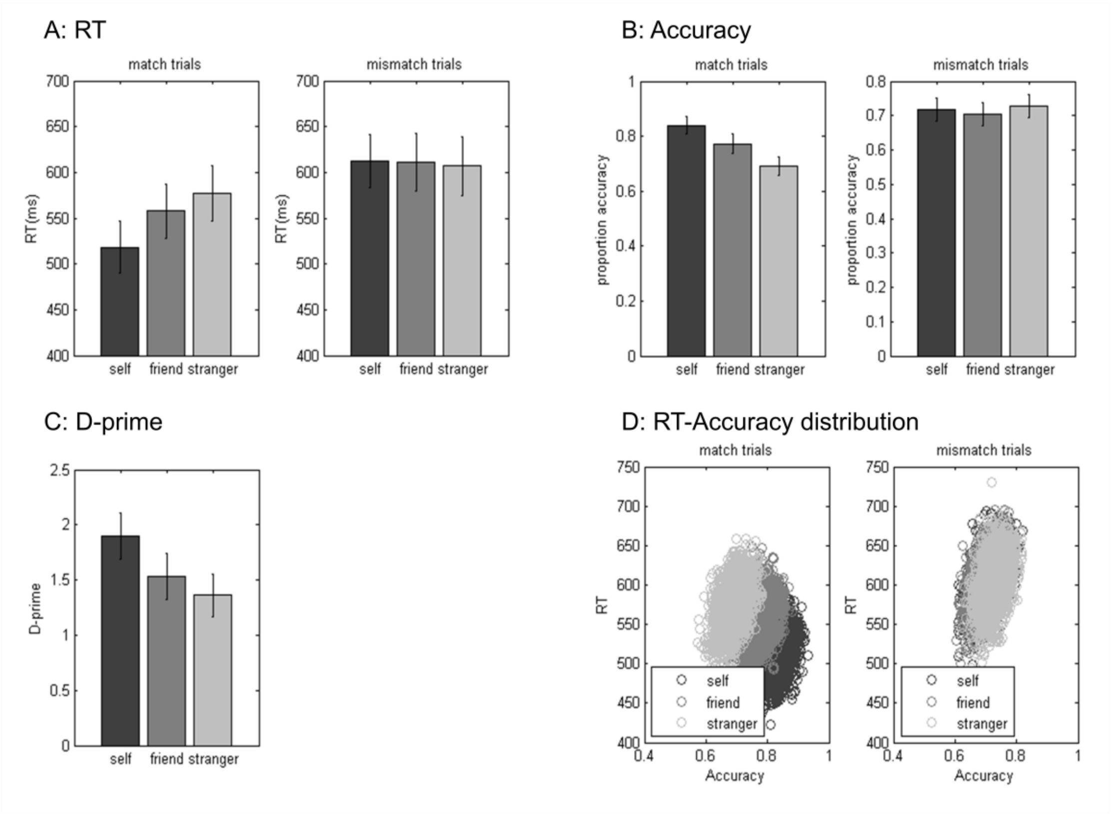

Figure 4: Behavioural results from the Matching Task for Experiment 2. Mean RTs (A), accuracy (B) and D-prime (C) to self, friend and stranger-associated faces for match trials (face and label were correctly matched) and mismatch trials (the label presented did not match the face). Error bars represent standard error. D shows the bootstrapped sample means for match and mismatch trials. The same bootstrapping technique used as in Experiment 1.

Next we analysed the data for the self-recognition task. We fitted the data into a sigmoid statistical model to determine the percentage of morphing at which the participant judged the amount of their own face and the other face to be equal (PSE; Sforza et al., 2010). To check that baseline PSE values for self-associated morphs and stranger-associated morphs did not differ, we first analysed the baseline PSE scores for each morph set in a repeated measures ANOVA with Morph Identity as a factor. There was no effect of morph identity on baseline PSE scores F (1, 27) = .65, p = .43, η^2 = .02, so we then analysed the PSE values in a repeated measures ANOVA with factors Morph Identity ('Self' vs 'Stranger' morphs) and Timing of Task (Pre- vs. Post-matching task). There was no main effect of Morph Identity, F

(1, 27) = .51, η^2 = .01, or Timing of Task, F (1, 27) = 2.89, p = .10, η^2 = .10, nor an interaction between Morph Identity and Timing, F (1, 27) = .25, p = .62, η^2 = .01, indicating that PSE scores were not influenced by the timing of the task or the association of a new face with the self. See Figure 5.

