Cognitive and Neural Foundations of Perceptual Biases for the Self and Social Groups



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Abstract

The notion of the self as distinct from other people is fundamental to the study of human psychology. Closely tied to this sense of self is the profound importance of belonging to social groups. The cognitive prioritisation of self- and ingroup-related information, known as self-bias and ingroup-bias, occurs across a multitude of cognitive domains. Although adaptively beneficial, biases arising from social categorisation are the source of prejudiced attitudes, discriminatory behaviours and intergroup conflict.

Several studies have demonstrated enhanced response times and accuracy performance in perceptual matching for self and ingroup stimuli compared to others and outgroups. However, the cognitive and neural mechanisms underlying these effects are relatively unexplored. The present thesis examines five core outstanding research questions: 1. What is the relationship between perceptual prioritisation for the self and social ingroups? 2. How does social context modulate ingroup-bias? 3. How quickly does group affiliation affect early perceptual processing? 4. Do trait differences underlie the strength of perceptual prioritisation for the self and social groups? 5. What are the commonalities and distinctions in the neural regions that underpin biases for the self and social ingroups?

Broadly, the findings of this thesis suggest that: 1. There is an overlap in the representation of stimuli associated with the self and ingroups but the performance advantages are likely to be driven by partly distinct processes. 2. Perceptual biases for ingroups are robust across differing social contexts. 3. Social categorisation quickly enhances low-level perceptual processing even when this categorisation is novel and random. 4. There is no evidence to suggest that individual trait differences in group identification or self-concept underpin the perceptual biases. 5. Cognitive prioritisation for the self and ingroups are supported at least in part by distinct neural mechanisms. Together, these findings provide a novel perspective on the relations between self and ingroup representation in brain and behaviour.

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Dedicated to the memory of my late supervisor,

Professor Glyn Humphreys

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Chapter 1: Introduction

Conceptualising the self and social ingroups

The notion of the self as distinct from other people is fundamental to the study of human psychology. Although questions relating to the core essence of self have been debated by philosophers for centuries and remain contentious (see Gertler, 2011), much work within experimental psychology has progressed our understanding of the importance of self-related phenomena. For example, the study of self-identity pertaining to individual characteristics (known as personal identity: Onorato & Turner, 2004); self-esteem and the formation of distinct perceptions of ourselves (e.g., Harter, 1993); and physical self recognition such as how we identify our own face in the mirror, or how we feel this body belongs to us (e.g., Tsakiris, 2008). These many aspects of self-related research are integral to our understanding of the importance of self-reference across multiple levels of cognition.

Closely tied to the sense of self is the profound importance of belonging to social groups. Our social worlds are made up of ingroups (groups to which we belong) and outgroups (those to which we do not) (e.g., Allport, 1954) and the propensity to categorise individuals into 'us' and 'them' is universally prevalent (Brown, 1991; Dunbar 1998). While belonging to social groups is adaptively beneficial in providing protection, support and the sharing of important resources (Correll & Park, 2005), social categorisation is also a source of intergroup conflict and related issues such as prejudiced attitudes and discriminatory behaviours (Hewstone, Rubin & Willis, 2002). Whilst we tend to

envision group membership as referring to static collectives imbued with historic social meaning such as religions, nationalities and ethnicities, in fact newer and more flexible affiliations such as with universities and sports teams similarly drive intergroup bias (e.g., Brewer & Gardner, 1996). Thus, understanding the basis of group membership and its relation to self identity serves as an important foundation in guiding interventions to reduce, or even prevent, social conflict.

In this introductory chapter, I will outline and discuss previous literature relating to self- and ingroup-bias effects, along with theory and evidence for a relationship between the two. I focus particularly on how self and ingroup relevance can affect even low-level and automatic attentional and perceptual processes. I also present evidence relating to the neural correlates of behavioural biases for the self and social ingroups across a multitude of experimental approaches. Following a detailed review of the existing literature relating to the neurocognitive effects of self- and ingroup-prioritisation, I present some outstanding research questions that serve as the basis for this thesis.

Self-bias effects across multiple cognitive domains

'Implicit egotism'

Information that is related to the self is consistently given unique preference and prioritisation across many kinds of cognitive processes. Implicit self associations tend to be favourable (Farnham, Greenwald & Banaji, 1999; Pelham, Carvallo & Jones, 2005) and research has found that individuals commonly prefer letters of the alphabet that are present within their own names and numbers that are

found in their own birthdates (Hoorens et al., 1990; Jones et al., 2004; Kitayama & Karasawa, 1997; Nuttin, 1985). The propensity to show these seemingly inane and often subconscious preferences for self-related material has been coined 'implicit egotism' (Pelham, Mirenberg & Jones, 2002).

These kinds of preferences for information relating to the self may be rooted in self-serving biases; the human inclination to attribute positivity to the self and negativity to external factors and causes (Heider, 1958; 1976). These are likely to serve adaptive benefits (Tiger, 1979) and indeed positive biases towards the self have been associated with good health and happiness (Kuiper, 1978; Peterson & Seligman, 1987; Taylor & Brown, 1994; Taylor et al., 2000), whilst the absence of such biases have been linked to poor health and depression (Lee & Seligman, 1997; Sweeney, Anderson & Bailey, 1986). A meta-analysis found self-serving biases to be present in almost every sample of 266 studies, although they were larger amongst children and older adults, and smaller amongst Asian than Western samples (Mezulis, Abramson, Hyde & Hankin, 2004). The importance of self-reference in cognitive functioning is, then, not to be underestimated.

Self-biases in object ownership

'The totality of my possessions reflects the totality of my being… I am what I have… what is mine is myself' (Sartre, 1943/1956).

It is intuitively straightforward to understand what Sartre meant when he spoke of the integrated relationship between the self and ownership. External features of the world, most commonly in the form of physical objects, can quickly be

associated as belonging to ourselves (Heider, 1958) and, furthermore, may become assimilated as a meaningful part of self identity (Wicklund & Gollwitzer, 1982). For example, most people will have experienced the particular unease when an inexpensive but personally valued item is lost or stolen. Similarly, these sorts of associations are commonly made to other people too: a partner's jumper can provide comfort in periods of time apart and the watch that belonged to a late grandparent can evoke a sense of their presence. Research suggests that this sense of 'mine' and 'yours' is fundamental to the way in which we develop information about our external worlds (Fasig, 2000).

As well as for items that have been associated with the self over a long period of time, even new object ownership can quickly affect subsequent processing. In one of the first studies examining self-bias in relation to novel ownership, Beggan (1992) found that participants consistently evaluated objects more favourably when they had been given ownership of them (in the experimental set-up), even when exposure was the same for owned and non-owned items, and even when the evaluation ratings were made immediately after endowment. It seems that 'mere ownership' increases preferences for objects so much that shortly after participants had been given items completely at random they were generally unwilling to exchange them for a potentially better deal (e.g., Knetsch, 1989; Knetsch & Sinden, 1984). In one well-known example, some participants were given a mug and then offered the chance to sell it or trade it for something of equal value. Those who had established ownership of the mug required twice the monetary compensation to sell it than the amount non-owners said they were willing to pay for the mug. Thus,

participants placed significantly higher value on the items they owned (Kahneman, Knetsch & Thaler, 1991).

Self-biases in memory performance

The preference for and higher value placed on items that have been associated as belonging to the self has important implications for cognitive performance. For example, an early study demonstrating a 'self-reference effect' in memory showed that participants were faster to recall adjective words that described themselves than words that did not (Rogers, Kuiper & Kirker, 1977). Further research demonstrated that this effect held for both explicit evaluative processing and also more implicitly for target cues that had previously been associated with the self (Turk, Cunningham & Macrae, 2008). A meta-analysis by Symons and Johnson (1997) found a consistent enhancing effect of self-reference on memory performance, suggesting superior encoding and more elaborate processing of self-related information. As well as memory for self-related trait descriptions, performance is also improved for objects that are newly assigned as belonging to the self (Cunningham, Turk, Macdonald & Macrae, 2008; Golubickis, Falben, Cunningham & Macrae, 2018). When participants moved picture cards into baskets that either belonged to themselves or to someone else, or watched picture cards being moved into these baskets by another person, they were faster and more accurate at recognising items that were put into their own baskets. However, there was no effect of whether self or other had placed the items into the baskets (Cunningham et al., 2008). As well as demonstrating enhanced cognition for items newly-associated as belonging to the self, this study also interestingly

demonstrated effects of transient ownership, as participants knew they would not keep the items after the study was over.

The physical self: face recognition

Research within the area of self and identity has commonly distinguished between knowledge of the psychological self (for example, relating to traits and attributes that belong to the self) and of the physical self, which entails perceptual knowledge of face and bodily experience (Kihlstrom, Beer & Klein, 2002). As well as biases relating to the processing of self-related attributes and characteristics, studies have also shown perceptual biases for stimuli relating to physical aspects of the self, such as face processing. For example, Tong and Nakayama (1999) found that participants were faster for own faces than unfamiliar faces on a visual search task and this was true even when they became highly familiarised with the stranger face and when the faces were presented from uncommon viewpoints such as upside-down. Evidence using event-related potentials (ERPs) showed that own faces are recognised faster than other faces (Keyes & Brady, 2010) and that facial orientation judgements (choosing whether the faces point to the left or to the right) are faster and more accurate for own faces (Sui, Liu & Han, 2009; Sui, Zhu, & Han, 2006). Overall, research suggests higher perceptual saliency and enhanced encoding of self faces than those belonging to familiar or unfamiliar other people. Attentional capture of self-related information is likely to play an important role in these effects (Truong & Todd, 2017).

Views of the self: self-esteem and self-construals

It is clear from a wide body of research that the self is given unique priority in human cognition. However, it is important to note here that the self, of course, is a complex and nuanced construct that is multifaceted and flexible in nature, rather than the monolithic entity that some of these simplified experimental paradigms may imply (McConnell, 2011). As mentioned previously, it is not the purpose of this thesis to postulate on the nature of the self. However, individual differences in subjective concept of self are of interest and relevance to examining self-bias effects. Subjective attitudes that we hold towards ourselves, known as self-esteem, have been widely studied in the field of social cognition (e.g., Harter, 1993; Rosenberg, 1965) and broadly relate to how positively or negatively we see ourselves. Low self-esteem is considered to be problematic with relation to psychological health and wellbeing (Fennell, 1997), and has also been linked to the absence of certain kinds of self-serving biases (reviewed in Blaine & Crocker, 1993). For example, implicit preferences for letters and numbers associated with one's own name are not typically found in individuals with low self-esteem (Jones et al., 2002).

Another component of self-concept that has received attention with relation to self-bias relates to the notion of self-construal (Markus & Kitayama, 1991). This focuses on the extent to which the self is defined as autonomous and distinct from others (independent self-construal) or as inextricably connected with those around them (interdependent self-construal). Self-construals are closely tied to cultural notions of Individualism (often found in the West) and Collectivism (commonly associated with non-Western cultures;

Triandis, 1989). However, levels of independent and interdependent self-construals also vary within individuals across both individualist and collectivist cultures (Brewer & Gardner, 1996; Trafimow, Triandis & Goto, 1991; Triandis, McCusker & Hui, 1990). Indeed, research has shown it is possible to flexibly enhance or reduce the saliency of independent and interdependent self-construals within individuals using priming techniques, resulting in a temporary shift in worldviews depending on the direction of the prime (Gardner, Gabriel & Lee, 1999). Self-construals have previously been shown to modulate certain self-bias effects (Mezulis et al., 2004). For example, the bias in recognition memory for self-associated compared to other-associated objects (Cunningham et al., 2008) was present for Western, but not Asian, participants. Furthermore, Asian participants actually showed higher recognition accuracy for objects that they had associated as belonging to their own mothers than those they had associated as belonging to themselves (Sparks, Cunningham & Kritikos, 2016). Also, unlike British participants, Chinese individuals did not show enhanced performance for facial orientation judgements of own compared to others' faces (Sui et al., 2009).

Intergroup biases as fundamental to social cognition

Attitudes, decision-making and implicit associations

'The human mind must think with the aid of categories… Once formed, categories are the basis for normal prejudgment. We cannot possibly avoid this process. Orderly living depends upon it.' (Allport, 1954, p. 19).

In the previous section, I presented research findings relating to the enhancing effects of self-reference on cognitive processes including memory and perception. As for the self, an abundance of research has shown that ingroup-biases are widely prevalent and can permeate almost all aspects of cognition (reviewed in Hewstone, Rubin & Willis, 2002). People generally prefer ingroups to outgroups and are more likely to feel positively towards words and descriptions that are associated with these categories (e.g., Perdue, Dovidio, Gurtman & Tyler, 1990). There is also a higher tendency to ascribe complex, secondary-level emotions that are more human in nature (such as pride and nostalgia as compared to happiness or anger) to ingroup members than to outgroup members. This effect has been found across a variety of types of groups and may provide a foundation for greater individuation of ingroups and even the dehumanisation of outgroups (Leyens et al., 2000; Paladino et al., 2002). Greater empathy tends to be shown to racial ingroup than to outgroup members and this can have important consequences for judicial decision-making (Johnson et al., 2002) and pain treatment (Drwecki, Moore, Ward & Prkachin, 2011). These ingroup-biases in empathy have been shown across other forms of social groups too, such as university affiliations (Tarrant, Dazeley & Cottom, 2010). Overall, ingroups tend to be judged more favourably when attributing positive and negative outcomes and explaining intergroup successes and failures (reviewed in Hewstone, 1990).

It is important to note in this context the distinction between ingroup favouritism and outgroup derogation (Brewer, 1999). While very early social psychological theory perceived intergroup dynamics such that 'ingroup love'

would directly correspond to ‘outgroup hate’ (Sumner, 1906), it is more widely accepted that preference is very often shown for ingroups whilst attitudes towards corresponding outgroups can be neutral or even mildly positive (Allport, 1954). Much of the literature on intergroup bias identifies ingroup favouritism, both explicit and implicit, across a range of domains (Hewstone et al., 2002). However, demonstrations of outgroup derogation in terms of active dislike of or willingness to harm members of outgroups are less frequent (Brewer, 1979, 1999). For example, Mummendey et al. (1992) showed that participants consistently favoured ingroup members when distributing positive outcomes, but did not correspondingly distribute more negative outcomes to outgroup members.

As well as measuring biases in intergroup judgements at conscious levels of processing, several studies have examined implicit biases for social ingroups that may operate at a more subconscious level (reviewed in Nosek, Greenwald & Banaji, 2007). The most common tool to capture automatic preferences for ingroups compared to outgroups is the Implicit Association Task (Greenwald, McGhee & Schwartz, 1998), which tests automatic associations between categories. In the standard task, participants simply group words using left or right keys, with each side representing a different category. For example, participants may first categorise words relating to ingroups and outgroups, then words relating to ‘pleasant’ or ‘unpleasant’. Then, words would be sorted by combinations of these, such as *ingroup* + *pleasant* and *outgroup* + *unpleasant*, and the reversals. Implicit positive associations between the categories included, for example, *ingroup* and *pleasant*, would be reflected in the extent to

which participants find it easier (as indicated by faster response times) to categorise ingroup words with the pleasant category. The standardised difference in response time between the conditions is used to calculate a score reflecting the strength of implicit association. A wealth of research evidence has shown implicit ingroup-bias effects across a multitude of types of social groups or categories (Nosek et al., 2007). As well as associations of racial ingroups with more positive valence (Greenwald et al., 1998) research has also demonstrated a link between positive valence and younger, compared to older, adults (Nosek et al., 2007) and in stereotypic gender associations, for example, between men and power, and women and warmth (Rudman, Greenwald & McGhee, 1996).

Intergroup modulation of perception

As well as affecting attitudes and decision-making processes, group membership also permeates lower-level perceptual judgements in a multitude of ways. Most notable here is the body of evidence demonstrating the effects of social categorisation on facial processing. For example, research has consistently shown a bias for own-race faces in recognition and memory across many kinds of study samples and social dynamics (reviewed in Hugenberg, Young, Bernstein & Sacco, 2010; meta-analysis and review by Meissner & Brigham, 2001). In one of the first experimental studies of this kind, both Black and White students were presented with 20 photographs, 10 Black and 10 White faces, and were then sequentially shown these again randomly amongst 60 previously unseen images. As expected, both Black and White participants

showed greater perceptual sensitivity, measured using signal detection theory, for faces of the same race (Malpass & Kravitz, 1969).

Interestingly, subsequent experiments showed that these effects extended from race categories to other kinds of social affiliations too. Middle class White participants were better at recognising White faces that were shown against wealthy backgrounds compared to those shown against impoverished backgrounds, demonstrating an effect of perceived socioeconomic status on facial encoding (Shriver, Young, Hugenberg, Berstein & Lanter, 2008). Similar effects were found for religious groups (Rule, Garrett & Ambady, 2010), university affiliation and also newly assigned group memberships (Bernstein, Young & Hugenberg, 2007). These results suggest that the enhanced processing of own-race faces is not just rooted in perceptual expertise caused by greater exposure. Eye-tracking research that aimed to elucidate the possible mechanisms underlying the effects of ingroup favouritism on facial recognition found that individuals pay more attention to the eyes of ingroup than outgroup members, both in the context of race and also for new social categories (Kawakami et al., 2014). As greater attendance to ingroup eyes was correlated with better subsequent facial recognition of and willingness to interact with an outgroup member, the authors noted the important role of visual attention in mediating intergroup biases.

In addition to the enhanced facial processing of ingroup members, social categorisation causes many other forms of biases in perception. For example, viewing Black faces enhanced participants' ability to spontaneously detect perceptually degraded images of objects associated with crime, probably

because of the activation of a stereotype between Black people and crime. Similarly, activating stereotypic attributes such as crime and basketball increased attention to Black faces (Eberhardt, Goff, Purdie & Davies, 2004). Research also found that White participants were faster to detect an armed Black person than an armed White person in a video game setting, and adopted a lower perceptual threshold for shooting these targets (Correll, Park, Judd & Wittenbrink, 2002). People were also more likely to mistake an innocuous tool for a weapon when carried by a Black person than by a White person (Correll, Wittenbrink, Crawford & Sadler, 2015). Indeed, only recently (July 2018) the filming of a rap video in London was subject to a stop-and-search by police owing to false reports of there being a firearm present by a member of the public (Virk, 2018). Thus, these perceptual biases have important real-world consequences.

The focus of the present thesis is on the effects of group membership on visual perception and attention. However, it is worth noting that social identity has a profound influence on other forms of perceptual processes, including tactile, pain, olfactory, gustatory and auditory (reviewed in Xiao, Coppin & Van Bavel, 2016). For example, in the context of the Magh Mela religious festival in India, loud noise was considered to be more pleasant when it was attributed to the festival rather than another source, and this effect was stronger amongst those who identified as pilgrims (Shankar et al., 2013). The weighty influence of social categorisation on perceptual processes has recently led Xiao et al. (2016) to propose a perceptual model of intergroup relations, conceptualising how

intergroup dynamics shape perception and, in turn, how perceptual processes may mediate intergroup relations.

Novel formations of 'us' and 'them': minimal group bias

It seems that the human drive for social classification is so great that ingroup favouritism is reliably elicited even under 'minimal group' conditions, whereby individuals are assigned to novel groups either randomly or on the ostensible basis of arbitrary information. One of the first experiments of this kind was conducted by Rabbie and Horwitz (1969), who randomly assigned participants to one of two novel groups without giving any criteria for these group assignments and then asked participants to make evaluative judgements about ingroup and outgroup members. The researchers found that the random group allocation did not affect evaluations of group members, but that simply tossing a coin to decide which group would receive a gift led participants to make more favourable evaluations of ingroup members. Following this study, Tajfel and his colleagues (Tajfel, 1970; Tajfel, Billig, Bundy & Flament, 1971) famously pioneered the way to understanding the minimal conditions necessary for intergroup bias to occur. In a series of innovative studies, boys in a school classroom setting were allocated to one of two groups and were told that the allocation was based on their performance on a dot estimation task (and later, art preferences). When they were subsequently asked to distribute small monetary amounts between pairs of recipients that were made up of ingroup and outgroup members (who were anonymous but whose group affiliation was provided), striking intergroup bias effects were shown. Using matrices designed to test various distribution strategies (comparing maximum ingroup profit,

maximum difference between the two groups in favour of the ingroup along with maximum joint profit and fairness) participants consistently demonstrated biases in favour of the ingroup (Tajfel et al., 1971). Importantly, as participants never made allocations to themselves, the results could not be explained in terms of self-interest. Further experiments found that the same effects held when the method of group categorisation was completely random and not based on any criteria, no matter how trivial (Billig & Tajfel, 1973), and also that the effects were not caused by the unfamiliar and contrived environment of the minimal group setting (Tajfel & Billig, 1974). Perhaps the most influential feature of these results is that they showed, for the first time, that ingroup-bias has a cognitive foundation, rather than a purely emotional one.

Ingroup favouritism within minimal groups is one of the most widely replicated effects in social psychology and has been demonstrated across many variations of the original paradigm and in many social contexts (e.g., reviewed in Diehl, 1990; Mullen, Brown & Smith, 1992). As well as allocating more generous rewards to novel ingroup members, studies have also shown that participants associate higher levels of implicit positive valence with novel ingroups (Ashburn-Nardo, Voils & Monteith, 2001; Otten & Wentura, 1999). Otten and Moskowitz (2000) demonstrated that when making spontaneous trait inferences, traits were more likely to be inferred from corresponding behavioural descriptions for *ingroup* members than for outgroup members when the traits were *positive*, but not when they were negative. At the more perceptual level, Ratner, Dotsch, Wigboldus, Van Knippenberg and Amodio (2014) found that novel group allocation altered mental representations of ingroup and outgroup

faces, creating visual biases that produced more favourable impressions (such as in attractiveness, intelligence and trustworthiness) of ingroup members. Thus, many studies have found that mere social categorisation is enough to elicit intergroup bias effects. As well as demonstrating the remarkable ease with which intergroup biases are formed, the minimal group paradigm also provides a valuable tool for measuring ingroup-bias in a controlled laboratory setting, utilised in Chapter 4 (Experiments 4, 5 and 6) of the present thesis.

Attentional and perceptual effects of social relevance

I have so far presented research evidence showing that self and ingroup relevance affects perceptual processes as well as higher-level decision-making. For example, facial recognition is enhanced for own and ingroup faces compared with those of other people and social outgroups (e.g., Meissner & Brigham, 2001; Tong & Nakayama, 1999). Research paradigms utilising face processing have been hugely valuable in informing us of the important role that self and ingroup relevance plays in perceptual processing, as well as in social attitudes and behaviours. However, stimuli such as faces and names are already highly learned and so it can be difficult to isolate the effects of social relevance from the effects of familiarity on performance.

A novel associative matching procedure developed by Sui, He and Humphreys (2012) established a method to study self-bias effects on visual perception and attention whilst controlling for complete equivalence across the target stimuli. In this study, participants learned to associate simple geometric shapes (e.g., square, circle and triangle) with social labels (e.g., ‘you’, ‘friend’

and ‘stranger’) by being told, for example, ‘you are the square, your best friend is the circle and a stranger is the triangle’. Following this short learning phase, participants then completed a computerised task in which they were asked to judge whether shape-label pairs presented on the screen conformed to the original pairings or not by responding with keys for yes and no. The stimuli were presented quickly at 100ms and a short response window of only 1100ms was given, allowing for automatic levels of processing. Each shape association (self, friend and stranger) could be matched or mismatched with the corresponding label, giving six conditions in total. See Figure 1.1, below, for a visual depiction of this task.

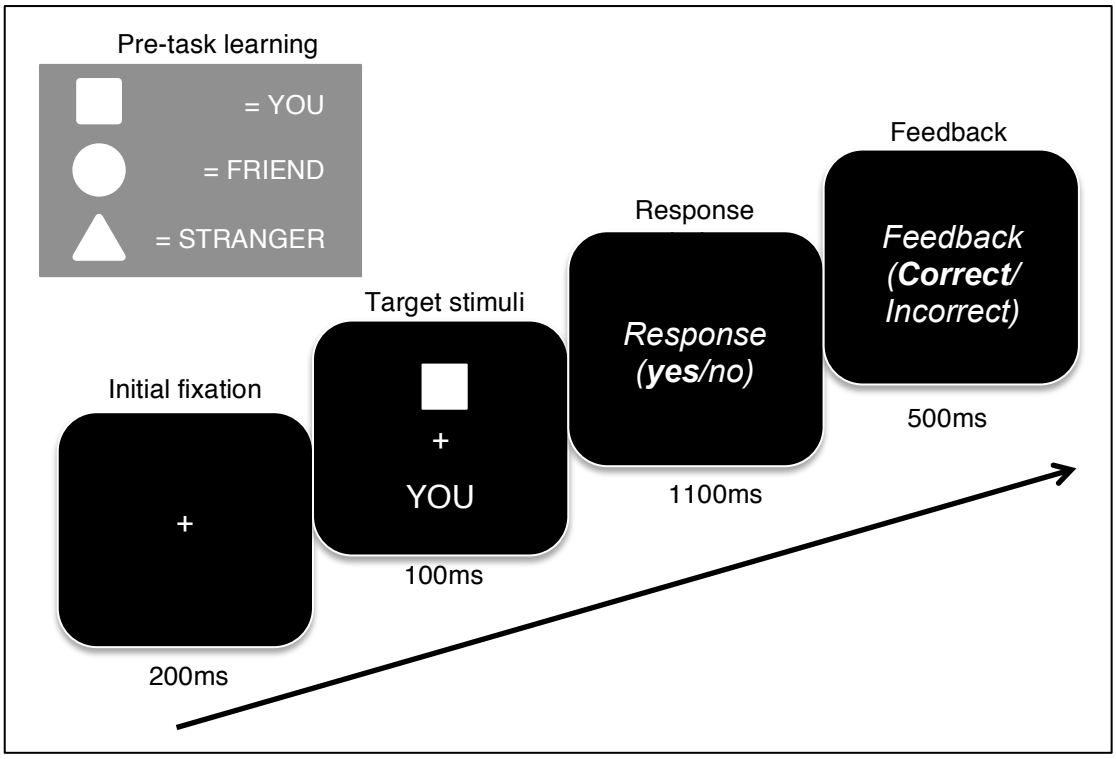


Figure 1.1: A schematic representation of the perceptual matching task developed by Sui, He and Humphreys (2012). There were 60 trials per condition distributed between six blocks and the shape-label pairings were counterbalanced across participants.

A prioritisation effect was found both in response time and accuracy scores for shapes associated with the self compared to those of friend and stranger, and also for friend compared to stranger shapes (Sui et al., 2012).

This effect held when ‘best friend’ was replaced with ‘mother’ and control experiments verified that these effects were not rooted in word length, concreteness or familiarity. In addition, self-associated stimuli showed weaker effects of visual degradation compared with other associations, consistent with the notion that self-relevance modulates early perceptual processing (also demonstrated by Sui, Liu, Mevorach & Humphreys, 2013; Sui & Humphreys, 2015).

Using variations of this task paradigm, subsequent research further examined the effects of self-relevance on perception and attention. For example, in a paradigm that manipulated the probabilities of socially relevant stimuli presentations, reducing the frequency of self-pairs did not weaken performance to these stimuli, whereas performance was impaired for mother and stranger stimuli under the lower probability conditions (Sui, Sun, Peng & Humphreys, 2012). This effect highlights the automaticity of self-bias effects, even under low probability of occurrence. Complementing these findings, further research demonstrated self-biases for even earlier stages of perceptual selection (Macrae, Visokomogilski, Golubickis, Cunningham & Sahraie, 2017). During a continuous flash suppression task, shapes that had been associated with the self remained suppressed for shorter periods of time, indicating that self relevance facilitated early visual awareness. These results draw a visual parallel to the classic auditory ‘cocktail party effect’ (Cherry, 1953). Here, dichotomous listening tasks have shown that whilst we subconsciously monitor all available information, anything relating to the self stands out and reaches awareness more readily. Extending further research on the benefits of the self on early

perceptual processing, Macrae, Visokomogilski, Golubickis and Sahraie (2018) more specifically tested the role of visual attention. Participants were presented with an array of Gabor patches and asked to report the orientation of the one with the highest perceived contrast. The researchers found that self-relevant cues enhanced the apparent contrast of the Gabor targets, facilitating the benefits of attention on stimulus processing. Furthermore, this effect was especially pronounced for associations of self-identity that were highly central to participants compared to ones that were less important or irrelevant.

Research within this area has also attempted to elucidate some of the possible mechanisms that underlie self-bias effects, such as intrinsic reward or positive emotion. Similar benefits were demonstrated for stimuli attached to high (compared to low) reward (Sui et al., 2012, Sui & Humphreys, 2015), and also for positive (compared to negative) valence (Stolte, Humphreys, Yankouskaya & Sui, 2017), suggesting that the self-biases exhibited may simply reflect intrinsic high reward value associated with the self (e.g., Northoff & Hayes, 2011) or positive emotion. However, there was no relationship between biases for the self and either high reward or positive valence (Stolte et al., 2017; Sui & Humphreys 2015), which indicated that the biases may be driven by distinct mechanisms. In line with this finding, redundancy gain effects were shown to hold distinctive patterns for self compared to reward stimuli, with self stimuli modulating stimulus integration at both perceptual and conceptual levels and reward stimuli only at conceptual levels (Sui & Humphreys, 2015).

Utilising a modified version of the matching paradigm, further research demonstrated that ingroup associations modulated perceptual processing for

neutral stimuli in the same way as self associations (Moradi, Sui, Hewstone & Humphreys, 2015). In this study, football supporters learned to pair the badges of their team, a rival team and a non-rival (neutral) team with newly associated geometric shapes and again responded to random shape-badge pairs. As for self-associated stimuli, an advantage for response 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.

Eye-tracking research utilising a similar task showed that participants found it harder to make anti-saccades away from ingroup associated stimuli when instructed to (Moradi et al., 2017a), but that ingroup relevance improved performance on a saccadic task overall (Moradi, Manohar, Duta, Enock & Humphreys, 2018). These results again demonstrated the important role of attentional capture. There was also a positive correlation between ratings of satisfaction with the team (Leach et al., 2008), both for the ingroup behavioural advantage (Moradi et al., 2015) and also for the amount of directional errors to ingroup stimuli on anti-saccadic trials (Moradi et al., 2017a). Overall, the novel associative matching paradigm introduced by Sui et al. (2012) has not only yielded evidence for social bias effects for newly-learned and previously neutral stimuli, but it has also provided a useful and innovative way to measure social biases across different domains, as well as establishing the specific mechanisms that may underlie them.

The relationship between the self and social ingroups

I have outlined how information relating to the self and social ingroups is given special preference and priority across many kinds of cognition, from attitudes and trait ascriptions to facial recognition and attentional capture. There appear to be similar advantage effects for the self and social groups across several domains, which may suggest some commonalities between the mechanisms underlying self and ingroup processing. Indeed, many social psychological theories are rooted in the premise that the psychological self extends to include other people and social ingroups such that group memberships form a vital part of self-representation. This premise 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; Turner, Oakes, Haslam & McGarty, 1994) and optimal distinctiveness theory (Brewer, 1991).

Briefly, social identity theory holds that social categories (such as nationalities, religions and political affiliations) to which we feel we belong provide an important part of our identities such that the defining characteristics of a social ingroup become a part of self-concept. Individuals possess both social identities, which make up the characteristics of given social ingroups, and personal identities, which are the attributes that are unique to themselves. Self-categorisation theory extends this reasoning by postulating that while people identify with many different social groups, the extent to which individuals categorise themselves according to their various social identities or their personal identity fluctuates depending on the salience of those identities in a specific, current social context (Turner et al., 1987). Optimal distinctiveness

theory (Brewer, 1991) attempts to explain the relationship between personal and social identity in terms of motivation and holds that categorising the self as part of social groups serves to fulfil the basic needs of belongingness and inclusion whilst also maintaining differentiation from others.

There is compelling experimental evidence to support the notion that the ingroup is cognitively represented as a part of the self. Smith and Henry (1996) asked participants to complete questionnaires relating to traits about themselves, an ingroup and an outgroup and then had them make yes/no self-descriptive judgements about the same traits on a computer. They found that traits on which the self matched the ingroup were responded to faster and more accurately than traits on which the self and ingroup were mismatched, showing a cognitive overlap between self and ingroup representation. There was no effect of matches or mismatches to the outgroup. The reverse effect was also demonstrated, with judgements about ingroup characteristics facilitated when they matched the self (Smith, Coats & Walling, 1999). The effect was further observed for attitude as well as trait judgements and was positively correlated with explicit measures of group identification, such that participants who showed a larger response time facilitation effect tended to report higher levels of social identity, a greater desire for closeness with the ingroup and higher perceived ingroup similarity (Coats, Smith, Claypool & Banner, 2000). This evidence led to the proposal of a connectionist model for self and ingroup representation.

Using the architecture of an Interactive Activation and Competition model (McClelland & Rumelhart 1981), Smith et al. (1999) conducted a simulation such that self and ingroup (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 ingroup (or partner) was then modelled. When a trait was positively connected to both ingroup 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 ingroup 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. The connectionist model strengthened the conclusion that self and other representations, rather than being stored as isolated and independent structures, 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 cognitive overlap between the personal and social self, in line with social identity theory and its successors.

In addition to social identity theory, 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, Gómez, 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) including fighting and dying for the ingroup (Gómez et al., 2011; Gómez, Morales, Hart, Vázquez, & Swann, 2011; Swann et al., 2014), willingness to self-sacrifice for the ingroup (Swann,

Gómez, Dovidio, Hart, & Jetten, 2010) and denial of ingroup wrongdoing (Besta, Gómez, & Vázquez, 2014).

Levels of group identification and identity fusion are typically assessed using self-report measures that pertain to the perceived importance of the group to the self and vice versa. For example, Leach et al. (2008) developed a widely used group identity scale that assesses five components of group identification across 14 items. These five components make up a two-dimensional model such that solidarity, satisfaction and centrality with the ingroup underlie 'self-investment' (a bond with the ingroup, positive feelings about ingroup membership and the importance and salience of the ingroup to the individual) while individual self-stereotyping and ingroup homogeneity underlie 'self-definition' (the perception of the self as similar to an ingroup prototype and of ingroup members sharing commonalities). The identity fusion literature has utilised a pictorial measure that asks individuals to rate the extent to which the self overlaps with the group on a series of circles that start separate and gradually overlap until one is entirely inside the other, indicating fusion (Swann, Gómez, Seyle, Morales, & Huici, 2009). A verbal scale has also been developed that assesses feelings of connectedness (the union between the personal and the social self) and reciprocal strength (the belief that the self and the ingroup strengthen one another) (Gómez et al., 2011).

Cognitive assimilation of self and ingroup

There is, then, compelling theory and research evidence to show the connectedness between personal and social identity, indicating that the

cognitive structure of the self may extend to incorporate important social groups. What, then, are the mechanisms by which these links arise? According to Social Identity Theory (Tajfel & Turner, 1979), individuals derive aspects of the self from the image of the ingroup. Thus, the mechanism for the psychological link between self and group is explained in terms of *self-stereotyping*, which describes assimilation of the view of the self to the prototype of the ingroup (Turner et al., 1987). Put simply, the self becomes stereotyped in relation to the ingroup such that the attitudes, values and traits of the group become those of the individual.

An alternative hypothesis relating to the assimilation between self and ingroup is known as *self-anchoring* (Cadinu & Rothbart, 1996; Van Veelen, Otten, Cadinu & Hansen, 2016). The self-anchoring hypothesis suggests that perception of the ingroup is largely based on the perception of the self. As self image tends to be positive (e.g., Baumeister, Tice & Hutton, 1989; Blaine & Crocker, 1993; Diener & Diener, 1996), thus so becomes the image of the group. Differentiation between ingroup and outgroup subsequently occurs by means of an oppositeness heuristic: we infer the characteristics of an outgroup to be different from those of the ingroup (Cadinu & Rothbart, 1996), so if the ingroup is viewed as positive (from anchoring to the self), then the outgroup is correspondingly viewed as negative. Arguments for an alternative to the self-stereotyping route to group affiliation are drawn from occurrences of ingroup favouritism within the minimal group paradigm (outlined by Van Veelen et al., 2015). For example, for self-stereotyping to occur, we would need at least some information about the group prototype. Not only is this unlikely in collectives in

which specific characteristics are vague, but it is impossible in minimal group situations whereby nothing is known about the ingroup at all other than the self as one ingroup member. Research studies have provided evidence both for self-stereotyping and self-anchoring, and overall evidence suggests that the route to group affiliation may depend on social context (Robbins & Krueger, 2005; Van Veelen et al., 2016).

