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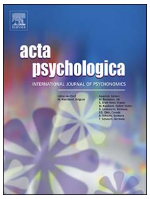

Self and team prioritisation effects in perceptual matching: Evidence for a shared representation

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ABSTRACT

Previous research has demonstrated that in-group favouritism occurs not only in higher-level judgments such as reward allocation, but also in low-level perceptual and attentional tasks. Recently, Moradi, Sui, Hewstone, and Humphreys (2015) found a novel effect of in-group bias on a simple perceptual matching task in which football fans responded more efficiently to stimuli newly associated with their own football team than stimuli associated with rival or neutral teams. This result is consistent with a robust self-bias effect in which individuals show a large performance advantage in responding to stimuli associated with the self over stimuli associated with a close friend or a stranger (Sui, He, & Humphreys, 2012). The present research utilised a perceptual matching paradigm to investigate the relations between self and in-group prioritisation amongst a sample of college rowers. Across two experiments, we demonstrated a reliable performance advantage for self and team stimuli. We also found a relationship between the self and team advantage in RT, and demonstrated an overlap in the perception of self- and team-associated shapes that was stronger in participants who reported a greater sense of group identity with their team. Further, we found no relation between the team bias and positive valence implicitly associated with the team, showing that the team bias effects are unlikely to be driven by emotional significance. The results are consistent with an overlap between self and in-group representation, which may provide evidence for a common process driving both self and in-group perceptual advantage effects.

1. Introduction

A great deal of evidence suggests that socially relevant information is given high priority in cognitive processing. Research has found that personally significant distractors are harder to ignore than neutral ones (e.g., Welford & Morrison, 1980; Wood & Cowan, 1995) and encoding information in relation to the self has repeatedly been shown to enhance memory performance (Cassidy & Gutchess, 2012; Conway & Pleydell-Pearce, 2000; Cunningham, Turk, Macdonald, & Macrae, 2008; Turk, Cunningham, & Macrae, 2008). A bias for the self is also observed in perceptual judgments such as facial recognition, with recognition faster (Keyes & Brady, 2010; Sui, Zhu, & Han, 2006) and orientation judgments enhanced (Sui, Liu, & Han, 2009) for own faces than faces belonging to others.

While this research has consistently shown that self-relevance modulates many forms of attentional and perceptual processes, the experiments have typically used highly familiar stimuli such as faces and names and so it has been difficult to isolate the effects of social relevance from effects of familiarity on performance. However, a series of recent studies demonstrated that newly made associations of the self and personally familiar people to neutral stimuli enhances their perceptual processing (Sui et al., 2012; Sui, Rotshtein, & Humphreys, 2013; Sui, Sun, Peng, & Humphreys, 2014). In a novel paradigm, participants learned to associate geometric shapes (e.g., square, circle and triangle) with social labels ('self', 'friend' and 'stranger') by being told, for example, 'you are the triangle, your best friend is the square and a stranger is the circle'. Following this short learning phase, participants then had to judge whether shape-label pairs subsequently presented very quickly on the computer screen conformed to the original pairings or not by responding with keys for yes and no. There was a large self-prioritisation effect, whereby shapes that were initially matched to the self were responded to faster and more accurately than shapes that were associated with others. Self-associated stimuli also showed weaker effects of stimulus degradation, consistent with perceptual processing being enhanced (Sui et al., 2012). Follow-up research using fMRI found that the self-matched shapes were associated with enhanced activity in

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brain regions linked to self-representation and social attention (the vmPFC and LpSTS), while other-matched shapes recruited a dorsal frontoparietal control network (Sui et al., 2013). The research demonstrated that tagging novel stimuli with self-relevance can rapidly direct attention and enhance perception and, most importantly, that these effects are not rooted in stimulus familiarity.

As well as giving high priority to information relating to the self, human cognition is also largely biased to material relating to social in-groups. Like self-associated information, preference for the in-group affects a wide range of psychological processes, with greater empathetic responses (Johnson et al., 2002; Xu, Zuo, Wang, & Han, 2009), more favourable reward allocation (Tajfel, 1970; Tajfel, Billig, Bundy, & Flament, 1971) and a higher likelihood of ascribing complex emotions (Leyens et al., 2000) to in-group than to out-group members. Furthermore, similar to biases for the self, biases for the in-group also extend to lower level perceptual tasks such as facial recognition (Brigham, Bennett, Meissner, & Mitchell, 2007; Cassidy & Gutchess, 2012; Michel, Corneille, & Rossion, 2007). A recent research study that utilised the matching paradigm described above (from Sui et al., 2012) explored whether in-group associations modulated perceptual matching for neutral stimuli in the same way as associations with the self did (Moradi et al., 2015). Football fans learned to pair the badges of the team that they supported, a rival team and a non-rival (neutral) team with newly associated geometric shapes (e.g. ‘your team is the circle, the rival team is the square and the neutral team is the triangle’). Following this stage, they then responded to random shape-badge pairs presented on screen very quickly as being correct or incorrect according to the previously learned associations. As for self-associated stimuli, a large advantage for reaction time and accuracy was found for shapes that were matched to participants' own team badges compared with shapes matched to rival and non-rival badges. Control experiments verified that these effects were not based on increased familiarity for stimuli associated with participants' own team badges, showing that the enhanced performance truly reflected social value. This conclusion was further supported by a positive correlation between the in-group advantage in perceptual performance and satisfaction with the team ratings on Leach et al.'s (2008) multi-component group identification scale. That there was no difference in responses to neutral and rival out-groups suggested the effects were rooted in in-group favouritism rather than out-group derogation.

Prior research thus shows that social significance, such as relevance to the self or an in-group, plays an important role in directing attention and enhancing perceptual processing. Perhaps then, the shared effects of self and in-group relevance on low-level cognition are driven by a common process that stems from a shared representation. This would imply that prioritisation for the self predicts prioritisation for the in-group, and vice versa. Alternatively, in-group prioritisation in this context may be driven by a component distinct from the self, such as emotional or motivational significance inherent in the concept of the group. Many social psychological theories are rooted in the premise that the psychological self extends to include other people and social in-groups such that group memberships form a vital part of self-representation. This forms the basis of social identity theory (Tajfel, 1982) and theories that have followed, such as self-categorisation theory (Turner, Hogg, Oakes, Reicher, & Wetherell, 1987) and optimal distinctiveness theory (Brewer, 1991). In addition to social identity theory and its successors, the theory of identity fusion has more recently been proposed as a unique form of alignment with a group such that in certain individuals or under specific circumstances, the personal self and the social self become completely at one (Swann, Jetten, Gomez, Whitehouse, & Bastian, 2012). In cases of identity fusion, boundaries between the personal and the social self are highly blurred and individuals are likely to care as much about group outcomes as self outcomes, which can lead to extreme forms of pro-group behaviour (Gómez & Vázquez, 2015).

Further, there is experimental evidence to support the notion that the in-group is cognitively represented as a part of the self. For example, Smith and Henry (1996) asked participants to complete questionnaires relating to traits about themselves, an in-group and an out-group and then had them make yes/no self-descriptive judgments on a computer on the same traits. They found that traits on which the self matched the in-group were responded to faster and more accurately than traits on which the self and in-group mismatched, showing a cognitive overlap between self and group representation. There was no effect of matches or mismatches to the out-group. The reverse effect was also demonstrated, with judgments about in-group characteristics facilitated when they matched the self (Smith, Coats, & Walling, 1999). The effect was further demonstrated for attitude as well as trait judgments and was positively correlated with explicit measures of group identification, such that participants who showed a large reaction time facilitation effect tended to report high levels of social identity, a greater desire for closeness with the in-group and higher perceived in-group similarity (Coats, Smith, Claypool, & Banner, 2000). This evidence led to the proposal of a connectionist model for self and in-group representation. Using the basic architecture of an Interactive Activation and Competition model (McClelland & Rumelhart, 1981), Smith et al. (1999) conducted a small-scale simulation such that self and in-group (or partner) nodes were connected by bidirectional positive links which were also connected to certain traits via positive or negative links. The process of answering a question about whether a certain trait described the in-group (or partner) was then modelled. When a trait was positively connected to both in-group and self, there was a much greater activation level (which corresponds to a faster behavioural response time) than when the trait was connected to the in-group alone. Furthermore, when the self-group link was strengthened (or weakened) to reflect perceived closeness with (or distance from) the group, the effect increased (or decreased) accordingly. Thus, the connectionist model predicted the observed behavioural results and strengthened the conclusion that representations of self and others are not stored as isolated and independent structures but are linked by direct connections indicating the strength of relationship and also by indirect connections through commonly shared traits. These experiments provide evidence for a shared cognitive representation of the personal and social self. In this case, we might then expect this overlap to manifest itself at the perceptual level too, with attentional prioritisation for the self (within the perceptual matching paradigm described above), predicting attentional prioritisation for the social in-group.