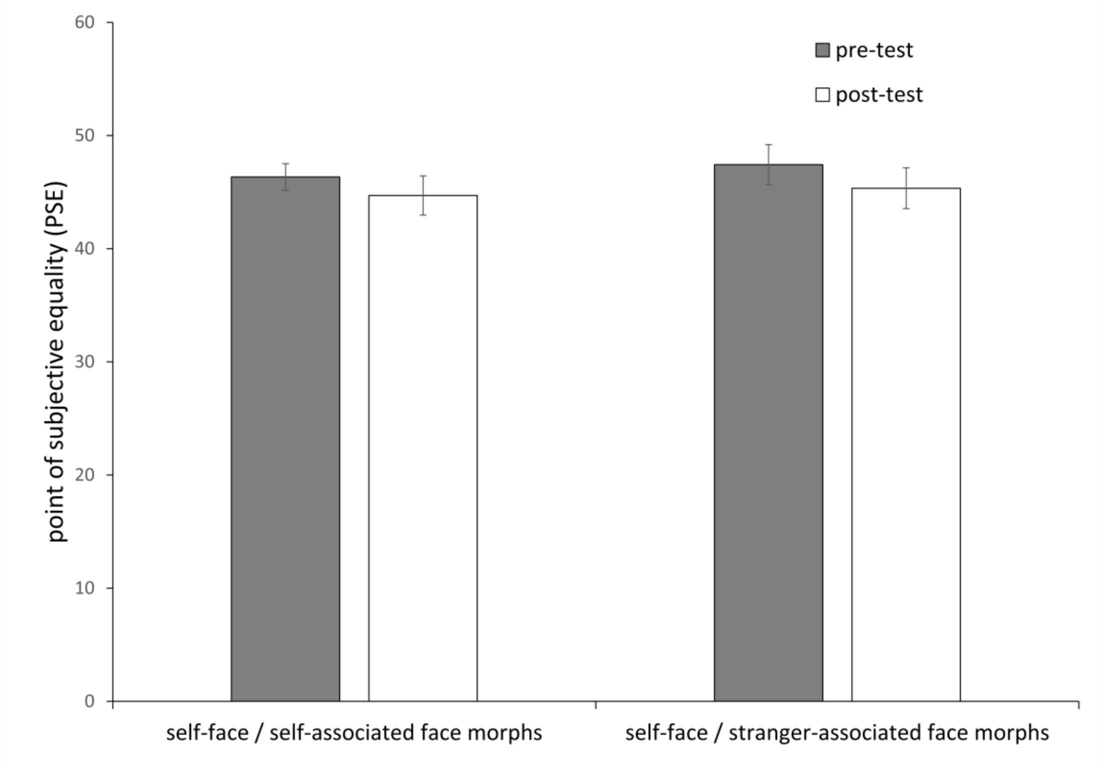

Figure 5: The bars represent the point in the morphing spectrum that participants perceived there to be an equal amount of their own and the other face (PSE). On the left are the mean PSEs for self and self-associated-face morphs, before and after the matching task. On the right are mean PSEs for self and stranger-associated face morphs, before and after the matching task. Positive changes from pre- to post-test would indicate an increased amount of the other's face at the perceived PSE, while negative changes would indicate more of the self face at the perceived PSE.

General Discussion

In this study, we tested whether a change in the conceptual representation of the self could elicit a change in the perceptual, bodily representation of the self. To do this, we first tested whether an association could be formed between the conceptual self-representation and an unfamiliar face. Following this association, we investigated whether a corresponding incorporation of the unfamiliar face had occurred in the bodily self-representation, such that participants would perceive an increase in physical similarity between their own and the newly associated face.

Previously, Sui et al. (2012) showed how a neutral shape could rapidly become associated with the conceptual self-representation, demonstrated by robust attentional and perceptual biases to the newly associated stimuli. We replicated this effect and extended it to the association of previously unfamiliar faces. Participants learned to associate identity labels (self, friend and stranger) with three previously unfamiliar faces, and then performed a perceptual matching task in which they judged whether presented face-label pairings were correct or incorrect. Over two experiments, we showed how an unfamiliar face could quickly become associated with the self, and that this benefitted the self-associated face with prioritised perceptual processing. Trials featuring an unfamiliar face previously associated with a self-label were responded to faster and more accurately than trials featuring faces associated with a friend or stranger.

In Experiment 2, we investigated whether this association of an unfamiliar face with the conceptual self-representation had an effect on the way the physical, bodily self was represented. We measured changes in perceived similarity between the participants' own face and an unfamiliar face, before and after a self-association with the unfamiliar face was established. However, we found that this incorporation of an unfamiliar face into the self-concept, and thus a change of the self at a conceptual level, was not able to alter the physical representation of the self. Following successful association of the self with an unfamiliar face, participants did not perceive their own face as more similar to the unfamiliar face.

The self-face is the most salient aspect of one's body. One's own face automatically captures attention (Brédart et al., 2006) and demands preferential processing above all other faces (Sui & Humphreys, 2013; Tong & Nakayama, 1999). Yet despite this strong salience of our own face, our results demonstrate that we are able to rapidly associate a previously unfamiliar face with our conceptual self-representation. Our results show a distinct response pattern to self-associated faces compared to both friend and stranger associations, reflecting the perceptual processing bias afforded to self-relevant stimuli. This rapid modification of perceptual processing to newly acquired self-associations fits in with a growing understanding of plasticity in the self, both in the physical and conceptual domains (bodily self: Paladino et al., 2010; Sforza et al., 2010; Tajadura-Jiménez et al., 2012; Tsakiris, 2008; conceptual self: Banakou et al., 2013; Maister et al., 2014).