The social neuroscience of prioritisation for the self and social ingroups

Why social neuroscience?

The last thirty years have seen increasing amounts of interest regarding the neurobiological processes underlying social cognition. This interdisciplinary approach was coined 'social neuroscience' by Cacioppo, Bernston, Sheridon and McClintock (2000), and holds that complex social dynamics may be better understood at multiple levels of analysis by measuring the neural, hormonal, cellular and genetic mechanisms that underlie higher-level attitudes and behaviours (Cacioppo, Bernston & Decety, 2010; Cacioppo & Cacioppo, 2013; reviewed in Cikara & Van Bavel, 2014). There is evidence to suggest that a biological understanding of social processes may better inform targeted intervention. For example, understanding that implicit prejudice and stereotyping are underpinned by distinct neural substrates may suggest different cognitive systems and thus could imply that interventions to reduce them require different approaches (Amodio, 2014).

Up to this point, I have presented research relating to self- and ingroup-biases across multiple levels of cognition, including for lower-level prioritisation effects in perceptual processing and visual attention (Moradi et al., 2015; Sui et al., 2012). Furthermore, I have presented theory and evidence relating to the notion of a cognitive overlap between self and ingroup representation. In the following paragraphs, I will discuss some of the recent neuroimaging literature with the hope of elucidating the neural regions than have been implicated in self- and ingroup-bias effects.

Neural correlates of self-related processing

A primary focus within social cognitive neuroscience has been in identifying the neural mechanisms that support self-related processing and, correspondingly, processing relating to other people (reviewed in Humphreys & Sui, 2016; Ruff & Fehr, 2014; Uddin, Lacoboni, Lange & Keenan 2007). Neuroimaging studies have overwhelmingly identified the involvement of cortical midline structures (CMS) as underlying self processing, including the ventromedial prefrontal cortex (vmPFC), dorsal medial prefrontal cortex (dmPFC), anterior cingulate cortex (ACC) and the posterior cingulate cortex (PCC) (reviewed in Musholt, 2013; Uddin et al., 2007). For example, examining the neural basis of the mere ownership effect on memory enhancement, Turk, Bussel, Waiter and Macrae (2011) found that encoding items to the self was underpinned in the dorsal part of the medial prefrontal cortex (dmPFC), along with the left insula and the supramarginal gyri bilaterally.

Studies on the neural basis of the self have utilised a multitude of paradigms to assess various facets of self processing, from self-referential trait judgements (Gusnard, Akbudak, Shulman & Raichle, 2001; Kelley et al., 2002) and self-appraisals, both direct and other-generated (Ochsner et al., 2005), to self facial recognition (Platek, Keenan, Gallup & Mohamed, 2004). Synthesising some of the research within this area, Northoff et al. (2006) conducted a meta-analysis of 27 imaging studies in which there was some content broadly relating to the self. Although tasks ranged from reflections on personality characteristics or physical appearance to facial orientation judgements, all of the studies showed activation during self compared to non-self stimuli presentation in medial regions including vmPFC, subgenual ACC, supragenual ACC, dmPFC, posterior cingulate cortex and precuneus, suggesting that these areas may underpin self-representation. Other studies have identified areas outside of midline structures, such as the temporal pole, temporoparietal junction and superior parietal cortex, insula, hippocampus and fusiform gyrus (e.g., Kircher et al., 2000; and reviewed by Legrand & Ruby, 2009), that exhibit enhanced activity for self compared to others. In fact, a more recent line of argument attempts to provide a unifying account by suggesting that self representation is not tied to one specific area of the brain, but rather may be modulated by a number of sensory regions depending on context and task (Apps & Tsakiris, 2014).

Despite the wealth of neuroimaging evidence, then, the specific neural mechanisms that support self-related processing remain relatively elusive. Importantly, discrepancies in the evidence regarding the neural foundation of

the self may be explained by distinguishing the specific component of the self being measured. A recent meta-analysis by Hu et al. (2016) separated studies testing the physical self, typically investigated with facial judgement paradigms, from studies of the psychological self, usually considered in terms of self-reflection and awareness of personal attributes. The authors found that the ACC, left inferior frontal gyrus and left insula gyrus were linked to both the physical (self face processing) and the psychological (self referential processing) self, demonstrating commonalities between the two components. For self face (compared to other face) processing, there was a widely distributed brain network involving areas in the right superior occipital gyrus adjacent to the angular gyrus, the bilateral inferior frontal gyrus and the bilateral fusiform gyrus adjacent to the inferior temporal gyrus. For self-referential (compared to other-referential) processing, however, cortical midline structures including the bilateral ACC, medial frontal gyrus and left precuneus were commonly activated. While the work was consistent with previous research implicating medial areas in self processing (e.g., Northoff et al., 2006), it demonstrated an important distinction between representations of the physical and psychological self.

Perceptual biases for the self in the brain

A current area of interest is in the neural underpinnings that support self-bias effects in perceptual matching. In the first fMRI study that utilised the matching task (Sui et al., 2012), participants formed associations between three geometric shapes and self, friend and stranger labels, and then performed the matching task within the scanner in which they judged whether randomly

presented pairs were correctly or incorrectly matched (Sui, Rotshtein & Humphreys, 2013). The researchers found that an area of the vmPFC and the left posterior superior temporal sulcus (lpSTS) showed increasing (self>friend>stranger) responses for matched pairs depending on the proximity to the self. Dynamic causal modelling demonstrated an increased projection from the vmPFC to the lpSTS for self-associated stimuli, implicating a functional coupling of these two regions as underlying the self-bias effect. Furthermore, the strength of response from these regions predicted the behavioural self-advantage in response times. A separate analysis of the mismatched pairs showed that the vmPFC responded to the self-related shape, while the lpSTS responded to both the shape and the label. Decreasing responses to self stimuli (compared to friend and stranger) were, on the other hand, reflected in the dorsal lateral prefrontal cortex (dlPFC), middle superior frontal gyrus, inferior parietal cortex, and right cuneus. Extending this work, Yankouskaya et al. (2017) used multi-voxel pattern analysis to test commonalities between self and reward biases in the brain and demonstrated the self-bias to be underpinned within a posterior part of the vmPFC, and high reward biases within a more anterior part of the vmPFC. The study confirmed that the self-bias effect in perceptual matching is reflected within the vmPFC and also showed that, despite appearing similar in behavioural effects, there may be fine-grained differences in patterns of activity for self-biases and other kinds of perceptual advantage effects.

Neuropsychological evidence also suggests distinct neural networks for self-related biases. Sui, Enock, Ralph, and Humphreys (2015) found that

damage to the vmPFC led to a reduced self-bias effect in the matching task, whilst damage to the lpSTS led to an increased self-bias, which was attributed to reduced ability to modulate attentional responses to socially salient stimuli through this brain region. Damage to the frontoparietal attentional control network was also linked to increased self-biases.

Neural correlates of the processing of social groups

Ingroup favouritism is widespread and permeates many levels of cognition, including emotion ascriptions (Leyens et al., 2000), reward allocation (Tajfel, 1970), facial recognition (Yan et al., 2017) and perceptual matching (Moradi et al., 2015). How, then, are these concepts of 'us' and 'them' represented in the brain, and what are the neural correlates underlying these ingroup-bias effects? Two comprehensive review papers from Amodio (2014) and Cikara and Van Bavel (2014) converge on identifying several key regions as being involved with group categorisation and evaluation. These regions include the amygdala, anterior insula, fusiform gyri, (ventral) striatum, medial prefrontal cortex and the anterior cingulate cortex (See Figure 1.2, below).

A number of studies that have examined the neural mechanisms underlying group processing have utilised face-categorisation paradigms and found increased activity within the anterior insula in response to Black faces compared to White faces in White participants (Lieberman, Hariri, Jarcho, Eisenberger, Bookheimer, 2005; Richeson et al., 2003. Ronquillo et al., 2007). This has been interpreted as a negative reaction to other-race individuals, owing to the involvement of the insula in visceral emotional processing (reviewed in

Amodio, 2014). Studies have also reported increased amygdala responses when White participants viewed Black faces compared to White faces (Hart et al., 2000). Moreover, the strength of this increase in amygdala activity has been found to correlate with implicit racial bias measures (Cunningham et al., 2004). However, Van Bavel, Packer and Cunningham (2008) found *increased* activity within the amygdala for ingroup faces within novel teams made up of both Black and White members, showing that the amygdala may in fact flexibly respond to stimuli with high perceptual salience and/or high motivational relevance, regardless of positive or negative valence.

Studies have found higher fusiform activity for own-race compared to own-race faces (Cunningham et al., 2004; Golby, Gabrieli, Chiao & Eberhardt, 2001), and this has been demonstrated for novel group faces too (Van Bavel et al., 2008; Van Bavel, Packer & Cunningham, 2011), indicating a perceptual advantage for ingroup face processing. These findings suggest that attentional biases towards ingroup stimuli are not necessarily based on past experience and familiarity and that mere social categorisation may lead to more individuated perceptual processing. Supporting the notion of perceptual biases in the brain for the encoding of ingroup faces, ERP evidence has found that novel ingroup faces elicited larger N170 amplitudes, known to reflect the structural encoding of faces (Ratner & Amodio, 2013). This suggests that novel group allocation affects the very earliest stages of face perception.

There is also evidence for that the vmPFC and the striatum respond to novel ingroup compared to outgroup faces (Van Bavel et al., 2011). Further studies suggest that the medial prefrontal cortex (mPFC) underlies higher-level

forms of social processing such as impression formation, considering the perspectives of others, and allocating reward to ingroup members (Amodio & Frith, 2006; Macrae, Heatherton & Kelley, 2004; Volz, Kessler & von Cramon, 2009). Additionally, responses in the mPFC and the ACC were elicited when participants viewed members of their own race in pain but not when they viewed other-race individuals in pain (Xu, Zuo, Wan & Han, 2009), demonstrating a possible neural basis for the racial bias in empathy effect.

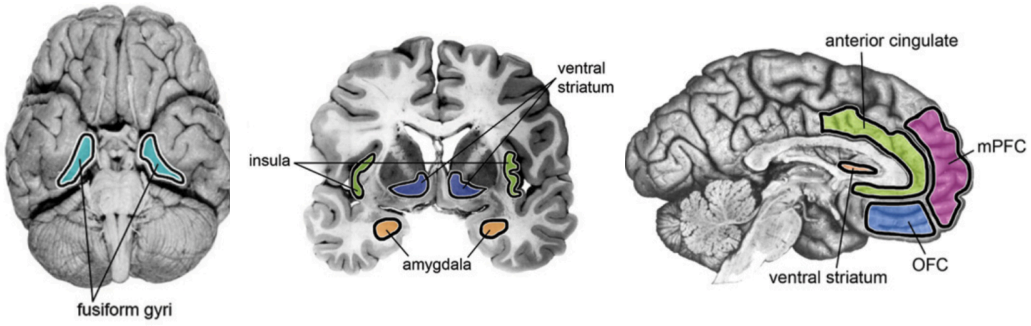


Figure 1.2: Anatomical depiction of several key brain regions associated with group membership and intergroup evaluations taken from Cikara and Van Bavel, 2014. The authors note that this figure only serves to show the locations of the various regions, rather than to indicate a neural network supporting aspects of social processing in general. Note: mPFC denotes medial prefrontal cortex and OFC denotes orbitofrontal cortex, which is also called the ventromedial prefrontal cortex within the literature and within this thesis.

Perceptual biases for ingroups in the brain

I have outlined some of the key findings relating to the neural processing of social ingroups and outgroups. Recently, Moradi, Mantini, Yankouskaya, Hewstone and Humphreys (2017b) examined the neural underpinnings of the ingroup-bias in lower-level perceptual matching. Using a version of the matching task (from Sui et al., 2012), football team supporters learned to associate shapes with badges of the team they supported (ingroup), a rival team, and a neutral team (outgroups). During fMRI, participants performed a standard version of the task in which they judged whether shape-label pairs were

matched or mismatched. For matched trials, no brain areas responded to ingroup compared to neutral or to rival stimuli, despite a significant behavioural advantage in both response time and accuracy. For mismatched trials, there was also no brain area that responded to ingroup badges compared to rival or neutral badges. There was, however, increased activity for rival and neutral (outgroup) badges compared to ingroup badges in clusters of the left lateral frontal and parietal cortices, left anterior insula, left intraparietal sulcus, left precuneus and left fusiform area. Furthermore, increased activation was found in the lpSTS for ingroup compared to outgroup shapes, an area identified by Sui et al. (2013) as implicated in the self-bias effect. There was also increased activity in the left inferior frontal gyrus for ingroup compared to outgroup shapes, leading the researchers to propose that ingroup shapes matched with outgroup badges are higher in saliency, akin to a Stroop-like effect (Stroop, 1935).

Although the same region in the lpSTS identified by Sui et al. (2013) showed greater responses to ingroup than outgroup shapes, Moradi et al. (2017b) present a different pattern of results. There were no differences in responses between ingroup and outgroup matched pairs, and the vmPFC did not show increased activity to ingroup shapes or badges. It is unclear whether differences in these fMRI results are reflective of fundamental differences in the processing of self- and ingroup-biases, or whether differences in the way that the tasks were implemented (i.e., badges rather than labels; different team affiliations for each participant; rival and neutral teams as baseline) obscured similarities. Experiment 7 of this thesis directly addresses these limitations.

Neural commonalities and distinctions between self and ingroup processing

As has been discussed, neuroimaging research has identified neural regions and networks that are involved in self and ingroup processing. Owing to the notion of a cognitive overlap between personal and social identities (i.e., Social Identity Theory: Tajfel & Turner, 1979) that has been detailed in the previous section, we might also expect an overlap in the neural regions implicated in self- and ingroup-biases. There do appear to be commonalities between the two, such as increased fusiform involvement for both self (Hu et al., 2016) and ingroup (Golby et al., 2001) face processing, and involvement of the ACC and medial frontal cortex for higher-level judgements related to the self (Northoff et al., 2006) and social groups (Volz et al., 2009). Ultimately though, differences in paradigms and methodologies used to assess self and ingroup representations makes it difficult to meaningfully compare these neuroimaging results.

Outstanding research questions

In this introductory chapter, I have discussed some of the principal psychological theory and research evidence relating to behavioural and neural effects of self and ingroup relevance. As I hope to have emphasised, self- and ingroup-biases have received considerable attention across multiple domains within social cognitive neuroscience, and these contributions have been integral to increasing our understanding of social cognition more broadly. I have focused much of this chapter on the *perceptual and attentional* effects of social relevance, from facial processing to novel associative matching, and have

outlined how self and ingroup stimuli are consistently prioritised at these more automatic levels of processing. While recent work has progressed in elucidating how self and ingroup relevance captures attention and shapes early perception, there are some notable questions that remain. This thesis identifies five outstanding questions relating to the behavioural and neural consequences of self- and ingroup-biases in perception and addresses these empirically across four experimental chapters.

1. What is the relationship between perceptual prioritisation for the self and social ingroups?

As I have outlined, cognitive performance is enhanced at the perceptual level for both self and ingroup related stimuli (Moradi et al., 2015; Sui et al., 2012). That effects are similar and comparable for both may indicate a common mechanism driving these bias effects. Indeed, this would be consistent with the main premise of social identity theory (Tajfel, 1982), that suggests an overlap between self and ingroup representation, and also with corresponding experimental work (Smith, Coats & Walling, 1999; Smith & Henry, 1996). Previous research examining the relationship between self-biases and those for high reward and positive emotion concluded they are driven by separate processes (Stolte et al., 2017; Sui & Humphreys 2015). It is unclear whether biases for ingroup stimuli are reflective of biases for the self or of more distinct mechanisms. Experiments 1 and 2 (in Chapter 2) test this question directly amongst a sample of college rowers.

2. How does social context modulate ingroup-bias?

Ingroup-bias effects in perceptual matching have been demonstrated amongst football supporters whereby rival and neutral teams were the two outgroup exemplars (Moradi et al., 2015). There were no differences in performance between rival and neutral football teams, which may be reflective of the ingroup-bias as rooted entirely in ingroup favouritism. However, it is unclear whether similar patterns would emerge across different kinds of ingroup/outgroup relations. For example, are more familiar outgroups given perceptual prioritisation compared to unfamiliar ones in the same way that friends are compared to strangers (Sui et al., 2012)? Does the threat saliency of an outgroup affect its perceptual processing (e.g., Devue, Belopolsky & Theeuwes, 2011; Ohman, Flykt & Esteves, 2001)? Experiment 3 (Chapter 3) examines the influence of differing intergroup contexts on perceptual prioritisation for ingroups amongst a sample of serving military personnel.

3. How quickly does group affiliation affect early perceptual processing?

As described previously within this chapter, ingroup favouritism is reliably elicited even under 'minimal group' conditions in which group membership is randomly or arbitrarily assigned and the categories contain no social meaning (Tajfel, 1970). There is some research evidence to suggest that minimal group allocation modulates early face processing (Van Bavel & Cunningham, 2009), demonstrating that even new social identities may have some perceptual effects. However, it is unclear whether minimal group allocation would similarly

enhance performance on the associative matching task, which, unlike face processing paradigms, does not contain any concrete social information. Does novel group allocation modulate early perceptual processing in this context? If so, how do biases for novel groups relate to biases for the self? Experiments 4, 5 and 6 (Chapter 5) examine these questions.

4. Do trait differences underlie the strength of perceptual prioritisation for the self and social groups?

There is evidence to show that self-esteem and self-construals may underlie certain social bias effects (e.g., Jones et al., 2002; Sparks et al., 2016; Sui et al., 2009). Moradi et al. (2015) also found that the satisfaction component of group identification (using the scale by Leach et al., 2008) was positively correlated with perceptual prioritisation for the ingroup. However, it is unclear whether perceptual biases for self and ingroups are reliably underpinned by these individual differences or whether these lower-level, automatic biases are separate from explicit attitudes towards the self and social groups. I test this question using correlation and moderation analyses with trait measures relating to group identification and self-concept through Experiments 1 to 6 (Chapters 2-4).

5. What are the commonalities and distinctions in the neural regions that underpin biases for the self and social ingroups?

Neuroimaging research has made progress in identifying neural regions and networks that are involved in processing social information. Several key areas have been implicated in self and ingroup representation (e.g., Cikara & Van

Bavel, 2014; Hu et al., 2016) and Sui et al. (2013) showed the vmPFC was central to self-biases in perceptual matching. However, whilst a relationship between self and ingroup representation has long been posited (Tajfel, 1982), there is little neuroimaging research that examines the neural overlap between self and ingroup representation. Experiment 7 (Chapter 6) directly compares the neural regions that underpin self- and ingroup-prioritisation using both established and novel ingroup exemplars.

Experimental approach

Throughout this thesis, I use modified versions of the matching task developed by Sui et al. (2012) in order to examine these five research questions. This task establishes a highly advantageous way to address these questions because it allows for concretely measuring behavioural advantages for self and ingroup stimuli whilst keeping the methods of measurement and the target stimuli exactly the same across different group exemplars and intergroup contexts. Additionally, several psychophysical measures can be obtained from this task and throughout the following experiments I utilised response time, accuracy (proportion of error) and *d*prime scores using signal detection theory (also known as perceptual sensitivity).

Signal detection theory (Green & Swets, 1966) is a useful measure within this paradigm as it allows for the distinction between effects that can be attributed to changes in perceptual sensitivity (i.e., the ability to discriminate between targets) and effects that are related to response biases (i.e., whether participants have a preferred type of response throughout the task). For

example, if individuals simply always respond ‘yes’ to self shapes, then they would score highly on self matched trials for which ‘yes’ is the right answer, but poorly on mismatched trials for which ‘no’ is the right answer. According to signal detection theory, this would represent a bias in responses towards self shapes, rather than increased perceptual sensitivity of them. The estimation of parameters included requires the classification of each response type as either a correct identification of a target (a ‘hit’ response), a correct rejection of a non-target (a ‘correct rejection’), a misidentification of a non-target as a target (a ‘false alarm’) and misjudging a target as a non-target (a ‘miss’). In the current experimental design, a response was considered as a hit when a matching shape-label pair appeared and participants responded ‘yes’; a correct rejection when the shape and label did not match and participants responded ‘no’; false alarm when a shape and label did not match and participants responded ‘yes’; and a miss when a shape and label matched but a ‘no’ response was given. The sensitivity index (*d*prime) represents the ability to distinguish matching and mismatching stimuli, and the response criterion represents a bias towards judging mismatching stimuli as matching, or the opposite.

Previous studies using signal detection within the matching task found that participants had significantly higher sensitivity for ingroup compared to outgroup shapes, showing they were better at correctly distinguishing whether these shapes matched or mismatched the labels, but that they had a significantly lower response criterion for ingroup compared to outgroup stimuli, meaning they more readily indicated that stimuli belonged to the ingroup than to outgroups (Moradi et al., 2015). By using multiple measures of task

performance, it is also possible to ensure that performance advantages are not attributed to speed/accuracy trade-offs (e.g., Ratcliff, 1985).

In conjunction with the measures obtained using the perceptual matching task, I use validated trait measures relating to group identification (Gómez et al., 2011; Leach et al., 2008), self-construals (Singelis, 1994) and self-esteem (Rosenberg, 1965) in order to measure the individual differences that underlie the bias[1] effects. By taking methods that are more traditionally associated with cognitive psychology and applying them to social psychological questions, I hope to provide a novel perspective on the relations between self and ingroup representation in brain and behaviour.

[1] **Bias** effects for the self and ingroups are also referred to interchangeably as **prioritisation** and **advantage** effects throughout this thesis.

Chapter Two: Comparing prioritisation effects for self and ingroup in perceptual matching

Chapter background

As set out in the introduction to this thesis, previous research has shown that cognitive biases for the self and social ingroups occur not only in high-level judgements such as preferences for self-owned items and greater allocation of monetary rewards for ingroup members, but also in lower-level perceptual tasks. Comparable prioritisation effects in perceptual matching for self-associated and ingroup-associated stimuli (compared to other individuals and outgroups) may be indicative of a common process underlying the advantage effects, which would be consistent with the notion of an overlap between self and ingroup representation, as put forward by social identity theory (Tajfel, 1982). The two experiments presented within this chapter aimed to directly examine the relationship between self and ingroup prioritisation effects amongst a sample of college rowers using modified versions of the perceptual matching paradigm (Sui et al., 2012). Self-reported levels of ingroup identification and identity fusion were also taken to examine whether these measures modulated performance for ingroup stimuli on the perceptual matching task.

Introduction

Cognition prioritisation for the self and social ingroups

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., Wolford & Morrison, 1980; Wood & Cowan, 1995) and encoding information in relation to the self has repeatedly been shown to enhance memory performance (e.g., Cunningham et al, 2008; Golubickis et al., 2018, Symons & Johnson, 1997; Turk et al., 2008). A bias for the self is also observed in perceptual judgements such as facial recognition, with recognition faster (Keyes & Brady, 2010) and orientation judgements more accurate (Sui et al., 2009) for own faces than faces belonging to others.

As well as giving high priority to information relating to the self, human cognition is also largely biased to material relating to social ingroups. Like self-associated information, preference for the ingroup affects a wide range of psychological processes, with greater empathetic responses (Johnson et al., 2002), more favourable reward allocation (Tajfel, 1970; Tajfel et al., 1971) and a higher likelihood of ascribing complex emotions (Leyens et al., 2000; Paladino et al., 2002) to ingroup than to outgroup members. Furthermore, similar to biases for the self, biases for the ingroup also extend to lower-level perceptual tasks such as facial recognition (Bernstein et al., 2007; Hugenberg et al., 2010; Malpass & Kravitz, 1969; Meissner & Brigham, 2001). Also at the more automatic level, a body of research has found evidence for implicit preferences

for ingroups compared to outgroups (reviewed in Nosek et al., 2007). For example, research has shown implicit associations between racial ingroups and positive valence and, correspondingly, racial outgroups and negative valence (Greenwald et al., 1998).

Biases for the self and ingroups in perceptual matching

While research has consistently shown that self and ingroup relevance modulates many forms of attentional and perceptual processes, these kinds of experiments have typically used familiar stimuli such as faces and names. Because of this, it has been difficult to isolate the effects of social relevance from the effects of familiarity on performance. However, a series of studies in which the self and social in-groups are newly associated with neutral stimuli have demonstrated performance advantages for personally relevant material even in the absence of familiarity (e.g., Moradi et al., 2015, 2017a; Sui et al., 2012; Sui & Humphreys, 2015; Wang et al., 2016). As described in Chapter 1, in a novel associative matching paradigm, participants learned to associate geometric shapes (e.g., square, circle and triangle) with social labels (e.g., 'you', 'friend' and 'stranger') by being told, for example, 'you are the triangle, your best friend is the square and a stranger is the circle'. After learning the associations, participants were asked to judge whether shape-label pairs presented 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 (Sui et al., 2012).

Utilising the same paradigm, further research demonstrated that ingroup associations modulated perceptual matching for neutral stimuli in the same way (Moradi et al., 2015). Here, 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'). They then responded to random shape-badge pairs presented on screen as being correct or incorrect. As for stimuli associated with the self, a large advantage in response time and accuracy was found for shapes that were matched to participants' own team badges compared with shapes matched to outgroup badges. Importantly, control experiments verified that these effects were not based in the increased familiarity for participants' own team badges. A positive correlation between the ingroup-advantage in perceptual performance and satisfaction with the team ratings on Leach et al.'s (2008) multi-component group identification scale further supported the conclusion that the advantage effect truly reflected social value. That there was no difference in responses to neutral and rival outgroups suggested the effects were rooted in ingroup favouritism rather than outgroup derogation.

Overlapping representations of self and ingroup

There is, then, robust evidence to suggest that tagging novel stimuli with self or ingroup relevance can rapidly direct attention and enhance perception and, most importantly, that these effects are not rooted in stimulus familiarity. Perhaps then, the similar effects of self and ingroup relevance on perception are driven by a common process stemming from a shared representation. This

would imply that prioritisation for the self predicts prioritisation for the ingroup and vice versa. Many social psychological theories hold that there is a cognitive overlap between self and ingroup such that group memberships form a vital part of self-representation (see Social Identity Theory: Tajfel, 1982; and Self-Categorisation Theory: Turner et al., 1987). There is also experimental evidence from trait and attitude judgement paradigms to support this notion (Coats et al., 2000; Smith et al., 1999; Smith & Henry, 1996). For example, when judging traits and attitudes as being self-descriptive or not, those for which the self matched the ingroup were responded to faster and more accurately than traits on which the self and ingroup mismatched. These effects were stronger amongst individuals who reported higher levels of ingroup identification (Coats et al., 2000), leading the authors to conclude that there is a cognitive overlap between self and in-group representation that is stronger for individuals higher in self-reported group identity.

Previous theory and research evidence relating to the notion of an overlap between the self and social ingroups may imply that a similar relationship could exist for self- and ingroup-biases in perception. Alternatively, it may be that perceptual prioritisation for social ingroups is driven by a component distinct from the self, such as the emotional or motivational significance inherent in the concept of the group. There is previous research evidence to suggest that emotional salience can guide attention and modulate early perceptual processing (e.g., Phelps, Ling & Carrasco, 2006; Schupp, Junghöfer, Weike, & Ham, 2003). It could be, then, that the emotional

significance of group identity drives the performance advantages in perceptual matching (e.g., Moradi et al., 2015).

Aims of the present study

If there is a shared cognitive representation for self and important social ingroups that facilitates overlapping trait and attitude judgements (Smith et al., 1999), then we might expect this to manifest itself at the perceptual level too, with attentional prioritisation for the self predicting attentional prioritisation for the social ingroup. While an overlap between self and ingroup has long been posited (Tajfel, 1982), the perceptual matching paradigm (Sui et al., 2012) allows direct measurement and comparison of the magnitude of self- and ingroup-prioritisation while uniquely keeping complete equality between the stimuli presented and the method of measurement.

The two experiments reported here examined the relationship between self- and ingroup-advantages in visual attention 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, neutral and rival labels with three different geometric shapes. In both tasks, participants responded to randomly presented shape-label pairs as correctly or incorrectly matched according to associations learned at the start of the experiment. Performance advantages were taken as the differences in response time and in perceptual sensitivity between own-associated (self/team)

shapes and other-associated (friend/neutral/stranger/rival) shapes, and the relationship between the self- and ingroup-advantages[2] was measured.

In addition to the perceptual tasks, subjective measures of perceived closeness and overlap between self, friend and stranger, and team, rival and neutral groups were taken in order to examine how these related to the perceptual biases and also to test whether 'friend' and 'stranger' labels are comparable to 'rival' and 'neutral' labels (whether they serve as equivalent baselines for measuring the performance advantages). Subjective measures of ingroup identification, identity fusion and perceived overlap between the self and others and the ingroup and outgroups were used to examine whether these individual differences were related to the magnitude of the prioritisation effects For example, Moradi et al. (2015) found a positive correlation between the ingroup-bias and *satisfaction* with the team. Here, the same measure of ingroup identification was used with the aim both of replicating and expanding on these findings.

Experiment 2 also examined the relationship between the self and ingroup perceptual advantages when the self, stranger, team and rival associations were made within the same task. This allowed measurement of the relations between the self- and ingroup-advantages when both self and ingroup stimuli were salient at the same time, while also controlling for task order effects. Furthermore, this version of the task made it possible to measure the cognitive overlap between self and ingroup shape associations by comparing

[2] As the team was the ingroup, these two terms are used interchangeably throughout this chapter.

trials for which self shapes were paired with team labels to those when self shapes were paired with rival labels (and similarly, team shapes paired with self labels compared to team shapes paired with stranger labels). Here, slower response times and higher error rates for self+*team* pairs than self+*rival* pairs, or team+*self* pairs than team+*stranger* pairs, would be indicative of a confusion in the representation of self and ingroup stimuli. The second experiment also used an implicit association task (Greenwald & Farnham, 2000), outlined in Chapter 1, to test whether the enhanced performance for the ingroup in the matching task reflected implicit positive valence.

I hypothesised that if self- and ingroup-prioritisation effects on the matching task are driven by the same underlying mechanism, there would be a positive relationship between the two. If, however, the biases are distinct and uncorrelated (as the biases for high reward and positive valence were found to be from the self; Stolte et al., 2017; Sui & Humphreys, 2015), then we might instead observe individual differences independently underlying the prioritisation effects. For example, levels of group identification may predict ingroup-bias but not self-bias.

Additionally, for Experiment 2, I conjectured that an overlap between self and ingroup representations would lead to greater difficulty in discriminating newly learned self and ingroup stimuli when presented in mismatched pairs than, for example, self and rival mismatches. A slower response time 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 ingroup stimuli.

Experiment 1

Methods

Participants

College rowers were recruited by email advertisements. A total of 42 rowers completed the experiment (30 female, mean age = 22.07 *SD* = 3.47), 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.

Sample size justification

Based on original work by Sui et al. (2012), a significant interaction effect in a 3 (shape condition: self/friend/stranger) x 2 (match condition: matched/mismatched) design was observed with eighteen participants, giving power of .98 at an alpha of .001[3]. For a similar effect size (η_p^2 = .56) at the same level of power within a 2 x 3 x 2 design (as used in the present experiment), a sample size of twenty was required to detect significant interactions between the main effects with α = .001. For the planned correlation analyses, similar work by Stolte et al. (2017) found a sample size of 37 gave a power of .83 (α = .01) in detecting a medium to large effect size. Based on this, a sample size calculation determined a sample size of at least 30 was required to detect a similar effect size at a similar level of power (.85) with an α of .05 (both for correlations between the social biases and for correlations between these biases and the questionnaire measures).

[3] All power and sample size calculations were conducted using either G*Power 3.1.9.2 or MorePower 6.0.4.

Stimuli and tasks

Participants performed two perceptual matching tasks adapted from Sui et al. (2012), completed sequentially, with half of the participants performing the personal (self, friend, stranger) association task first and half the group (team, rival, neutral) 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 first 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 randomly generated shape-label pair for 100ms. Participants then had 1100ms 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 500ms 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, match/mismatch; and three shape conditions, self, friend and stranger). The whole task took approximately fifteen minutes.

The group association task took exactly the same format as the personal association task, other than participants learned to associate three different geometric shapes with names 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 by email before the start of the experimental 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 118 x 118 pixels, 4.16 x 4.16cm, corresponding to a visual angle of around 4.8° x 4.8° as viewed 50cm from the screen) were presented randomly above a white fixation cross (0.8° x 0.8°) 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-inch monitor.

Personal distance and inclusion of other in the self measures

To assess the perceived closeness between self, friend and stranger or own, rival and neutral teams, participants completed a Personal Distance scale developed by Sui et al. (2012) and the Inclusion of the Other in the Self 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. This method was also used to measure perceived closeness between the three teams in question (i.e., team and rival, team and neutral and rival and neutral). Lower scores indicate a closer perception of the relationship between the two individuals or teams. Participants also completed the IOS, which presents seven pairs of circles that vary in degree of overlap 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). Participants completed three versions of this (self-friend, self-stranger and self-stranger) along with a modified version to assess overlap between own, rival and neutral teams. Higher scores on this scale imply greater overlap. See Appendix A for full Personal Distance and IOS scales.

Questionnaire measures

Measures of group identification were obtained using Leach et al.'s (2008) 14-item multi-component scale that identifies five components of ingroup identification: individual self-stereotyping, ingroup 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 ingroup, positive feelings about ingroup membership and the importance and salience of the ingroup to the individual) while individual self-stereotyping and ingroup homogeneity underlie 'self-definition' (the perception of the self as similar to an ingroup prototype and of ingroup members sharing

commonalities). Measures of identity fusion (designed to capture connectedness between the personal and social self) were established using the 7-item verbal scale developed by Gómez et al. (2011).

Procedure

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

Statistical analyses

The data were analysed in SPSS 24 (Armonk, New York: IBM Corp). I examined biases for the self and ingroup using repeated measures ANOVAs on response time, accuracy and sensitivity (*d*prime) scores. There were two task types (personal: self, friend and stranger associations; and group: team, rival and neutral associations); three shape conditions (own: self/team; close other: friend/neutral; and distant other[4]: stranger/rival); and 2 match conditions (matched/mismatched). For response time and accuracy scores, a 3 (shape condition) x 2 (task type) x 2 (matched/mismatched) repeated measures ANOVA was used to measure the differences in performance between shape associations.

[4] Although 'close other' and 'distant other' are more applicable to friend and stranger than the neutral and rival groups, these terms are used for both tasks for simplicity in describing how the conditions were combined within the levels of the ANOVAs.

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 using the following formula whereby H denotes correct hits and F false alarms (Green & Swets, 1966):

$$d' = z(\mathrm{H}) - z(\mathrm{F})$$

The response criterion (RC) for each participant was also calculated (Macmillan, 1993):

$$RC = -0.5 * [z(\mathrm{H}) + z\,(\mathrm{F})]$$

As matched and mismatched trials were combined for sensitivity and response criterion, a 3 (shape condition) x 2 (task type) repeated measures ANOVA was used to measure the effects of shape association on each of these performance measures.

I measured the relationship between the self- and ingroup-biases using bivariate correlations. An alpha of .05 was used throughout, and all pairwise comparisons reported were corrected using Bonferroni's adjustment.

Results (Experiment 1)

For the response time analysis, only correct responses were included, and those higher or lower than 2.5 standard deviations from the mean response time for each participant under each condition were excluded as a standard way of removing the influence of outliers (e.g., Ratcliff, 1993). This eliminated less than 5% of the overall dataset. The analysis was then performed on the remaining trials.

Own-associated biases in response time

There were three within-subject variables: task type (personal or group), shape category (own: self/team; close other: friend/neutral; distant other: stranger/rival) and match condition (matched/mismatched). A 2 (task: personal/group) x 3 (shape condition: own/close other/distant other) x 2 (matched/mismatched) repeated measures analysis of variance (ANOVA) was used to test for the effect of shape association on response time scores.

There was no significant effect of task type, $F(1, 41) = 1.41$, $p = .242$, $\eta_p^2 = .033$, showing that response times were similar for the personal and group association tasks. There was a significant effect of shape, $F(2, 82) = 65.11$, $p < .001$, $\eta_p^2 = .614$, with response times fastest for own-associated shapes, (M = 694.98 ±8.94), followed by close other, (M = 727.70 ±9.84), and slowest for distant other (M = 734.55 ±9.78) shapes. Pairwise comparisons revealed that significant differences existed between own and close other shapes and own and distant other shapes (both $p < .001$), but not between close and distant other shapes ($p = .215$).