The present research explores whether the self and in-group biases in visual perception, measured by perceptual matching (Moradi et al., 2015; Sui et al., 2012), are driven by overlapping representations of self and in-group information. Evidence for an overlap between self and group in higher-level processes such as trait judgments has been demonstrated (Coats et al., 2000), but is this also relevant to effects on lower-level, perceptual and attentional processes? If so, we would expect to see a positive correlation between the self and in-group advantages in performance on the perceptual matching task. We might also expect more difficulty in discriminating between newly-learned self and in-group stimuli than, for example, self and rival group stimuli. The two experiments reported here utilised the perceptual matching paradigm described above (Sui et al., 2012) to explore the relationship between the self- and team-oriented advantages in visual perception in a sample of college rowers. In Experiment 1, participants performed two separate matching tasks: one in which they learned to associate self, friend and stranger labels with three separate geometric shapes, and the other in which they learned to associate team, rival and neutral labels with three different geometric shapes. In both tasks, participants had to respond to randomly presented shape-label pairs as correctly or incorrectly matched according to the previously learned associations (learned earlier, at the beginning of the experiment). Performance advantages were taken as the differences in reaction time and in accuracy between self/team shapes and ‘non-self’ (the average of friend and stranger) and ‘non-team’ (the average of neutral and rival) shapes, and the relationship between the self and team advantages was investigated. In addition to the perceptual tasks, subjective measures of perceived closeness and overlap between self, friend and stranger, and team, rival and non-rival were assessed using a questionnaire to assess whether 'friend' and 'stranger' labels are comparable to 'rival' and 'non-rival' labels within the perceptual matching tasks (i.e., whether they serve as equivalent baselines for measuring the performance advantages). Experiment 2 investigated the self and team perceptual advantages when the self, stranger, team and rival associations were made within the same task. This allowed us to explore the similarities between the self and team advantages when both self and group stimuli were salient at the same time, while also controlling for potential problems associated with order effects. Furthermore, this version of the task made it possible to explore the overlap between self and in-group perceptual processing by comparing mismatched trials for which self shapes were matched with team labels to those when self shapes were matched with rival labels. The second experiment also assessed the effects of explicitly reported group identification and further used implicit association measures (Greenwald & Farnham, 2000) to investigate whether the enhanced performance for the team in the matching task reflected implicit positive valence associated with the team. We hypothesised that a shared process driving the two kinds of advantage effects would be reflected in a positive relationship between the perceptual advantages for self and team. Additionally, we conjectured that an overlap between self and in-group representations would mean greater difficulty in discriminating newly-learned self and in-group stimuli when presented in mismatched pairs than, for example, self and rival mismatches. A slower RT and higher error rate for self-team pairs than self-rival pairs, or team-self pairs than team-stranger pairs, would be indicative of a cognitive confusion between self and in-group stimuli.

2. Experiment 1

2.1. Methods

2.1.1. Participants

College rowers were recruited by email advertisements. Based on prior work, eighteen participants was determined to be the minimum sample size required to observe a group-level difference between the critical condition means with a power of 0.80, alpha = 0.01. We aimed to double this sample size for a meaningful correlational analysis, with 30 as the minimum adequate number based on work by Stolte, Humphreys, Yankouskaya, and Sui (2017). A total of 49 rowers from a range of College rowing teams[2] completed the experiment. Seven participants were excluded on the basis of having chance levels of accuracy across both perceptual matching tasks (accuracy rate < 0.55), because chance level scores would render bias measures meaningless. This left a total of 42 (30 female, mean age = 22.36 ± 1.06), all of whom were right-handed and had normal or corrected-to-normal vision. Informed consent was obtained from all participants prior to the experiment.

2.1.2. Stimuli and tasks

Two perceptual matching tasks adapted from Sui et al. (2012) were performed by each participant and completed sequentially, with half of the participants performing the personal-association task first and half the group-association task first. In the personal-association task, participants learned to associate three geometric shapes with self, friend and stranger labels and then had to judge if randomly presented shape-label pairs were correctly or incorrectly matched according to the initial associations. The shape-label pairings were firstly made by an on-screen instruction (e.g. 'you are the square, your best friend is the circle and a stranger is the triangle'). Following this brief learning phase, the computer task began. In each trial, participants were presented with a central fixation cross for 500 ms after which a randomly-generated shape-label pair was presented for 100 ms. Participants then had 1100 ms to respond whether the shape-label pairing was matched correctly or incorrectly by pressing keys *m* and *n* (counterbalanced for *yes* and *no* responses) and feedback (correct or incorrect) was given on the screen for 500 ms at the end of each trial. The task consisted of 6 blocks of 60 trials (excluding 12 practice trials at the beginning) and overall accuracy was given at the end of each block, along with an 8-second break. There were six conditions within the task: two match conditions, matched/mismatched; and three shape conditions, self, friend and stranger. The whole task took approximately 15 min.

The group-association task had exactly the same format as the personal-association task other than participants learned to associate three different geometric shapes with labels of their own rowing team, a rowing team that they considered to be a rival, and another rowing team that they considered to be neutral to theirs, a non-rival. The names of the three teams were reported to the researcher by email before the session and the computer task was adjusted accordingly such that each participant made shape associations with their own unique choices. The associations across both tasks between the six shapes (circle, hexagon, octagon, pentagon, square and triangle) and the six written labels (self, friend, stranger; team name, rival team name and neutral team name) were counterbalanced across participants along with task order. The shapes used in the personal-association task were always different from the shapes used in the group-association task. In both tasks, the geometric shapes (each $3.8^\circ \times 3.8^\circ$) were presented randomly above a white fixation cross ($0.8^\circ \times 0.8^\circ$) against a grey background at the centre of the screen, with a matched or mismatched label presented simultaneously below the central fixation point. The experiment was run on a PC using E-Prime software (version 2.0) and displayed on a 17-in monitor.

2.1.3. Personal distance and IOS measures

To assess the perceived closeness between self, friend and stranger or own, rival and non-rival teams, participants completed a personal distance scale developed by Sui et al. (2012) and the inclusion of the self in the other scale (IOS), developed by Aron, Aron, and Smollan (1992). The personal distance scale asks participants to mark two points on a straight line to represent where the two individuals in each question (i.e., self and friend, self and stranger or friend and stranger) fall in relation to one another. The distance between the two marks (in mm) then serves as a measure of the perceived closeness between the individuals. We also used this method to measure perceived closeness between the three teams in question (i.e., team and rival, team and non-rival and rival and non-rival). Smaller scores indicate a closer perception of the relationship between the two individuals or teams. Participants also completed the IOS, which presents seven pairs of circle that vary in the overlap between them such that the first picture shows no overlap and the last almost total overlap. Participants are asked to select the pair of circles that best represents the relationship between themselves and the other individual (each represented by a circle). We asked participants to complete three versions of this task (self-friend, self-stranger and self-stranger) along with a modified version to assess overlap between own, rival and non-rival teams. Higher scores on this scale imply greater overlap.

2.1.4. Procedure

Participants first performed the two association tasks, the order of which was counterbalanced such that half of the participants performed the personal-association task first and half of the participants performed the group-association task first. Following the two perceptual matching tasks, participants then completed the self and team personal distance and then the IOS scales. The experiment took approximately 1 h in total and participants were remunerated at a rate of £10 per hour for their

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[2] We acknowledge that the correct term in rowing is a 'crew' rather than a team. However, since team biases were explored by Moradi et al. (2015), and since the phenomena are general, team-related ones, we use the term team in this article.

time.

2.2. Results and discussion

For the reaction time analysis only correct responses were included, and those higher or lower than 2.5 standard deviations from the mean reaction time for each participant under each condition were excluded as a standard way of removing the influence of outliers. This eliminated < 5% of the overall dataset. The analysis was then performed on the remaining trials. Sensitivity was measured using a signal detection approach whereby matched and mismatched trials for each shape were combined to give a measure of *d* prime (Green & Swets, 1966), and the response criterion (*C*) for each participant was also calculated (Macmillan, 1993).