The association of a previously unfamiliar face with the conceptual self-representation did not affect the perception of one's own face. On one level, this is surprising as previous research has demonstrated the striking malleability of the self-face representation (Paladino et al., 2010; Sforza et al., 2010; Tajadura-Jiménez et al., 2012), and has also suggested the existence of functional links between conceptual and bodily aspects of the self-representation. For example, Paladino et al. (2010) showed that the modulation of perceived facial-similarity through interpersonal multisensory integration affects the experience of conceptual 'closeness' with the IMS individual, increasing the perception of not only physical but also psychological similarity. There was also evidence to suggest that the converse relationship might be true; that the modulation of conceptual aspects of self may have a knock-on effect on the bodily self-representation. The modulation of trust with another individual has been shown to affect the perceived physical similarity between one's self and the other individual (Farmer et al., 2013). Based on this we hypothesised that the association of the conceptual self with an unfamiliar face would affect the perceived physical similarity between the self and the self-associated face. However, our findings demonstrated no functional link between alterations to the conceptual self-representation and the bodily self-representation.

One explanation for our findings could be that our paradigm tested the pure effect of self-association on bodily representations, and lacked any form of social interaction. In contrast, Farmer et al. (2013)'s paradigm involved an interaction with another through a trust game, in which the other player actively rewarded or punished the participant. The effect of trustworthiness on increased perceived physical similarity may play a functional role, as it could induce kin-like behaviours in future interactions, benefitting the participant (DeBruine, Jones, Little, & Perrett, 2008). DeBruine (2002) has shown that individuals are more likely to trust others who bear a physical resemblance to them, and so a modulation of the bodily-self representation to more closely resemble those who act pro-socially towards one's self may reflect a functional role in driving future interactions.

Despite there being evidence for changes in body representation leading to changes in conceptual self- and other-processing (Banakou et al., 2013; Maister et al., 2014; Paladino et al., 2010), our results suggest that the converse relationship, whereby basic self-association at the conceptual level can alter body representations, does not hold. Therefore, our results support a hierarchical model of the self with unidirectional connections flowing in a bottom-up direction, from bodily self-representations to conceptual self-representations. If this is the case, then it is important to investigate the effects of these basic associations with the conceptual self-representation on higher levels of interpersonal processing, as while these associations do not seem to alter self-other relations at the physical bodily level, they may have an effect on the self-other relationship further up the processing hierarchy. In this way, the incorporation of an unfamiliar face into the conceptual self-representation may have interesting effects in the social domain. For example, the perception of another individual as an out-group member, based only on facial characteristics, can have profound effects on a number of social cognitive processes, ranging from explicit (e.g. ratings of trustworthiness, intelligence, attractiveness) to implicit attitudes, as well as affecting interpersonal behaviours

(Pavan, Dalmaso, Galfano, & Castelli, 2011; Ratner, Dotsch, Wigboldus, van Knippenberg, & Amodio, 2014). Crucially, research has suggested that the neurological correlates of face perception also differ depending on whether the face belongs to an in-group or out-group member (Golby, Gabrieli, Chiao, & Eberhardt, 2001), even when group membership distinctions are arbitrary (Ratner & Amodio, 2013). These studies show that in-group faces benefit from prioritised perceptual and attentional processing relative to out-group faces.

In our study, a perceptual processing bias towards a minimally self-associated face affected basic identity processing (as measured by the matching task), but it might also result in prioritised processing of the self-associated face's social signals, such as emotional expressions and gaze cueing, in a similar way to that observed for established in-group members (Pavan et al., 2011). Our social lives are structured around categorising other individuals as either 'in-group' or 'out-group', and we show strong self-associations with people who we conceptualise as similar to ourselves. Our findings have demonstrated, at a relatively pure and fundamental level, that rapidly formed self-associations with another individual can alter the way in which their face is processed, and this modulation of perceptual processing may have fascinating knock-on consequences for social cognition.

In conclusion, we firstly demonstrated that the conceptual self-representation can be extended to include a previously unfamiliar face, and that this extension of the conceptual self to the newly associated face results in enhanced perceptual processing of the self-associated face. We also found that this modulation of the conceptual self-representation did not affect the perception of the physical bodily self, suggesting a hierarchical model of the self with unidirectional links between levels flowing in a bottom-up direction. In this case we may have identified a mechanism that can affect higher-level self-other processing; the extension of prioritised perceptual processing to the self-associated face may extend to the processing of social signals belonging to the face, such as emotion expression, gaze cues or social group membership.

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