There was a significant effect of match condition, with faster responses for matched than for mismatched trials, $F(1, 41) = 254.33$, $p < .001$, $\eta_p^2 = .861$. There was no significant interaction between task and shape, with the effect of shape on response time consistent across personal and group associations, $F(2, 82) = 1.08$, $p = .345$, $\eta_p^2 = .026$. Similarly, there was no significant interaction between task and match condition, $F(1, 41) = 0.23$, $p = .881$, $\eta_p^2 = .001$. There was a significant interaction between shape and match, $F(2, 82) = 52.97$, $p < .001$, $\eta_p^2 = .564$, showing a differential effect of shape on response

time according to match condition. There was also a significant three-way interaction between shape, match and task type, $F(2, 82) = 9.51$, $p < .001$, $\eta_p^2 = .188$, indicating that the interaction between shape and match on response time 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, $F(2, 82) = 53.70$, $p < .001$, $\eta^2 = .567$, but not on mismatched trials, $F(2, 82) = 2.46$, $p = .091$, $\eta^2 = .057$. 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 $p < .001$). Response times within the group association task followed a similar pattern, with a significant effect of shape condition on matched, $F(2, 82) = 35.43$, $p < .001$, $\eta^2 = .464$, but not mismatched, $F(2, 82) = .83$, $p = .442$, $\eta^2 = .020$, trials. For matched pairs, team shapes were responded to significantly faster than neutral and rival shapes (both $p < .001$). However, there was no difference between neutral and rival shapes ($p = 1.00$).

In summary, the response time data analysis found that for matched pairs, own-associated shapes were responded to significantly faster than other-associated shapes. While friend shapes were responded to significantly faster than stranger shapes, there was no difference between neutral and rival shapes. See Figure 2.1, below, for a bar chart depicting response time scores

for matched and mismatched trials under each shape condition. Table 2.1 shows mean and standard deviation (*SD*) scores[5] for each condition.

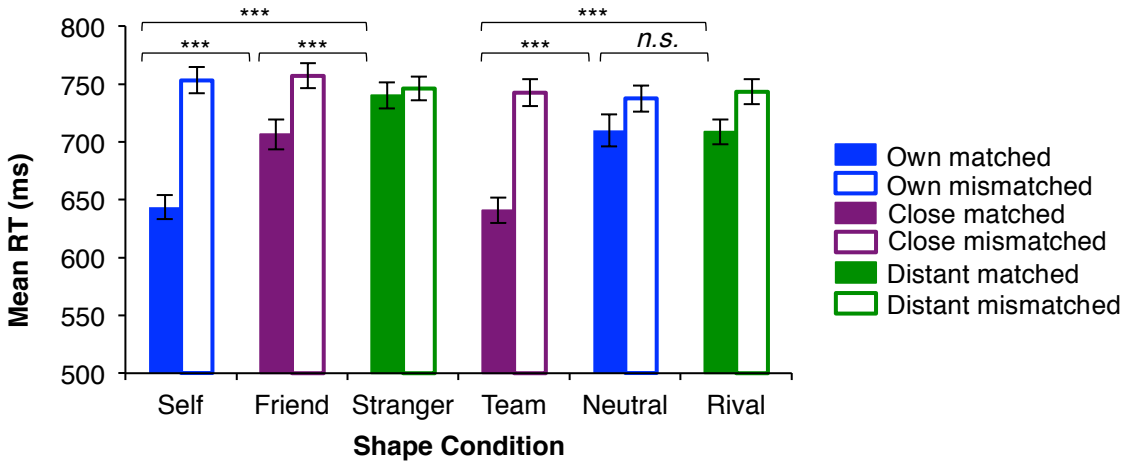


Figure 2.1: Mean response time scores as a function of shape (own/close other/distant other), match (matched/mismatched) and task type (personal/group) in Experiment 1. Error bars represent standard errors. *Note*: *** denotes $p < .001$; *n.s.* denotes non-significant.

Own-associated biases in *d*prime (perceptual sensitivity)

A 2 (task: personal/group) x 3 (shape: own/close other/distant other) repeated measures ANOVA found that there was no significant effect of task on *d*prime scores, $F(1, 41) = .44$, $p = .511$, $\eta_p^2 = .011$, indicating that sensitivity was comparable across both task types. There was a significant main effect of shape, $F(2, 82) = 58.08$, $p < .001$, $\eta_p^2 = .586$, with greater sensitivity for own than for close and distant other shapes (both $p < .001$), but with no difference between the two other associations ($p = .413$). There was no significant interaction between task and shape, $F(2, 82) = .79$, $p = .086$, $\eta_p^2 = .058$.

Similar to the response time and accuracy data, the *d*prime scores demonstrated performance advantages for own (self and team) compared to

[5] The same analysis was run on accuracy data and exactly the same pattern of results was found. There was a self and team advantage in comparison to the other shapes for matched trials. There was also an advantage for friend in comparison to stranger, but no difference in accuracy performance between neutral and rival outgroups.

other (friend, stranger, neutral and rival). There were no significant differences in sensitivity between other shapes (friend and stranger or neutral and rival outgroups) in either task. See Figure 2.2, below, for a bar chart depicting sensitivity scores for each shape condition, separated by task for ease of presentation, and Table 2.1 for means (standard deviations in parentheses).

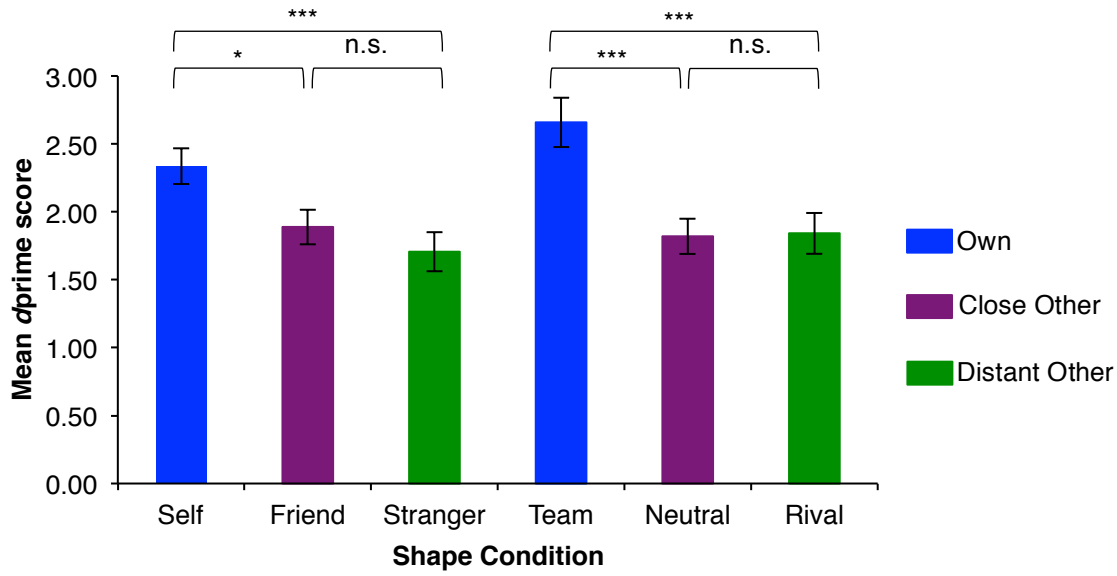


Figure 2.2: Mean sensitivity (*d*prime) scores as a function of shape (own/close other/distant other) and task (personal/group) for Experiment 1. Error bars represent standard errors. *Note*: *** denotes $p < .001$; * denotes $p < .01$; n.s. denotes non-significant.

Table 2.1: Mean response times (RTs) for correct responses and accuracy rates (proportions of correct responses), along with mean *d*prime scores (Experiment 1). *Note*. Standard deviations in parentheses.

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

Correlations between advantages for self and ingroup

The results indicated that performance was enhanced for self in relation to friend and stranger and for team in relation to neutral and rival shapes. Next, I examined whether the response time and sensitivity performance advantages for the ingroup were correlated with the performance advantages for the self. To calculate the self-advantage score in response time for each participant, scores for friend and stranger were averaged together (to give a non-self baseline) and the self score was deducted from this mean for each participant (for matched pairs[6]). To calculate the self *d*prime advantage for each participant, the mean for friend and stranger scores together were deducted from the score for the self. The team-advantage scores were calculated in the same way, taking the difference between the team and the mean average of the rival and neutral (non-team) conditions. Own shape scores were subtracted from other shape scores for response time biases so that they remained positive, as lower scores indicate better performance. Bias corrected and accelerated bootstrap 95% CIs are reported in square brackets.

There was a significant positive correlation between the self- and ingroup-advantage in response time, $r_s(40) = 0.339$ [0.023, 0.543], $p = 0.028$, but not in sensitivity, $r_s(40) = -0.105$ [– 0.448, 0.235], $p = 0.509$. Figure 2.3 shows a scatterplot depicting the relationship between the self and ingroup response time (a) and *d*prime (b) advantages compared to the other-associated conditions.

[6] As the self- and team-advantages in response time and accuracy were observed only for matched trials, only matched trials were included in calculating the bias scores.

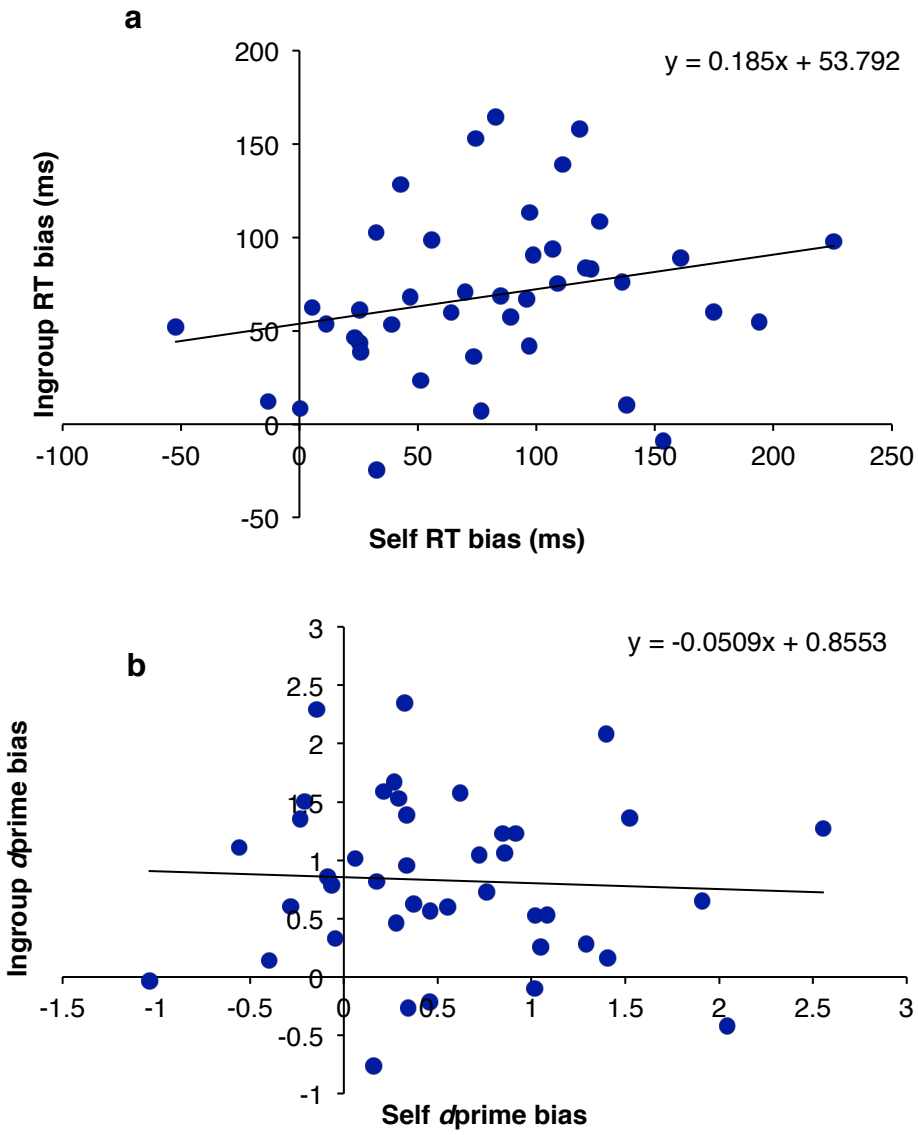


Figure 2.3: The relationship between self (compared to the mean of friend and stranger) and ingroup (compared to the mean of neutral and rival) advantages in response time (p<.05) (a) and *d*prime (p = .509) (b) for Experiment 1.

Self-report measures

Personal distance and inclusion of the other in the self scales

One participant did not complete the personal distance scale, leaving a total *N* of 41 for this measure. The mean scores for the subjective distance between each pair of individuals and teams (Personal Distance) and the perceived overlap between the same pairs (IOS) are shown in Table 2.2 below. The two

measures were significantly correlated with each other such that the smaller the perceived distance between each pair of individuals or teams on the PD scale, the greater the overlap between them as rated on the IOS scale. These correlation coefficients are also shown in Table 2.2.

Table 2.2: Mean Personal Distance and Inclusion of Other in the Self scores, along with correlation coefficients (*df* = 39 for all) for the relationship between each measure (Experiment 1): *Note.* Standard deviations in parentheses; PD denotes Personal Distance; IOS denotes Inclusion of Other in the Self.

	Mean PD (*SD*)	Mean IOS (*SD*)	Correlation *r* (*p*)
Self-Friend	1.40 (1.97)	5.55 (1.31)	-.407 [-.700, .131] (.008)
Self-Stranger	9.26 (3.80)	1.61 (0.85)	-.429 [-.647, -.168] (.005)
Friend-Stranger	8.82 (4.01)	1.76 (1.03)	-.377 [-.593, -.158] (.015)
Team-Neutral	5.82 (3.23)	2.71 (1.70)	-.536 [-.697, -.349] (<.001)
Team-Rival	7.30 (3.86)	2.57 (1.48)	-.605 [-.778, -.358] (<.001)
Neutral-Rival	7.14 (3.77)	2.28 (1.50)	-.378 [-.607, -.084] (.014)

A 2 (personal or group) x 3 (pairing: self-friend, self-stranger, friend-stranger or team-neutral, team-rival, neutral-rival) repeated measures ANOVA was used to measure differences in perceived Personal Distance between the pairs of individuals and groups. There was no significant effect of personal vs. group, $F(1, 40) = .82$, $p = .372$, $\eta_p^2 = .020$. However, there was a significant effect of the pair type, $F(2, 80) = 57.22$, $p < .001$, $\eta_p^2 = .589$, and also a significant interaction between the two, $F(2, 80) = 29.52$, $p < .001$, $\eta_p^2 = .425$.

One-way repeated measures ANOVAs performed separately for personal and group pairs were used to decompose the interaction. For personal pairs, $F(2, 80) = 106.20$, $p < .001$, $\eta^2 = .73$, the distance between self-friend was

rated as significantly smaller than between self-stranger and friend-stranger (both $p < .001$), but there was no difference in ratings of distance between self-stranger and friend-stranger ($p = .661$). For group distance, there was only a marginal effect of pair type, $F(2, 82) = 2.52$, $p = .086$, $\eta^2 = .058$. There was no difference in perceived distance between team-neutral and team-rival ($p = .215$), or between team-rival and neutral-rival ($p = 1.00$), but the distance for team-neutral was significantly closer than for neutral-rival ($p = .007$).

A similar 2 (personal or group) x 3 (pairing: self-friend, self-stranger, friend-stranger or team-neutral, team-rival, neutral-rival) repeated measures ANOVA was used to measure differences in IOS scores between the pairs of individuals and groups. There was a significant effect of personal compared to group, $F(1, 41) = 7.82$, $p = .008$, $\eta_p^2 = .160$, and of pair type, $F(2, 82) = 87.39$, $p < .001$, $\eta_p^2 = .681$, and there was also a significant interaction between the two, $F(2, 82) = 58.97$ $p < .001$, $\eta_p^2 = .590$. For personal IOS scores, $F(2, 82) = 257.74$, $p < .001$, $\eta^2 = .863$, the overlap between self-friend was significantly greater than for self-stranger and friend-stranger (both $p < .001$), but there was no difference between self-stranger and friend-stranger ($p = .549$). There was no significant effect of pair type on group IOS scores, $F(2, 82) = .95$, $p = .390$, $\eta^2 = .023$, thus showing an equivalent perceived overlap between the three teams[7].

These results demonstrate a different pattern of responses for self-reported distance and overlap between the personal and group labels. Self and

[7] There were no significant correlations between the Personal Distance and IOS scores and the self- and team-biases in response time, accuracy or sensitivity.

friend were rated as significantly 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. These differences may explain why there were significant advantages for friend compared to stranger in the matching task, but no differences between neutral and rival teams. There may also be implications here for the correlations between the bias scores. Friend and stranger baselines (used to calculate the self-advantage) may not be equivalent to neutral and rival baselines (used to calculate the team-advantage). It is possible that these non-equivalent baselines could obscure a stronger relationship between the self- and ingroup-biases.

Identity fusion and group identification

Bivariate correlation analyses were used to test whether the biases for the team in the matching task were associated with fusion or identification with the team. The mean score for identity fusion was 31.40 (0.83), the mean score for self-investment was 19.25 (2.05) and the mean score for self-definition was 8.91 (2.17). There was a significant positive relationship between identity fusion and self-investment, $r(40) = .633$ [.446, .778], $p < .001$; between identity fusion and self-definition, $r(40) = .481$ [.191, .704], $p < .001$; and between self-investment and self-definition, $r(40) = .686$ [.523, .812], $p < .001$.

There were no significant correlations between the ingroup-bias in response time and self-reported identity fusion, $r(40) = -0.31$ [-.303, .271], $p = .844$, self-investment, $r(40) = .020$ [-.230, .283], $p = .901$, or self-definition $r(40) = .033$ [-.240, .296], $p = .836$. Similarly, there were no significant correlations

between the ingroup-bias in sensitivity and measures of identity fusion, $r(40) = -.186$ [-.410, .052], $p = .239$, self-investment, $r(40) = -.152$ [-.387, .087], $p = .338$, or self-definition, $r(40) = -.181$ [-.438, .096], $p = .253$[8].

Discussion (Experiment 1)

Experiment 1 examined the relationship between the self- and ingroup-advantages in perceptual matching identified by Sui et al. (2012) and Moradi et al. (2015). In two separate matching tasks, I replicated the self- and ingroup-advantage effects in response time, accuracy and perceptual sensitivity, and found them to be of a comparable magnitude. For response time data, there was a performance advantage for own- (self and team) compared to other-associated (friend, stranger, neutral and rival) shapes. There was also an advantage for friend in comparison to stranger, but no difference between neutral and rival outgroups. Similarly, there was an advantage for own associations in sensitivity, but no difference between friend and stranger, or neutral and rival (other associations). There was a positive correlation between the self- and ingroup-biases in response time, but there was no such relationship for sensitivity scores. Furthermore, there were no relationships between the self and team advantages on the matching task and any of the components of the group identification scales that were measured by self-report.

[8] When the group identification scores were separated into the five subcomponents of solidarity, satisfaction, centrality, individual self-stereotyping and ingroup homogeneity, there were again no significant relationships between any of these group identity scores and the ingroup-bias in response time, accuracy or *d*prime.

The positive correlation between the self and team advantages in response time supports the view that there is an overlap between cognitive representations of the self and of important ingroups (Coats et al., 2000; Smith et al., 1999; Smith & Henry, 1996). Evidence for this was previously demonstrated using a trait judgement paradigm in which participants were faster to respond to self-descriptions that matched the ingroup than to those that did not (e.g., Smith & Henry, 1996). The present results contribute to this line of research by demonstrating that there are similar effects for lower-level attentional and perceptual processes, indicating that a cognitive overlap between self and ingroup representation is the source of shared advantage effects (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 ingroup. However, the relationship was relatively small and not observed for sensitivity advantages.

It should be noted here that the advantage for the self found within the matching task tends to correlate positively within individuals across different blocks and sessions, demonstrating the social prioritisation effect to be robust and trait-like (Stolte et al., 2017; Sui & Humphreys, 2015). For this reason, if the self and group advantages reflected a common process, then we would expect them to correlate with one another in the same way. It could be argued here that the relationship between advantage for the self and the ingroup 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 advantages for the self and team are both driven by something else, such as positive emotion or reward. However, prior research shows that this is unlikely to be the case. 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, but that there was no correlation between the two kinds of biases. Similarly, Stolte et al. (2017) found that associating stimuli to positive emotion also modulated performance on the same paradigm, but that while self-biases and positive emotion biases were correlated within themselves over two sessions, they were not correlated with each other within the same individuals.

Similar to previous work by Sui et al. (2012) and Moradi at al. (2015), there was an advantage for friend in comparison to stranger, but there was no difference in responses for the two outgroup shapes (neutral and rival). That there was an advantage for friend in comparison to stranger may reflect the greater overlap and smaller perceived distance between the self and friend than between the self and stranger (and between friend than stranger) as reported by the IOS and Personal Distance scales. This also may explain why there were no differences in responses to the two outgroups in that there was no difference in perceived distance or overlap between team and neutral and team and rival. This result also implies that the effect stems from ingroup favouritism rather than outgroup derogation. If the latter were the case, differences in performance for the rival and neutral team would be expected, which was not observed.

Although performance on the matching task yielded a similar pattern of results amongst the college rowers and the football fans, there was no

relationship between the advantage for the team and any of the components of the ingroup identification scale as was reported by Moradi et al. (2015), who found a positive relationship between the ingroup perceptual advantages and satisfaction scores. The same ingroup identification scale was used (Leach et al., 2008) but there were no relationships between the team-bias in response time, accuracy or sensitivity and either component (self-investment or self-definition) of the scale. When the scale was split into the five subcomponents of solidarity, satisfaction, centrality, individual self-stereotyping and ingroup homogeneity, there were still no significant relationships between these scores and the in-group performance advantages. It could be that the interpersonal dynamic of identification with a sports team one supports is not the same as identification with a team for which one is an active member. In addition to this, the outgroup teams used as baselines to measure team-advantage effects in the matching task may not be equivalent. Football rivalries can be taken notoriously seriously, often resulting in real feelings of hostility and even aggressive behaviour. Rowing rivalries, at least in this college setting, are typically friendly ones, and members of different teams are likely to share much in common. The slight discrepancy in results here highlights the importance of exploring multiple group exemplars in order to make sure all effects generalise across different social contexts.

Two potential problems with measuring the relations between the advantages for the self and ingroup that arise from the design of this first experiment should be noted. Separate matching tasks performed sequentially were used to measure the two advantages and performance was always

improved with practice in the second task. Potential correlations between self- and ingroup-biases may have been obscured by these task order effects. Similarly, the use of non-equivalent 'other' shape associations made within the personal and group tasks may have created different baselines against which the social biases were measured. For example, responding to self when the other shapes were friend and stranger may have caused a different response pattern to responding to team when the other shapes were neutral and rival names. As discussed, 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 neutral. A second experiment attempted to address the limitations associated with task order and the contrast of self and team shapes with potentially non-equivalent 'other' shapes by including self, stranger, team and rival shape associations within the same task. Using this design also made it possible to test whether the self- and ingroup-biases remained constant in the presence of one another. An implicit association task (Greenwald & Farnham, 2000) was also used to measure whether the ingroup-advantage was supported by positive valence.

Experiment 2

Methods

Participants

As for Experiment 1, sample size was determined by previous work by Sui et al. (2012). Twenty-eight was determined to be the minimum sample size needed to detect a similar effect size ($\eta_p^2 = 0.5$) with the same power (.98) and $\alpha = .001$.

For the correlational analyses, a sample size of 30 was again taken as the minimum required, as determined for Experiment 1. A total of 31 rowers (20 female, mean age = 22.19 ± .64) from several 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.

Stimuli and tasks

In a modified version of the perceptual matching task that was used in the first experiment, self, stranger, team and rival 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 match/mismatch), with 72 trials per condition. The whole task took between 15 and 20 minutes and exactly the same experimental parameters were used as for the first experiment.

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 response time between the team-positive and team-negative association blocks: the greater the *D*, the stronger the implicit positive association with the team.

Questionnaire measures

Participants completed the same group identification (Leach et al., 2008), and identity fusion (Gómez et al., 2011) scales as described for Experiment 1 (Appendix A).

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 modified self-esteem implicit association task and then the group identification and identity fusion questionnaires. The experiment took approximately 45 minutes and participants were again compensated at a rate of £10 per hour for their time.

Statistical analyses

I examined biases for the self and ingroup using repeated measures ANOVAs on response time, accuracy and sensitivity (*d*prime) scores. There were two task types (personal: self and stranger; and group: team and rival); two shape conditions (own: self/team and other: stranger/rival); and 2 match conditions (matched/mismatched). For response time and accuracy scores, a 2 (shape condition) x 2 (task type) x 2 (matched/mismatched) repeated measures ANOVA was used to measure the differences in performance between shape associations. As for Experiment 1, matched and mismatched trials were combined for sensitivity and response criterion and so a 2 (shape condition) x 2 (task type) repeated measures ANOVAs were used to measure the effects of shape association on each of these performance measures.

I measured the relationship between the self- and ingroup-biases along with the relationship between the ingroup-biases and scores from the implicit association task using bivariate correlations. Differences between specific mismatch combinations (i.e., the self shape paired with the team label

compared to the self shape paired with the rival label) were measured using paired samples *t*-tests. An alpha of .05 was used throughout, and all pairwise comparisons reported were corrected using Bonferroni's adjustment.

Results (Experiment 2)

As for Experiment 1, only correct responses were included in the response time analysis and those higher or lower than 2.5 standard deviations from the mean for each participant under each condition were excluded (e.g., Ratcliff, 1993). This again eliminated less than 5% of the overall dataset.

Own-associated biases in response time

As for Experiment 1, there were three within-subject variables: task type (personal or group), shape category (own-associated: self/team, or other-associated: stranger/rival) and match condition (match/mismatch). A 2 (association type: personal/group) x 2 (shape category: own/other) x 2 (match/mismatch) repeated measures ANOVA was computed to test for the effect of shape association on response time scores.

There was no significant effect of association type on response time, showing speed of responses to be generally similar across personal and group associations, $F(1, 30) = .90$, $p = .348$, $\eta_p^2 = .029$. There were significant effects both of shape, $F(1, 30) = 15.86$, $p < .001$, $\eta_p^2 = .346$, and of match condition, $F(1, 30) = 107.11$, $p < .001$, $\eta_p^2 = .781$, with faster responses for own (M = 676.70 ±10.69) than other (M = 694.03 ±9.97) associated shapes, and for matched (M = 655.21 ±10.08) than for mismatched (M = 715.51 ±10.93) pairs. There was a significant interaction between shape and match condition, $F(1,$

30) = 63.50, $p < .001$, $\eta_p^2 = .679$, showing the effect of shape on response time to be dependent on whether the pairs were matched correctly or incorrectly. There was also a significant interaction between association type and shape, $F(1, 30) = 4.01$, $p = .054$, $\eta_p^2 = .118$, but not between association type and match, $F(1, 30) = 3.07$, $p = .09$, $\eta_p^2 = .093$. Finally, there was a significant three-way interaction between association type, shape and match condition, $F(1, 30) = 6.02$, $p = .02$, $\eta_p^2 = .167$.

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, $t(30) = 4.75$, $p < .001$, $d = 0.85$, and team shapes were responded to significantly faster than rival shapes, $t(30) = 3.35$, $p = .002$, $d = 0.60$. For mismatched pairs, stranger shapes were responded to significantly faster than self shapes, $t(30) = 2.09$, $p = .046$, $d = 0.37$, and rival shapes were responded to significantly faster than team shapes, $t(30) = 2.07$, $p = .047$, $d = 0.37$.

These results show that own shapes were responded to significantly faster than other shapes, but only under matched conditions. For mismatched conditions, other shapes were responded to significantly faster than own shapes, however this effect was smaller. See Figure 2.4 for a bar chart depicting response times for matched and mismatched trials under each shape condition, and Table 2.3 for mean (*SD*) scores[9].

[9] The same analysis was run on raw accuracy scores and similarly found that both self and team shapes were prioritised over stranger and rival shapes when correctly paired. When incorrectly paired, self shapes were responded to with marginally lower accuracy than stranger shapes, but there was no difference between team and rival.

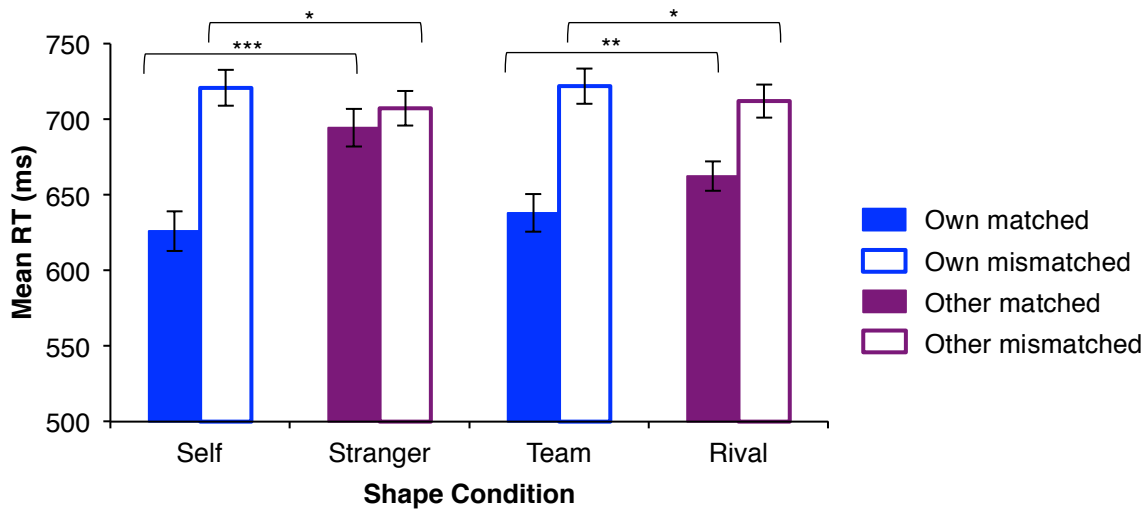


Figure 2.4: Mean response time scores as a function of shape, match and task for Experiment 2. Error bars represent standard errors. *Note*: *** denotes $p < .001$; ** denotes $p < .01$; * denotes $p < .05$.

Own-associated biases in *d*prime

A 2 (association type: personal or group) x 2 (shape: own or other) repeated measures ANOVA found no significant effect of association type, $F(1, 30) = 2.72$, $p = .109$, $\eta_p^2 = .083$, showing sensitivity to be similar for personal and group shapes. There was a significant effect of shape, $F(1, 30) = 5.60$, $p < .001$, $\eta_p^2 = .484$, with greater sensitivity for own (self and ingroup) than for other (stranger and outgroup) shapes. There was no significant interaction between association type and shape, $F(1, 30) = .04$, $p = .834$, $\eta_p^2 = .001$. Thus, sensitivity was higher for self in comparison to stranger, and also for team in comparison to rival. See Figure 2.5 for a bar chart depicting sensitivity scores for each shape condition, and Table 2.3 for mean and standard deviation (*SD*) scores[10].

[10] Again, the same analysis was run on response criterion scores and found that RC was significantly lower for own (self and ingroup) than for other (stranger and outgroup) associations.

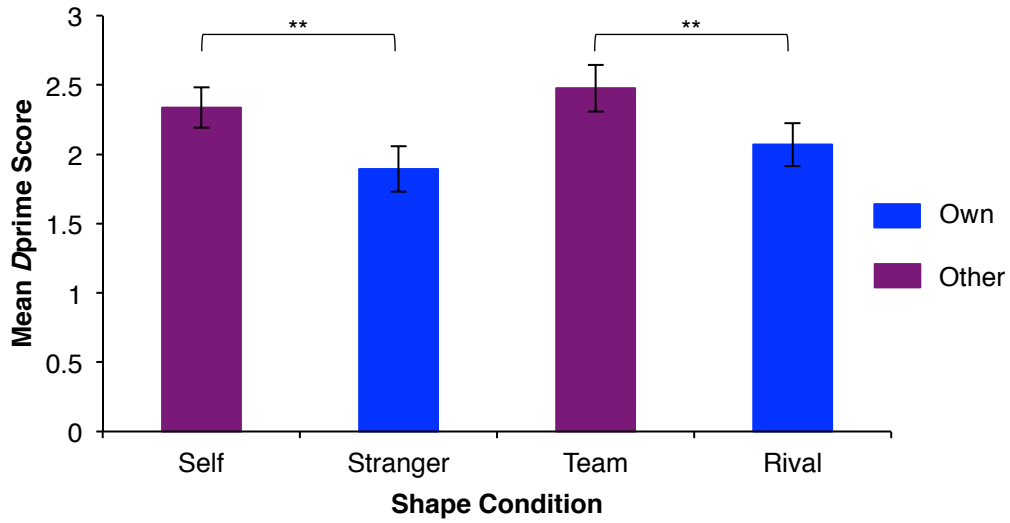


Figure 2.5: Mean *d*prime scores for each shape condition for Experiment 2. Error bars represent standard errors. *Note*: ** denotes $p < .001$.

Table 2.3: Mean response time scores for correct responses and accuracy rates (proportions of correct responses), along with mean *d*prime scores for Experiment 2). SDs are in parentheses.

Shape	RT (ms) *matched*	RT (ms) *mismatched*	Accuracy *matched*	Accuracy *mismatched*	*D* prime
Self	626.08 (73.42)	720.75 (65.95)	0.87 (0.12)	0.83 (0.09)	2.33 (0.81)
Stranger	694.40 (69.06)	707.28 (63.70)	0.72 (0.17)	0.86 (0.12)	1.89 (0.92)
Team	638.00 (68.75)	721.96 (65.21)	0.88 (0.12)	0.84 (0.10)	2.48 (0.94)
Rival	662.38 (53.80)	712.07 (61.03)	0.81 (0.14)	0.83 (0.10)	2.07 (0.87)

Analyses of mismatched trials

Overlap for self and ingroup within response time data

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 own shapes. To examine this effect further, performance across specific mismatched shape-label combinations was compared. If an ingroup is represented as part of the self, then we might expect slower response times 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 response time between self shapes paired with team labels and self shapes paired with rival labels[11].

Correct responses were significantly slower when self shapes were presented with team labels than with rival labels, $t(30) = 3.09$, $p = .004$, $d = 0.55$, 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 response times between team shapes presented with self labels than with stranger labels, $t(30) = .71$, $p = .485$, $d = 0.13$[12]. Table 2.4, below, shows the mean response times and proportions of correct responses (accuracy scores) for these mismatched shape-label pairs.

Table 2.4: Mean response times for correct responses and accuracy rates (proportions of correct responses) for specific mismatched pairs (Experiment 2). *Note*. Standard deviations are in parentheses.

Shape + Label	RT (ms)	Accuracy
Self + Team (Ingroup)	730.45 (80.17)	.78 (.14)
Self + Rival (Outgroup)	700.19 (73.63)	.87 (.13)
Team (Ingroup) + Self	720.27 (77.31)	.79 (.15)
Team (Ingroup) + Stranger	726.29 (68.16)	.87 (.11)

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

[12] Similarly, there were significantly higher error rates for self shapes paired with team labels than for self shapes paired with rival labels and also for team shapes paired with self labels than for team shapes paired with stranger labels.

Overlap between self and ingroup and group identification

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 'confusion' between self and ingroup shapes. To test this hypothesis, the difference in response time 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. I then tested 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, $r(29) = .380$ [.021, .651], $p = .035$, and self-investment, $r(29) = .372$ [.002, .645], $p = .040$, but not with self-definition, $r(29) = .303$ [-.079, .646], $p = .086$. Figure 2.6 depicts the relationship between the self-group overlap (indicated by a greater difference between self+*team* and self+*rival* pairs) and identity fusion.