2.2.1. Reaction time scores

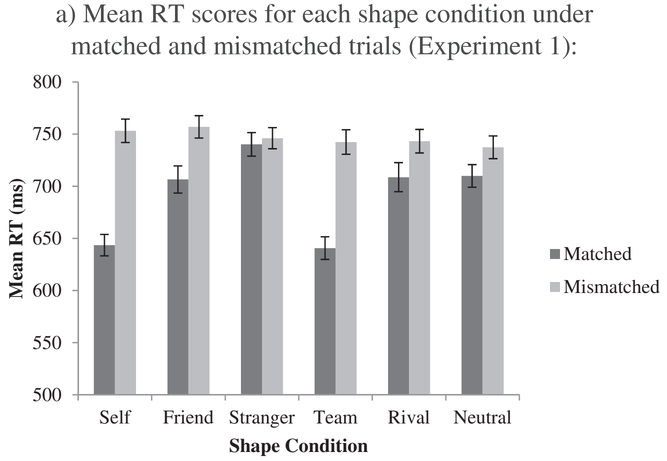
There were three within-subject variables: task type (personal/group), shape category (high priority: self/team; mid priority: friend/neutral; low priority: stranger/rival) and match condition (matched/mismatched). A 2 (task: personal/group) × 3 (shape condition: high/mid/low priority) × 2 (matched/mismatched) repeated measures analysis of variance (ANOVA) was used to test for the effect of shape association on reaction time (RT) scores. Note: RT scores in mismatched trials were based on the shapes (not the labels) in order to control for the effects of word frequency between the labels.

There was no significant effect of task type, $F(1, 41) = 1.41$, $p = 0.242$, $\eta_p^2 = 0.033$, showing that RTs were similar for the personal and the group association tasks. There was a significant effect of shape, $F(2, 82) = 65.11$, $p < 0.001$, $\eta_p^2 = 0.614$, with RTs fastest for high-priority shapes, ($M = 694.98 \pm 8.94$), followed by mid-priority shapes, ($M = 727.70 \pm 9.84$), and slowest for low-priority shapes ($M = 734.55 \pm 9.78$). Pairwise comparisons revealed that significant differences existed between high- and mid-priority shapes and high- and low-priority shapes (both $p < 0.001$), but not between mid- and low-priority shapes ($p = 0.215$). There was also a significant effect of match condition, with faster responses made for matched than for mismatched trials, $F(1, 41) = 254.33$, $p < 0.001$, $\eta_p^2 = 0.861$.

There was no significant interaction between task and shape, with the effect of shape on RT consistent across personal and group associations, $F(2, 82) = 1.08$, $p = 0.345$, $\eta_p^2 = 0.026$. Similarly, there was no significant interaction between task and match condition, $F(1, 41) = 0.23$, $p = 0.881$, $\eta_p^2 = 0.001$. There was a significant interaction between shape and match, $F(2, 82) = 52.97$, $p < 0.001$, $\eta_p^2 = 0.564$, showing a differential effect of shape on RT according to match condition. There was also a significant three-way interaction between shape, match and task type, $F(2, 82) = 9.51$, $p < 0.001$, $\eta_p^2 = 0.188$, indicating that the interaction between shape and match on RT was also dependent on task. To decompose these interactions, one-way repeated measures ANOVAs were performed separately on matched and mismatched conditions for both task types.

Within the personal association task, there was a significant effect of shape condition on matched trials, $F(2, 82) = 53.70$, $p < 0.001$, $\eta^2 = 0.567$, but not on mismatched trials, $F(2, 82) = 2.46$, $p = 0.091$, $\eta^2 = 0.057$. For matched pairs, self shapes were responded to significantly faster than friend shapes and also stranger shapes, and friend shapes were responded to significantly faster than stranger shapes (all $p < 0.001$). RTs within the group association task followed a similar pattern, with a significant effect of shape condition on matched, $F(2, 82) = 35.43$, $p < 0.001$, $\eta^2 = 0.464$, but not mismatched, $F(2, 82) = 0.83$, $p = 0.442$, $\eta^2 = 0.020$, trials. For matched pairs, team shapes were responded to significantly faster than neutral and rival shapes (both $p < 0.001$). However, there was no difference between neutral and rival shapes ($p = 1.00$), unlike for friend and stranger shapes in the personal task.

In summary, the RT data analysis found that for matched pairs, self and team shapes were responded to significantly faster than the other shapes. While friend shapes were responded to significantly faster than stranger shapes, there was no difference between neutral and rival shapes. See Fig. 1a for a bar chart depicting RTs for matched and mismatched trials under each shape condition, and Table 1 for mean and standard deviation (*SD*) scores.


a) Mean RT scores for each shape condition under matched and mismatched trials (Experiment 1):

b) Mean *d* prime scores for each shape condition (Experiment 1):

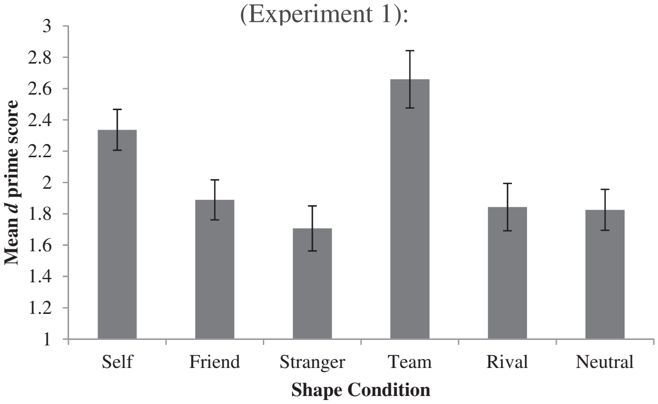


Fig. 1. a Mean RT scores for each shape condition under matched and mismatched trials (Experiment 1): b: Mean *d* prime scores for each shape condition (Experiment 1).

2.2.2. D prime and response criterion

A 2 (task: personal/group) × 3 (shape: high/mid/low priority) repeated measures ANOVA found that there was no significant effect of task on *d* prime scores $F(1, 41) = 0.44$, $p = 0.511$, $\eta_p^2 = 0.011$, indicating that sensitivity was comparable across both association types. There was a significant main effect of shape, $F(2, 82) = 58.08$, $p < 0.001$, $\eta_p^2 = 0.586$, with sensitivity greater for high than for mid and low priority shapes (both $p < 0.001$), but with no difference between the latter two ($p = 0.413$). There was a marginal interaction between task and shape, $F(2, 82) = 0.79$, $p = 0.086$, $\eta_p^2 = 0.058$.

Separate one-way repeated measures ANOVAs performed on each task type found a significant effect of shape for the personal task, $F(2, 82) = 16.23$, $p < 0.001$, $\eta^2 = 0.284$, with self shapes responded to with greater sensitivity than friend ($p = 0.002$) and stranger ($p < 0.001$) shapes. Sensitivity scores were generally higher for friend than for stranger, but this was not significant ($p = 0.186$). Similarly, there was a significant effect of shape on sensitivity within the group association task, $F(2, 82) = 35.71$, $p < 0.001$, $\eta^2 = 0.466$, with greater sensitivity for team than for neutral and rival shapes (both $p < 0.001$), but with no difference between the latter two ($p = 1.00$). Similar to the RT data, the *d* prime scores demonstrated performance advantages for self compared to friend and stranger and for team compared to neutral and rival. When Bonferroni-adjusted, there were no significant differences in sensitivity between friend and stranger

Table 1
Mean RT scores for correct responses and proportions of correct responses in Experiment 1, and mean *d* prime and response criterion scores (Experiment 1).

Shape	RT (ms) *matched*	RT (ms) *mismatched*	Accuracy *matched*	Accuracy *mismatched*	*D* prime	*RC*
Self	643.49 (66.46)	753.23 (72.77)	0.89 (0.09)	0.80 (0.13)	2.33 (0.85)	− 0.19 (0.35)
Friend	706.52 (84.38)	756.98 (69.64)	0.82 (0.12)	0.78 (0.13)	1.89 (0.83)	− 0.06 (0.30)
Stranger	740.18 (73.30)	746.07 (65.80)	0.73 (0.16)	0.81 (0.13)	1.71 (0.93)	0.19 (0.29)
Team	640.73 (70.36)	742.46 (75.89)	0.91 (0.07)	0.82 (0.16)	2.66 (1.19)	− 0.21 (0.34)
Rival	708.70 (90.26)	743.23 (73.25)	0.79 (0.16)	0.78 (0.15)	1.84 (0.98)	− 0.02 (0.31)
Neutral	709.89 (70.04)	737.40 (70.64)	0.80 (0.13)	0.79 (0.16)	1.83 (0.85)	− 0.02 (0.30)

Note. SDs in parentheses; *RC* denotes Response Criterion.

shapes or between neutral and rival out-group shapes. See Fig. 1b for a bar chart depicting sensitivity scores for each shape condition, and Table 1 for means (*SD*).