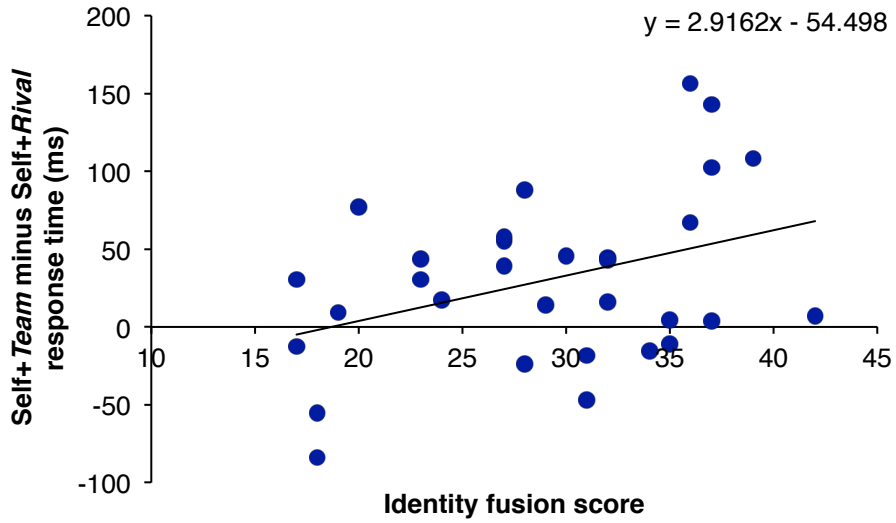


Figure 2.6: The positive relationship between the difference in response time scores (ms) for self+*team* and self+*rival* mismatched pairs and identity fusion.

Correlations between biases for the self and ingroup

There was an advantage for self in comparison to stranger and for team in comparison to rival in response time (for matched pairs only) and also in sensitivity. I next tested whether there was a relationship between the self- and ingroup-prioritisation effects. Performance advantages for self and ingroup were taken as the difference scores between self and stranger and between team and rival. There was no significant relationship between the advantages for the self and ingroup in response time, $r(29)= -.301$ [-.623, .266], $p = .100$, although a negative trend implied that as prioritisation for the team increased, prioritisation for the self decreased. There was no relationship between the advantages for the self and ingroup in sensitivity (*d*prime), $r = -.076$ [-.374, .202], $p = .683$. Figure 2.7 depicts the relationship between the advantage scores for self and ingroup in response time (a) and in sensitivity (b).

The positive relationship between the advantage scores for the self and ingroup in response time observed in Experiment 1 was not replicated in Experiment 2 and in fact there was a trend towards a negative relationship. It appears that when self and ingroup are directly competing for attention (rather than being presented separately), one takes priority over the other, but when they are separated, a similar level of prioritisation applies to both.

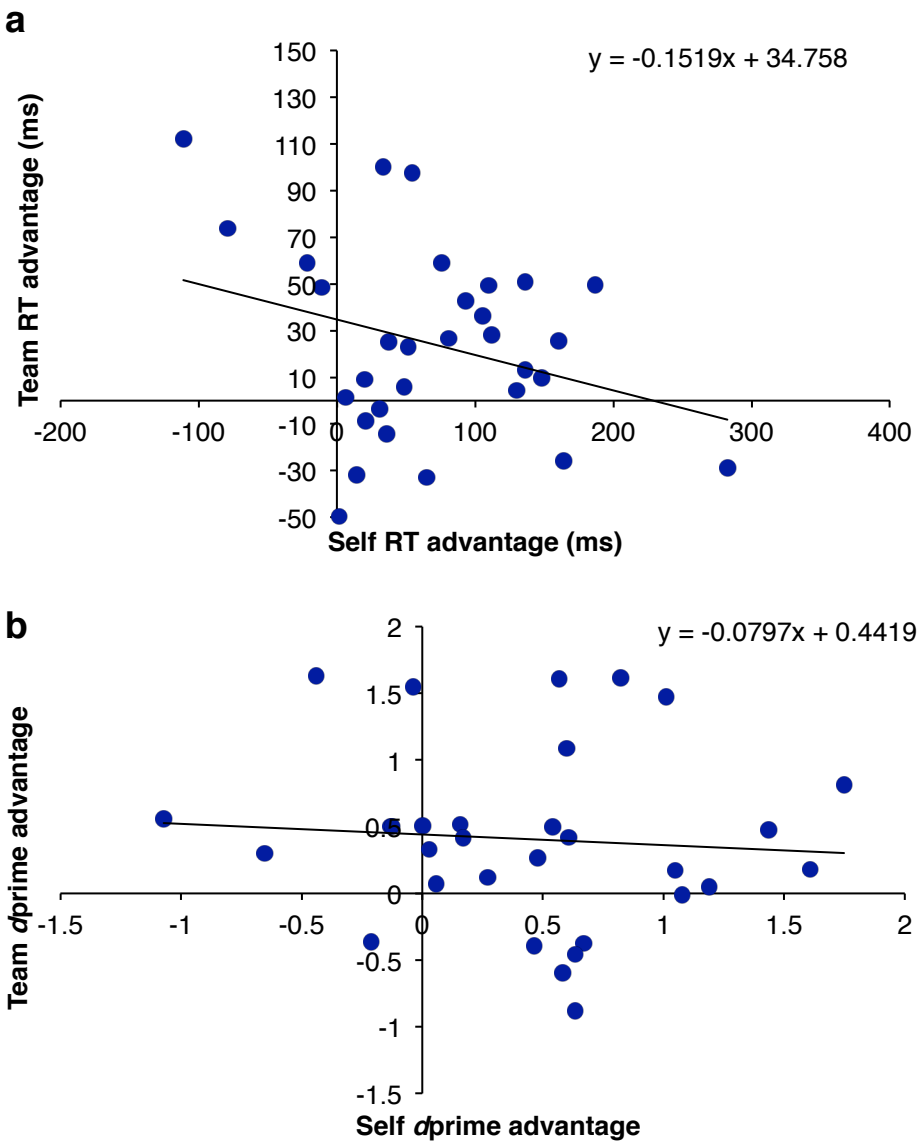


Figure 2.7: The relationship between the advantages for the self and ingroup in response time (a) and sensitivity (b) for Experiment 2.

Implicit association task

An implicit association task was used to assess whether the ingroup performance advantages were related to implicit positive emotion. All participants showed a moderate to strong preference for their own team compared to the rival team, such that they found it easier to associate positive attributes with the name of their own team (Mean implicit association score d = .84 ± .05). However, there was no significant correlation between the implicit association scores and the ingroup-advantage in either response time, $r(29)$= -.180 [-.527, .145], p = .379, or in sensitivity, $r(29)$= -.158 [-.519, .284], p = .440. This suggests ingroup-prioritisation in the perceptual matching task was not associated with positive valence.

Self-report measures

Identity fusion and group identification

As for Experiment 1, correlation analyses were used to test whether the ingroup-biases were associated with identity fusion or identification with the team. The mean score for identity fusion was 29.06 (7.10), the mean score for self-investment was 18.88 (2.41) and the mean score for self-definition was 8.65 (1.86). There was a significant positive relationship between identity fusion and self-investment, $r(29)$= .716 [.513, .859], p< .001; between identity fusion and self-definition, $r(29)$= .546 [.267, .761], p< .001; and between self-investment and self-definition, $r(29)$= . 474 [.149, .716], p= .007.

There were no significant correlations between the ingroup-bias in response time and self-reported measures of identity fusion, $r(29)$ = .171 [-.257,

.546], p = .359, self-investment, $r(29)$ = -.100 [-.504, .304], p = .593 or self-definition $r(29)$ = .017 [-.297, .332], p = .928. Similarly, there were no significant correlations between the ingroup-bias in sensitivity and identity fusion, $r(29)$ = -.166 [-.496, .235], p = .373, self-investment, $r(29)$ = -.148 [-.494, .224], p = .426 or self-definition, $r(29)$ = .004 [-.227, .239], p = .983[13].

Discussion (Experiment 2)

Experiment 2 aimed to provide a cleaner design with which to measure the relationship between the advantages for the self and ingroup in the perceptual matching task by eliminating task order effects and limiting the social comparisons of self and team to stranger and rival (i.e., not including friend and neutral associations). Self, stranger, team and rival associations were made within one task and the same questionnaire measures of fusion and group identification were taken. An implicit association task measured implicit positive valence associated with the ingroup in order to assess whether positive emotion plays a role in driving the ingroup-bias effect. I found that response time and sensitivity performance was again enhanced for self and team shapes in comparison to stranger and rival shapes, and these advantage effects were of a comparable magnitude. When difference scores between self and stranger and team and rival were taken, there were no significant relationships between self- and ingroup-advantages in response time and sensitivity. There was also no relationship between the advantage score for the ingroup and associated implicit positive valence. Similar to Experiment 1, the self-report measures of

[13]When the group identification scores were separated into the five subcomponents of solidarity, satisfaction, centrality, individual self-stereotyping and ingroup homogeneity, there were again no significant relationships between any of these group identity scores and the ingroup-bias in response time, accuracy or *d*prime.

group identification were not correlated with the social biases. Analysis of the mismatched trials showed that responses to self shapes paired with team labels were responded to slower and with higher error than self shapes paired with rival labels, pointing to difficulty in discriminating self and ingroup stimuli. This effect was stronger in individuals reporting higher levels of identity fusion and group identification.

This experiment replicated Experiment 1 in that there were advantages for the self and ingroup relative to stranger and rival which were of a comparable magnitude. However, a trend towards a negative relationship between the self- and ingroup-biases in response time may suggest that when both self and ingroup are salient at the same time and competing for attention, one takes priority over the other. This would be consistent with the principle of functional antagonism, a central tenet of self-categorisation theory (Turner et al., 1987), which holds that as the salience of one identity (personal or social) increases, the salience of the other will subside. As the effect was not significant, however, conclusions that can be drawn are limited. Similar to Experiment 1, there were no reliable relationships between the self- and ingroup-biases and measures of group identification or identity fusion.

There is evidence to suggest that emotional salience can guide attention and modulate early perceptual processing (Phelps et al., 2006; Schupp et al., 2003). This has led to speculation that it could be the emotional significance of group identity that drives the effect on perceptual matching such that ingroup shapes acquire a positive emotional tag (e.g., Moradi et al., 2015). This was examined using an implicit measure of positive valence associated with the

ingroup (adapted from the self-esteem implicit association task developed by Greenwald & Farnham, 2000). No correlation was found between the ingroup performance advantage in the matching task and the implicit association score and, accordingly, there is no evidence to suggest that the advantage for the ingroup is underpinned by emotional or motivational factors. Stolte et al. (2017) concluded that the self-bias effect found in this task does not simply reflect the positive valence associated with the self, and results from the present study indicate this is true of ingroup-bias too. However, conclusions from null results should of course be interpreted with caution.

The pattern of results showed a clear advantage for self and team-associated shapes, but performance for rival shapes was also enhanced compared to stranger shapes. The same pattern was observed in the first experiment in which responses for rival shapes appeared 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. Perhaps, then, the enhanced performance shown for the rival team in the second experiment reflects a certain camaraderie. Alternatively, the enhanced attention paid to rival in comparison to stranger may reflect threat attached to the rival team (e.g., Bishop, 2008). This highlights the need for future research to examine this rival-as-friend versus rival-as-threat question by utilising different exemplars of social groups such as nationalities or religions.

Although there was no significant relationship between the bias for the self and ingroup, the interesting effects observed for specific combinations of

shape-label mismatches indicated a difficulty in distinguishing self from ingroup stimuli. Slower response times and higher error rates for self shapes paired with team labels than self shapes paired with rival labels and, within accuracy data, team shapes paired with self labels than team shapes paired with stranger labels, imply a cognitive overlap between self and ingroup representation. It appeared to be more difficult to reject self and team information appearing together as a correct pair, than self and rival or team and stranger combinations, suggesting that a shared representation may lead to confusion in distinguishing between self and ingroup when fast and automatic perceptual discrimination is required. Furthermore, this effect was stronger in those who reported higher levels of identity fusion and group identification. This 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). The present results provide novel evidence for an overlap between self and group-related stimuli even when the stimuli are newly learned as belonging to the self or to the group.

Chapter discussion

Across two experiments, I found a performance advantage in perceptual matching for self and team-associated shapes compared to friend, stranger, neutral and rival shapes, replicating results reported by Sui et al. (2012) and Moradi et al. (2015). Furthermore, the self- and ingroup-biases were of a similar magnitude. There was some evidence of a relationship between the two prioritisation effects, with a marginal positive relationship observed in

Experiment 1, but a trend towards a negative relationship observed in Experiment 2. Although the correlational evidence was limited, slower response times and higher error rates for self+*team* than self+*rival* and team+*stranger* mismatched pairs implied an overlap in cognitive representation for newly learned self and ingroup stimuli. This effect was further corroborated by being positively associated with identity fusion and group identification, with those reporting higher levels of each finding it more difficult to distinguish self and ingroup stimuli.

Previous research and theory suggests that similar effects of self and ingroup on various forms of cognition are driven by a shared mental representation of the two 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 ingroups 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 ingroup as an extension of the self (e.g., Tajfel, 1982), experimental evidence for this has often relied on self-report measures and trait judgements, which are not entirely protected from demand characteristics or familiarity effects (e.g., Coats et al., 2000; Smith et al., 1999; Smith & Henry, 1996). The perceptual matching paradigm provides a way to measure implicit prioritisation for the self and ingroup using the same metric without relying on overly familiar stimuli. Similar magnitudes of self- and ingroup-biases implied a common process, but there were not consistent relationships between the two kinds of prioritisation. The

use of non-equivalent baseline measures (stranger name vs. rival team name) and individual differences in perceived closeness to the stranger and rival may, however, have obscured a potential relationship. Future research would benefit from utilising uniform ingroups and outgroups to eliminate effects of the different dynamics between the multitude of rowing teams and their respective 'rivals' that were involved (e.g., team status and prestige, seriousness of rivalry, time spent with rival team members and so on). This is examined in subsequent experiments within this thesis.

Results from the perceptual matching paradigm provide a measure of automatic overlap between self and ingroups without relying on familiar stimuli. However, there is an argument to suggest that differential familiarity within the targets remain. For example, that greater familiarity with ingroup labels could have helped with the perceptual matching judgements. Experiments 4, 5 and 6 (Chapter 4), utilising the minimal group paradigm, address this concern. On a similar note, it could be suggested that differences in word usage frequency could explain, in part, the advantage effects for self and ingroup 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 for self compared to stranger and team compared to rival. However, 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 has a lower frequency usage value than 'friend' and 'other'. Although this evidence suggests word

usage frequency is unlikely to be a driving factor for these bias effects, the concern is also addressed in Chapter 4 using minimal groups.

Findings from the mismatched pair combinations in Experiment 2 were in line with the connectionist model of self and ingroup representations put forward by Smith et al. (1999), who observed a response time facilitation for trait judgements on which the self matched the partner or the ingroup. A cognitive overlap in self, partner and ingroup representations was proposed to account for these results. In the present study, presenting a self shape with a team name or vice versa impeded performance. This is likely to be because of a difficulty distinguishing self from ingroup at the speed of the task. The stronger effect found in those higher in group identification provides novel evidence for the notion that explicit attitudes towards the ingroup affects the ability for perceptual discrimination between stimuli that are newly learned as belonging to the self or to the group.

The results from the two experiments reported in this chapter support and extend previous work by Sui et al. (2012) and Moradi et al. (2015), who initially demonstrated the self- and ingroup-biases in performance on the same perceptual matching task. While Moradi et al. (2015) utilised a sample of football supporters to measure ingroup-bias, here the same effect was found in a different sample: members of college rowing teams. This implies that the ingroup-bias in perceptual matching is likely to be stable across a variety of social groups and demographic characteristics of individuals. That there were no differences in performance between rival and neutral associations in Experiment 1 suggests that the team effects are rooted in ingroup favouritism as

opposed to outgroup 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. A smaller advantage for the team in comparison to the rival in Experiment 2 was detected, which demonstrates the need to examine this effect further with a wider range of social groups. Outgroups in the traditional sense are social groups that an individual does not identify with. In the present sample, however, individuals may perceive some similarity between themselves and 'outgroup' members because they are all rowers at the same university. It is possible, however, that potential differences could be obscured by a greater threat associated with the rival and this is addressed in Chapter 3. That social bias reflects ingroup favouritism and not outgroup derogation is in line with social identity theory's formulation, that ingroup favouritism is primary and present even in the absence of intergroup hostility or competition (e.g., Hinkle & Brown, 1990).

Perhaps most surprising from the present study was that there were no consistent relationships between the self- and ingroup-advantages and any of the self-report questionnaire measures. In contrast to findings from Moradi et al. (2015), there were no relationships between any of the components of group identification and the strength of ingroup-advantage. This implies that lower-level attentional prioritisation for a social ingroup is not necessarily related to subjective, self-reported, levels of ingroup identification or feelings of unity with

the group. Low-level perceptual discrimination, then, is not, in this case, affected in a top-down manner by pre-existing attitudes and interpersonal perspectives.

Overall, the results from this first experimental chapter provide novel evidence to suggest some overlap between the processes at play behind self- and ingroup-prioritisation in attention and perception. Further studies are needed to measure the relationship between the two kinds of social biases in different samples and exemplars of social ingroups. The first study gives a good foundation to further examine individual differences in social biases along with the cognitive and neural mechanisms by which links between self- and ingroup-biases arise.

Chapter 3: Prioritisation for the self and ingroups in military personnel

Chapter background

As outlined in the introduction chapter, biases for the self and social ingroups in perceptual matching have been reliably demonstrated across several studies. Experiments 1 and 2 provided some evidence for a shared process driving the prioritisation effects and for an overlap in the representation of stimuli newly associated with the self and social ingroups. Although performance in perceptual matching was enhanced for friend associations compared to stranger associations, there were no differences between 'neutral' and 'rival' outgroups. It is unclear whether different kinds of ingroup/outgroup relations would change this pattern of ingroup-bias. For example, previous research shows that stimuli associated with social threat tend to enhance perception and capture attention. Therefore, the perceived threat value of a social group may also modulate performance on the perceptual matching task. Again, using modified versions of the matching task, the experiment presented in this chapter examined the influence of differing intergroup contexts on perceptual prioritisation for ingroups amongst a sample of military personnel. This experiment also expanded on Experiments 1 and 2 in measuring the relationship between self and ingroup prioritisation effects under different ingroup exemplars, along with the extent to which these are underpinned by group identification, identity fusion and self-construals.

Introduction

Biases for the self and ingroups in perception and attention

Experiments 1 and 2 found performance advantages in perceptual matching for own-associated stimuli (self and ingroup) compared to other-associated stimuli (friend, stranger, neutral outgroup and rival outgroup) in a sample of college rowers. These findings replicated results reported by Sui et al. (2012) and Moradi et al. (2015), who found robust performance facilitation effects for self and ingroup stimuli on a similar perceptual matching task. Expanding on this work, Experiment 1 demonstrated a positive relationship between the response time biases for the self and ingroup which indicated the possibility of a common process driving self- and ingroup-prioritisation. The results suggested an overlap between self and ingroup representation, consistent with social identity theory and self-categorisation theory (Brewer, 1991; Tajfel, 1982; Turner et al., 1987). This was corroborated by participants showing poorer performance for pairs of self shapes mismatched with team labels than self shapes mismatched with rival labels in Experiment 2, showing greater difficulty in distinguishing self from team stimuli, even when the social value of the stimuli was newly learned.

Despite these novel findings, the relationship between the response time biases for self and ingroup in Experiment 1 was only marginal and not present in Experiment 2. It may then be that self- and ingroup-biases are driven by partially but not entirely overlapping processes. Firm conclusions regarding this relationship were limited within Experiments 1 and 2 because the inclusion of members of a variety of rowing teams may have created non-uniform measures

of team-bias within participants, potentially obscuring a stronger relationship. For example, rowing teams varied with regards to team status, prestige and the seriousness of the reported rivalry. Therefore, the conception of 'rival' and even 'neutral' teams may have contained different levels of perceived competition between participants. As differential scores were used to measure the biases, this may have led to non-equivalent 'baseline' scores. The present study aims to overcome this limitation by replicating the results across a more uniform sample: three (equivalent) units of military personnel and the same outgroup exemplars for members of each unit. By including fewer social ingroups and outgroups, potential confounding effects of differing dynamics between the multitude of rowing teams and their respective 'rivals' should be reduced.

Furthermore, although they were established team members, as university students in a competitive academic environment, the rowers (from Experiments 1 and 2) were also likely to be self-focused individuals who spend a great deal of time working toward goals relating to personal success. Military personnel are likely to be more group-oriented, commonly having to make decisions that best benefit the units that they are working with whilst leaving self-interests aside. The present experiment examines the relationship between self- and ingroup-biases within this sample of individuals. Social identity theory is rooted in the premise that the psychological self extends to include social ingroups such that group memberships form a vital part of self-representation (Tajfel, 1982). More recently, the theory of identity fusion has been proposed as a unique form of alignment with a group such that for individuals highly aligned with their group, the personal self and the social self become completely at one

(Swann et al., 2012). Thus, a more robust relationship between self- and ingroup-prioritisation might be expected within individuals for whom group membership is a central part of the self-concept.

Local and extended group alignment

As mentioned above, if the self and group advantage effects *are* driven by a common process, then we would expect a stronger relationship between the two to emerge when the ingroup-bias is measured in a more uniform way across participants (by the inclusion of members of equivalent social groups, along with the same outgroup exemplars for each group) and also amongst a sample of group-oriented individuals for which ingroup affiliation is an important part of self identity. It is possible, though, that in fact distinct processes drive the self and ingroup advantage effects. In this case, there might be a common process specific to group-oriented processing that is distinct from the self. To my knowledge, no research has directly measured whether the amount of perceptual bias shown for one social ingroup is predictive of the amount shown for another. If this were the case, it could be argued that ingroup-prioritisation is a broad, trait-like phenomenon rather than specific to particular social categories.

There is some evidence from identity fusion research to suggest that self-reported alignment with certain individuals predicts self-reported alignment with a larger social ingroup (Vázquez, Gómez, Ordoñana & Paredes, 2015). Identity fusion is described as a unique form of group alignment that entails a 'visceral feeling of oneness with the group' (Swann et al., 2012, p. 1) and the literature

on this topic broadly distinguishes between two kinds of fusion: local and extended. Local fusion occurs with relatively small groups in which individuals are likely to know one another personally, for example, within families, sports teams and military units. Extended fusion, on the other hand, refers to alignment with relatively large collectives that are composed of many individuals. Examples of the latter include religions, ethnicities and political parties, and within these larger groups in which personal relationships with all members would not be possible, ties are formed based on shared histories, causes and values.

In addition to local and extended fusion, interpersonal fusion is proposed as a third form of alignment in which two individuals are fused with one another and this may occur, for example, between siblings and close friends (Vázquez et al., 2015). Interestingly, there is research evidence to suggest that interpersonal fusion (in this case, fusion with a sibling) is positively associated not only with endorsement of extreme behaviours (fighting and dying) on the sibling's behalf, but also with a form of extended fusion with the country as a whole (Vázquez et al., 2015). In this study, participants responded to a questionnaire that included measures of fusion with a sibling, willingness to fight or die for their sibling (e.g., 'I would fight someone who was physically threatening my sibling') and measures of fusion with their country. The results showed that fusion with the sibling predicted not only willingness to fight or die for their sibling, but also fusion with their country, and this held when gender, gender similarity, age and difference in age between siblings were controlled for. The authors note that this result should not be interpreted purely in

dispositional terms because previous research has demonstrated that fusion is in fact not related to personality traits (Swann et al., 2009) and by definition should be exclusive to one group. However, it could be argued that interpersonal fusion facilitates extended fusion by the projection of familial ties onto larger social collectives.

This research may suggest a common mechanism underlying the phenomenon of identity fusion both between individuals and with larger social groups. Results from Experiment 1 in the previous experimental chapter demonstrated a relatively small but significant relationship between prioritisation for the self and for the ingroup in the perceptual matching task. However, the relationship between attentional biases for different social ingroups has not yet been measured. The present experiment examined whether there is a positive relationship between attentional biases for two separate types of group alignment, which may indicate a general, group-related processing mechanism. Previous studies within this topic of social psychology have tended to rely on self-report measures (e.g., the aforementioned study by Vázquez et al., 2015), which are useful in providing information about explicit cognitive processes and higher-level decision-making. The study described in this chapter, however, measures automatic perceptual prioritisation of ingroup information in order to examine whether similar conclusions can be drawn at a lower level of information processing.

Attentional prioritisation for threat

In Experiments 1 and 2, there were no differences in performance between the rival and neutral teams and performance for the rival was enhanced compared to the stranger. As discussed, these findings could be interpreted as the rival, in this context, being more akin to a friend in the sense that individuals across the teams were members of the same university and would be likely to share similarities and even friendships with one another. Alternatively, the slightly enhanced performance for the rival may have occurred because of an association with competitive threat.

A large body of research evidence has demonstrated that threatening information receives attentional prioritisation over neutral information. For example, studies have shown that images depicting threat or danger such as spiders, snakes or angry faces receive higher priority in visual selection tasks than non-threatening stimuli (e.g., Devue et al., 2011; Ohman et al., 2001; Schmidt, Belopolsky & Theeuwes, 2012). In addition to the use of threatening images, research has used fear conditioning paradigms as a more ecologically valid way to measure attentional capture to threat-associated stimuli. For example, Schmidt, Belopolsky and Theeuwes (2015) included two forms of task-irrelevant distractor stimuli in a visual search task: one that had previously been associated with an electrocutaneous stimulus. Results showed search times were significantly slower on the task when the threat-associated stimulus was present than when a physically identical but threat-neutral distractor stimulus was present. These findings complemented many similar research studies that have shown attentional capture to fear-conditioned stimuli (e.g.,

Koster, Crombez, Van Damme, Verschuere & De Houwer, 2004; Notebaert, Crombez, Van Damme, De Houwer & Theeuwes, 2011).

It is likely that attentional priority to threat-related stimuli has an adaptive benefit (LeDoux, 1996). This may also be related to benefits observed for processing other kinds of emotionally relevant stimuli such as those associated with high reward (Anderson, Laurent, & Yantis, 2011). However, while there is substantial research evidence demonstrating that stimuli associated with threat tend to be given high priority in attentional processing, only a small amount of research has tested whether these cognitive processes are enhanced for stimuli associated with social groups that are perceived as threatening. One such study utilised the faces of young Black men, who are often stereotyped as violent and dangerous (e.g., Maner et al., 2005; Payne, 2001) to measure the effects of a perceived *social threat* on attentional processes (Trawalter, Todd, Baird & Richeson, 2008). In a dot-probe detection paradigm, the researchers found that amongst a sample of White respondents, attention was enhanced to the faces of young Black men compared to young White men (each presented for only 33ms), indicating that the threat associated with Black male faces modulates early attentional processing. This effect was eliminated when the target faces displayed averted eye-gaze, a cue that may serve to attenuate the perceived threat signal. This study suggests that images of perceived threatening social group members capture and enhance attention in the same way as for evolutionary threats such as dangerous animals. Capellini, Sacchi, Ricciardelli, and Actis-Grosso (2016) also showed responses were slowed for threat stimuli

depicting alongside outgroup compared to ingroup members, showing outgroup stimuli may become more salient when explicit threat is perceived.

The present study aimed to further examine this by including two group associative learning tasks: one including an ingroup, a familiar outgroup and a neutral outgroup, and the other including an ingroup, a familiar outgroup and, importantly, an explicitly threatening outgroup. In this task, the 'threat' outgroup was very pertinent: military personnel were asked respond to 'ISIS'[14] associations in the shape-matching task described in Experiments 1 and 2. For these individuals, this collective enemy would be seen to pose a very real threat not only to national security but also to the lives of themselves and other members of the military. Based on the literature on attentional prioritisation for threat that is discussed above, the present experimental design allowed for examination of whether performance for stimuli associated with a threatening social group is also enhanced.

Aims of the present study

If the marginal correlation between self- and ingroup-prioritisation found in the student sample of Study 1 was indeed indicative of a shared cognitive representation for self and social ingroups, then it is likely that this relationship would be more robust in a sample for which the ingroup is a more central part of the self, as would be expected for military personnel.

Furthermore, if the slightly enhanced performance for the rival (relative to stranger) observed in Experiment 2 was representative of a threat component,

[14] Although this is not officially the correct term for this 'non-state actor' threat group (Da'esh is the recognised name under MoD guidance), it was advised that this was the term most commonly used amongst the personnel at the time of the study taking place.

then an explicitly threatening group association may be given higher priority than a neutral group in the matching task. The experiment reported in the present chapter utilised three versions of the perceptual matching paradigm (Sui et al., 2012) to measure the relationships between the self- and ingroup-advantages in a sample of military personnel, along with the processing of stimuli associated with a threatening social group.

Participants performed three separate matching tasks: one in which they learned to associate self, friend and stranger labels with three separate geometric shapes; one in which they learned to associate unit, familiar unit and neutral unit labels with three different geometric shapes; and a third in which they learned to associated country (UK), ally (America) and threat (ISIS) labels with three different shapes again. In all three tasks, participants had to respond to randomly presented shape-label pairs as correctly or incorrectly matched according to the newly learned associations. Performance advantages were taken as the differences in response time and sensitivity between own (self/unit/country) shapes and other (friend/familiar/ally or stranger/neutral/threat) shapes, and the relationships between the advantages for self and ingroups were measured. In addition to the matching tasks, subjective measures of perceived closeness and overlap between self, friend and stranger; unit, familiar unit and neutral unit; and country, ally and threat were taken along with self-reported measures of ingroup identification, identity fusion, and independent and interdependent self-construals. Moradi et al. (2015) found a positive correlation between ingroup-bias and satisfaction with the ingroup amongst football supporters. However, Experiment 1 did not find

any relationships between self- and ingroup-biases and self-reported levels of group identification or identity fusion. Here, the same measure of ingroup identification was used with the aim of further examining the discrepancy between these findings.

I hypothesised that if prioritisation for the self and ingroups are driven by a common mechanism, then a positive correlation between the two biases would be observed. If, however, self- and ingroup-biases draw from distinct processes, then there would be a positive correlation between biases for the two social ingroups independent from the self.

Additionally, if attentional capture to threat enhances performance on the perceptual matching task, a performance advantage for the threat group on the country association task would be expected. If, however, the biases are purely rooted in ingroup favouritism, as proposed by Moradi et al. (2015) and concluded in the previous experimental chapter (Experiments 1 and 2), then the pattern of results should be similar for the two group tasks.

Experiment 3

Methods

Participants

Military personnel were recruited with the help of a military advisor at the Defence Science and Technology Laboratory, who arranged for short presentations advertising the study to be given onsite to members of three different units. Based on previous work by Sui et al. (2012), a significant interaction effect in a 3 (shape condition) x 2 (match condition) design was

observed with eighteen participants, giving a power of .98 at an alpha of .001[15]. To detect interactions between the main effects in a 3 (task: personal, unit, or country) x 3 (shape association: own, familiar other or unfamiliar other) x 2 (match: match vs. mismatch) design with a similarly large effect size at the same level of power and α, a sample size of just 10 would be sufficient. For the planned correlation analyses, a useable sample size of 37 was determined to be the minimum necessary based on similar work by Stolte et al. (2017), who found this number gave a power of .83 (α = .01) in detecting a medium to large effect size.

A total of 48 military personnel completed the experiment (46 male, mean age = 25.73, *SD* = 4.68) and all had normal or corrected-to-normal vision. The personnel were from three units: two Infantry regiments (*N* = 16 and 15) and one regiment of The Royal Artillery (*N* = 17). The ranks held by participants varied across units (for one of the Infantry regiments there were 4 lance corporals and 12 fusiliers and for the other there were 8 lance corporals and 7 riflemen. Within the Royal Artillery regiment, there was 1 sergeant, 1 corporal, 5 lance bombardiers, and 10 gunners). The length of time that the participants had been in the unit ranged from 3 months to 18 years, with a mean of 4.77 years, *SD* = 3.67. Informed consent was obtained from all participants prior to starting the experiment.

[15] All power and sample size calculations were conducted using either G*Power 3.1.9.2 or MorePower 6.0.4.

Participant exclusions

Thirteen participants had to be excluded from the final analyses because of poor task performance (chance level, <55%) across **one or more** of the matching tasks. Ten participants were excluded for the personal association task, 8 for the unit association task and 6 for the country association task. Note: some participants were excluded from more than one task. A total of thirty-five participants were included within the final analyses of the main effects.

For the correlation analyses, participants were excluded according to performance on the specific tasks included in each analysis. For example, if a participant performed at below chance level on the personal association task but performed well on the unit and country association tasks, their data would be included when analysing the correlation between unit- and country-biases but not when analysing the correlation between self- and country-biases. This method of participant inclusion/exclusion was used in order to preserve data where possible for reasons of statistical power. The sample sizes for each correlation analysis are presented in the relevant section of the results.

Stimuli and tasks

Three perceptual matching tasks adapted from Sui et al. (2012) were performed by each participant and completed sequentially, with the order of tasks counterbalanced across participants. Different shapes were used in each task such that 9 shapes were included overall. 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. All

experimental design and parameters were exactly the same as for Experiment 1. There were six conditions within the task: three shape conditions (self, friend and stranger) and two match conditions (match/mismatch). The whole task took under fifteen minutes.

The unit association task took exactly the same format as the personal association task, except that participants learned to associate three different geometric shapes with names of their own unit, another unit that they were familiar with, and also a neutral civilian organisation (the fire brigade). The 'familiar' units that were included were suggested by the military advisor who helped to coordinate the study and were the same for all participants within one unit. The country association task was the same again, but this time participants learned to associate three different geometric shapes with their own country (United Kingdom), an ally country (America), and a threat group (ISIS). The associations between shapes (diamond, hexagon, circle in the personal task; pentagon, cross, square in the unit task; triangle, rectangle, octagon in the country task) and social labels were counterbalanced across the participants. In all three tasks, the geometric shapes (each 118 x 118 pixels, 4.16 x 4.16cm) were presented randomly above a central white fixation cross against a grey background, with a matched or mismatched label (Arial font, size 36) presented simultaneously below the central fixation point. The experiment was run on Windows laptops using E-Prime software (version 2.0) and displayed on 13-inch screens.

Inclusion of Other in the self (IOS) measures

To assess the perceived overlap between self, friend and stranger; unit, familiar unit and neutral group; and country, ally and threat group, participants completed the IOS scale, developed by Aron et al., (1992) and modified for the group versions, described in the methods section of Experiment 1[16] (See Appendix A).

Questionnaire measures

Measures of group identification were obtained using Leach et al.'s (2008) 14-item multi-component scale, and measures of identity fusion were assessed using the 7-item verbal scale developed by Gómez et al. (2011). Both of these scales are described in greater detail in the methods section of Experiment 1. The self-construals scale (Singelis, 1994) was also included to measure the strength of independent and interdependent self-construals within each participant. This is a 24-item scale, with half of the items relating to independence, the separateness and uniqueness of the individual often stressed in the West; and half of the items relating to interdependence, the emphasis on connectedness and relations often found in non-Western cultures. For each item, participants indicate the extent to which they agree or disagree with a statement on a 7-point scale from 1 (*strongly disagree*) to 7 (*strongly agree*). For example, 'I enjoy being unique and different from others in many respects' is an example of an independent item and, 'My happiness depends on the happiness of those around me' is an example of an interdependent item.

[16] While Experiments 1 and 2 also utilised the Personal Distance scale developed by Sui et al. (2012), only the IOS scales were used in the present study because the Personal Distance scores were previously highly correlated with the IOS scores.

The items for each sub-scale are then summed to give a total score for each component. All questionnaire materials are presented in Appendix A.

Procedure

The study took place in classrooms at the Barracks at which participants were based (across three different locations, one for each unit involved) and there were five participants per experimental session, with desks arranged such that participants could not see one another's screens and questionnaire answers. Participants first performed the three association tasks, the order of which was counterbalanced across participants such that one third of the participants performed the personal association task first, the unit association task second and the country association task last; another third of the participants performed the unit association task first, the country association task second and the personal association task last; and the final third of the participants performed the country association task first, the personal association task second and the unit association task last. Following completion of the three perceptual matching tasks, all participants then completed the group identity, identity fusion, self-construal, personal distance and IOS scales. The questionnaires were always completed after the matching tasks in order to keep the order the same across participants for the individual-level predictions (correlations). The experiment took approximately one and a half hours in total and participants were compensated at the standard military 'Experimental Test Allowance' rate[17].

[17] This was at a rate of £2.78 per test, up to a maximum of £13.90 (before tax and NI deductions).

Statistical analyses

The data were analysed in SPSS 24 (Armonk, New York: IBM Corp). I examined biases for the self, unit and country using repeated measures ANOVAs on response time and sensitivity (*d*prime) scores. There were three task types (personal: self, friend and stranger associations; unit: own unit, familiar unit and neutral group associations; and country: own country, ally country and threat group associations); three shape conditions (own: self/unit/country; familiar other: friend/familiar unit/ally country; and unfamiliar other: stranger/neutral group and threat group); and 2 match conditions (matched/mismatched). For response time scores, a 3 (shape condition) x 2 (task type) x 2 (matched/mismatched) repeated measures ANOVA was used to measure the differences in performance between shape associations.

As for Experiments 1 and 2, perceptual 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). The response criterion for each participant was also calculated (Macmillan, 1993). As matched and mismatched trials were combined for sensitivity and response criterion, a 3 (shape condition) x 2 (task type) repeated measures ANOVA was used to measure the effects of shape association on each of these performance measures.

I measured the relationship between the biases for the self, unit and country using bivariate correlations along with the relationships between own-associated biases and the self-report measures. I also compared the magnitude of the self and ingroup biases between the rower sample (Experiment 1) and

the military sample (the present experiment) in a cross-experimental comparison using independent samples t-tests. An alpha of .05 was used throughout, and all pairwise comparisons reported were corrected using Bonferroni's adjustment.

Results

As for Experiments 1 and 2, only correct responses were included for the response time analyses, and those higher or lower than 2.5 standard deviations from the mean response time for each participant under each condition were excluded (Ratcliff, 1993). As task performance was poorer within this experiment, the first block for each task was excluded from data analysis to reduce total error rates such that the first blocks served as an extended practice.

Own-associated biases in response time

A 3 (task: personal/unit/country) x 3 (shape condition: own/familiar other/unfamiliar other) x 2 (matched/mismatched) repeated measures analysis of variance (ANOVA) was used to test for the effect of shape association on response time scores[18].

There was a marginal effect of task type, $F(2, 68) = 2.75$, $p = .071$, $\eta_p^2 = .075$, with response times slowest for the personal task ($M = 719.55 \pm 11.94$), followed by the country task ($M = 700.20 \pm 11.18$), then the unit task ($M = 698.48 \pm 13.84$). After Bonferroni-adjustment, however, there was no difference

[18] The same analysis was conducted including the number of years in the military unit as a covariate and the main effect and interaction results remained the same.

in speed of responses between personal and country (p = .093), personal and unit (p = .161) or unit and country (p = 1.00) tasks.

There was a significant effect of shape, $F(2, 68) = 20.28$, $p < .001$, $\eta_p^2 = .374$, with own shapes (M = 688.80 ± 11.63) faster than familiar other (M = 716.21 ±11.23) and unfamiliar other (M = 713.23 ± 11.08) shapes (both $p < .001$), but with no difference between the two other conditions (p = 1.00). There was also a significant effect of match condition, $F(1, 34) = 160.89$, $p < .001$, $\eta_p^2 = .826$, with faster responses made for matched (M = 676.13 ± 10.86) than for mismatched (M = 736.03 ± 11.52) trials.

There was no significant interaction between task and shape, $F(4, 136) = 1.39$, $p = .242$, $\eta_p^2 = .039$, demonstrating the effect of shape to be similar across personal, unit and country tasks. There was, however, a marginal interaction between match and task, $F(2, 68) = 3.08$, $p = .053$, $\eta_p^2 = .083$, and a significant interaction between shape and match, $F(2, 68) = 24.94$, $p < .001$, $\eta_p^2 = .423$. There was no three-way interaction between shape, match and task, $F(4, 136) = 1.219$, $p = .306$, $\eta_p^2 = .035$.

In order to decompose the interaction between shape and match, separate one-way repeated measures ANOVAs were conducted for matched and mismatched trials. The mean was created for own shapes of self, unit and country scores; for familiar other shapes of friend, familiar unit and ally scores; and for unfamiliar other shapes of stranger, neutral and threat scores (N = 35). There was a significant effect of shape on response time for matched trials, $F(2, 68) = 33.29$, $p < .001$, $\eta_p^2 = .495$, with faster response times for own compared

to familiar and unfamiliar others (both $p < .001$), but with no difference between the two other conditions ($p = 1.00$). However, there was no significant effect of shape on response time for mismatched trials, $F(2, 68) = 0.05$, $p = .947$, $\eta_p^2 = .002$, showing that the effect of shape condition on response time was driven only by matched pairs.

Figure 3.1 presents the mean response times for own and other shape conditions across both matched and mismatched trials. Table 3.1, below, presents the mean response time scores for each shape condition within each task along with the corresponding proportion of correct responses.

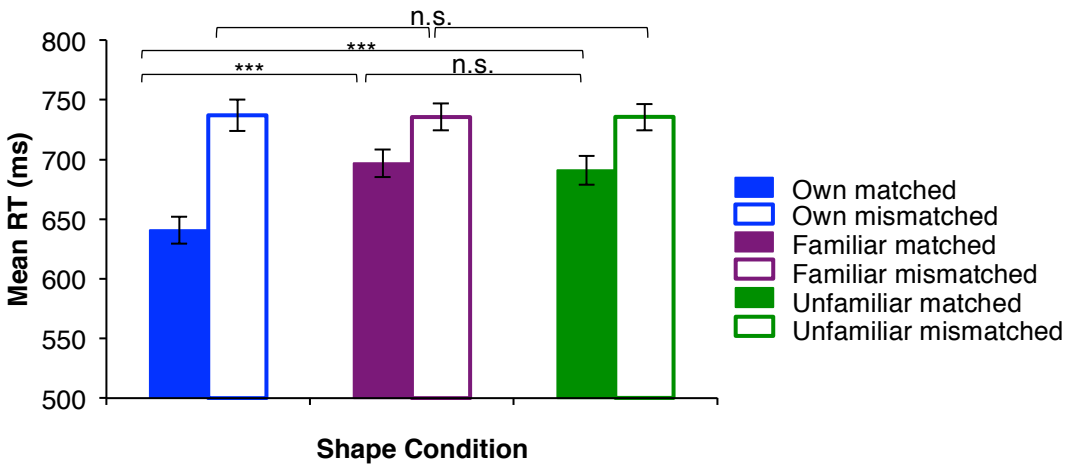


Figure 3.1: Mean response time (RT) scores as a function of shape association (own/familiar other/unfamiliar other) and match condition. Error bars represent standard errors. *Note*: *** denotes $p < .001$; n.s. denotes non-significant.

In summary, the response time data followed the same pattern for each task. Responses were significantly faster for own shapes (self, unit and country) compared to other shapes (friend and stranger/familiar and neutral outgroups/ally and threat outgroups), but there were no differences between

familiar and unfamiliar other shape conditions. A significant interaction showed the prioritisation effect was driven solely by the matched trials[19].

Own-associated biases in dprime (perceptual sensitivity)

A 3 (task: personal/unit/country) x 3 (shape: own/familiar other/unfamiliar other) repeated measures ANOVA[20] found a significant effect of task on sensitivity, $F(2, 68) = 4.62$, $p = .013$, $\eta_p^2 = .120$. Sensitivity was greater for the country ($M = 2.45 \pm .19$) than for the personal ($M = 1.82 \pm .22$) task ($p = .027$), but not for the unit ($M = 2.26 \pm .20$) than for the personal task ($p = .077$). There was no difference in sensitivity between unit and country tasks ($p = 1.00$). There was a significant effect of shape, $F(2, 68) = 35.17$, $p < .001$, $\eta_p^2 = .508$, with sensitivity greater for own than for familiar and unfamiliar other shapes (both $p < .001$), but with no difference between the two other shape conditions ($p = .265$). There was no significant interaction between task and shape, $F(4, 136) = 1.46$, $p = .219$, $\eta_p^2 = .041$, showing the effects of shape on sensitivity to be equivalent across the personal, unit and country association tasks.

Similar to the response time data, the *d*prime scores demonstrated performance advantages for self compared to friend and stranger, for unit compared to familiar and neutral outgroups, and for country compared to ally and threat outgroups. There were no significant differences in sensitivity

[19] A similar pattern of results was observed for accuracy data. For matched trials, accuracy was greater for own than other shapes, and there was no difference between the two other shape conditions. For mismatched trials, accuracy was greater for stranger than for self (with no difference between stranger and friend, or self and friend), and for unit than neutral outgroup (with no difference between unit and familiar outgroup, or familiar and neutral outgroups). There was no effect of shape for mismatched trials within the country task.

[20] As for the response time analysis, the same ANOVA was conducted including the number of years in the military unit as a covariate and again the results were unchanged.

between the two other shape conditions in any of the three association tasks[21]. See Figure 3.2 for a bar chart depicting sensitivity scores for shape association type and Table 3.1 for means (*SD*).

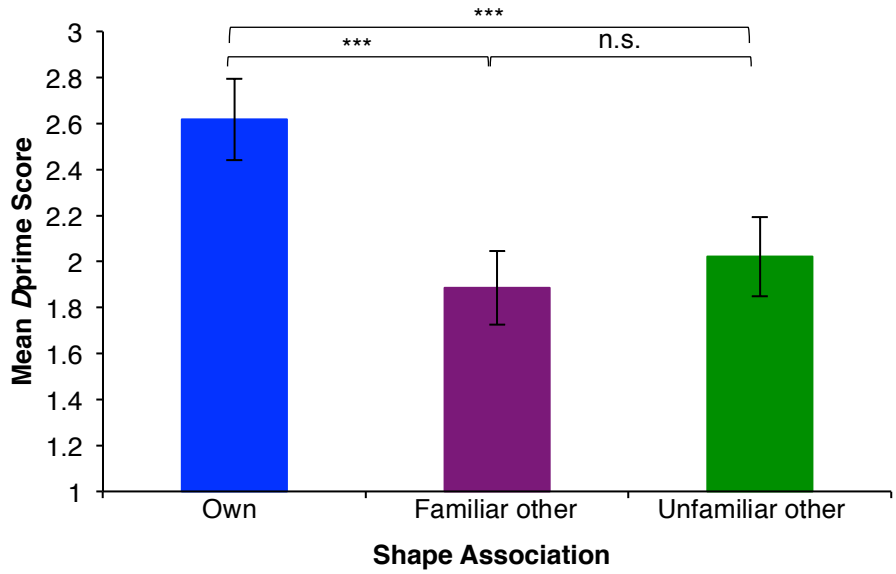


Figure 3.2: Mean sensitivity (*d*prime) scores as a function of shape association type across the three tasks. Error bars represent standard errors. *Note*: ** denotes $p < .001$; n.s. denotes non-significant.

[21]The same analysis was conducted for response criterion scores and demonstrated a significantly lower criterion for own than for other shapes across all three tasks, but with no difference between other shapes.

Table 3.1: Mean response times for correct responses and accuracy rates (proportions of correct responses) for matched and mismatched trials, along with mean *d*prime scores. *Note*, standard deviations in parentheses.

Shape	RT (ms) *matched*	RT (ms) *mismatched*	Accuracy *matched*	Accuracy *mismatched*	*D* prime
Self	645.89 (101.10)	742.33 (116.70)	.86 (.12)	.68 (.24)	.202 (1.47)
Friend	708.22 (113.71)	732.75 (115.84)	.74 (.15)	.70 (.22)	1.44 (1.38)
Stranger	698.56 (97.59)	727.92 (103.58)	.71 (.19)	.75 (.20)	1.59 (1.47)
Unit	610.42 (107.03)	694.26 (144.94)	.89 (.13)	.79 (.20)	2.70 (1.60)
Familiar unit	666.05 (122.11)	704.21 (132.62)	.78 (.16)	.79 (.19)	1.85 (1.10)
Neutral	666.21 (123.12)	707.64 (132.62)	.78 (.17)	.75 (.22)	1.83 (1.35)
Country	645.13 (79.80)	736.24 (73.78)	.89 (.15)	.82 (.17)	2.68 (1.23)
Ally	684.55 (71.15)	739.89 (76.24)	.82 (.15)	.79 (.17)	2.12 (1.18)
Threat	679.34 (96.00)	739.26 (83.71)	.81 (.16)	.80 (.1)	2.20 (1.42)

Correlations between advantages for the self and ingroups

The group-level analyses indicated that for response time (for matched pairs) and sensitivity scores, performance was enhanced for the self in relation to friend and stranger, for the unit compared to a familiar unit and a neutral outgroup, and for the country in relation to the ally and threat groups. There were no differences in response time or sensitivity between friend and stranger, familiar or neutral outgroups, or ally and threat outgroups. Next, the relationships between the response time and sensitivity advantages for own compared to the other shape associations were examined. Bias corrected and accelerated bootstrap 95% CIs are reported in square brackets.

Differential scores between self and 'non-self' (the mean of friend and stranger) in response time (for matched pairs[22]) and in sensitivity were taken as performance advantages for the self. Similarly, differential scores between the unit and 'non-unit' (the mean of familiar and neutral outgroups) were taken as performance advantages for the unit. Differences between the country and 'non-country' (the mean of ally and threat) were the performance advantages for the country. As lower scores indicate better performance in response time measures, own shape scores were subtracted from other shape scores so that response time bias scores remained positive. For example, the response time bias for the self was:

((Friend+Stranger)/2) - Self response time

For sensitivity biases, other shape scores were subtracted from own shape scores.

Self and Unit (N = 35)

There was no significant relationship between the self-advantage and the unit-advantage in response time, $r(33) = -.093$ [-.474, .330], $p = .595$, nor in sensitivity, $r(33) = -.296$ [-.560, .052], $p = .084$, although the latter correlation analysis showed a trend towards a negative relationship.

[22] The performance advantages in response time were found only under matched trials, and so only these were included for calculating advantage scores.

Self and Country (N = 37)

There was no significant relationship between the self-advantage and the country-advantage in response time, $r(35) = .012$ [-.307, .291], $p = .942$, nor in sensitivity, $r(35) = <.000$ [-.301, .285], $p = .999$.

Unit and Country (N = 38)

There was a significantly positive relationship between the unit-advantage and the country-advantage in response time, $r(36) = .406$ [.186, .569], $p = .011$, and also in sensitivity, $r(36) = .339$ [.068, .576], $p = .037$. Figure 3.3 depicts the positive relationships between the advantages for the unit and country in both response time (a) and in sensitivity (b).

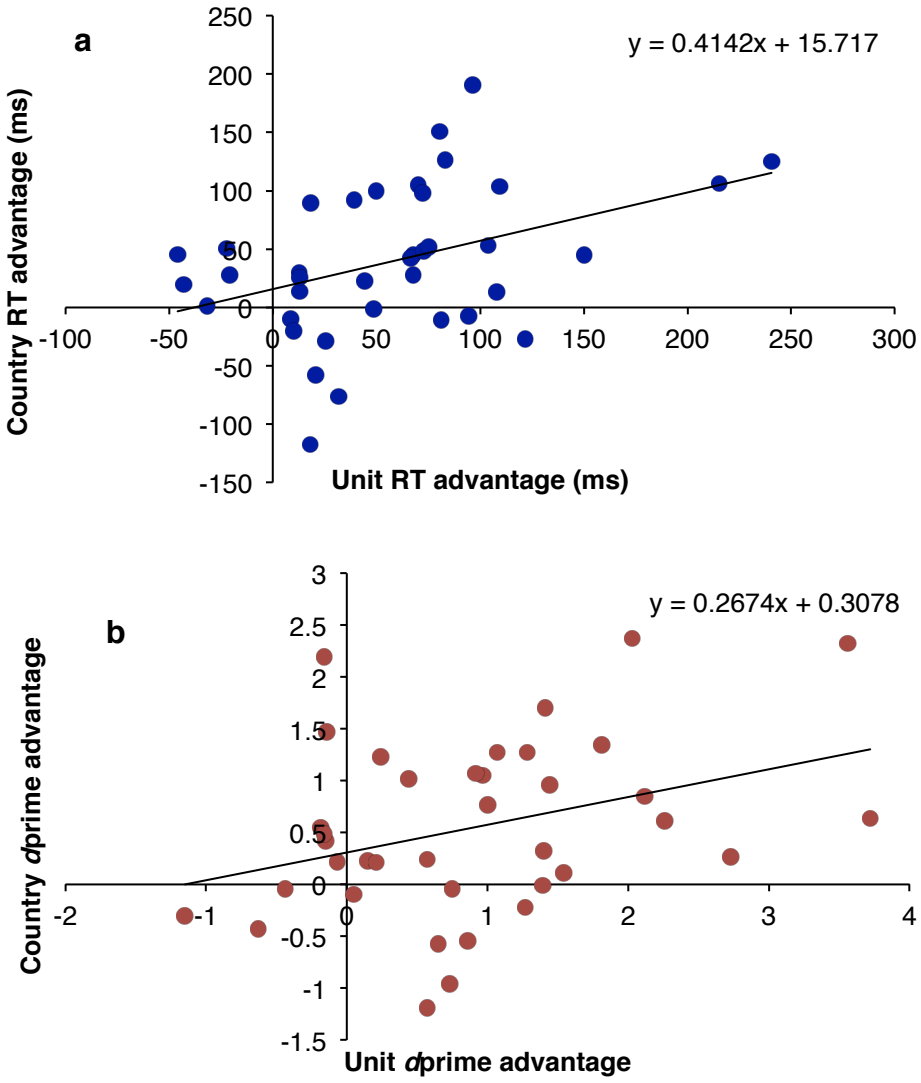


Figure 3.3: The positive relationships between unit- and country-advantages in response time (RT) (a) and in sensitivity (b) ($N = 38$, both $p<.05$).

In summary, the response time and sensitivity advantages for the self were not significantly correlated with those for the unit or for the country. However, the performance advantages for the unit were significantly positively correlated the advantages for the country.

Self-report measures

Inclusion of the Other in the Self (IOS)

The mean scores for the perceived overlap (IOS) between each pair of individuals (self, friend, stranger) and social groups (unit, familiar unit, neutral outgroup and country, ally and threat group) are shown in Table 3.2, below. All 48 participants completed this scale.

Table 3.2: Scores for Inclusion of Other in the Self*. Note.* Standard deviations in parentheses; IOS denotes Inclusion of Other in the Self.

	Mean IOS (*SD*)
Self-Friend	5.77 (.22)
Self-Stranger	1.60 (.12)
Friend-Stranger	1.88 (.17)
Unit-Familiar	2.25 (.25)
Unit-Neutral	1.73 (.19)
Familiar-Neutral	1.79 (.21)
Country-Ally	4.63 (.26)
Country-Threat	1.54 (.20)
Ally-Threat	1.54 (.20)

A 3 (personal, unit or country) x 3 (pairing: self-friend, self-stranger, friend-stranger/unit-familiar, unit-neutral, familiar-neutral/country-ally, country-threat, ally-threat) repeated measures ANOVA was used to measure the perceived overlap between the pairs of individuals and groups. There was a significant main effect of category (personal/unit/country pairs), $F(2, 94) = 16.95$, $p < .001$, $\eta_p^2 = .265$, with overlap ratings generally higher for personal ($M = 3.08 \pm .13$) than for unit ($M = 1.92 \pm .18$) ($p < .001$) and country ($M = 2.57 \pm .17$) ($p = .044$) pairs and for country than for unit ($p = .011$) pairs. There was also a significant

main effect of pair type, $F(2, 94) = 235.60$, $p < .001$, $\eta_p^2 = .834$, with significantly higher overlap for self-friend/unit-familiar/country-ally pairs ($M = 4.22 \pm .17$) than for self-stranger/unit-neutral/country-threat pairs ($M = 1.63 \pm .11$) and friend-stranger/familiar-neutral/ally-threat pairs ($M = 1.74 \pm .12$) (both $p < .001$). There was no difference between self-stranger/unit-neutral/country-threat and friend-stranger/familiar-neutral/ally-threat pairs ($p = .508$).

There was a significant interaction between the pair category (personal, unit, country) and the pair type, $F(4, 188) = 46.95$, $p < .001$, $\eta_p^2 = .500$. One-way repeated measures ANOVAs performed separately for personal, unit and country pair categories were conducted to decompose this interaction. For the personal pairs, $F(2, 94) = 262.17$, $p < .001$, $\eta^2 = .848$, the overlap between self-friend was greater than between self-stranger and friend-stranger (both $p < .001$). There was no significant difference in the overlap between self-stranger and friend-stranger ($p = .255$). For perceived overlap between unit pairs, $F(2, 94) = 3.57$, $p = .054$, $\eta^2 = .071$, there was only a marginal effect of pair type, with slightly higher overlap between unit and familiar group than between unit and neutral outgroup and familiar and neutral outgroup, although these scores were not significantly different ($p = .109$ and .246, respectively). There was also no difference between unit and neutral and familiar and neutral pairs ($p = 1.00$). For country pairs, $F(2, 94) = 99.45$, $p < .001$, $\eta^2 = .679$, the overlap between country and ally ($M = 4.63 \pm .26$) was rated as significantly greater than country and threat ($M = 1.54 \pm .20$) and ally and threat ($M = 1.54 \pm .20$) (both $p < .001$). There was no difference in overlap ratings between country-threat and ally-

threat (p = 1.00)[23]. Figure 3.4, below, depicts the mean perceived overlap scores for each shape pairing (high-mid; high-low; mid-low) and social category (personal, unit and country).

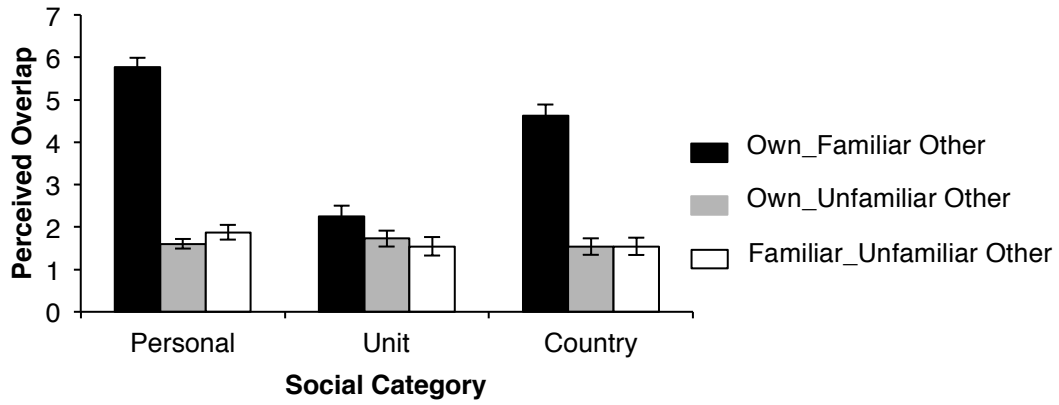


Figure 3.4: Self-reported perceived overlap between own-familiar other, own-unfamiliar other and familiar-unfamiliar other social conditions for each social category (personal, unit and country). Error bars represent standard errors.

Identity fusion, group identification and self-construals

Correlations were computed to measure whether the unit-biases were associated with self-reported measures of identity fusion or identification with the unit and also whether the biases for the self, unit or country were associated with independent or interdependent self-construals.

All participants completed the fusion and group identification scales, but one participant did not complete the self-construal scale. There were no significant relationships between the biases for the unit and self-reported measures of group identification (self-investment or self-definition) or identity fusion. There were also no significant relationships between the biases for the self, unit or country and self-reported measures of independent or

[23] There were no significant relationships between the self or group biases in the matching task and self-reported perceived overlap between the social labels within each condition.

interdependent self-construals. Appendix B contains mean scores of self-reported measures of fusion with the unit, group identification (self-investment and self-definition) with the unit, and self-construals (independent and interdependent) and the correlation coefficients showing the relationship between each component of the scales are also presented. The full correlation analyses between the biases for the self, unit and country and the self-report measures are also presented in Appendix B.

Cross experimental analysis:

Comparing results from Experiment 1 (self- and ingroup-biases in rowers) with the present experiment

An independent samples t-test found that overall, response times were marginally faster in the military sample (M = 652.22, SD = 118.59) than the rowers sample (M = 691.58, SD = 60.44), $t(83) = 1.92$, $p = .058$, $d = 0.42$, but there was no significant difference in sensitivity scores between the rowers (M = 2.04, SD = .55) and the military personnel (M = 1.81, SD = 1.22), $t(83) = 1.12$, $p = .266$, $d = 0.24$.

Self-bias

Independent samples t-tests were used to compare the strength of self-bias in response time and in sensitivity between the sample of rowers (Experiment 1, N = 42) and the sample of military personnel (N = 38) in the present study.

The response time advantage for the self in relation to stranger was significantly smaller amongst the military sample than the rowers sample, $t(78) = 3.06$ $p = .003$, $d = 0.68$, however there was no significant difference in the self-bias in response time relative to friend between the two samples, $t(78) =$

.04, p = .968, d = 0.01. There were no significant differences in the advantage for the self in sensitivity between the rowers and the military personnel, either in comparison to stranger, $t(78) = 1.01$, p = .315, d = 0.23, or to friend, $t(78)$ = .70, p = .484, d = 0.16.

Ingroup-bias (team/unit)

There were no significant differences between the rowers and military personnel in the response time advantage for the ingroup (unit/rowing team) compared to the familiar unit/rival team, $t(80) = .903$, p = .369, d = 0.20, or in relation to the neutral outgroups (neutral group/neutral team), $t(80) = .968$, p = .336, d = 0.21. Similarly, there were no significant differences between the two samples in the sensitivity advantage for the ingroup (unit/rowing team) in relation to the familiar unit/rival team, $t(80) = .189$, p = .851, d = 0.04, or in relation to the neutral outgroups, $t(80) = .143$, p = .886, d = 0.03. Table 3.3, below, presents the mean response time and sensitivity bias scores for both of the experimental samples.

Table 3.3: Mean scores for self and ingroup response time and sensitivity biases for the sample of rowers (Experiment 1) and of military personnel (Experiment 3). *Note.* Standard deviations in parentheses.

	Mean score (SD) for Rowers (Experiment 1)	Mean Score (SD) for Military (present study)
Self – Stranger response time	96.70 (55.92)	52.67 (72.21)
Self – Friend response time	63.03 (71.62)	62.33 (84.84)
Ingroup – Familiar/Rival outgroup response time	67.97 (60.70)	55.63 (63.08)
Ingroup – Neutral outgroup response time	69.17 (50.47)	55.79 (73.13)
Self – Stranger *dprime*	.63 (.80)	.43 (.98)
Self – Friend response time *dprime*	.45 (.78)	.58 (.94)
Ingroup – Familiar/Rival outgroup response time *dprime*	.82 (.71)	.85 (1.00)
Ingroup – Neutral outgroup response time *dprime*	.83 (.84)	.87 (1.25)

Chapter discussion

Using three variations of the perceptual matching task, performance advantages were found for self compared to friend and stranger shapes, unit compared to familiar and neutral outgroup shapes, and country compared to ally and threat shapes. The enhanced performance in response time and sensitivity for own associated stimuli replicated and extended previous research (e.g., Moradi et al., 2015; Sui et al., 2012) and was also consistent with results reported in Experiments 1 and 2. Although performance was generally better for

the group (unit and country) association tasks than the personal association task, the biases for the self and ingroups were of a similar magnitude to one another and there were no differences in performance between the two 'other' shapes (friend/stranger; familiar outgroup/neutral outgroup; ally/threat) across the three tasks. Consistent with findings reported in Experiments 1 and 2, there were no relationships between self-reported levels of group identification and identity fusion with the unit and the magnitude of the performance advantage for the unit compared to the familiar and neutral outgroups.

I begin by discussing the implications of the results for one of the primary questions of this study: whether the ingroup-bias observed is indicative purely of ingroup favouritism, or whether additional intergroup dynamics, in this case the perceived outgroup threat level, also modulates task performance. These results are set in relation to research literature within the area of threat and attention. Following this, the observed relationships between self- and ingroup-biases are discussed within the context of social identity theory. The implications of the self-report data are then considered, and I conclude that the self and ingroup perceptual biases may be distinct from explicit feelings and attitudes towards the self and group. Following this, I then address the cross-experimental similarities and distinctions between the present study and Experiment 1. Finally, I acknowledge some limitations and suggest improvements for further research.

A primary aim of the present study was to determine whether the ingroup-biases in perceptual matching are reflective purely of ingroup favouritism, or whether social categories holding adaptive importance in other

ways, such as groups that are perceived as inherently threatening, are also shown cognitive prioritisation. Previously, Moradi et al. (2015) found no difference amongst football supporters in performance for shapes associated with a rival team and shapes associated with a neutral team, leading to the conclusion that the advantage effects observed are rooted purely in ingroup favouritism rather than outgroup derogation (e.g., Brewer, 1999). These results were supported by findings reported in Experiment 1, which found no differences in performance for rival and neutral rowing teams (while there was a difference between friend and stranger). Consistent with previous findings, the present study found no differences in response time or in sensitivity between the two outgroups within either group association task (between the familiar unit and the neutral group within the unit task, or between the ally and threat groups on the country association task). This indicates that the cognitive prioritisation demonstrated in this paradigm is based simply on ingroup favouritism, rather than on more complex intergroup dynamics.

Although a body of literature suggests that threatening stimuli, such as dangerous animals or angry facial expressions (e.g., Devue et al., 2011; Ohman et al., 2001; Schmidt et al., 2012) capture attention and enhance perceptual processing (or impair task performance when presented as a distractor), there were no prioritisation effects for the threat group on the matching task. This contrasts particularly to research showing that attention is enhanced to faces of a social group perceived as threatening (e.g., young Black males; Trawalter et al., 2008). One limiting factor is that the military personnel in this study were not specifically asked how threatening they perceived ISIS to be and the threat level

was assumed to be high based on the advice given by the military advisor. Despite this potential limitation, if we assume that the threat element was present, that there were no differences in performance between the threat and ally groups within the country task implies that the social biases exhibited simply reflect a preference for information that holds high relevance to the self and ingroup. With regards to previous literature finding enhanced attention for threat-related stimuli, it may be that the visual features of the threat are important components in capturing attention and that the novel shape association reduced the social threat value. Additionally, it is possible that if a variation of the task was designed such that an explicit threat group was included alongside two neutral (non self-relevant) groups, then prioritisation for threat might be observed. Future research could examine this question.

Another primary aim of this experiment was to further measure the relationship between self- and ingroup-prioritisation effects by replicating Experiment 1 using a more homogenous sample of ingroup and outgroup associations, as outlined in the introduction. There were no positive relationships between biases for the self and for the unit or country, either in response time or sensitivity. This contrasted to the marginal positive relationship between the self- and ingroup-bias in response time reported in Experiment 1. The central tenet of social identity theory holds that the psychological self extends to include other people and social ingroups such that group memberships form a vital part of self-representation (e.g., Tajfel, 1982). This concept is further supported by research evidence that finds an overlap in the processing of traits and attitudes associated with the self or with a close social

ingroup (e.g., Smith et al., 1999; Smith & Henry, 1996). The self- and ingroup-biases amongst the military sample were of a comparable magnitude, but performance was better overall for the group than the personal tasks, indicating that the serving soldiers were generally better at processing group-related stimuli. The difference in overall task performance for personal and group associations might, at least in part, explain the lack of a relationship between the two.

A trend towards a negative relationship between the advantages for the self and unit in sensitivity was observed. This may imply that, at least for this particular group (the military personnel), as the tendency to prioritise the self increases, the tendency to prioritise the group decreases (as measured by perceptual discrimination), and vice versa. This notion relates to Turner's principle of functional antagonism, an important part of self-categorisation theory and closely linked to the social identity perspective (Turner et al., 1987). This principle holds that while many social identities exist within each individual, as the salience of one increases, the salience of another correspondingly decreases. The dominant social identity at any given time is likely to be dependent on the social context that the individual is in. The present results indicate that the tendency to prioritise the self or an important social group may work within a similar dynamic. However, the negative relationship observed was marginal and was not present for relationships between advantages for the self and country.

While there were no positive relationships between the advantage effects for the self and ingroups, the two kinds of ingroup-biases (unit and country)

were positively correlated both for response time and sensitivity measures, implying a common process for both forms of group-related processing. Some of the identity fusion literature suggests the strength of interpersonal alignment to be predictive of alignment with an extended social group (Vázquez et al., 2015) and the present study provides novel evidence to suggest that perceptual prioritisation for one social group predicts perceptual prioritisation for another. In this case, ingroup favouritism manifested at the attentional level may be a stable, trait-like characteristic that remains constant independent of the specific social category or context (for example, in relation to neutral or threat groups) in which it is measured.

Consistent with results reported in Experiments 1 and 2, the present study found no relationships between self-reported measures of group identification or identity fusion and perceptual prioritisation for the unit. This contrasts with results reported by Moradi et al. (2015), who found that self-reported satisfaction with the team (a sub-component of the same group identification scale utilised in the present study) predicted the ingroup-advantage amongst a sample of football supporters. This discrepancy might be explained in terms of a qualitative difference in supporting a team from an outside perspective (as for football supporters) and partaking as an active member of a team (as for the rowers and military personnel). Perhaps in the case of the latter, ingroup-prioritisation is automatic and present even in the absence of explicit satisfaction with the social group. For example, there is research evidence to suggest that partaking in synchronous behaviours with group members (for which the coordinated movement involved in rowing and in

military marching are good examples) has positive consequences for group bonding through the release of endorphins and certain other neurohormones (Launay, Tarr & Dunbar, 2016; Tarr, Launay & Dunbar, 2016). It is possible that this bonding effect has a motivating impact on ingroup-bias separate from more conscious attitudes towards the ingroup.

The Inclusion of the Other in the Self (IOS) scores revealed that the self-friend overlap was rated as significantly greater than the self-stranger and friend-stranger overlap, and there was no difference between self-stranger and friend-stranger overlap ratings. The same pattern was not observed for the unit category, for which there were no significant differences in overlap ratings between any of the three pair conditions (unit-familiar, unit-neutral, neutral-familiar). For the country category, a more similar pattern to the personal-related pairs was observed: there was greater perceived overlap between country-ally than country-threat, and no difference between country-threat and ally-threat pairs.

It is important to note that a stronger relationship between the self- and group-prioritisation effects amongst the military sample was hypothesised not only because of a greater homogeneity in the group associations, but also because I expected higher levels of identity fusion (a ‘oneness’ between self and group) and group identification within this sample. Perhaps surprisingly, there were no trends towards greater feelings of fusion amongst the military personnel (although there was not enough power to conduct formal statistical comparisons). Although the lives of the military personnel are very much centred around their units (they live together, eat together, train together and so

on), perhaps feelings relating to the group as being ‘work’ or even a more conscious awareness of the need to keep an individual identity salient could account for the these results. For the rowers, time spent with their team is time away from work, but for the military, the opposite is true. This is purely speculation and to better understand these issues more specific questionnaires or interviews would need to be conducted. However, the difference in subjective identification with the group may also contribute to explaining the discrepancy in findings with regards to the relationship between prioritisation for the self and ingroup. Further to this, the cross-experimental analysis revealed that the military sample displayed a significantly smaller self-bias in response time in relation to stranger than the rowers did, indicating less discrimination between self and unfamiliar other in perceptual performance.

It is important to note that the positive relationship between the self- and ingroup-biases demonstrated in Experiment 1 was relatively weak. An alternative hypothesis to the notion of a common process for both advantage effects is that the self- and ingroup-prioritisation are actually, at least in part, distinct. In previous research that utilised the same perceptual matching paradigm, no relationships were found between self and positive emotion (Stolte et al., 2017), or between self and high reward (Sui & Humphreys, 2015) biases. These findings indicate that self-related processing is not simply reducible to prioritisation for positive valence or high reward that may be intrinsically linked to the self (e.g., Northoff & Hayes, 2011), but rather holds a unique value. In the same way, it could be argued that ingroup-prioritisation is not rooted entirely in self prioritisation and that these processes are to some extent separate ones.

Limitations

The study benefitted from the inclusion of three equivalent units of military personnel, allowing for more uniform group exemplars across participants, and there was further advantage to the design in that is was possible to examine the perceptual advantages with relation to more specific social dynamics (i.e., threat vs. friendship). The results implied that perceptual processing was affected only by personal relevance and not by threat salience. However, one limiting factor to conclusions drawn regarding this is that perceived threat levels were not explicitly taken and were simply presumed to be high. Thus, although unlikely, it is not impossible to rule out that, for this particular sample, ISIS was not seen as particularly threatening. No attitude measures towards any of the outgroups included across the tasks were taken, and future studies would benefit from including outgroup as well as ingroup measures, in order to both affirm the given outgroups were indeed 'neutral', 'familiar', 'threat', 'friend' and so on, and also to examine whether individual attitudes mediated the perceptual biases for the ingroup. To minimise potential individual differences in group-related attitudes, further studies would benefit from the use of minimal groups so that varying factors including time in the group, group status, and interaction with outgroup members, are similar across participants. This is addressed in the next experimental chapter (Chapter 4, Experiments 4, 5 and 6).