The same analyses were performed for response criterion data (*C*). There was a marginal effect of task, $F(1, 41) = 3.43$, $p = 0.071$, $\eta_p^2 = 0.077$, with a slightly lower *C* adopted for the group ($M = -0.02 \pm 0.032$) than the personal ($M = -0.09 \pm 0.03$) associations. There was a significant effect of shape, $F(2, 82) = 16.48$, $p = 0.001$, $\eta_p^2 = 0.287$, with a lower *C* for high than for mid ($p = 0.003$) and low ($p < 0.001$) priority shapes, and also for mid than low priority shapes ($p = 0.058$). Additionally, there was a significant interaction between task and shape, $F(2, 82) = 4.47$, $p = 0.014$, $\eta_p^2 = 0.098$.

For personal associations, there was a main effect of shape on *C*, $F(2, 82) = 37.30$, $p < 0.001$, $\eta^2 = 0.476$, with a significantly lower *C* for self than stranger ($p < 0.001$) and friend than stranger ($p = 0.002$), but with no difference between self and friend ($p = 0.167$). There was also an effect of shape on *C* for group associations, $F(2, 82) = 5.01$, $p = 0.009$, $\eta^2 = 0.109$, with a significantly lower *C* for team than for neutral ($p = 0.017$) and rival ($p = 0.047$) shapes, but with no difference between the latter two ($p = 1.00$). Therefore, for personal associations, a lower *C* was adopted for both self and friend compared to stranger shapes, while for group associations, a lower *C* was adopted for team compared to neutral and rival shapes.

2.2.3. Correlations between self and team advantages

The results indicated that performance was enhanced for self-associated shapes in comparison to friend and stranger and for team shapes in comparison to neutral and rival shapes in both RT and sensitivity. Next, we investigated whether the advantage in performance for the self was correlated with the advantage in performance for the team. In order to calculate the self advantage score for RT, the two non-self conditions (stranger and friend) were averaged together and the self score was deducted from this for each participant. To calculate the self *d*prime advantage for each participant, the two non-self conditions were averaged together and then deducted from the self score. The team advantage scores were calculated in the same way, taking the difference between the team and the averaged non-team conditions (rival and neutral). Bias corrected and accelerated bootstrap 95% CIs are reported in square brackets.

There was a significant positive correlation between the self and team advantage in reaction time, $r_s = 0.339$ [0.023, 0.543], $p = 0.028$, but not in sensitivity, $r_s = -0.105$ [−0.448, 0.235], $p = 0.509$. A scatterplot showing the correlation between the self and team advantages in RT in comparison to ‘non-self’ and ‘non-team’ respectively is presented in Fig. 2.

2.2.4. Personal distance and the inclusion of the self in the other scale

One participant did not complete the personal distance (PD) scales and so the sample size for this analysis was 41. The mean scores for subjective distance between each pair of individuals and teams along with the perceived overlap between these pairs are shown in Table 2 (below). These measures were significantly correlated such that the closer each pair of individuals was rated on the PD scale (i.e., smaller distance), the greater the perceived overlap between them on the IOS scale. These correlation coefficients are also shown in Table 2.

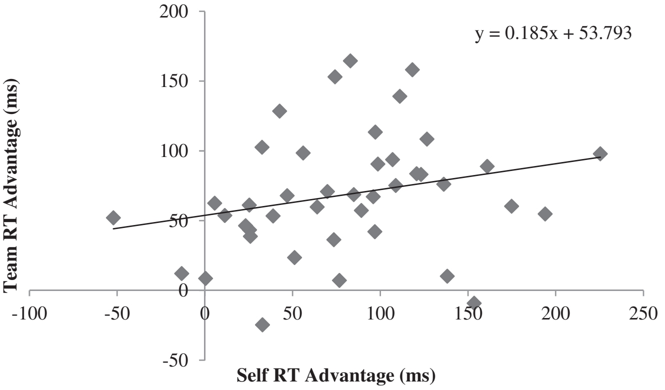


Fig. 2. The correlation between the self and team RT advantages relative to ‘non-self’ and ‘non-team’ (Experiment 1).

A 2 (personal or group) × 3 (pairing: self-friend, self-stranger, friend-stranger or team-neutral, team-rival, neutral-rival) repeated measures ANOVA was used to explore differences in perceived personal distance (PD) between the pairs of individuals and groups. There was no significant effect of personal vs. group, $F(1, 40) = 0.82$, $p = 0.372$, $\eta_p^2 = 0.020$, however there was a significant effect of the pair type, $F(2, 80) = 57.22$, $p < 0.001$, $\eta_p^2 = 0.589$, and also a significant interaction between the two, $F(2, 80) = 29.52$, $p < 0.001$, $\eta_p^2 = 0.425$. One-way repeated measures ANOVAs performed separately for personal and group pairs were used to decompose the interaction. For personal distance scores, $F(2, 80) = 106.20$, $p < 0.001$, $\eta^2 = 0.73$, the distance between self-friend was rated as significantly smaller than that between self-stranger and friend-stranger (both $p < 0.001$), but there was no difference in ratings of distance between self-stranger and friend-stranger ($p = 0.661$). For group distance scores, there was only a marginal effect of pair type, $F(2, 82) = 2.52$, $p = 0.086$, $\eta^2 = 0.058$. There was no difference in perceived distance between team-neutral and team-rival ($p = 0.215$), or between team-rival and neutral-rival ($p = 1.00$), but the distance between team-neutral was significantly closer than between neutral-rival ($p = 0.007$).

A similar 2 (personal or group) × 3 (pairing: self-friend, self-stranger, friend-stranger or team-neutral, team-rival, neutral-rival) repeated measures ANOVA was used to explore differences in IOS scores between the pairs of individuals and groups. There was a significant effect of personal vs. group, $F(1, 41) = 7.82$, $p = 0.008$, $\eta_p^2 = 0.160$, and of pair type, $F(2, 82) = 87.39$, $p < 0.001$, $\eta_p^2 = 0.681$, and there was also a significant interaction between the two, $F(2, 82) = 58.97$ $p < 0.001$, $\eta_p^2 = 0.590$. For personal IOS scores, $F(2, 82) = 257.74$, $p < 0.001$, $\eta^2 = 0.863$, the overlap between self-friend was significantly greater than for self-stranger and friend-stranger (both $p < 0.001$), but there was no difference between self-stranger and friend-stranger ($p = 0.549$). There was no significant effect of pair type

Table 2
Mean Personal Distance and Inclusion of Other in the Self scores, and correlation coefficients for the relationship between each measure (Experiment 1).

	Mean PD (SD)	Mean IOS (SD)	Correlation *r* (*p*)
Self-Friend	1.40 (1.97)	5.55 (1.31)	− 0.407 [− 0.700, 0.131] (0.008)
Friend-Stranger	8.82 (4.01)	1.76 (1.03)	− 0.377 [− 0.593, − 0.158] (0.015)
Self-Stranger	9.26 (3.80)	1.61 (0.85)	− 0.429 [− 0.647, − 0.168] (0.005)
Team-Neutral	5.82 (3.23)	2.71 (1.70)	− 0.536 [− 0.697, − 0.349] (< 0.001)
Neutral-Rival	7.14 (3.77)	2.28 (1.50)	− 0.378 [− 0.607, − 0.084] (0.014)
Team-Rival	7.30 (3.86)	2.57 (1.48)	− 0.605 [− 0.778, − 0.358] (< 0.001)

Note. SDs in parentheses; PD denotes Personal Distance, and IOS Inclusion of Other in the Self.

on group IOS scores, $F(2, 82) = 0.95$, $p = 0.390$, $\eta^2 = 0.023$, thus showing an equivalent perceived overlap between the three teams.[3]

These results demonstrate a different pattern of responses for self-reported distance and overlap between the personal and group labels. Self and friend were rated as closer and as having greater overlap than self-stranger and friend-stranger, but there were no such differences for team ratings, with similar closeness and overlap between all three. This may explain why we observed a significant difference between friend and stranger in the matching task, but not between neutral and rival teams. There may also be implications here for the relations between the bias scores – friend and stranger baselines to self may not be equivalent to neutral and rival baselines to team in calculating the advantage scores. It is possible that these non-equivalent baselines could obscure a stronger relationship between the self and in-group biases.