Positive relationships between the ingroup-biases in perceptual processing implied a shared process for group processing that is at least partially distinct from the self. However, conclusions regarding this are also limited in that the two social ingroups included (unit and country) were linked

and hierarchical in nature. A military unit is a sub-group of the British army, and fighting with the unit ultimately entails fighting for one's country. It is not possible to ascertain whether the positive relationship between the ingroup-advantages arose because of the hierarchical connection between the two groups, or whether a general group-related processing mechanism means that ingroup-prioritisation at the attentional level is stable within individuals. To put this in another context, while a bias for a university sports team might predict a bias for the university as a superordinate group, would this also predict the bias for an unrelated social category such as a nationality or ethnicity? Future studies could examine this question in more detail.

Finally, the most notable shortcoming to these results is that the lack of positive relationship between the biases for the self and ingroups failed to replicate results from Experiment 1. Lower ratings of identity fusion amongst the military personnel could be related and it must be kept in mind when making these cross-experimental comparisons that there are general differences between the samples used in the two studies in terms of gender, education level and socioeconomic status, all of which could have an effect on social dynamics.

Conclusion

Overall, the study benefits from replicating and extending previous findings within a novel sample. Military personnel commonly think and act in group-oriented ways. Indeed, to some extent they are trained to leave self-interests aside in order to advance the collective that they are working with, and so to study self and group prioritisation within this sample is particularly pertinent.

Despite some limitations that have been discussed in the paragraph above, the results provide evidence for a common mechanism for ingroup processing that is, at least in part, distinct from self processing. Furthermore, that there was no effect of a threat group on the advantage effect leads to the conclusion that the social biases are rooted entirely in self and ingroup favouritism rather than alternative forms of adaptive relevance or outgroup hostility. This study thus provides grounds to further examine the common and distinct processes that are involved in prioritisation effects for the self and social ingroups.

Chapter 4: Prioritisation for the self and ingroup under minimal group conditions

Chapter background

The human propensity for social classification is so great that ingroup favouritism is reliably elicited even under 'minimal group' conditions, whereby individuals are assigned to novel groups either randomly or on the ostensible basis of arbitrary information. As described in Chapter 1, as well as affecting higher-level decision-making such as monetary reward allocation, there is also evidence to suggest that minimal group allocation modulates perceptual processing, such as in face categorisation. However, it is unclear whether minimal group allocation similarly enhances performance on the associative matching task, which, unlike face processing paradigms, does not contain any concrete social information. The three experiments presented within this chapter utilised modified versions of the matching paradigm to examine whether novel group allocation modulates early perceptual processing in the same way as was observed for college rowers (Chapter 2) and military personnel (Chapter 3). The following three experiments also aimed to elucidate the mechanisms underlying perceptual biases for novel ingroups by measuring how they relate to biases for the self and measures of self-construals and self-esteem.

Introduction

Perceptual biases for the self and established ingroups

The previous two experimental chapters (Experiments 1, 2 and 3) found performance advantages in perceptual matching for self stimuli compared to friend and stranger and for ingroup stimuli compared to neutral, rival (Experiments 1 and 2), familiar and threat (Experiment 3) outgroups. These findings extended results reported by Sui et al. (2012) and Moradi et al. (2015). Furthermore, there was a marginal positive relationship between the self and ingroup response time bias in Experiment 1 (amongst college rowers), indicating the possibility of a common process driving the self- and ingroup-bias effects. However, this positive relationship was not replicated in Experiment 3 (amongst military personnel), and in fact there was a trend towards a negative relationship between the bias scores for the self and ingroup. Prioritisation effects for two separate ingroups (military unit and country), on the other hand, were robustly positively correlated. None of the previous experiments (Experiments 1, 2 or 3) found individual differences such as self-reported measures of group identification or self-construals to be a significant predictor of the perceptual advantage effects.

While some explanation for the lack of positive relationship between the self- and ingroup-bias within Experiment 3, such as individual differences in the baseline levels of group identification, was put forward in the discussion, it was noted that future research would benefit from directly addressing this discrepancy. The present experiments benefit from the use of a minimal group

paradigm, which involves the random allocation of participants into novel groups based on arbitrary factors (Rabbie & Horwitz, 1969; Tajfel et al., 1971). The minimal group paradigm is useful for ensuring that factors such as duration of group membership, group status, and previous interaction with outgroup members, are equal across participants.

The minimal group paradigm

Human cognition is so motivated towards social classification that ingroup favouritism can be elicited even under 'minimal group' conditions in which group allocation is entirely arbitrary and without the presence of any pre-existing social content. Across a series of studies, Tajfel (1970) famously showed that mere social categorisation was enough to elicit ingroup favouritism and outgroup discrimination effects. In the original experiments (Tajfel et al., 1971), boys in a school classroom setting were allocated to one of two groups and then asked to distribute small monetary amounts between several pairs of recipients made up of ingroup and outgroup members, who were anonymous but whose group affiliation was provided. Ingroup bias occurred across a variety of distribution strategies within the monetary allocation task. Ingroup favouritism within the minimal group paradigm has now been demonstrated in many different contexts and is one of the most robust and widely-replicated effects within social psychology (e.g., Allen & Wilder, 1975; Brewer & Silver, 1978; Doise et al., 1972; Mullen et al., 1992). Importantly, these studies provided the foundation to explore social biases from a cognitive, rather than purely emotional, perspective.

Tajfel et al. (1971) defined a set of necessary criteria for groups to be truly minimal: there should be no face-to-face interaction between participants within or between groups; the group membership of all participants should not be disclosed; there should be no link between the basis for the categorisation and the measure of ingroup favouritism; the outcome measure of ingroup-bias should involve significant choices but ones that are of no direct value to the individual; and the opportunity to respond with intergroup differentiation should be in competition with the opportunity to maximise equality. In identifying this 'baseline' condition for prejudice, the researchers also created a useful paradigm that served to induce group identity in an experimental setting. This ability to generate novel social group dynamics that are absent from any pre-existing stereotypes and historical conflict has been of great benefit to the field of social cognition and many researchers have utilised this approach (reviewed in Bourhis & Gagnon, 2001).

Interestingly, the effect of novel group allocation appears to take on enough meaning within individuals that it can actually alter pre-existing and automatic discriminatory cognitive processes toward an established outgroup. For example, Van Bavel and Cunningham (2009) found that when White participants were assigned to new groups consisting of both Black and White individuals, automatic evaluations of Black ingroup members were improved relative to Black outgroup members. Similarly, Sheng and Han (2012) found that incorporating other-race individuals to one's own novel 'team' eliminated a 'racial bias in empathy' effect in neural responses to pain.

As well as minimal group effects in higher-level decision-making tasks such as greater resource allocation and preferable trait judgements (e.g., Locksley, Ortiz, & Hepburn, 1980), research has also found minimal group-biases for more automatic processes. Otten and Wentura (1999) demonstrated that when making spontaneous trait inferences, traits were more likely to be inferred from corresponding behavioural descriptions for *ingroup* members than for outgroup members when the traits were *positive*, but not when they were negative. However, trait inferences for outgroup members were not in turn facilitated by *negative* behavioural descriptions, implying evidence for implicit ingroup favouritism but not outgroup derogation (i.e., explicit negative attitudes towards the outgroup). The findings suggested that novel ingroup-bias is associated with automatic positive affect. Investigating this more directly, Ashburn-Nardo et al. (2001) utilised an implicit association task (Greenwald, et al., 1998) to measure the automatic association between novel social groups and implicit positive valence. Across three studies, participants found it significantly easier to pair ingroup names with positive words and outgroup names with negative words. Together, the findings provide some of the first evidence that the process of evaluative differentiation between new ingroups and outgroups is automatic and implicit, without necessary intent or conscious awareness on the part of the individual.

Whilst these studies provide evidence for the fact that novel ingroup-bias affects implicit as well as explicit cognitive processes, the focus of previous research has mainly been on automatic positive affect. One primary aim of the present study is to determine whether minimal group allocation affects low-level

perceptual discrimination on the social matching task (Sui et al., 2012). This could provide insight as to whether minimal group allocation permeates even the more fundamental attentional and perceptual processes that are independent of motivational and emotional relevance.

There is neural evidence to suggest that minimal group allocation affects early visual processing. For example, Ratner et al. (2014) found that novel group allocation altered mental representations of ingroup and outgroup faces, creating visual biases that produced more favourable impressions (e.g., in attractiveness, intelligence and trustworthiness) of ingroup members. Further, ERP measures demonstrated a difference in the structural encoding of the faces of novel group members, perhaps serving to allow greater individuation and cognitive elaboration of ingroup than outgroup faces (Ratner & Amodio, 2013). Using the perceptual matching paradigm (Sui et al., 2012), the present study examines whether neutral (non-face) stimuli that are associated with novel ingroups are shown perceptual prioritisation compared to novel outgroups.

Affiliation of the self to new social groups

As described above, preference for novel ingroups over novel outgroups has been demonstrated across many different study designs, methodologies and paradigms, both implicit and explicit (e.g., reviewed in Bourhis & Gagnon, 2001). However, there are competing theories as to how and why these favouritism effects for minimal groups occur. Outcome measures regarding preference for novel groups appear similar to those as for established groups

(for example, greater resource allocation, preferable trait judgements, automatic positive valence), but are the mechanisms behind established and novel ingroup biases the same? By measuring the relationship between self- and ingroup-prioritisation effects across a variety of group exemplars, the perceptual matching paradigm that is utilised throughout this thesis provides a useful way to examine the common and distinct processes that are involved in self- and ingroup-prioritisation, and, more importantly, the mechanisms by which the ingroup-biases arise.

According to Social Identity Theory (Tajfel & Turner, 1979), individuals derive aspects of the self from the image of the ingroup. Thus, one of the primary reasons for ingroup favouritism, including within the minimal group paradigm, is that when the group image is positive, self-esteem is enhanced by virtue of the self belonging to the group. The mechanism for the psychological link between self and group is here explained in terms of *self-stereotyping*, which describes assimilation of the view of the self to the prototype of the ingroup (Self-Categorisation Theory: Turner et al., 1987). Put simply, the self becomes stereotyped in relation to the ingroup such that the attitudes, values and traits of the group become those of the individual. While there is good research evidence for this process, (e.g., Cadinu, Latrofa & Carnaghi, 2013; Hogg & Turner, 1987; Onorato & Turner, 2004), a compelling alternative to account for ingroup favouritism effects within the minimal group paradigm has also been proposed, known as *self-anchoring* (Cadinu & Rothbart, 1996; Van Veelen et al., 2015). The self-anchoring hypothesis posits that rather than the self being assimilated to the group, it is in fact the group that is assimilated to

the self. As outlined by Van Veelen et al. (2015), the need for an alternative to the self-stereotyping route to affiliation with and preference for the ingroup within the minimal group paradigm is evident for several key reasons. Firstly, rather than simply becoming depersonalised exemplars of a given group, individuals retain a sense of personal identity that is separate from group identity. Longitudinally, we tend to retain individual identities when becoming affiliated with new social groups (Deaux, 1993). Further, self-stereotyping in terms of a group membership would be context-dependent because most individuals belong to many kinds of social groups (e.g., ethnicity, nationality, gender, university affiliation, and so on) and so the view of the self would change according to the salience of the social dynamics at the time. Finally, for self-stereotyping to occur, we would need adequate information about the group prototype, which would be unlikely in collectives in which specific characteristics are vague and impossible in minimal group situations whereby nothing is known about the group at all.

The self-anchoring hypothesis was originally proposed by Cadinu and Rothbart (1996) and suggests that perception of the ingroup within the minimal group paradigm is largely based on the perception of the self. As self image tends to be positive (e.g., Baumeister et al., 1989; Blaine & Crocker, 1993; Diener & Diener, 1996), so becomes the image of the group and differentiation between ingroup and outgroup then occurs by an oppositeness heuristic. Research evidence for this model was provided across a series of four experiments utilising a trait judgement paradigm in which participants were asked to make judgements about an ingroup or an outgroup based only on

information given to them about the other group (Cadinu & Rothbart, 1996). For both familiar and unfamiliar attributes, when making decisions about an ingroup, participants tended to ignore information about the outgroup and instead based judgements on the self. However, when making decisions about an outgroup, participants tended to use the differentiation (oppositeness) principle, assuming the outgroup to be opposite of the ingroup. Furthermore, participants were much more willing to generalise characteristics of the self to the group than vice versa. These findings were replicated by Otten & Moscowitz (2000) and expanded upon by Otten and Wentura (2001), who utilised a trait judgement paradigm to directly compare the strength of trait valence for self and group evaluations. The researchers found self-evaluation was a better predictor of ingroup-evaluation than the positive or negative valence of traits, and whilst the strength of generalisation from self to group was greater for positive traits, it was also significant for negative ones. The authors concluded that inferring characteristics of an ingroup from the self serves as a cognitive heuristic that allows us to fill a gap from the known (the self) to the unknown (the novel ingroup).

Originally, the self-anchoring hypothesis was mainly aimed at explaining ingroup favouritism within minimal groups, in which it is unlikely that self-stereotyping could occur because of the lack of any obvious social content relating to the group. However, following further experimental studies (Otten, 2004; Otten & Epstude, 2006), it has more recently been argued that self-anchoring is relevant to affiliation with established groups as well. In fact, a convincing integrative model of self-stereotyping and self-anchoring as two

complementary cognitive pathways to social identification has been proposed (Van Veelen et al., 2015). Interestingly, there is evidence that self-stereotyping plays a greater role in identification with groups that are clearly defined (e.g. Latrofa et al., 2010), whilst self-anchoring plays a greater role in affiliation with less defined groups, such as minimal ones (Van Veelen et al., 2013). Consistent with this, a meta-analysis including 19 studies found that projection of the personal self onto the group is more likely in minimal groups than under established group conditions (Robbins & Krueger, 2005).

Most of the research that has examined the mechanisms by which ingroup-bias occurs (outlined above) utilises trait judgement paradigms in which participants must consider attributes and characteristics, both positively and negatively valenced, as belonging to themselves or a given social group. For the most part, these kinds of paradigms involve high-level evaluative decision-making processes. To my knowledge, there are no studies comparing the relationship between self-bias and novel ingroup-bias for more automatic processes, including the attentional prioritisation effects that we observe within the perceptual matching task (Moradi et al., 2015; Sui et al., 2012). The present study aims to expand on the research linking ingroup favouritism to the self under minimal group conditions by investigating whether these effects are present for automatic, lower-level attentional prioritisation effects for self and ingroup stimuli.

Individual differences in the view of the self

As mentioned above, if ingroup favouritism in the minimal group paradigm is largely based on the perception of the self, then this self-view must be positive for the ingroup to correspondingly be regarded as positive too. It follows, then, that if the self were actually considered negative, then so would be the ingroup. Thus, self-esteem is likely to act as a moderating factor within this model, with preference for novel ingroups more likely amongst individuals with adequate self-esteem (Cadinu & Rothbart, 1996). In line with this view, a series of experiments conducted by Gramzow and Gaerter (2005) found that individual trait self-esteem scores significantly predicted the amount of favouritism (in the form of ascribing positive and negative traits and behaviours) towards a novel ingroup that was objectively the same as the corresponding outgroup. Further, this effect remained even when the ingroup image was manipulated to appear objectively less favourable than the outgroup. It may then be that individuals with high self-esteem tend to identity more strongly with new social ingroups because of the projection of a more positive self view.

On a similar note, Van Veelen et al. (2015) point out that while few studies have focussed on the role of independent and interdependent self-construals on individual differences in self-anchoring, this also would be an interesting avenue for further research. Self-construals define the extent to which the self is perceived as autonomous and distinct from others (independent self-construal) or as inextricably connected with those around them (interdependent self-construal) (Markus & Kitayama, 1991). Although closely tied to cultural notions of Individualism (typically found in the West) and

Collectivism (typically associated with non-Western cultures, Triandis, 1989), levels of independent and interdependent self-construals vary within individuals across both individualist and collectivist cultures (Brewer & Gardner, 1996; Gardner, Gabriel & Lee, 1999; Trafimow, Triandis & Goto, 1991; Triandis, McCusker & Hui, 1990). There is some evidence to suggest that individual differences in self-construals may modulate certain kinds of self-bias effects (Mezulis et al., 2004; Sparks et al., 2016), but there is little research examining the role of self-construals on ingroup-bias effects, or on the relations between prioritisation for the self and social ingroups. Group affiliation via self-anchoring places high importance on the personal self, and so perhaps in this case higher levels of independent construal would be positively related to novel ingroup-biases. The present study tests whether self-reported levels of self-esteem and independent and interdependent self-construals are related to attentional prioritisation effects for novel ingroups.

Aims of the present experiments

An abundance of research utilising the minimal group paradigm has found ingroup favouritism effects across a variety of outcome measures, from resource allocation to facial recognition (discussed in greater detail above). The primary aim of the present study was to test whether ingroup favouritism for minimal groups is also demonstrated within lower-level perceptual processing.

If attentional prioritisation for novel ingroups is demonstrated here then a further question of interest is how these relate to biases for the self. If self-anchoring is the means to favouritism for novel groups, then we would expect

the self-bias to be a reliable predictor of the ingroup-bias. While an overlap between self and novel ingroup judgements has been demonstrated for processes involving higher-level decision-making and evaluative judgements (discussed above), the perceptual matching paradigm allows direct measurement and comparison of the magnitude of lower-level prioritisation for self- and novel ingroup-prioritisation. Importantly, this methodology provides a way of keeping complete equality between the familiarity of the target stimuli and the method of measuring responses to the stimuli.

The three experiments reported here again used a modified version of the perceptual matching paradigm (Sui et al., 2012) to measure the relationship between self- and ingroup-prioritisation in visual perception within a minimal group paradigm. In Experiment 4, participants performed two separate matching tasks in one session: one in which they learned to associate self and stranger labels with geometric shapes, and the other in which they were allocated to novel teams and learned to associate ingroup and outgroup labels with different geometric shapes. In both tasks, participants had to respond to randomly presented shape-label pairs as correctly or incorrectly matched according to associations learned at the start of the experiment. Performance advantages were taken as the differences in response time and in sensitivity between own associated (self/ingroup) shapes and other associated (stranger/outgroup) shapes, and the relationship between the self- and ingroup-biases was measured.

In addition to the perceptual tasks, self-reported measures of self-esteem and independent and interdependent self-construals were collected to measure

the individual differences that might underlie the magnitude of ingroup-prioritisation for a novel group. For example, if positive self view is important for anchoring to a new social group (e.g., Gramzow & Gaertner, 2005), then we might expect measures of self-esteem to moderate the magnitude of attentional prioritisation for the novel ingroup.

Experiment 5 aimed to examine the relationship between the self- and ingroup-prioritisation effects when the self, stranger, ingroup and outgroup associations were made within the same task. This allowed measurement of the relations between the self- and ingroup-advantages when both self and group stimuli were salient at the same time. For example, does perceptual prioritisation for the novel ingroup remain when the self competes for attentional resources? This may inform us about the extent to which the novel group is assimilated as a part of the self. This design also made it possible to further examine the overlap between self and ingroup by comparing trials for which self shapes were matched with ingroup labels to those when self shapes were matched with outgroup labels (and similarly ingroup shapes paired with self vs. outgroup shapes paired with stranger). As described in Experiment 2, a slower response time and higher error rate for self shapes paired with ingroup labels than outgroup labels, or ingroup shapes paired with self labels than stranger labels, would be indicative of a cognitive confusion between self and ingroup stimuli.

Experiment 6 aimed to replicate the effects demonstrated in Experiment 4 by measuring the relationship between the self and ingroup perceptual advantages but this time when the social associations were made within

different blocks within the *same* task. In this design, self and stranger association blocks were alternated with ingroup and outgroup association blocks. This allowed for a more direct comparison of the magnitude of self- and novel ingroup-bias by controlling within participants for task order and practice effects, whilst also removing direct competition between self and group (as implemented in Experiment 5).

I hypothesised that (1) a robust performance advantage for the novel ingroup would be demonstrated on the perceptual matching task in the same way as previously demonstrated for self and established ingroup associations. (2) If the primary mechanism by which we affiliate with novel social groups is self-anchoring, then the self-bias would be a reliable predictor of the bias for the novel ingroup. If, however, group processing is in fact at least partially distinct from self processing, then this relationship may not be observed. (3) If the novel ingroup-bias is related to individual differences in perception of self, then we may expect self-reported levels of self-esteem and independent/interdependent self-construals and scores to moderate the social prioritisation effects.

Statistical analyses

The data were analysed in SPSS 24 (Armonk, New York: IBM Corp). For all response time analyses, only correct responses were included, and those higher or lower than 2.5 standard deviations from the mean response time for each participant under each condition were excluded as a standard way of removing outliers (e.g., Ratcliff, 1993). Each analysis was then performed on the remaining trials. As for previous experiments, matched and mismatched

trials for each shape were combined to give a measure of *d*prime (Green & Swets, 1966) and the response criterion for each participant was also calculated (Macmillan, 1993).

For each experiment within the present chapter (Experiments 4, 5 and 6), I examined biases for the self and ingroup using repeated measures ANOVAs on response time and sensitivity (*d*prime) scores. There were two task types (personal: self and stranger associations; and group: ingroup and outgroup associations), two shape conditions (own: self and ingroup; and other: stranger and outgroup); and two match conditions (matched/mismatched). For response time, a 2 (shape condition) x 2 (task type) x 2 (matched/mismatched) repeated measures ANOVA was used to measure the differences in performance between shape associations. For sensitivity and response criterion, a 2 (shape condition) x 2 (task type) repeated measures ANOVA was measured the effects of shape association on each of these performance measures.

As for Experiment 2 (Chapter 2), In Experiment 5, I compared specific combinations of personal and group mismatched pairs in order to test whether participants found it more difficult to reject self and ingroup paired stimuli than self and outgroup or ingroup and stranger. A greater difficulty in rejecting self and ingroup as correct would indicate an overlap in the cognitive representation of newly learned self and ingroup associations. Paired samples t-tests were used to examine differences in response time and accuracy scores for *self*+ingroup and *self*+rival, along with *ingroup*+self and *ingroup*+stranger.

For Experiments 4 and 6, I measured the relationship between the self- and ingroup-biases using bivariate correlations. Additionally, I used moderation analyses using MODPROBE (Hayes, 2009) in order to examine whether self-reported levels of independent self-construal, interdependent self-construal or self-esteem interacted with the relationships between the performance biases for the self and ingroup. For the moderation analyses, data from Experiment 4 and Experiment 6 were combined in order to provide higher power. These results are reported at the end of the results section for Experiment 6. An alpha of .05 was used for all statistical tests, and all pairwise comparisons reported were corrected using Bonferroni's adjustment. For the correlation analyses, bias corrected and accelerated bootstrap 95% CIs are reported in square brackets.

Experiment 4

Methods

Participants

Participants were recruited via the University of Oxford (Department of Experimental Psychology) online recruitment system. For a comparable sample size to those of Experiments 1 (rowers) and 3 (military personnel), a total of 50 individuals took part. The same sample size was used so that results across the experiments could be meaningfully compared. Three participants were excluded on the basis of having chance accuracy for one or both tasks ($M < .55\%$), leaving a total sample size of forty-seven (24 female, range 19-34 years, mean age = 23.61, $SD = 3.66$), 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 according to approved ethical procedures.

Stimuli and tasks

Two perceptual matching tasks adapted from Sui et al. (2012) were performed by each participant, with half of the participants performing a personal association task first and half a group association task first. The tasks were similar to those described in Experiments 1 and 3, however, as for Experiment 2, there were two (not three) social labels per task. Two social conditions per task were included primarily because the present study utilised a minimal group paradigm, which traditionally includes only two social groups: one novel ingroup and one novel outgroup (e.g., Tajfel et al., 1971). In order to be consistent with previous research, only one ingroup and one outgroup was included for the group task, and correspondingly only self and stranger labels for the personal task. Two shapes rather than one were associated with each social label because the task becomes very easy with just two associations and social biases in performance might have been eliminated if there were ceiling effects.

In the personal task, participants learned to associate two geometric shapes with 'self' and two with 'stranger' labels and then had to judge if randomly presented shape-label pairs were correctly or incorrectly matched. Exactly as with Experiments 1, 2 and 3, the shape-label pairings were made by an on-screen instruction (e.g., 'you are the square and the triangle and the stranger is the pentagon and the circle'). Following this brief learning phase, the computer task began with a 2-second central fixation cross. In each trial, participants were presented with a randomly-generated shape-label pair for

100ms. Participants had 1100ms to respond as to 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 500ms at the end of each trial. The task consisted of 6 blocks of 64 trials per block (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 four conditions within the task: two match conditions, (matched/mismatched); and two shape conditions (self and stranger), with 96 trials per condition. The group association task took exactly the same format as the personal association task, other than participants learned to associate geometric shapes with names of newly-assigned teams (see below). The tasks took approximately twelve minutes each.

The associations across both tasks between the eight shapes (circle, triangle, square, pentagon, octagon, cross, diamond, rectangle) and the four written labels (self, stranger; Team Blue, Team Green) 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 118 x 118 pixels, 4.16 x 4.16cm, corresponding to a visual angle of around 4.8° x 4.8° as viewed 50cm from the screen) were presented randomly above a white fixation cross (0.8° x 0.8°) 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-inch monitor.

Questionnaire measures

Independent and interdependent self-construal scores were obtained using Singelis' (1994) 30-item scale, described in the methods section of Experiment 3. Self-esteem was also measured using Rosenberg's (1965) scale, which consists of 10 items that measure subjective positive and negative feelings about the self. For example, 'I feel that I have a number of good qualities' or, 'At times I think I am no good at all'. Items were answered using a 4-point Likert scale format ranging from *Strongly Agree* to *Strongly Disagree*. See Appendix A for full versions of each of these scales.

Procedure

Firstly, participants were verbally allocated to either Team Green or Team Blue by being told:

'For this study, each participant is randomly assigned to one of two teams: Team Green or Team Blue. You are on Team (Green). Please remember your team affiliation throughout this study'.

Those allocated to Team Blue received the corresponding instruction. Team allocation was made such that odd-numbered participant numbers were allocated to Team Green, while even-numbered participant numbers were allocated to Team Blue. After the group allocation, participants performed the two association tasks and then the self-report measures. The experiment took approximately forty-five minutes in total and participants were compensated at a rate of £10 per hour for their time.

Results (Experiment 4)

Own-associated biases in response time data

There were three within-subject variables: task type (personal: self/stranger or group: ingroup/outgroup associations); shape category (own: self/ingroup, or other: stranger/outgroup) and match condition (matched/mismatched). A 2 (task: personal/group) x 2 (shape: own/other) x 2 (matched/mismatched) repeated-measures analysis of variance (ANOVA) was used to test for the effect of shape on response time scores.

There was no significant effect of task type, $F(1, 46) = .902$, $p = .347$, $\eta_p^2 = .019$, showing that response time was similar across the personal and group tasks. There was a significant effect of shape, $F(1, 46) = 29.62$, $p < .001$, $\eta_p^2 = .392$, with faster response times for own ($M = 744.77 \pm 8.59$[24]) than other ($M = 766.14 \pm 8.64$) shapes. There was also a significant effect of match condition, $F(1, 46) = 242.73$, $p < .001$, $\eta_p^2 = .841$, with faster response times for matched ($M = 725.36 \pm 8.54$) than for mismatched ($M = 785.54 \pm 8.68$) trials.

There was no significant interaction between task and shape, $F(1, 46) = 1.01$, $p = .319$, $\eta_p^2 = .022$, nor between task and match, $F(1, 46) = 1.54$, $p = .222$, $\eta_p^2 = .032$. There was, however, a significant interaction between shape and match condition $F(1, 46) = 58.09$, $p < .001$, $\eta_p^2 = .558$, such that own shapes were responded to significantly faster than other shapes on matched trials, $t(46) = 7.91$, $p < .001$, $d = 1.15$, while other shapes were responded to

[24] Denotes standard error

significantly faster than own shapes on mismatched trials (although this effect was of a smaller magnitude), $t(46) = 2.31$, $p = .026$, $d = 0.34$.

There was a three-way interaction between task, shape and match, $F(1, 46) = 8.24$, $p = .006$, $\eta_p^2 = .152$. Subsequent paired-samples *t*-tests found that for the personal association task, self shapes were responded to significantly faster than stranger shapes on matched trials, $t(46) = 7.99$, $p < .001$, $d = 1.16$, but that stranger shapes were responded to significantly faster than self shapes on mismatched trials, $t(46) = 2.94$, $p = .005$, $d = 0.43$. For the group association task, ingroup shapes were responded to significantly faster than outgroup shapes on matched trials, $t(46) = 5.57$, $p < .001$, $d = 0.81$, but there was no significant difference between ingroup and outgroup shapes on mismatched trials, $t(46) = .93$, $p = .357$, $d = 0.14$.

In summary, the effect of shape on response time was similar across both tasks for matched conditions, but differed for the mismatched conditions. See Figure 4.1, below, for a bar chart depicting response times for matched and mismatched trials for each shape association, and Table 4.1 (below) for mean and standard deviation (*SD*) scores[25].

[25] Accuracy data followed the same pattern as response time data. Accuracy was significantly higher for self shapes than stranger shapes on matched trials, but for stranger shapes on mismatched trials. Accuracy was significantly higher for ingroup shapes than outgroup shapes for matched pairs, but there was no difference between in- and outgroup mismatched pairs.

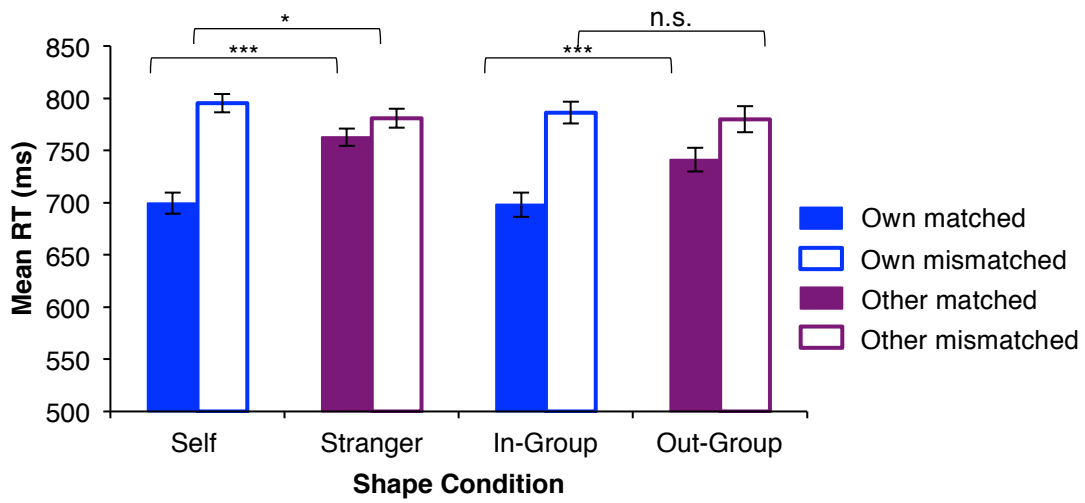


Figure 4.1: Mean response time (RT) scores as a function of shape (self vs. stranger, ingroup vs. outgroup), match (matched vs. mismatched) and task (self vs. group) for Experiment 4. Error bars represent standard errors. *Note*: *** denotes $p < .001$; * denotes $p < .01$; n.s. denotes non-significant.

Own-associated biases in *d*prime (perceptual sensitivity)

A 2 (shape: own/other) x 2 (task: personal/group) repeated measures ANOVA revealed a significant main effect both of shape, $F(1, 46) = 46.63$, $p < .001$, $\eta_p^2 = .503$ and also of task type, $F(1, 46) = 24.44$, $p < .001$, $\eta_p^2 = .347$. Sensitivity was greater for own ($M = 1.99 \pm .12$) than for other ($M = 1.37 \pm .13$) shapes, and for the personal ($M = 2.02 \pm .11$) than the group ($M = 1.37 \pm .13$) task.

There was a significant interaction between shape and task on sensitivity, $F(1, 46) = 7.70$, $p = .008$, $\eta_p^2 = .143$. Self shapes were responded to with greater sensitivity than stranger shapes, $t(46) = 3.68$, $p < .001$, $d = .54$, and ingroup shapes were responded to with greater sensitivity than outgroup shapes, $t(46) = 6.72$, $p < .001$, $d = .98$[26]. Similar to the response time data, the *d*prime scores demonstrated performance advantages for self compared to stranger, and for ingroup compared to outgroup. Sensitivity was enhanced in

[26] Response criterion scores were significantly lower for self than stranger shapes and for ingroup than outgroup shapes.

the personal task, but the main effect of shape on sensitivity was actually twice the magnitude in the group task compared to the self task. Figure 4.2 shows a bar chart depicting sensitivity scores for each shape association, and Table 4.1 shows the means (*SD*).

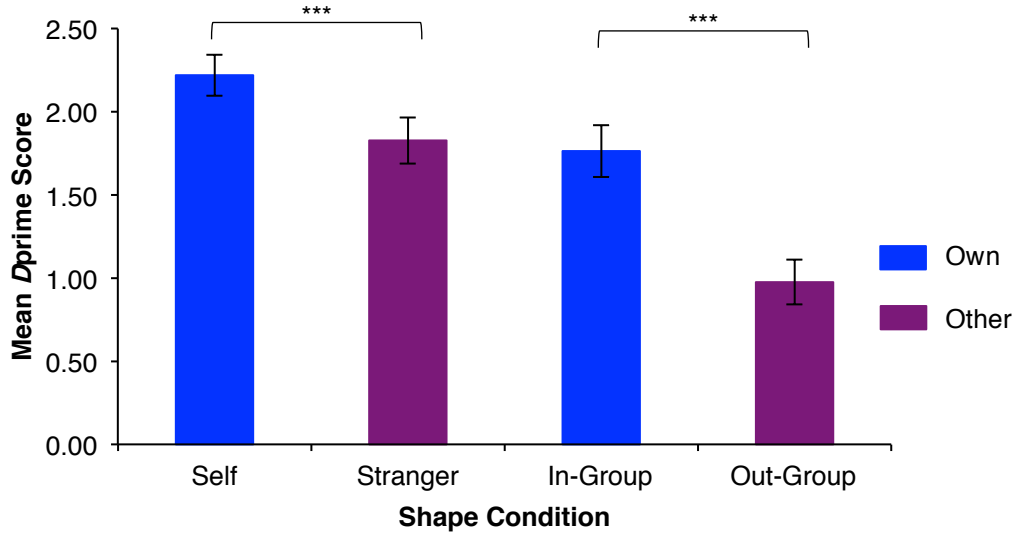


Figure 4.2: Mean sensitivity (*d*prime) scores as a function of shape and task (Experiment 4). Error bars represent standard errors. *Note*: *** denotes $p < .001$.

Table 4.1: Mean response times for correct responses and accuracy rates (proportions of correct responses), along with mean *d*prime scores (Experiment 4). *Note*. Standard deviations are in parentheses.

Shape	RT (ms) *matched*	RT (ms) *mismatched*	Accuracy *matched*	Accuracy *mismatched*	*D* prime
Self	699.37 (68.90)	795.34 (60.08)	0.91 (.08)	0.76 (.14)	2.22 (0.79)
Stranger	762.77 (57.90)	780.84 (61.61)	0.77 (.13)	0.81 (.12)	1.83 (0.93)
Ingroup	698.18 (80.68)	786.17 (70.95)	0.87 (.10)	0.65 (.20)	1.76 (1.05)
Outgroup	741.13 (76.99)	779.82 (84.52)	0.72 (.14)	0.60 (.21)	0.98 (0.91)

Correlations between advantages for the self and ingroup

The results indicated that response time (for matched pairs) and sensitivity scores were enhanced for own shapes compared to other shapes. Difference scores between self and stranger and between ingroup and outgroup in both response time (for matched pairs[27]) and sensitivity were taken as a measure of the magnitude of the self- and ingroup-biases. For response time, scores for own shapes were deducted from scores for other shapes (as lower scores indicate better performance) and for sensitivity, scores for other shapes were deducted from scores for own shapes. The relationships between the self- and ingroup-advantages were then measured using bivariate correlations.

One data-point was identified as showing extremely low self- and ingroup-bias scores (below 2.5SD from the group mean) in both response time and in sensitivity. This outlier was excluded for the following analysis (e.g., Barnett & Lewis, 1978; Lovie, 1986), in particular because it caused the correlation coefficients to appear stronger when included. The total *N* for the subsequent analyses was therefore 46.