2.3. Discussion: experiment 1

This first experiment explored the relationship between the self and team advantages in perceptual matching identified by Sui et al. (2012) and Moradi et al. (2015). In two separate perceptual matching tasks, we replicated the self and team advantage effects and also demonstrated a positive correlation between the two for RT data. The positive correlation between the self and team advantages in reaction time supports the view that there is an overlap between cognitive representations of the self and of important in-groups (Coats et al., 2000; Smith et al., 1999; Smith & Henry, 1996). Evidence for this was previously demonstrated using a trait judgment paradigm in which participants were faster to respond to self-descriptions that matched the in-group than to those that did not (e.g., Smith & Henry, 1996). Our results contribute to this line of research by demonstrating that similar effects hold for lower level, attentional and perceptual processes, indicating that a cognitive overlap between self and in-group representation is the source of shared advantage effects in lower-level cognition (i.e., perceptual benefits). By utilising the perceptual matching paradigm designed by Sui et al. (2012) using neutral shapes, these results also remove the possible role that familiarity of the target stimulus might play in, for example, judging traits relating to the self or to the in-group.

It could be argued here that the self-team advantage correlation does not necessarily imply a shared cognitive representation and that, for example, any form of perceptual bias demonstrated under this paradigm might be correlated by nature of the design. Or, alternatively, it may be suggested that the self and team advantages are both driven by something else, such as positive emotion or reward. Prior research, however, shows that this is unlikely to be the case. There is evidence to suggest that high reward values modulate attentional processes in the same way as social relevance does (e.g., Anderson & Yantis, 2013), which has caused speculation that prioritisation for the self (and, by extension, the in-group) simply reflects intrinsic reward (Northoff & Hayes, 2011). Examining this argument, Sui et al. (2012) found that high reward stimuli (e.g., £8 as opposed to £0.50) modulated perceptual matching in the same way that self-stimuli did, with enhanced performance and weaker stimulus degradation effects for high than low reward shape associations. However, exploration of the interaction between self bias and reward bias found no correlation between the two, implying that although self and reward tagging yielded similar effects, they are actually driven by distinct processes (Sui & Humphreys, 2015). That no correlation was found between self and high reward advantages in the perceptual matching task also shows both that the self-team advantages are not necessarily correlated by nature of the design and also that they reflect something distinct from reward. Further to this, Stolte et al. (2016) found that associating stimuli to positive emotion also modulated performance on the same perceptual matching paradigm, with performance enhanced for the stimuli associated with the most positive emotion (e.g., ‘happy’ over ‘neutral’ and ‘sad’). Again, while self biases and positive emotion biases were correlated within themselves over two sessions, showing a reliable, trait-like measure, they were not correlated with each other within the same individuals. The authors concluded that as they had matched the two tasks as closely as possible, the lack of correlation between self and positive emotion advantages suggests distinct processes involved in driving the two kinds of advantage effects.

That the self and team advantages in RT were correlated is consistent with an underlying overlap between self and in-group representation. It must be noted, though, that there was no such relationship between the self and team advantages in sensitivity, implying that the self and team prioritisation effects, although likely to be related, may not in fact reflect entirely the same process. However, two potential problems with measuring the relations between the self and team advantages, arising from the design of Experiment 1, should be noted. Separate matching tasks were used to measure the two advantages and task performance was always improved with practice in the second task. This meant that the self or team accuracy advantage in the second task tended to be smaller as overall sensitivity increased. Potential correlations between self and team advantages in sensitivity may then have been obscured by task order effects. Similarly, the use of different ‘other’ shape associations made within the self and team-association tasks may have reduced the self-team correlations. For example, responding to self when the other shapes are stranger and friend may cause a different response pattern to responding to team when the other shapes are rival and neutral team names. The personal distance and IOS data reflect the fact that the relationship between self and friend or self and stranger is not conceptually the same as between team and rival or team and non-rival. On these measures, we found that self and friend were rated as much closer than own team and a non-rival team, while there was more perceived distance and less overlap between self and stranger than between own team and a rival and own team and a non-rival team. It seems that rival and neutral team categories fall somewhere between a stranger and a friend in terms of perceived closeness to the team, so although they elicited very similar effects, the two tasks (self- and team-associations) may not be equivalent ways of measuring the two social biases.

A second experiment attempted to address the limitations associated with task order and the contrast of self and team shapes with potentially

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[3] There were no significant correlations between the PD and IOS scores and the self and team-oriented biases in RT or in sensitivity.

non-equivalent ‘other’ shapes by including self, stranger, team and rival shape associations within the same task. This design also allowed us to explore whether the self and team biases remained constant in the presence of one another. Additionally, we were able to look directly at an overlap between self and in-group representation by comparing specific combinations of self and team mismatched pairs. Our second experiment included self-reported measures of group identification to explore the potential moderating effects of these measures on the self-group relationship, and also included an implicit association task to assess whether the team advantage was supported by positive valence associated with the team.

3. Experiment 2

3.1. *Methods*

3.1.1. *Participants*

As for Experiment 1, college rowers were recruited by email advertisements. A total of 31 rowers (20 female, mean age = 22.19 ± 0.6) from a range of college rowing teams completed the experiment, all of whom were right-handed and had normal or corrected-to-normal vision. Informed consent was again obtained from all participants.

3.1.2. *Stimuli and tasks*

In a modified version of the perceptual matching task that was used in the first experiment, self, stranger, team and rival team labels were each paired with a different geometric shape and these associations were again counterbalanced across participants. Participants were again instructed that they would have to judge whether shape-label pairings presented on the screen were correctly or incorrectly matched according to the initial associations. This time, self- and team-associations were included within the same blocks within the same task. There were eight conditions in total (self/stranger/team/rival x matched/mismatched), with 72 trials per condition. The whole task took between 15 and 20 min and exactly the same experimental parameters were used as in the first experiment.

3.1.3. *Questionnaire measures*

Measures of identity fusion (designed to capture connectedness between the personal and social self) were obtained using the 7-item verbal scale developed by Gómez et al. (2011). Measures of group identification were obtained using Leach et al.'s (2008) 14-item multi-component scale that identifies five components of in-group identification: individual self-stereotyping, in-group homogeneity, solidarity, satisfaction and centrality. The five components make up a two-dimensional model such that solidarity, satisfaction and centrality underlie ‘self-investment’ (a bond with the in-group, positive feelings about in-group membership and the importance and salience of the in-group to the individual) while individual self-stereotyping and in-group homogeneity underlie ‘self-definition’ (the perception of the self as similar to an in-group prototype and of in-group members sharing commonalities).

3.1.4. *Implicit association task*

In addition to the perceptual matching task, participants also performed an adapted version of the self-esteem implicit association task (Greenwald & Farnham, 2000), which assessed automatic associations of team and rival categories with positive and negative valence. In the task, participants were asked to press a left or right key (*E* or *I*) in order to categorise words that appeared in the centre of the screen, with each side representing a different category. First, participants performed 20 trials in which they categorised words as relating to their own team (e.g., ‘us’) and a rival team (e.g., ‘others’). In the next 20 trials, participants grouped words as belonging to ‘pleasant’ (e.g., ‘lovely’) or ‘unpleasant’ (e.g., ‘horrible’) categories. Following this, there were 20 practice trials in which participants categorised words into target-attribute combinations (e.g., team + pleasant or rival + unpleasant) that were assigned to the same side in the first two parts, before 40 test trials of the same nature. After this, the assignment keys for the team categories were swapped such that if the team category was on the left before it would now appear on the right, and 20 trials provided the same practice as described in the first step. Finally, 20 practice trials in which the target-attribute combinations were reversed (e.g., team + unpleasant, rival + pleasant) were performed, followed by 40 test trials of the same. Implicit association between the team and positive valence is reflected in the extent to which individuals find it easier (indicated by faster response times) to associate their own team with pleasant items. A final *D* score is generated for each participant, which consists of the standardised differences in reaction time between the team-positive and team-negative association blocks: the greater the *D*, the stronger the implicit positive association with the team.

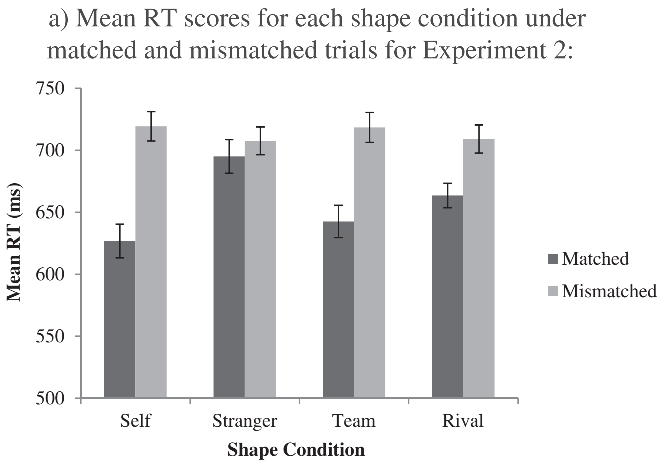
3.1.5. *Procedure*

Participants first performed the perceptual matching task (described above) in which self, stranger, team and rival labels were associated with four different geometric shapes. After the perceptual matching task, participants completed the Implicit Association Task and then the group identification and identity fusion questionnaires. The experiment took approximately 45 min and participants were remunerated at a rate of £10 per hour for their time.

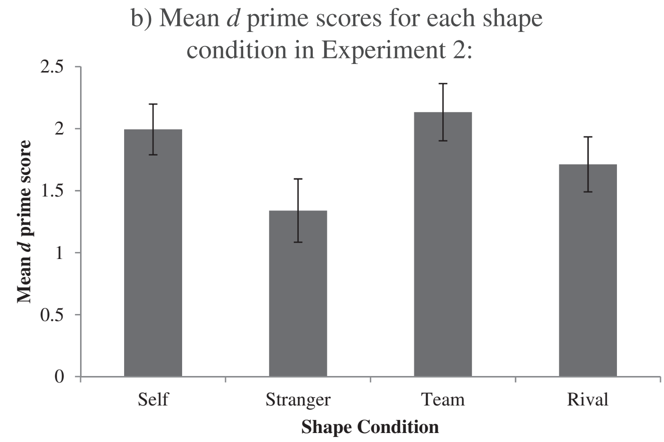
3.2. *Results and discussion*

3.2.1. *Reaction time scores*

As for Experiment 1, there were three within-subject variables: task



a) Mean RT scores for each shape condition under matched and mismatched trials for Experiment 2:



b) Mean *d* prime scores for each shape condition in Experiment 2:

Fig. 3. a: Mean RT scores for each shape condition under matched and mismatched trials for Experiment 2: b: Mean *d* prime scores for each shape condition in Experiment 2.

Table 3
Mean RT scores for correct responses and proportions of correct responses under matched and mismatched trials and mean *d* prime and response criterion values (Experiment 2).

Shape	RT (ms) *(matched)*	RT (ms) *(mismatched)*	Accuracy *(matched)*	Accuracy *(mismatched)*	*d* prime	RC
Self	626.84 (74.62)	719.27 (65.10)	0.87 (0.12)	0.83 (0.09)	1.99 (1.11)	− 0.35 (0.44)
Stranger	695.02 (74.15)	707.54 (61.31)	0.72 (0.17)	0.85 (0.12)	1.34 (1.39)	0.03 (0.59)
Team	642.57 (71.63)	718.44 (66.15)	0.88 (0.11)	0.83 (0.10)	2.13 (1.26)	− 0.28 (0.55)
Rival	663.50 (54.45)	709.05 (62.05)	0.80 (0.14)	0.84 (0.09)	1.71 (1.21)	− 0.03 (0.42)

Note. SDs in parentheses; RC denotes Response Criterion.

type (personal or group), shape category (high priority: self/team, or low priority: stranger/rival) and match condition (matched/mismatched). A 2 (association type: personal/group) × 2 (priority: high/low) × 2 matched/mismatched) repeated measures ANOVA was used to test for the effect of shape association on RT scores.

There was no significant effect of association type on RT, showing speed of responses to be generally similar across personal and group associations, $F(1, 30) = 0.90$, $p = 0.348$, $\eta_p^2 = 0.029$. There were significant effects both of shape, $F(1, 30) = 15.86$, $p < 0.001$, $\eta_p^2 = 0.346$, and of match condition, $F(1, 30) = 107.11$, $p < 0.001$, $\eta_p^2 = 0.781$, with faster responses for high ($M = 676.70 \pm 10.69$) than low ($M = 694.03 \pm 9.97$) priority shapes, and for matched ($M = 655.21 \pm 10.08$) than for mismatched ($M = 715.51 \pm 10.93$) pairs. There was a significant interaction between shape and match condition, $F(1, 30) = 63.50$, $p < 0.001$, $\eta_p^2 = 0.679$, showing the effect of shape on RT to be dependent on whether the pairs were matched correctly or incorrectly. There was also a significant interaction between association type and shape, $F(1, 30) = 4.01$, $p = 0.054$, $\eta_p^2 = 0.118$, but not between association type and match, $F(1, 30) = 3.07$, $p = 0.09$, $\eta_p^2 = 0.093$. Finally, there was a significant three-way interaction between association type, shape and match condition, $F(1, 30) = 6.02$, $p = 0.02$, $\eta_p^2 = 0.167$.

Paired samples *t*-tests performed separately on matched and mismatched conditions for each association type found that for matched pairs, self shapes were responded to significantly faster than stranger shapes, $t(30) = 4.75$, $p < 0.001$, $d = 0.85$, and team shapes were responded to significantly faster than rival shapes, $t(30) = 3.35$, $p = 0.002$, $d = 0.60$. For mismatched pairs, stranger shapes were responded to significantly faster than self shapes, $t(30) = 2.09$, $p = 0.046$, $d = 0.37$, and rival shapes were responded to significantly faster than team shapes, $t(30) = 2.07$, $p = 0.047$, $d = 0.37$. These results show that self and team shapes were responded to significantly faster than stranger and rival shapes, but only under matched conditions. For mismatched conditions, stranger and rival shapes were responded to significantly faster than self and team shapes; however this effect was smaller. See Fig. 3a for a bar chart depicting RTs for matched and mismatched trials under each shape condition, and Table 3 for mean (*SD*) scores.

3.2.2. D prime and response criterion

A 2 (association type: personal or group) × 2 (shape: high or low priority) repeated measures ANOVA found no significant effect of association type, $F(1, 30) = 2.72$, $p = 0.109$, $\eta_p^2 = 0.083$, showing sensitivity to be similar for personal- and group-related shapes. There was a significant effect of shape, $F(1, 30) = 5.60$, $p < 0.001$, $\eta_p^2 = 0.484$, with greater sensitivity for self and team ('high priority') shapes than for stranger and rival ('low priority') shapes. There was no significant interaction between association type and shape, $F(1, 30) = 0.04$, $p = 0.834$, $\eta_p^2 = 0.001$, showing that the effect of shape was not dependent on whether it was self- or team-related. Thus, sensitivity was higher for self in comparison to stranger and also for team in comparison to rival. See Fig. 3b for a bar chart depicting sensitivity scores for each shape condition, and Table 3 for mean and standard deviation (*SD*) scores.

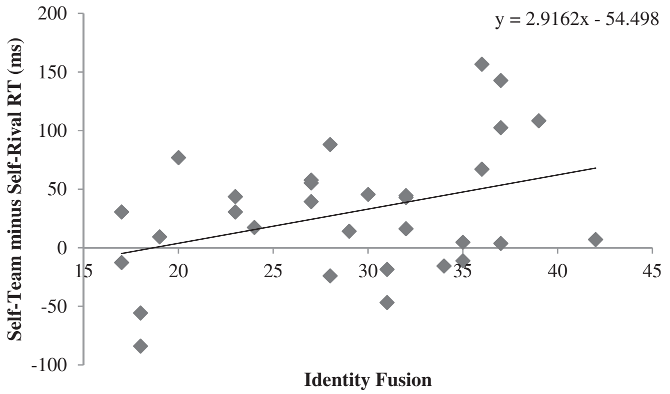


Fig. 4. The positive relationship between the difference in RT between self-team and self-rival mismatched pairs and identity fusion.

A similar 2 × 2 repeated measures ANOVA for *C* found a significant effect of association type, $F(1, 30) = 4.90$, $p = 0.035$, $\eta_p^2 = 0.140$, with a lower *C* for group ($M = -0.06 \pm 0.04$) than for personal ($M = 0.05 \pm 0.04$) associations. There was also a significant effect of shape, $F(1, 30) = 39.77$, $p < 0.001$, $\eta_p^2 = 0.570$, with a lower *C* for high than for low priority shapes. There was a marginal interaction between association type and shape, $F(1, 30) = 3.234$, $p = 0.082$, $\eta_p^2 = 0.097$. Paired samples *t*-tests found that the *C* for self was significantly lower than for stranger $t(30) = 5.47$, $p < 0.001$, $d = 0.98$, and the *C* for team was significantly lower than for rival $t(30) = 2.566$, $p = 0.016$, $d = 0.46$. The effect size for the difference in *C* between self and stranger was twice that of the difference between team and rival. Table 3 reports the mean RT values under each condition, the proportion of correct responses, along with the mean *d* prime and response criterion values.