There was a significant positive relationship between the self- and ingroup-advantages in response time, $r(44) = .368$ [.095, .596], $p = .012$[28], but

[27] As the self- and ingroup-advantages in response time (and accuracy) were observed only for matched trials, only these were included in calculating the bias scores.

[28] There was also a marginal positive relationship ($p = .06$) between the self- and ingroup-advantages in accuracy scores.

there was no significant relationship between the two sensitivity advantages, $r(44) = .080$ [-.157, .300], $p = .598$[29] (see Figure 4.3).

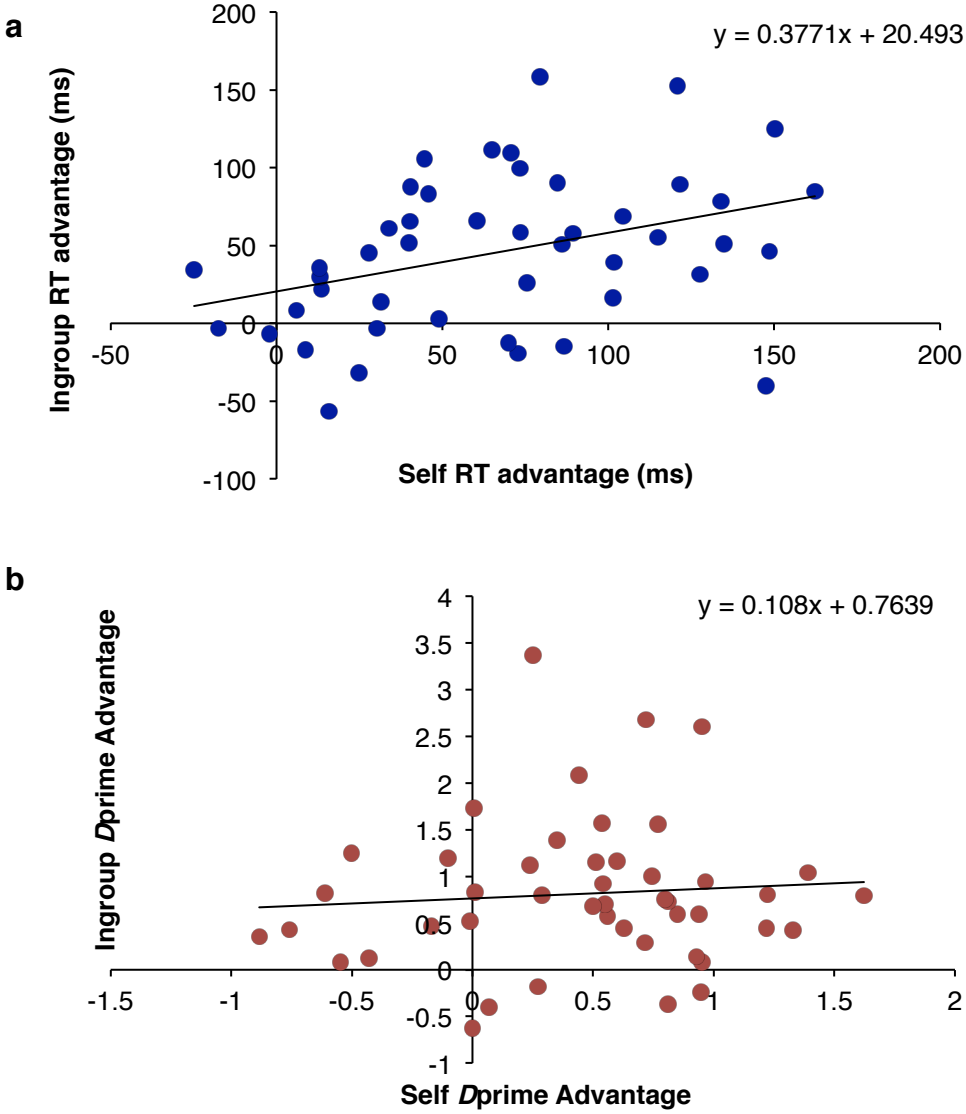


Figure 4.3: The relationship between self- and ingroup-advantages in (a) response time (RT) (stranger minus self, outgroup minus ingroup) and (b) sensitivity (self minus stranger, ingroup minus outgroup) for Experiment 4.

[29] When the identified outlier was included in the correlation analyses, the correlation between the self- and ingroup-advantages in response time was $r = .478$ [.174, .704], $p < .001$, and in sensitivity was $r = .191$ [-.072, .390], $p = .198$.

Discussion (Experiment 4)

The first experiment within this chapter aimed to establish whether there was an ingroup-advantage in perceptual matching within the minimal group paradigm in the same way as has been previously demonstrated for established social groups. Further, the experiment aimed to examine whether this novel ingroup-advantage was predicted by the self-advantage. Utilising two separate matching tasks, the self- and ingroup-advantage effects identified previously (Moradi et al., 2015; Sui et al., 2012) in response time, accuracy and sensitivity were replicated. For matched trials, self shapes were responded to significantly faster than stranger shapes and ingroup shapes were responded to significantly faster than outgroup shapes. For mismatched trials, stranger shapes were responded to significantly faster than self shapes, but there was no difference in response time between ingroup and outgroup shapes. Furthermore, *d*prime scores were enhanced for self than stranger and for ingroup than outgroup shapes when matched and mismatched trials were combined. There was also a significant positive relationship between the self- and ingroup-advantage in response time, but not in *d*prime scores.

The present findings extend previous work by Moradi et al. (2015), who found response time and sensitivity advantages amongst football supporters when responding to the badge of the team they supported compared to rival and neutral team badges. Similarly, Experiments 1 and 2 of the present thesis found comparable effects for rowers in responding to the stimuli association with their own team compared to neutral and rival teams, and Experiment 3 replicated this again in a sample of military personnel. The ingroup exemplars in

the previous studies are socially established and meaningful and the present experiment (Experiment 4) expanded upon these results by demonstrating that an ingroup-bias in attentional prioritisation is manifested even when group affiliations are new, arbitrary and randomly assigned.

These results are in line with the vast body of literature demonstrating the effects of minimal group allocation not only on higher-level decision-making such as resource allocation (e.g., Allen & Wilder, 1975; Brewer & Silver, 1978; Doise et al., 1972; Tajfel et al., 1971), but also on more implicit processes (Ashburn-Nardo et al., 2001; Otten & Wentura, 1999; Sheng & Han, 2012). Whilst previous research has shown that minimal group allocation affects the early visual processing of faces belonging to new ingroup and outgroup members (Ratner & Amodio, 2013; Ratner et al., 2014), the present study extends these findings by demonstrating that novel group allocation also affects the early perceptual processing of previously neutral, *non-face* stimuli.

In addition to the ingroup-advantage effects, the results also demonstrated a significant positive relationship between the response time advantages for the self and novel ingroup, perhaps indicating a common mechanism underling these effects. While Experiment 1 of the present thesis demonstrated a positive relationship between the self and ingroup response time advantages (using college rowers), there was no such trend in Experiment 3 (using military personnel). The relationship between the self and ingroup response time advantages here is perhaps indicative of a self-anchoring mechanism driving the advantage for the novel ingroup (Cadinu & Rothbart, 1996). A comprehensive meta-analysis found that the projection of the self onto

a social group is more likely in minimal group than established group conditions (Robbins & Kreuger, 2005). It could then be that the novel ingroup-bias observed in the perceptual matching paradigm is in fact a simple extension of the reliable self-advantage that has been demonstrated across many studies (e.g., Stolte et al., 2017; Sui et al., 2012; Sui & Humphreys, 2015). Although there was a correlation between the self and ingroup response time advantages, there was no such relationship between the advantages in *d*prime scores. This may be because there was a different pattern of responses for mismatched trials, and the *d*prime scores combine these together.

The present experiment (Experiment 4) benefitted from a unique approach to measuring minimal group-biases in low-level attentional prioritisation by using random ingroup allocation combined with the perceptual matching paradigm. As has been mentioned previously, this paradigm is particularly useful in allowing for comparison across social associations whilst keeping the method of measurement and the visual features of the stimuli exactly the same. However, the design of the first experiment was such that separate matching tasks for self and ingroup associations were performed sequentially, so task order effects associated with practice may have slightly reduced the strength of similarity between responses for self and ingroup. The next experiment (Experiment 5) attempted to address this issue by including self, stranger, ingroup and outgroup associations within the same task. Importantly, this design (as for Experiment 2), allowed me to test whether the self- and ingroup-biases remained constant when both kinds of stimuli were present. Further, as the paradigm included combinations of shape-label pairings

for self and ingroup together, this also allowed examination of the overlap between self and novel ingroup representation. For example, as observed in Experiment 2, higher error rates and slower response times for self shapes paired with ingroup labels than self shapes paired with outgroup labels would indicate a cognitive overlap between self and ingroup stimuli.

Experiment 5

Methods

Participants

Participants were again recruited via the online system. A total of 22 individuals (14 female, age range 19-28years, mean age = 23.30, *SD* = 2.71) took part, 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 according to approved ethical procedures. Based on Experiment 2, which utilised a similar design to the present experiment, a sample size of eighteen was determined to be sufficient to detect a similar effect size ($\eta p^2 = 0.346$) with a power of .90 and $\alpha = .05$ for the main effect of shape on response time and sensitivity in the 2 (shape: own/other) x 2 (task type: personal/group) x 2 (match/mismatch). Therefore, although this sample size was smaller than that of Experiment 4, a larger sample size was not necessary to establish the main effects.

Stimuli and tasks

In a modified version of the perceptual matching task similar to that described for Experiment 2, personal and group associations were made within the same blocks of the same task. Participants first learned to pair Self, Stranger, Team Green and Team Blue labels with different geometric shapes (circle, square, triangle, pentagon), which were again counterbalanced across participants. Following this short learning phase, participants were required to judge whether shape-label pairings presented on the screen were correctly or incorrectly matched according to the initial associations. The task consisted of six blocks of 96 trials per block (excluding 12 practice trials at the beginning). There were eight conditions within the task: four shape conditions (self, stranger, ingroup, outgroup) and two match conditions (matched/mismatched), with 72 trials per condition. The whole task took approximately 20 minutes and exactly the same experimental parameters were used as for the first experiment.

Questionnaire measures

Participants completed the same independent and interdependent self-construals (Singelis, 1994) and self-esteem (Rosenberg, 1965) scales as described for Experiment 1 (Appendix A).

Procedure

Participants were verbally allocated to either Team Green or Team Blue in the same way as for Experiment 4. Participants first performed the matching task (described above) in which self, stranger, ingroup and outgroup labels were associated with four different geometric shapes. After the matching task, participants completed the self-report scales. The experiment took

approximately 30 minutes and participants were compensated at a rate of £10 per hour for their time.

Results (Experiment 5)

Own-associated biases in response time data

A 2 (association type: personal/group) x 2 (shape: own/other) x 2 (matched/mismatched) repeated measures ANOVA was used to determine the effect of shape association on response time. There was a significant effect of association type, with responses faster for the personal (M = 682.03 ±10.89) than the group (M = 705.41 ±11.01) shapes, $F(1, 21) = 25.06$, $p < .001$, $\eta_p^2 = .544$. There was also a marginal effect of shape, $F(1, 21) = 4.23$, $p = .052$, $\eta_p^2 = .167$, with faster response times for own (M = 686.61 ±10.86) than for other (M = 697.84 ±10.91) shapes. There was a significant effect of match condition, $F(1, 21) = 79.28$, $p < .001$, $\eta_p^2 = .791$, with responses faster for matched (M = 662.55 ±9.60) than for mismatched (M = 724.89 ±12.71) pairs.

There was no significant interaction between association type and shape, $F(1, 21) = 2.70$, $p = .116$, $\eta_p^2 = .114$. However, there was a significant interaction between association type and match condition, $F(1, 21) = 25.01$, $p < .001$, $\eta_p^2 = .544$, and between shape and match condition, $F(1, 21) = 18.56$, $p < .001$, $\eta_p^2 = .469$. Further, there was a significant three-way interaction between association type, shape and match, $F(1, 21) = 7.38$, $p = .013$, $\eta_p^2 = .260$.

To decompose this three-way interaction, separate paired-samples t-tests were performed for personal and group associations on matched and mismatched pairs. Responses were significantly faster for self shapes than for

stranger shapes on matched trials, $t(21) = 4.53$, $p < .001$, $d = .97$, but significantly faster for stranger shapes than for self shapes on mismatched trials, $t(21) = 3.46$, $p = .002$, $d = .74$. There was no significant difference in response time scores between ingroup and outgroup shapes either for matched $t(21) = .95$, $p = .356$, $d = .20$, or for mismatched, $t(21) = 1.13$, $p = .271$, $d = .24$, trials[30]. See Figure 4.4 for a bar chart depicting response times for matched and mismatched trials under each shape condition, and Table 4.2 for mean (*SD*) scores.

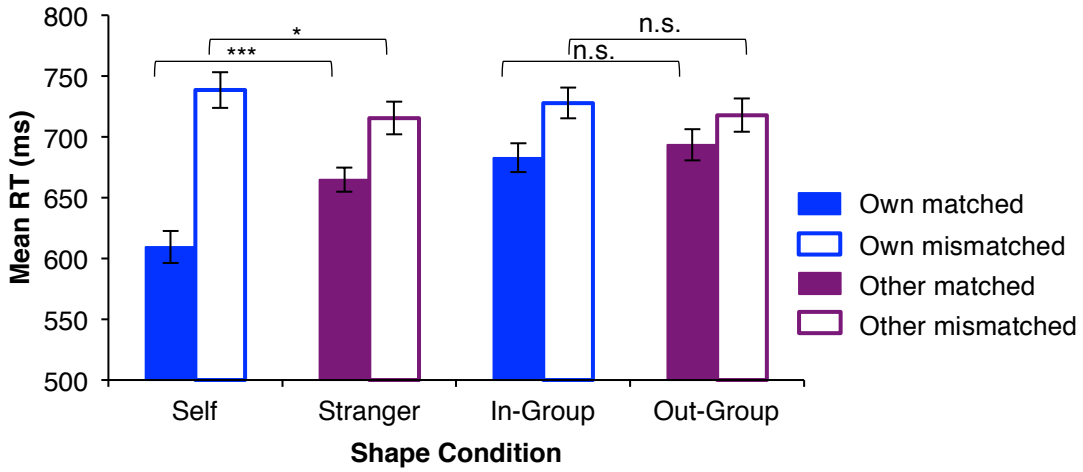


Figure 4.4: Mean response time (RT) scores as a function of shape, match and task type for Experiment 5. Error bars represent standard errors. *Note*: ** denotes $p < .001$; * denotes $p < .01$; n.s. denotes non-significant.

Own-associated biases in *d*prime (perceptual sensitivity)

A 2 (association type: personal or group) x 2 (shape: own/other) repeated measures ANOVA was used to test for the effect of shape condition on sensitivity (*d*prime) scores. There was a marginal effect of association type, $F(1, 21) = 3.22$, $p = .087$, $\eta_p^2 = .133$, whereby sensitivity was greater for personal (*M*

[30] Accuracy data followed a similar pattern. Accuracy was significantly higher for self shapes than stranger shapes on matched trials, but there was no difference in accuracy between ingroup and outgroup.

= 2.19 ± .19) than for group (*M* = 1.98 ± .19) associations, and also a significant effect of shape, $F(1, 21) = 8.20$, $p = .009$, $\eta_p^2 = .281$, with greater sensitivity for own (*M* = 2.27 ± .18) than for other (*M* = 1.91 ± .20) shapes. A significant interaction between the two variables, $F(1, 21) = 5.63$, $p = .027$, $\eta_p^2 = .211$, indicated that the effect of shape was dependent on the association type. Subsequent paired-samples *t*-tests revealed that participants demonstrated enhanced perceptual sensitivity for self shapes relative to stranger shapes, $t(21) = 3.17$, $p = .005$, $d = .67$, but that there was no difference between ingroup and outgroup shapes, $t(21) = .83$, $p = .417$, $d = .18$. Similar to response time data, responses were enhanced for self relative to stranger, but not for ingroup relative to outgroup stimuli[31]. See Figure 4.5 for a bar chart depicting sensitivity scores for each shape condition, and Table 4.2 for mean and standard deviation (*SD*) scores.

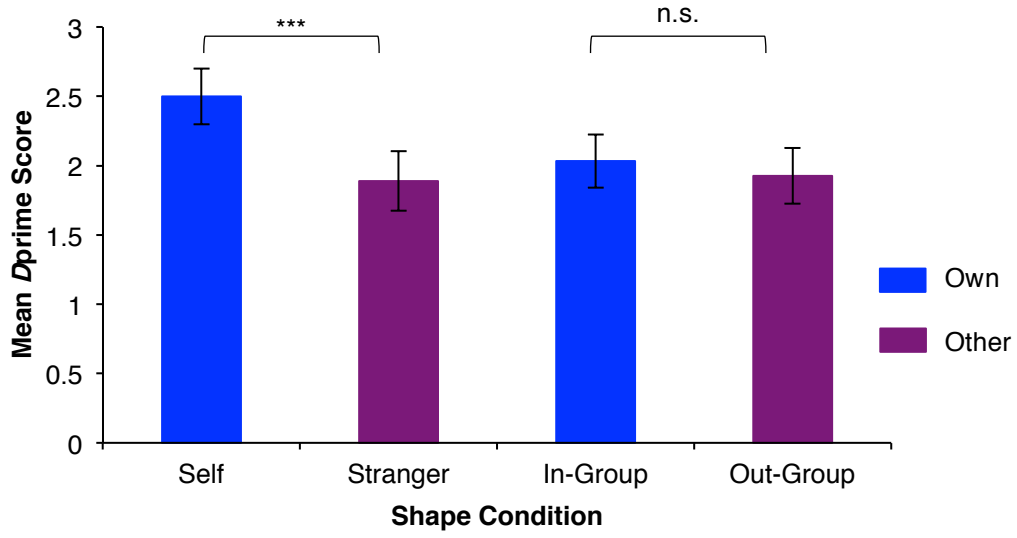


Figure 4.5: Mean *d*prime scores for each shape condition Experiment 5. Error bars represent standard errors. *Note*: ** denotes $p < .001$; n.s. denotes non-significant.

[31] The response criterion was significantly lower for self shapes than for stranger shapes, but there was no difference in this between ingroup and outgroup shapes.

Table 4.2: Mean response times (RTs) for correct responses and accuracy rates (proportions of correct responses), along with mean *d*prime scores (Experiment 5). *Note*. Standard deviations are in parentheses.

Shape	RT (ms) *matched*	RT (ms) *mismatched*	Accuracy *matched*	Accuracy *mismatched*	*D* prime
Self	609.38 (62.32)	738.58 (69.06)	.92 (.05)	.77 (.17)	2.50 (.95)
Stranger	664.74 (46.10)	715.42 (62.84)	.81 (.13)	.77 (.17)	1.89 (1.01)
Ingroup	682.68 (55.62)	727.78 (59.10)	.84 (.12)	.79 (.14)	2.03 (.90)
Outgroup	693.42 (59.66)	717.78 (64.49)	.79 (.14)	.80 (.13)	1.93 (.94)

Analysis of mismatched pairs

Response time data

Although there was no significant advantage for the novel ingroup compared to the novel outgroup, performance for specific mismatched shape-label combinations was measured to test for an overlap between the representation of the self and novel ingroup. If the novel ingroup is anchored to the self, then we would expect slower response times when responding 'no' to a self shape mismatched with an ingroup label than a self shape mismatched with an outgroup label, as the latter would be more obviously incongruent. Paired-samples *t*-tests were conducted to determine if there were differences in response time scores between self shapes paired with ingroup labels and self shapes paired with outgroup labels[32].

There were no significant differences in response times for self shapes paired with ingroup labels than for self shapes paired with outgroup labels, *t*(21)

[32] There were 24 trials for each mismatched condition.

= 1.22, p = .235, d = .26, indicating that participants were no more hesitant to reject self shapes paired with ingroup labels as incorrect than self shapes paired with outgroup labels. However, ingroup shapes paired with self labels were responded to significantly faster than ingroup shapes paired with stranger labels, $t(21) = 2.19$, p = .041, d = 0.46. That participants were faster to correctly reject ingroup shapes paired with self labels is opposite to the predicted effect, and merely suggests generally faster responses for self labels than stranger labels.

Accuracy data

Although there were no differences between the mismatched pairs in response times, accuracy scores were significantly higher for self shapes paired with outgroup labels than self shapes paired with ingroup labels, $t(21) = 2.18$, p = .041, d = 0.47. Accuracy scores were also marginally higher for ingroup shapes paired with stranger labels than ingroup shapes paired with self labels, $t(21)$ = 1.87, p = .075, d = 0.40. Participants were more accurate at rejecting self shapes paired with outgroup labels and ingroup shapes paired with stranger labels than at rejecting self and ingroup mismatching combinations. That participants found it easier to reject self+*outgroup* than self+*ingroup* and ingroup+*stranger* than ingroup+*self* indicates an overlap in the way that newly learned self and novel ingroup stimuli are represented. Table 4.3, below, depicts the mean response times and proportions of correct responses (accuracy scores) for each mismatched pair of interest.

Table 4.3: Mean response times for correct responses and accuracy rates (proportions of correct responses) for specific mismatched pairs (Experiment 5). *Note*. Standard deviations are in parentheses.

Shape + Label	RT (ms)	Accuracy
Self + Ingroup	745.18 (79.04)	.72 (.24)
Self + Outgroup	730.63 (74.51)	.79 (.16)
Ingroup + Self	706.50 (69.08)	.79 (.21)
Ingroup + Stranger	729.08 (57.58)	.86 (.13)

Note: Although self-report measures of self-esteem and self-construals were obtained, as outlined in the methods, these were not included in the final analysis for this experiment. This was because there was no perceptual bias for the ingroup in relation to the outgroup to correlate the self-report measures with.

Discussion (Experiment 5)

Experiment 5 again examined the relations between self- and novel ingroup-advantages in the perceptual matching paradigm; this time when self, stranger, ingroup and outgroup shape-label pairs were presented within the same blocks of the same task. This design allowed for comparison of self and ingroup attentional biases when both kinds of social stimuli were present at the same time. Unsurprisingly, a strong self-bias effect was found, with significantly faster responses for self than for stranger shapes on matched trials (but not on mismatched trials) and significantly enhanced *d*prime scores. However, there was no response time or *d*prime advantage for ingroup compared to outgroup shapes within this design. These results contrast to those from Experiment 4, which demonstrated a robust ingroup-advantage even when the groups were

new and arbitrarily assigned. Similarly, the results contrasted to Experiment 2 of this thesis, in which a significant ingroup-advantage amongst the college rowers was found even when the self and ingroup pairings were presented within the same task, as was the case here. This suggests that novel ingroup-biases on the perceptual matching task do not follow exactly the same patterns as those for established groups, particularly when competing with the self for attention.

The results imply that when self and novel ingroup associated stimuli directly compete for attention, the self takes priority, with the ingroup-bias effect disappearing. In fact, comparable responses for stranger, ingroup and outgroup associations (see Figures 4.4 and 4.5, above) imply that stimuli here were classed as 'self' or 'non-self', irrespective of group affiliation. Thus, in a more cognitively demanding task (i.e., four shape-label associations rather than 2 or 3) and with limited attentional resources, self significance plays a more important role in capturing attention than minimal group affiliation. Interestingly, this is not the case for established groups, in which both kinds of social biases remained constant even in the presence of one another (Experiment 2). It may be that because of the higher importance of the self than the new social category, the self associated stimuli retain higher salience. Turner's principle of functional antagonism, which is an important part of self-categorisation theory and closely linked to the social identity perspective (Turner et al., 1987), holds that whilst many social identities exist within each individual, as the salience of one increases, the saliency of the other will correspondingly decrease. Thus if the self is highly salient in comparison to the minimal group, then attention may be shifted entirely to the self. With regards to the notion of self-anchoring, it may

be that when explicit self stimuli are present, the projection of the self onto novel ingroup associations is less important.

Although there was no ingroup-advantage effect, responses to specific combinations of shape-label mismatches indicated greater difficulty in distinguishing self from ingroup stimuli, thus providing some evidence for an overlap in the representation of self and ingroup. Error rates were significantly lower for self shapes paired with outgroup labels than with ingroup labels and marginally lower for ingroup shapes paired with stranger labels than with self labels. Therefore, participants were better at responding 'no' to self/outgroup and ingroup/stranger combinations than self/ingroup combinations. This indicates a cognitive overlap between self and ingroup stimuli, suggesting the ingroup to be represented as part of the self (Coats et al., 2000; Smith et al., 1999). However, these findings only applied to accuracy, and not response time, scores, and the effect sizes were relatively small.

This experiment aimed to measure the relationship between self- and novel ingroup-advantage effects when both kinds of stimuli were presented within the same set of trials. As there was a discrepancy in results regarding minimal group-advantage effects between Experiments 4 and 5, Experiment 6 aimed to reintroduce the ingroup-advantage effect by separating self and ingroup associations into alternating blocks of the same task in order to reduce competition between self and ingroup whilst still controlling for practice effects.

Experiment 6

Methods

Participants

As for Experiments 4 and 5, participants were recruited via the online recruitment system. Based on the sample size calculation described for Experiment 5, and for a comparable sample size, again a total of 22 individuals took part (12 female, age range 19-35 years, mean age = 25.18, *SD* = 4.5). Again, although this sample size was smaller than that of Experiment 4, 22 was sufficient to establish the main effects and compare these to Experiment 5. All of the participants were right-handed and had normal or corrected-to-normal vision. As before, informed consent was obtained from all participants prior to the experiment.

Stimuli and tasks

In another version of the matching task, personal and group associations were this time made within *different* blocks of the *same* task. Participants learned to pair two geometric shapes each with Self, Stranger, Team Green and Team Blue labels, again counterbalanced, and had to judge whether shape-label pairings subsequently presented were correctly or incorrectly matched. There were six blocks of 80 trials per block (excluding 12 practice trials at the beginning) and personal and group blocks were alternated such that there were 3 of each. Half of the participants were presented with a personal block first and half with a group block first. Participants were given a break in between each block during which they were reminded on-screen of the shape-label

associations. This was to make sure that performance did not suffer as a result of the increased demands of eight shape associations within the same task duration. There were eight conditions: four shapes (self, stranger, ingroup, outgroup) each either matched or mismatched, with 60 trials per condition. The whole task took approximately 20 minutes and the experimental parameters were the same as for previous experiments.

Questionnaire measures

Participants completed the independent and interdependent self-construals (Singelis, 1994) and self-esteem (Rosenberg, 1965) scales (Appendix A).

Procedure

Participants were verbally allocated to either Team Green or Team Blue in the same way as for Experiments 4 and 5. Participants first performed the matching task (described above) and then completed the three self-report scales. The experiment took approximately 30 minutes and participants were compensated at a rate of £10 per hour for their time.

Results (Experiment 6)

Own-associated biases in response time data

There were three within-subject variables within the task: association type (personal or group blocks); shape category (own: self/ingroup and other: stranger/outgroup) and the match condition (matched or mismatched). A 2 x 2 x 2 repeated measures ANOVA with association type (personal/group), shape condition (own/other) and match condition (matched/mismatched) as the three

within-subject variables was used to test for the effect of shape on response time scores.

There was no effect of task type on response time, $F(1, 21) = .04$, $p = .847$, $\eta_p^2 = .002$, showing that response times were generally similar for personal and group associations. There was a significant effect of shape on response time, $F(1, 21) = 24.17$, $p < .001$, $\eta_p^2 = .535$, with significantly faster responses for own (self and ingroup) ($M = 722.28 \pm 14.89$) than other (stranger and outgroup) ($M = 755.95 \pm 14.15$) shapes. There was also a significant effect of match condition, $F(1, 21) = 64.09$, $p < .001$, $\eta_p^2 = .753$, with responses to matched pairs ($M = 714.42 \pm 13.99$) significantly faster than responses to mismatched pairs ($M = 763.80 \pm 14.88$).

There was no significant interaction between task and shape, $F(1, 21) = .004$, $p = .950$, $\eta_p^2 = .000$, but there was a significant interaction between task and match condition, $F(1, 21) = 4.35$, $p = .049$, $\eta_p^2 = .171$, and between shape and match condition, $F(1, 21) = 68.78$, $p < .001$, $\eta_p^2 = .766$. There was no significant three-way interaction between task, shape and match, $F(1, 21) = .39$, $p = .540$, $\eta_p^2 = .018$.

Separate paired-samples t-tests performed on matched and mismatched trials for each task type found that responses for self shapes were significantly faster than for stranger shapes under matched, $t(21) = 6.23$, $p < .001$, $d = 1.33$, but not mismatched, $t(21) = 1.75$, $p = .096$, $d = 0.37$, trials. Similarly, responses for ingroup shapes were significantly faster than for outgroup shapes for matched $t(21) = 6.20$, $p < .001$, $d = 1.32$, but not mismatched $t(21) = .982$, $p =$

.340, d = 0.21 trials[33]. Figure 4.6 depicts a bar chart representing response times for matched and mismatched trials under each shape condition, and Table 4.4 (below) presents mean and standard deviation (*SD*) scores.

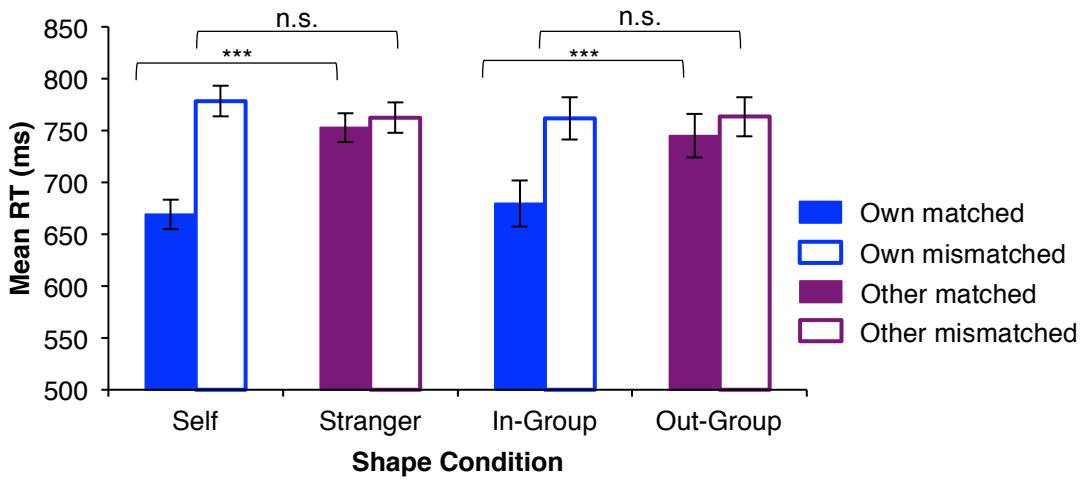


Figure 4.6: Mean response time (RT) scores as a function of shape, match and task for Experiment 6. Error bars represent standard errors. *Note*: ** denotes $p < .001$; n.s. denotes non-significant.

Own-associated biases in *d*prime (perceptual sensitivity)

A 2 (association type: personal/group) x 2 (shape: own/other) repeated measures ANOVA found a significant effect of shape on sensitivity scores, $F(1, 21) = 43.95$, $p < .001$, $\eta_p^2 = .677$, with sensitivity significantly enhanced for own (self and ingroup) ($M = 2.19 \pm .20$) over other (stranger and outgroup) ($M = 1.40 \pm .15$) shapes. There was no significant effect of association type on sensitivity, $F(1, 21) = .92$, $p = .349$, $\eta_p^2 = .042$, and no significant interaction between association type and shape, $F(1, 21) = .15$, $p = .710$, $\eta_p^2 = .007$. Thus, sensitivity was significantly enhanced for self relative to stranger shapes and for ingroup relative to outgroup shapes. Figure 4.7 depicts a bar chart representing

[33] Accuracy for self shapes was significantly higher than for stranger shapes on matched trials, but the reverse was true for mismatched trials. Accuracy for ingroup shapes was significantly higher than for outgroup shapes for matched trials, but there was no difference between ingroup and outgroup for mismatched trials.

sensitivity scores for each shape condition, and Table 4.4 (below) presents mean and standard deviation (*SD*) scores.

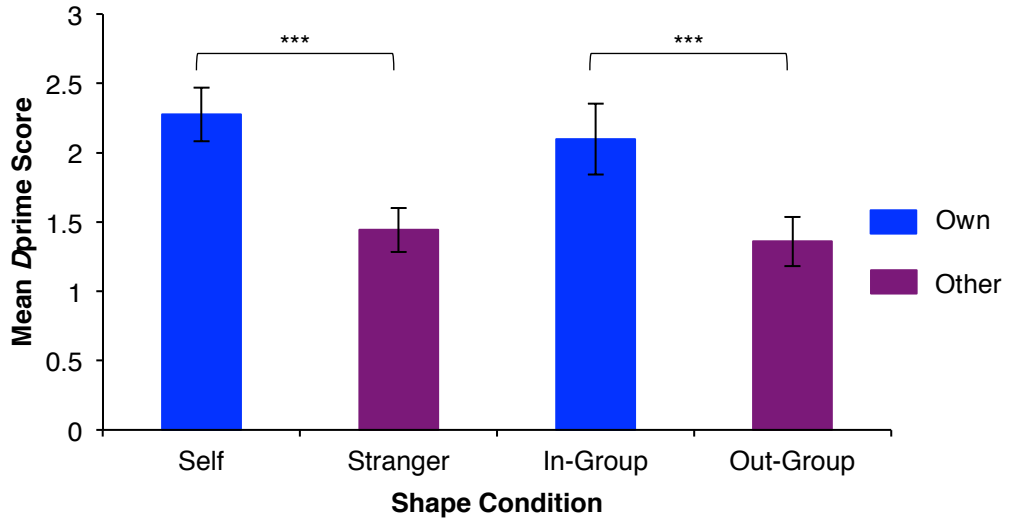


Figure 4.7: Mean sensitivity (*d*prime) scores as a function of shape and task for Experiment 6. Error bars represent standard errors. *Note*: ** denotes $p < .001$.

Table 4.4: Mean response times (RTs) for correct responses and accuracy rates (proportions of correct responses), along with mean *d*prime scores (Experiment 6). *Note*. Standard deviations are in parentheses.

Shape	RT (ms) *matched*	RT (ms) *mismatched*	Accuracy *matched*	Accuracy *mismatched*	*D*prime
Self	669.25 (67.16)	778.37 (68.54)	0.91 (.08)	0.74 (.15)	2.28 (.91)
Stranger	752.90 (65.86)	762.59 (68.97)	0.66 (.15)	0.82 (.12)	1.44 (.74)
Ingroup	679.68 (105.15)	761.80 (96.67)	0.88 (.16)	0.71 (.20)	2.09 (1.20)
Outgroup	744.97 (97.88)	763.34 (88.48)	0.69 (.16)	0.76 (.16)	1.36 (.83)

Correlations between the advantages for the self and ingroup

Both response time and sensitivity data indicated that performance was enhanced for own shapes compared to other shapes. As for Experiment 4, difference scores between self and stranger and between ingroup and outgroup

shapes for both response time and sensitivity were taken as indicators of the relative magnitude of self- and ingroup-prioritisation. The relationship between the performance advantages for self and ingroup was then measured using bivariate correlations.

There was a significant positive relationship between the self- and ingroup-advantages in response time, $r(20) = .579$ [.213, .837], $p = .006$ (Figure 4.8a), but not in sensitivity, $r(20) = -.200$ [-.541, .123], $p = .384$ (Figure 4.8b).