3.2.3. The relationship between self- and team-associated stimuli

An advantage for stranger over self and for rival over team shapes for mismatched pairs implied that it was easier for participants to say 'no' to incorrectly paired 'other' shapes than incorrectly paired self and team shapes. To explore this effect further, performance scores to specific mismatched shape-label combinations were compared with each other. If an in-group is represented as part of the self, then we might expect slower RTs when responding 'no' to a self-team mismatched pair than a self-rival mismatched pair, as the latter is more obviously incongruent. Paired-samples *t*-tests were used to determine if there was a difference in RT between self shapes paired with team labels and self shapes paired with rival labels.[4]

Correct responses were significantly slower when self shapes were presented with team labels than with rival labels, $t(30) = 3.09$, $p = 0.004$, $d = 0.55$, indicating that participants were more hesitant to reject these as correctly-matched pairs (or were faster to perceive a mismatch between self and rival). However, there was no difference in RTs between team shapes presented with self labels than with stranger labels, $t(30) = 0.71$, $p = 0.485$, $d = 0.13$.

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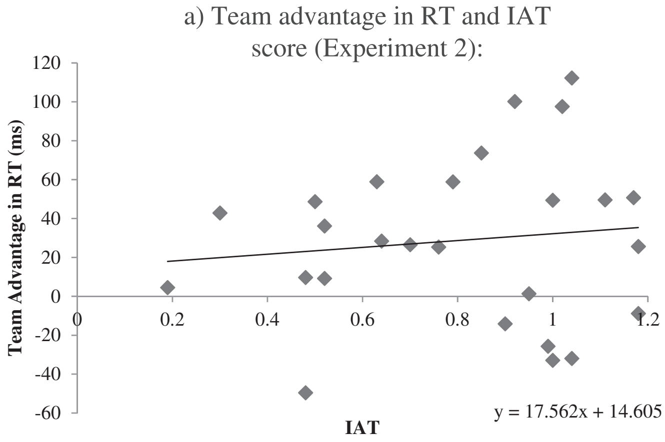
[4] There were 24 trials per specific mismatched condition (3 mismatched labels per shape = 72 total).



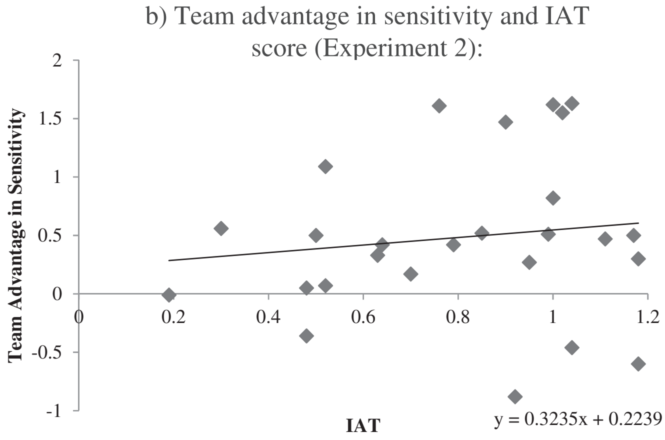


Fig. 5. a Team advantage in RT and IAT score (Experiment 2): b: Team advantage in sensitivity and IAT score (Experiment 2).

3.2.4. *Group identification measures*

There were no significant correlations between the team advantage in RT and self-reported measures of identity fusion, *r(31)* = 0.171 [− 0.257, 0.546], *p* = 0.359, self-definition *r(31)* = 0.017 [− 0.297, 0.332], *p* = 0.928, and self-investment, *r(31)* = − 0.100 [− 0.504, 0.304], *p* = 0.593, indicating that the prioritisation effect did not simply reflect explicit attitudes to the group.

However, if identity fusion measures the extent to which the self is at one with the group, then we might expect those higher in self-reported feelings of fusion to show greater overlap in perception between newly-learned self and in-group shapes. To test this hypothesis, the difference in RT between self-team (shape-label) and self-rival (shape-label) mismatched conditions was taken as an indicator of how much more difficult participants found discriminating self from team than self from rival. We then investigated whether these difference scores were related to measures of identity fusion and group identification. A greater difference between responses to self-team and self-rival conditions (with a larger score indicating greater difficulty in discriminating self from team) was positively correlated with self-reported measures of identity fusion, *r(31)* = 0.380 [0.021, 0.651], *p* = 0.035, and self-investment, *r(31)* = 0.372 [0.002, 0.645], *p* = 0.040, and marginally positively correlated with self-definition, *r(31)* = 0.303 [− 0.079, 0.646], *p* = 0.086. Fig. 4 depicts the relationship between the self-group overlap (indicated by a greater difference between self-team and self-rival pairs) and identity fusion.

3.2.5. *Implicit association tests*

We also assessed whether the team advantages in accuracy and reaction time in the perceptual matching task were associated with implicit positive attitudes to the team. All participants showed a moderate to strong preference for their own team compared to the rival team, meaning that they found it easier to associate positive attributes with their own team name (Mean IAT score = 0.84 ± 0.05). However, there were no correlations between the team advantage (in relation to rival) and the IAT score either in reaction time (*r*(26) = − 0.180 [− 0.527, 0.154], *p* = 0.379) or in sensitivity (*r*(26) = − 0.158 [− 0.519, 0.284], *p* = 0.440), suggesting that preference for the team in the perceptual matching task was not associated with positive valence. Scatterplots depicting this are shown below in Fig. 5a and b.

3.3. *Discussion: experiment 2*

Experiment 2 aimed to provide a cleaner design with which to explore the self and team advantages in the perceptual matching task by eliminating task order effects and providing the same social comparisons for self and team responses. Self, friend, stranger and rival shape associations were made within one task and we also included explicit measures of group identification. An implicit association measure was also used to look at the relationship between positive valence and the team performance advantage to assess whether positive emotion plays a role in driving the in-group bias effect. Under the 4-shape matching task, we found that performance was enhanced for both the self and the team shapes in comparison to stranger and rival shapes. An analysis of the mismatched trials demonstrated that responses to self shapes paired with team labels were responded to more slowly and with a higher error rate than self shapes paired with rival labels, pointing to a difficulty in discriminating self- from team-associated stimuli. This effect was stronger in individuals reporting higher levels of identity fusion and group identification. There was no correlation between the team advantage scores and implicit positive valence associated with the team, suggesting that the team advantage effects are not rooted in emotion.

The performance disadvantage in discriminating self from team stimuli (as opposed to self from rival stimuli) again provided evidence for a shared representation of self and in-group information (e.g., Smith et al., 1999). This argument is further supported by the fact that this effect was stronger in individuals with higher reported levels of identity fusion (and also self investment and self definition). Evidence for the effects of self-reported identity fusion on the self-group perceptual overlap is consistent with previous findings showing that stronger effects of the self-group overlap in trait recognition were correlated with explicit measures of group identification (Coats et al., 2000).

In our second experiment, the pattern of results showed a clear advantage for self and team-associated shapes, but performance for rival shapes was also better than performance for stranger shapes. The same pattern was observed in our first experiment in which responses for rival shapes were more equivalent to responses for friend than stranger shapes. These results may reflect the fact that college rowing team rivalries are friendly ones and team members are likely to know one another. Furthermore, all members of both teams are students at the same university, who share similarities with each other, meaning that the ‘out-group’ (rival team) may not be perceived as that dissimilar to the in-group or, indeed, the self. The scores from the personal distance and IOS scales from Experiment 1 support the notion that the rival team is subjectively perceived as somewhere between a friend and a stranger: rival teams were on average marked as being closer to and having greater overlap with the team than a stranger with the self, but as being less close and having a smaller overlap with the team than a friend with the self. Perhaps, then, the enhanced performance shown for the rival team in the second experiment reflects that there is still a certain camaraderie with the rival team. Alternatively, the enhanced attention paid to rival in comparison to stranger may reflect threat attached to the rival team (e.g., Bishop, 2008). That the PD and IOS scores obtained in Experiment 1 suggest a greater perceived distance and smaller overlap between team and rival than self and friend pairs suggests that enhanced performance for rival in comparison to stranger shapes does not necessarily reflect friendship. However, similar responses for rival and neutral teams are not indicative of the enhanced performance for the rival team reflecting threat, either, because then we would expect performance to be enhanced for rival over neutral. Future research would benefit from utilising different exemplars of social groups such as nationalities or religions to explore this rival-as-friend versus rival-as-threat question.

There is evidence to suggest that emotional salience can guide attention and modulate early perceptual processing (Schupp, Junghöfer, Weike, & Hamm, 2003). This has led to speculation that it could be the emotional significance of the team identity that drives the team effect of perceptual matching such that team-associated shapes acquire a positive emotional tag (e.g., Moradi et al., 2015). We investigated this by using an implicit measure of positive valence associated with the team (adapted from the self-esteem implicit association task developed by Greenwald & Farnham, 2000). No correlation was found between the team advantage performance in the matching task and the implicit association score and accordingly, we suggest that the team advantage in perceptual matching is not underpinned by emotional or motivational factors. A similar conclusion has recently been drawn by Stolte, Humphreys, Yankouskaya, and Sui (2015) concerning the self advantage in perceptual matching. They examined perceptual matching of shapes associated with personal labels (self, friend and stranger) and of faces with different emotional expressions (happy, neutral, sad). There were advantages in matching for both self-related stimuli and stimuli associated with positive emotion and valence. However, the two advantage effects did not correlate even though each was stable in individuals across time (test-retest effects correlated for each measure separately). Stolte et al. concluded that the benefit in perceptual matching for self stimuli does not stem from associated positive valence. We draw the same conclusion for the team advantage effect and suggest instead that the self and team biases in visual attention are driven by unique processes involved in self-representation.

4. General discussion

Across two experiments, we found a performance advantage in perceptual matching for self and team-associated shapes compared to friend, stranger, rival and non-rival (neutral) shapes, replicating results reported by Sui et al. (2012) and Moradi et al. (2015). We demonstrated a positive relationship between the self and team performance advantages in reaction time (but not in sensitivity) and we also found there to be more difficulty (manifested in slower RT and higher error rate) in discriminating self from team stimuli than self from rival stimuli. Further, this effect was positively correlated with self-reported measures of identity fusion and in-group identification. Finally, there was no relationship between implicit positive valence associated with the team and the team performance advantage, suggesting that the effect is not driven by positive emotion.

We suggest that the self and team perceptual prioritisation effects are driven by a shared mental representation of self and in-group such that the cognitive structure of the self extends to incorporate important social groups. This is consistent with the central premise of social identity theory and its successors, which hold that the psychological self extends to incorporate social in-groups such that group membership is inextricably linked with self-concept (e.g., Tajfel, 1982; Turner et al., 1987). While social identity theory has long held the concept of the in-group as an extension of the self (e.g., Tajfel, 1982), experimental evidence for this has often relied on self-report measures and trait judgments, which are not entirely protected from demand characteristics or familiarity effects. Results from the perceptual matching paradigm provide an implicit measure of self-group overlap without relying on familiar stimuli. While there is an argument to say that differential familiarity within the targets remain – for example, that greater familiarity with in-group labels could have helped with the perceptual matching judgments – similar experiments utilising the minimal group paradigm have elicited the same effects, thus demonstrating an in-group bias in perceptual matching in the total absence of familiarity (Enock, Sui, Humpreys, & Hewstone, 2017). On a similar note, it could be suggested that differences in word usage frequency could explain, in part, the self and team advantage effects and the relations between the two. For example, if the difference in frequency of the word 'you' in relation to the word 'stranger' is greater than the difference between the team name and the rival name, this could act as a potential confound in interpreting differences in responses to stranger and rival shape-label pairs. However, again based on subsequent work, differences in frequency of word usage between our social labels is unlikely to be a problem. Using minimal groups, for which the team names would have been equally (un)familiar to participants, similar advantages for the team were found. Furthermore, effects of word frequency were controlled for by Sui et al. (2012), who found no difference in effects when 'you' (high frequency word) was replaced with 'yourself', which actually has a lower frequency usage value than 'friend' and 'other'.

Our results are in line with the connectionist model of self and in-group representations put forward by Smith et al. (1999), who observed an RT facilitation for trait judgments on which the self matched the partner or the in-group. A cognitive overlap in self, partner and in-group representations was proposed to account for these results. The connectionist model, proposed by Smith et al. (1999), strengthened the argument that representations of self and others are not stored as isolated and independent structures but are linked by direct connections indicating the strength of relationship and also by indirect connections through commonly shared traits. Our results offer further support to this interpretation by showing novel evidence for shared self and in-group processes in lower level forms of cognition (i.e., perceptual matching), distinct from higher-level forms of decision-making such as trait judgments. In line with the facilitation effect of self and in-group items on judgments to one another, it would be interesting for future research to explore how self-related stimuli are facilitated by group-related stimuli and vice versa in perceptual tasks similar to the ones used in the present research. For example, would we observe redundancy gains, the improvements in performance in response to multiple, redundant stimuli versus single stimuli, in self-directed responses in perceptual matching if in-group associated stimuli were presented simultaneously? The stronger relationship between the self and group overlap found in those who reported higher levels of identity fusion and of group identification further supports the conclusion that the relationship reflects a shared representation that drives attentional prioritisation for important social information. It could then be that these basic attentional prioritisation effects drive self and in-group favouritism in higher-level processes, such as facilitation in trait judgments identified by Smith and colleagues.

The results discussed both support and extend previous work by Sui et al. (2012) and Moradi et al. (2015), who initially demonstrated the self and in-group biases in performance on the same perceptual matching task. While Moradi et al. (2015) utilised a sample of football supporters to measure the team bias, we found the same effect in a different sample of members of college rowing teams. This implies that the in-group bias in perceptual matching is likely to be stable across a variety of social groups and demographic of individuals. That we detected no differences in performance between rival and neutral team-associations in Experiment 1 suggests that the team effects are rooted in in-group favouritism as opposed to out-group derogation. There would be no difference in familiarity between the rival and the neutral team in these instances because in the university rowing system, all teams attend and row in the same regattas and participate in the same races. Therefore, potential differences in performance to rival and neutral teams are unlikely to be obscured by greater familiarity with the rival. It is possible, however, that potential differences could be obscured by a greater threat associated with the rival and this question could be explored in future research. That social bias reflects in-group favouritism and not out-group derogation is in line with social identity theory's formulation, that in-group favouritism is primary and present even in the absence of intergroup hostility or competition (e.g., Hinkle & Brown, 1990).

Only a small advantage for the team in comparison to the rival in Experiment 2 was detected, which demonstrates the need to explore this effect further with a wider range of social groups. Out-groups in the traditional sense are social groups that an individual does not identify with. In our sample, however, individuals may perceive some similarity between themselves and 'out-group' members because they are all rowers at the same university. It would be interesting to explore whether the self-group correlations are stronger in individuals for whom the group is an even more central part of the self-concept. While good exemplars of team members, rowers are also likely to be self-focused individuals who spend a lot of time working toward goals relating to personal success. Professional players of team sports or military personnel are likely to be much more team-oriented in their day-to-day lives, and future research could explore how the self and team biases (and the relations between the two) might be altered as a result.

The self-bias effect in shape-label matching originally demonstrated by Sui et al. (2012) has been found to be associated with enhanced activity in brain regions linked to self-representation and areas responding to stimuli with high environmental salience (the ventromedial prefrontal cortex and the posterior superior temporal sulcus respectively), while other matched shapes recruit a dorsal frontoparietal control network (Sui et al., 2013). This fMRI research demonstrates how tagging neutral stimuli with self-relevance directs attention and enhances perception by activating distinct neural circuits. It would be beneficial for future research to explore the neural correlates of the in-group bias in the same matching task in order to compare these with the self effects. If the self and in-group biases in visual attention are, as we suggest, driven by a common representation, then we would expect to see an overlap in the brain areas that are involved in both effects. As we found that group identification affected the ability to discriminate self from team stimuli, it would also be interesting to explore whether the strength of neural activation common to self and in-group representation is correlated with self-report measures of group identity.

Overall, our results provide novel evidence to suggest that the effects of self and in-group relevance on attention and perceptual processing are driven by a shared representation, in line with an overlap in the cognitive structure of the self and important social in-groups. These results support the connectionist model developed by Smith et al. (1999) and also provide an argument for the idea that self and in-group preference in high-level processes such as trait judgments are driven bottom-up by lower level prioritisation in attention. The research gives a strong foundation to further explore individual differences in the relations between self and team oriented biases, along with the cognitive and neural mechanisms by which these links arise.

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