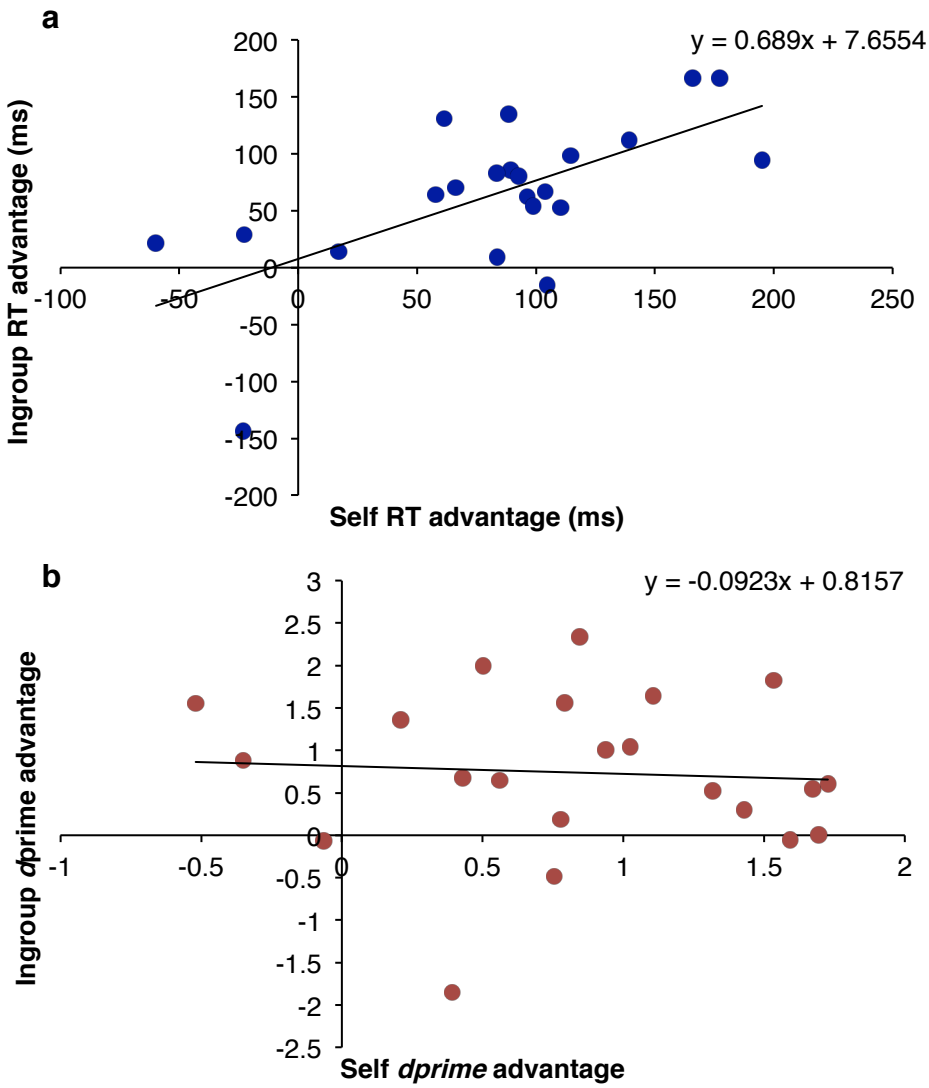


Figure 4.8: The relationship between self- and ingroup-advantages in (a) response time (N = 22, $p<.01$) and (b) sensitivity (N = 22, $p = .384$) for Experiment 6.

Discussion (Experiment 6)

Experiment 6 aimed to replicate the minimal ingroup-advantage effect that was observed in Experiment 4 in a cleaner design by eliminating potential task order effects. By separating the self and ingroup associations into alternating blocks within the same task, the ingroup-advantage in response time and sensitivity that was observed in Experiment 4, but eliminated in Experiment 5, was re-established. Furthermore, a positive relationship between the self- and ingroup-biases in response time was observed. As noted in the discussion for Experiment 4, this contributes to previous research by showing that minimal group allocation causes a bias in early perceptual processing as well as, for example, resource allocation (e.g., Allen & Wilder, 1975; Brewer & Silver, 1978; Doise et al., 1972; Tajfel et al., 1971) and implicit positive affect (Ashburn-Nardo et al., 2001; Otten & Wentura, 1999; Sheng & Han, 2012). The robust ingroup-advantage effect also suggests that biases for socially established groups, as shown in previous experiments of this thesis, can be obtained not only with established social stimuli, but also novel social categories as well.

Although the self and ingroup associations were present within the same task as for Experiment 5, the separation into alternating blocks appeared to sufficiently reduce the direct competition for attention between the self and the novel group such that the ingroup-bias was demonstrated. This suggests that individuals are able to quickly switch attentional priority between self and novel ingroup relevance when they are required to only focus on one at a time. In the blocked design of this study, there were similar effect sizes for the self and ingroup response time and sensitivity advantages, and there was a strong

relationship between the self- and ingroup-biases in response time that was also found for Experiment 4. The stronger correlation effect size may have occurred because there were no effects of task order on responses to self and ingroup associations. The relationship again provides evidence for self-anchoring (Cadinu & Rothbart, 1996). As the self-advantage is predictive of the advantage for the novel ingroup, despite having no obvious social content, it seems most likely that this arises out of a projection of self relevance onto the group. As mentioned previously, prior work has found no relationship between biases for the self and high reward or positive valence (Stolte et al., 2017; Sui & Humphreys 2015) even when measured by the matching paradigm in the same way. Thus, the relationship observed presently does indeed imply a conceptual connection between self- and novel ingroup-prioritisation.

Similar to Experiment 4, there was no relationship between the self- and ingroup-advantage effects in sensitivity. Again, this is likely to be because matched and mismatched trials were combined, the effects of which were slightly different between personal and group associations. Overall, this experiment replicated and strengthened the conclusions of Experiment 4, providing further evidence for an ingroup-advantage in perceptual matching for novel social categories.

Self-report measures (Experiments 4 and 6)

Self-esteem and self-construals

Data from Experiments 4 and 6 were combined to give greater power in the self-report data analyses (total N = 69), but data from Experiment 5 were not

included because there was no ingroup-bias in response time or in sensitivity. Correlations were used to measure whether the self- and ingroup-biases were associated with self-esteem and independent/interdependent self-construals. Two outliers were removed because they were above 2.5SD from the group mean score for both the self-bias and ingroup-bias in response time (Barnett & Lewis, 1978; Lovie, 1986). Additionally, three participants did not complete the self-esteem scale.

The mean score for interdependent self-construal was 69.56 (SD = 8.90); the mean score for interdependent self-construal was 70.03 (SD = 9.63); and the mean score for self-esteem was 29.78 (SD = 9.63). There was a significant positive relationship between self-reported levels of independent self-construal and self-esteem, $r(62) = .328$ [.122, .504], $p = .008$. There was no significant relationship between interdependent self-construal and self-esteem, $r(62) = .078$ [-.170, .329], $p = .539$, or between interdependent and independent self-construal, $r(65) = .176$ [-.086, .405], $p = .164$. The positive relationship between self-esteem and independent self-construal implies that positive feelings of self worth are associated with a focus on the internal attributes of the self and a view of the self as unique and separate from others. Figure 4.9 depicts this positive relationship.

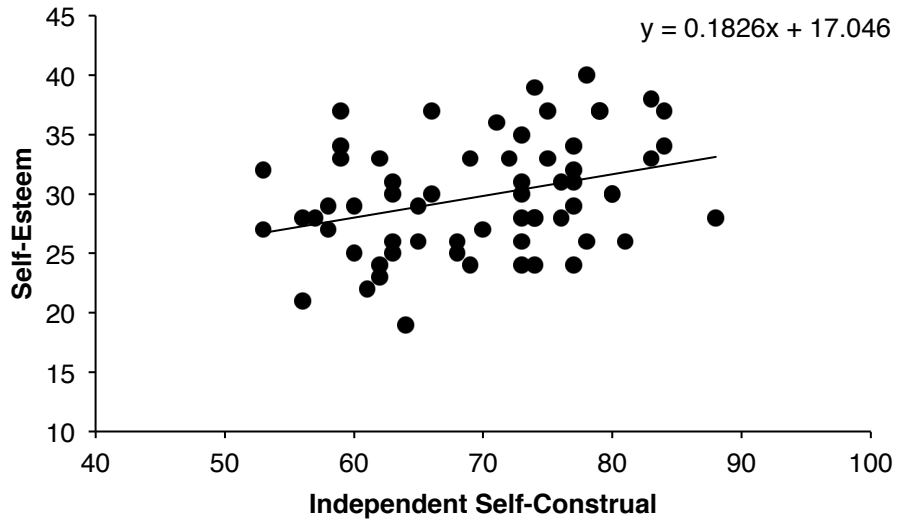


Figure 4.9: The positive relationship between self-esteem and independent self-construal (data from Experiments 4 and 6 combined).

Self-report measures and own-associated biases

There was no significant relationship between the self-bias in response time and independent self-construal, $r(65) = .063$ [-.163, .317], $p = .613$, interdependent self-construal, $r(65) = .105$ [-.131, .336], $p = .396$, or self-esteem, $r(62) = .089$ [-.197, .343], $p = .485$. Similarly, there was no significant relationship between the ingroup-bias in response time and independent self-construal, $r(65) = .135$ [-.111, .371], $p = .278$, interdependent self-construal, $r(65) = .079$ [-.164, .331], $p = .527$, or self-esteem, $r(64) = .-.052$ [-.366, .248], $p = .681$[34].

Moderation analyses

As mentioned in the introduction, if ingroup-bias is driven at least in part by a self-anchoring mechanism, then we may expect the relationship between self-

[34] There were also no significant relationships between the advantages for the self and ingroup in sensitivity and self-reported measures of independent self-construal, interdependent self-construal, or self-esteem.

bias and ingroup-bias to be moderated by individual differences in self-views. To examine this in the context of the perceptual prioritisation effects demonstrated in Experiments 4 and 6, I used moderation analyses to test whether self-esteem, independent self-construal and interdependent self-construal moderated the relationship between the self and ingroup response time biases.

Three separate regression models were run with self-bias in response time as the predictor variable, ingroup-bias in response time as the dependent variable, and self-reported levels of (1) self-esteem, (2) independent self-construal and (3) interdependent self-construal as the moderator variables. These analyses were run in SPSS using MODPROBE (Hayes, 2009) and all predictor variables were mean-centred prior to analysis. Using this approach, significant interactions are typically followed up by examining the conditional effect of the predictor variable at 1 standard deviation below the mean (low), at the mean, and 1 standard deviation above the mean (high) of the moderator variables.

The first regression analysis, containing self-bias in response time as the focal predictor, ingroup-bias in response time as the dependent variable and self-esteem as the moderator variable, revealed that self-bias in response time significantly predicted ingroup in response time (b = .433, 95% CI [0.203, 0.663], $t(60) = 3.77$, $p < .001$), while self-esteem did not (b = -.890, 95% CI [-3.360, 1.580], $t(60) = -.721$, $p = .474$) and there was no significant interaction (b = -.021, 95% CI [-.068, .026], $t(60) = -.896$, $p = .374$).

The second regression analysis, containing independent self-construal as the moderator variable, revealed that self-bias in response time significantly predicted ingroup-bias in response time (b = .446, 95% CI [0.231, 0.660], t(63) = 4.15, p < .001), while independent self-construal did not (b = .616, 95% CI [-.678, 1.910], t(63) = .961, p = .345) and there was no significant interaction (b = .001, 95% CI [-.025, .025], t(63) = .007, p = .995).

Similarly, the third regression analysis, containing interdependent self-construal as the moderator variable, again revealed that self-bias in response time significantly predicted ingroup-bias in response time (b = .419, 95% CI [0.195, 0.641], t(63) = 3.75, p < .001), while independent self-construal did not (b = -.004, 95% CI [-1.222, 1.214], t(63) = -.007, p = .994) and there was no significant interaction (b = -.012, 95% CI [-.036, .012], t(63) = -1.02, p = .314)[35].

Chapter discussion

Across three experiments, I examined the effects of minimal group allocation on low-level biases in perceptual processing. A robust advantage in response time and sensitivity for stimuli associated with the self and the ingroup was found when self and ingroup associations were responded to in separate tasks (Experiment 4) and in separate blocks of the same task (Experiment 6). However, when self and ingroup associations were presented within the same task blocks, the prioritisation effects were only observed for stimuli associated with the self (Experiment 5). Although there was no ingroup-advantage effect when self and ingroup stimuli were present in the same task blocks, higher error

[35] The same analyses on sensitivity (*d*prime) scores also showed no significant interaction effects.

rates for self shapes paired with ingroup than with outgroup labels and marginally higher error rates for ingroup shapes paired with self than with stranger labels indicated the possibility of a shared cognitive representation of newly-learned self and (novel) ingroup stimuli. Further to this, there were robust positive correlations between the self and ingroup response time biases in both Experiments 4 and 6, suggesting a shared mechanism driving prioritisation effects for the self and new social ingroups. There were no relationships between the prioritisation effects in the perceptual matching task and subjective measures of self-esteem or independent/interdependent self-construals. Further, these self-report measures did not significantly moderate the relationship between self- and ingroup-prioritisation effects.

In this section, I begin by addressing the implications of the results regarding the observed minimal group-bias and how these relate to previous research in the area of novel group allocation on early visual processing. Following this, the relationships between the self- and ingroup-prioritisation effects are discussed with a focus on evidence for self-anchoring as a mechanism for the novel ingroup-bias. The implications of the self-report data are then considered, and I conclude that, similar to the previous two studies within this thesis, the perceptual advantages for socially relevant stimuli exhibited within the matching task are distinct from explicit attitudes towards the self and social dynamics. Following this, I acknowledge some key limitations within this study and make some suggestions for future research.

As noted in the individual discussion sections for each experiment, the prioritisation effects found for ingroup associated stimuli within the matching

task complement a vast number of previous research studies that find ingroup favouritism effects in the minimal group paradigm across a range of outcome measures, from reward allocation (Tajfel, 1971) to a bias in facial representation (Ratner et al., 2014). The present results, in which mere social categorisation altered attention to previously neutral geometric shapes, demonstrates for the first time that the minimal group-bias also extends to early visual perception even when no obvious social content (e.g., faces) is present. Previous research examining the neural encoding of faces has also found that minimal group allocation affects early visual processing. Ratner and Amodio (2013) used ERP measures and demonstrated larger N170 amplitudes for ingroup than outgroup members, indicating superior structural encoding of novel ingroup faces. The authors note that this early bias in visual processing may in turn facilitate more elaborate attributions, such as character traits and emotional states, of ingroup and outgroup members (i.e., Ratner et al., 2014). Expanding on these findings, results from the present study indicate a bias in early visual processing even for non-face stimuli. This fundamental perceptual bias in categorising social information may then drive further effects relating to ingroup-bias. For example, greater attentional resources allocated to ingroup stimuli may then cause better differentiation of ingroup and outgroup members (i.e., Meissner & Brigham, 2001). The present findings, then, add to the line of research that suggests social information influences early perceptual processing in a top-down way, contrasting to more traditional models of visual perception (e.g., Marr, 1982). Even minimal group allocation provides a motivating factor in directing attention and enhancing early perceptual processing.

Although Experiments 4 and 6 demonstrated a robust minimal group effect, the novel ingroup-prioritisation effect was eliminated when self stimuli were present (Experiment 5). As the ingroup-bias was present in Experiment 2 (amongst college rowers) under exactly the same experimental design, this indicates a difference in the mechanisms behind novel and established ingroup-prioritisation effects. It may be that established social groups contain more meaning and personal significance than novel ones, enabling them to remain a priority even when self stimuli are also present. Novel groups, however, may not hold enough inherent personal meaning to retain attention when task demands are greater and the self competes for attention. This point highlights an important methodological consideration: if novel group-biases do not always follow the same patterns as established group-biases, then studies utilising minimal group paradigms hold the potential of showing a different pattern of responses, particularly with relation to personal significance. It would be interesting for further research to delve further into the specific mechanisms behind the processing of established and novel ingroup stimuli.

Both Experiments 4 and 6 provided evidence for a positive relationship between the self- and novel ingroup-advantage in response time, indicating a shared process driving the two advantage effects. This is consistent with a great deal of experimental evidence and theory that suggests ingroups are represented as part of the self (e.g., Coats et al., 2000; Smith, et al., 1999; Smith & Henry, 1996; Turner et al., 1987). However, Experiment 1 (rowers) found only a relatively weak relationship between self- and ingroup-biases and Experiment 3 (military personnel) found no relationship at all. The correlation

reported in the present experiments (4 and 6) may, then, be particular to minimal groups. This notion complements work on the self-anchoring hypothesis (Cadinu & Rothbart, 1996; Van Veelen et al., 2015), that suggests that ingroup favouritism arises, at least in some cases, by the projection of the self onto the group. This contrasts to the traditional social identity approach, which explained ingroup-bias in terms of the self assimilating to the group (Tajfel & Turner, 1979).

Original research for self-anchoring utilised a trait judgement paradigm in which it was found that participants ascribed characteristics to novel ingroups based on information about the self (Cadinu & Rothbart, 1996; Otten, 2000; Otten & Wentura, 2001). The present study implies that lower-level ingroup-bias may also arise from projection of self significance. As suggested by Van Veelen et al. (2015), this may serve as a cognitive heuristic that allows a gap to be filled from the known (the self) to the unknown (the novel ingroup). As mentioned previously, discrepancies in the mechanisms behind biases for established and novel ingroups would benefit from further investigation.

When the data from Experiments 4 and 6 were combined, there were no relationships between the self- and ingroup-prioritisation effects in perceptual processing and self-reported measures of self-esteem or self-construals. Previous research demonstrated that trait self-esteem scores (Rosenberg, 1965) predicted the degree to which novel ingroups were shown favouritism in positive trait ascriptions (Gramzow & Gaerter, 2005). This is complementary to the notion of self-anchoring, for which the view of the self would need to be positive in order for the projection of the self to cause a favourable view of the

ingroup. On a similar note, Van Veelan et al. (2015) suggested that independent self-construal may predict ingroup favouritism in the context of self-anchoring because of the high importance placed on the personal self. That no such relations were found in the present study suggests that these trait measures are distinct from lower-level attentional prioritisation effects. Previous experiments within the present thesis similarly found no such relationships between the social biases and levels of group identification or independent/ interdependent self-construals. As concluded in the previous chapters, it seems that low-level perceptual discrimination for socially relevant stimuli is not affected top-down by explicit attitudes towards the self and social groups. Instead, the social biases exhibited are fundamental and automatic, independent of individual attitudes.

Limitations

The three experiments reported in this chapter benefitted from replicating previous findings using a minimal group paradigm in which self- and ingroup-prioritisation measures were exactly equal. However, there are some limitations to the design that must be addressed. Firstly, participants were not given any criteria at all for the minimal group allocation. Previous studies, on the other hand, have ostensibly used art preference or dot estimation abilities (e.g., Tajfel, 1971; Ratner & Amodio, 2013) to give at least some reason, however arbitrary, for the new group affiliation. It cannot, then, be ruled out that an ingroup-bias effect would have been elicited in Experiment 5 if there were at least some apparent criteria to provide meaning to the categorisation. However, other previous studies have used similarly random allocation such as a coin toss and still shown strong ingroup-bias effects within the minimal group paradigm (e.g.,

Gaertner & Insko, 2000). Furthermore, although previous work by Stolte et al. (2017) and Sui and Humphreys (2015) found no relations between self-bias and positive valence or high reward when measured in the same way, there was no direct control in this experiment to check that *any* form of attentional prioritisation was not correlated simply by the nature of the design. However, the previous experiments (1, 2 and 3) within this thesis imply that this is not the case. Finally, one important aim of this study was to determine whether self-esteem was predictive of the self- and novel ingroup-advantages and of the strength of relationship between the two. However, all participants scored relatively highly on the self-esteem scale, the mean score for self-esteem was 29.78 (SD = 9.63) with a range between 19 and 40. According to the original scale, scores below 15 suggest low self-esteem (Rosenberg, 1965), and so none of the participants were in this category. There may not, then, have been enough variance to determine if levels of self-esteem relate to the self- and ingroup-prioritisation effects.

Conclusions

The results from this experimental chapter provide novel evidence for minimal group effects on low-level perceptual processing of previously neutral stimuli. Further, strong positive relations between self- and novel ingroup-biases provide support for self-anchoring: the projection of the self onto novel social groups to fill a cognitive gap between the known and the unknown. The small discrepancies identified between the pattern of results demonstrated for novel and established group-advantages indicate the need for follow-up research to examine the similarities and differences in mechanisms for established ingroup-

bias and novel ingroup-bias. The next experimental chapter (Experiment 7) of this thesis addresses this question using fMRI to gain insight into the neural mechanisms behind the different social prioritisation effects.

Chapter 5: Neural correlates of perceptual biases for the self and social ingroups

Chapter background

The introduction to this thesis outlined the importance of self and ingroup significance on a wide range of cognitive processes, from trait judgements to memory performance and facial recognition. Furthermore, Experiments 1 to 6 within the previous experimental chapters identified robust advantage effects in perceptual matching for stimuli newly associated with the self and social ingroups, both novel and established. How then, are concepts of 'self' and 'other, 'us' and 'them', represented in the brain? Social cognitive neuroscience has made a great deal of progress in identifying neural regions and networks that are involved in processing social information. Many studies have shown the medial prefrontal cortex to be involved in aspects of self-representation, and a ventral part of this region was found to underpin the self-bias effect in perceptual matching. However, it is unclear whether perceptual biases for social ingroups are driven by similar or distinct behavioural and neural mechanisms. The use of different task paradigms has previously made it hard to compare the neural overlap in self and ingroup representation and little neuroimaging research has examined this overlap directly. The present experiment used fMRI to examine the neural regions associated with self and ingroup biases and also compared neural responses for established and novel social groups.

Introduction

Behavioural advantages for the self and ingroups

The previous six experiments within this thesis have demonstrated robust self- and ingroup-prioritisation effects using an associative matching task in which social labels are associated with random geometric shapes. Faster response times, higher accuracy and increased sensitivity for self and ingroup have indicated an advantage for own- compared to other-associated stimuli even when familiarity effects are removed and the social information is newly-learned. Furthermore, there is some evidence for a positive relationship between self- and ingroup-biases (Experiment 1), which appears stronger when the ingroups are novel (Experiments 4 and 6). However, the experiment with military personnel (Experiment 3) demonstrated no such effect, with the biases for established ingroups (unit and country) being significantly correlated with one another, but with no relationship to biases for the self. One pertinent line of enquiry, then, is whether these perceptual biases for self and ingroup stimuli are driven by common or distinct neural mechanisms. By using the matching paradigm in which equivalent stimuli are newly associated with social labels, this study examines the neural underpinnings of ingroup-advantage effects in perceptual matching for both established and novel groups, and also directly tests the overlap and distinction with the neural correlates of self-prioritisation effects.

The neural correlates of self-related processing

In research spanning the past two decades, social cognitive neuroscience has made a great deal of progress in identifying the neural mechanisms that support self-related processing and, correspondingly, processing relating to other people (reviewed in Humphreys & Sui, 2016; Ruff & Fehr, 2014; Uddin et al., 2007). Many Neuroimaging studies have identified the involvement of cortical midline structures (CMS) as underlying self processing, including the ventromedial prefrontal cortex (vmPFC), dorsal medial prefrontal cortex (dmPFC), anterior cingulate cortex (ACC) and the posterior cingulate cortex (PCC) (reviewed in Musholt, 2013; Uddin et al., 2007).

Studies on the neural basis of the self have used many paradigms to assess various facets of self processing, including self-referential trait judgements (Gusnard et al., 2001; Kelley et al., 2002), self-appraisals (Ochsner et al., 2005), and self facial recognition (Platek et al., 2004). A comprehensive meta-analysis by Northoff et al. (2006) found that medial regions including vmPFC, subgenual ACC, supragenual ACC, dmPFC, posterior cingulate cortex and precuneus all responded to self compared to non-self conditions, irrespective of whether the tasks involved reflections on personality characteristics or physical appearance. Other studies have found areas outside of midline structures such as temporal pole, temporoparietal junction and superior parietal cortex, insula, hippocampus and fusiform gyrus that exhibit enhanced activity for self compared to other (e.g., Kircher et al., 2000; and reviewed by Legrand & Ruby, 2009).

Discrepancies within evidence regarding the neural foundation of the self may be explained by distinguishing the specific component of the self being measured. A recent meta-analysis by Hu et al. (2016) found that the ACC, left inferior frontal gyrus and left insula gyrus were linked to both the physical self (self face processing) and the psychological self (self referential processing) but that areas in the right superior occipital gyrus adjacent to the angular gyrus, the bilateral inferior frontal gyrus and the bilateral fusiform gyrus adjacent to the inferior temporal gyrus responded specifically to self face processing.

Self-biases in the brain

The first fMRI study examining the neural regions associated with advantages for the self in the matching task (Sui et al., 2012) found that an area of the vmPFC and the left posterior superior temporal sulcus (lpSTS) showed increasing (self>friend>stranger) responses for matched pairs depending on the proximity to the self (Sui et al., 2013). Decreasing responses to self stimuli (compared to friend and stranger) were, on the other hand, reflected in the dorsal lateral prefrontal cortex (dlPFC), middle superior frontal gyrus, inferior parietal cortex, and right cuneus. Further analyses of the mismatched pairs showed that the vmPFC responded to the self-related shape, while the lpSTS responded to both the shape and the label. These findings suggested that the self-bias has specific neural correlates, different from those involved in processing information related to friends or strangers.

The neural correlates of processing relating to social groups

When processing information relevant for social groups, neural correlates tend to be somewhat overlapping with those identified for the self but also distinct. A number of studies that have examined the neural mechanisms underlying group processing have utilised face categorisation paradigms and found responses within the anterior insula in response to Black faces compared to White faces in White participants (Lieberman et al., 2005; Richeson et al., 2003. Ronquillo et al., 2007). This has been interpreted as a negative reaction to other-race individuals, owing to the involvement of the insula in visceral emotional processing (reviewed in Amodio, 2014). Studies have also reported increased amygdala responses when White participants viewed Black faces compared to White faces (Hart et al., 2000) and further that the strength of this increase in amygdala activity was correlated with implicit racial bias measures (Cunningham et al., 2004). However, Van Bavel et al. (2008) found *increased* responses within the amygdala for ingroup faces within novel teams made up of both Black and White members, showing that the amygdala may in fact respond flexibly to stimuli with high perceptual salience, regardless of positive or negative valence.

Studies have found higher fusiform response for own-race compared to other race faces (Cunningham et al., 2004; Golby et al., 2001), and this has been demonstrated for novel group faces too (Van Bavel et al., 2008; Van Bavel et al., 2011), suggesting a perceptual advantage for ingroup face processing. There is also evidence for involvement of the vmPFC and the striatum for novel ingroup compared to outgroup faces (Van Bavel et al., 2011). Further evidence

suggests the mPFC underlies higher-level forms of social processing such as impression formation, considering the perspectives of others, and allocating reward to ingroup members (Amodio & Frith, 2006; Macrae et al., 2004; Volz et al., 2009). Bringing together findings from this line of research, two comprehensive review papers from Amodio (2014) and Cikara and Van Bavel (2014) converge on identifying several key regions as being involved with group categorisation and evaluation. These regions include the amygdala, anterior insula, fusiform gyri, (ventral) striatum, medial prefrontal cortex and the anterior cingulate cortex.

Perceptual biases for ingroups in the brain

Moradi et al. (2017b) examined the neural underpinnings of the ingroup-bias in lower-level perceptual matching. Football team supporters learned to associate shapes with badges of the team they supported (ingroup), a rival team, and a neutral team (outgroups) and, during fMRI, performed a standard version of the task (Sui et al., 2012) in which they judged whether shape-label pairs were matched or mismatched. For matched trials, there was no brain area that responded to ingroup compared to neutral or to rival stimuli, despite a significant behavioural advantage. For mismatched trials, there was no increased activity for ingroup badges compared to rival or neutral badges. There was, however, processing of rival and neutral (outgroup) badges compared to ingroup badges in clusters of the left lateral frontal and parietal cortices, left anterior insula, left intraparietal sulcus, left precuneus and left fusiform.

Unlike for self compared to friend and stranger (Sui et al., 2013), Moradi et al. (2017b) did not find neural differences in responses between ingroup and

outgroup matched pairs, and the vmPFC did not show increased activity to ingroup shapes or badges. It is unclear whether differences in these fMRI results are reflective of fundamental differences in the processing of self- and ingroup-biases, or whether differences in the way that the tasks were implemented (i.e., badges rather than labels; different team affiliations for each participant; rival and neutral teams as baseline) obscured similarities.

Common and distinct neural correlates for self and ingroup

There appear to be some commonalities between self and in-group processing in the brain. For example, research has shown increased fusiform involvement for both self (Hu et al., 2016) and ingroup (Golby et al., 2001) face processing, and involvement of the ACC and medial frontal cortex for higher-level judgements related to the self (Northoff et al., 2006) and social groups (Volz et al., 2009). Ultimately though, differences in paradigms and methodologies used to assess self and ingroup representations can make it hard to meaningfully compare these neuroimaging results.

To my knowledge, just one fMRI experiment attempted to directly compare the overlap in the neural basis of self and ingroup processing (Scheepers et al., 2013). Using a face categorisation paradigm, these results showed adjacent (but not overlapping) regions within the right inferior frontal gyrus, right inferior and superior parietal lobe for self and ingroup (members of the same university) faces, but only amongst those who reported higher levels of ingroup identification. These findings provide novel evidence that similar brain regions are involved for self and ingroup facial processing and the paradigm

benefitted from measuring these in the same way within subjects. However, the study did not directly test statistically for neural overlap or interaction effects between self and ingroup facial processing and also did not control for potential differences in familiarity of self faces compared to other faces (friend, ingroup members or outgroup members). The present study aims to test the neural mechanisms underpinning lower-level attentional biases towards self and ingroup stimuli while also eliminating any familiarity effects of the target stimuli.

The neural processing of established compared to minimal groups

Much of the research that has examined the neural basis of group categorisation and ingroup-bias has utilised exemplars of established groups (such as race) as ecologically valid and socially meaningful (e.g., Cunningham et al., 2004; Hart et al., 2000). However, several studies have also utilised the minimal group paradigm to understand the neural basis of social categorisation, and results for novel groups do not always mirror those from, for example, racial groups (Van Bavel et al., 2008). Differences between established group categories, along with particular social contexts, may produce varying neuroimaging results. For example, findings may be confounded by whether the responders are majority group members viewing minority group members or vice versa (group status) and face categorisation tasks may be affected simply by the visual features of the stimuli such as luminance and contrast (Cikara & Van Bavel, 2014).

It is, then, important to control for variables such as group status, social context, pre-existing stereotypes, group identification and even the visual features of the target stimuli when assessing the neural basis of ingroup-biases, and the use of minimal groups provides a way to do so (Cikara & Van Bavel, 2014). No study, to my knowledge, has directly compared neural responses for socially established and novel ingroups. The present study aims to do so whilst also keeping the visual features of the target stimuli exactly comparable. This will provide insight into whether biases for established and novel ingroups are processed in similar or distinct ways in the brain. Clarity on this matter will be of methodological use for future studies in terms of justifying the extrapolation of neuroimaging results from novel group categorisation to established and ecologically meaningful social group exemplars.

Aims of the present experiment

As discussed thus far, there is a large amount of neuroimaging evidence that elucidates the neural underpinnings of self- and ingroup-biases. However, because of the variety of methodologies and paradigms used to measure these, it has been difficult to directly examine the relations between self and ingroup processing. The present experiment directly compares the neural correlates of self-related biases to those of ingroup-related biases.

The experiment reported here again utilised a version of the associative matching paradigm (Sui et al., 2012) to examine the neural correlates underlying the self- and ingroup-bias effects, for both established social groups (university affiliation and traditional rival) and also for novel social groups using

a minimal group paradigm. This task creates the opportunity to measure responses to self associations and ingroup associations in exactly the same way, while keeping the familiarity and visual features of the target stimuli identical across the different social conditions. Rather than focusing on emotional, motivational or reward-driven aspects of self and social ingroups, this experiment aims to elucidate the neural mechanisms underpinning the more basic attentional biases for own-associated social stimuli.

Participants learned to associate one geometric shape each with self, stranger, Oxford (established ingroup), Cambridge (established outgroup), Team Blue (novel ingroup) and Team Green (novel outgroup). During fMRI, responses were then made to randomly generated shape-label pairs as matched or mismatched according to the initial associations. The difference in BOLD (blood-oxygen-level dependent) response between self and stranger, established ingroup and outgroup and novel ingroup and outgroup matched pairs was measured to indicate differential neural activity for own compared to other social associations (self and ingroups vs. stranger and outgroups). Conjunction analyses and interaction effects assessed common and distinct regions for self- and ingroup-biases.

I hypothesised that self (compared to stranger) biases would be observed in the vmPFC as demonstrated by Sui et al. (2013) and Yankouskaya et al. (2017). Although previous experiments within this thesis found behavioural similarities between self- and ingroup-biases, Moradi et al. (2017b) did not observe differences in the vmPFC for ingroups and outgroups. As outlined above, the amygdala, fusiform area and anterior insula have been found to be

involved in perceptual biases for ingroups, and the ventral striatum, ACC and mPFC in higher-level group-related biases (reviewed by Amodio, 2014, and Cikara & Van Bavel, 2014). Using whole-brain correction and a combined mask of these six regions of interest plus the lpSTS (identified for self associations on the matching task: Sui et al., 2013), I examined whether perceptual biases for ingroups were associated with increased activation in similar or distinct regions as for the self.

Experiment 7

Methods

Participants

Thirty-six participants were recruited via the University of Oxford (Department of Experimental Psychology) online recruitment system and university participant databases. To be eligible to take part in the study, participants had to be right-handed, have normal or corrected-to-normal vision, no current or previous neurological or psychiatric disorders, and safe for 3T MRI scanning. Additionally, all participants had to be current students at Oxford University and have no prior affiliation with Cambridge University, as this was the ingroup/outgroup exemplar utilised. Two participants were excluded from the final analysis based on poor task performance during scanning (accuracy less than 50%), leaving a final sample of 34 (17 female, mean age = 25.26, *SD* = 3.74, age range = 19-33 years). Informed consent was obtained from all participants prior to the experiment according to approved ethical procedures.

Stimuli and tasks

In a version of the matching task, personal (self and stranger), established ingroup and outgroup (Oxford and Cambridge) and novel ingroup and outgroup ('Team Green' and 'Team Blue') associations were made within alternating blocks, with three blocks of each association type. Participants learned to pair a geometric shape (circle, diamond, pentagon, rectangle, square, triangle) with each social label ('you', 'stranger', 'Oxford', 'Cambridge', 'Team Green', 'Team Blue'), and the pairings were counterbalanced. As per the standard task, participants had to judge whether shape-label pairings presented on the screen were matched correctly or incorrectly by pressing one of two buttons on an MRI-compatible button box held in the scanner. Half of the participants pressed left for 'match' and right for 'mismatch' and the other half did the opposite in order to control for potential motor and laterality effects across participants.

There were twelve conditions in total (self, stranger, established ingroup, established outgroup, novel ingroup, novel outgroup; each matched or mismatched), with 42 trials per condition. In total, there were 504 trials separated over 9 blocks. The order of blocks was counterbalanced three ways across the participants so that roughly a third completed alternating blocks of personal, then established group, then novel group associations; a third completed alternating blocks of established group, then novel group, then personal associations; and a third completed alternating blocks of novel group, then personal, then established group associations. The shape and label were presented respectively above and below a fixation cross at the centre of the screen. All stimuli and text were presented in white against a black screen that

was situated 1.5m away from the participant. Before entering the scanner, participants learned the shape-label associations with an on-screen instruction on a laptop computer and performed a short practice version of the task with 5 trials per condition separated into one block each of personal, established group and novel group associations. In the practice task, feedback ('correct' or 'incorrect') was given after each trial in order to aid learning, but this feedback was not given during scanning. The task was created and presented in Presentation software (Neurobehavioural Systems, Albany, CA).

Procedure

After informed consent was taken, participants were verbally allocated to the novel team by being told:

'For this study, each participant is randomly assigned to one of two teams: Team Green or Team Blue. You are on Team Blue. Please remember your team affiliation throughout this study'.

In fact, all participants were allocated to Team Blue, as Experiment 4 of this thesis found no differences in biases for 'Team Blue' and 'Team Green' novel group allocation using this task. Following this, participants performed the practice version of the matching task, before beginning the scanning session.

Within the scanner, each task block began with a written on-screen reminder of the shape-label pairings for the upcoming block, along with which buttons corresponded to each response. Each trial began with a fixation cross for 500ms, followed by a randomly presented shape-label pairing for 100ms, followed by a response window of 1000ms in which time a '?' symbol was

displayed. The time between trials (ITI) was jittered with randomly generated intervals that were between 1.5 and 9 seconds, with a mean of 3 seconds. Participants were given an 8-second break in between each block, during which the reminder of the upcoming shape-label associations and button responses appeared on the screen. The task took 36 minutes and the whole experiment lasted for approximately 1 hour in total. Participants were remunerated at a rate of £20 per hour for their time.

Statistical analysis of behavioural data

The behavioural data were analysed in SPSS 24 (Armonk, New York: IBM Corp). I examined biases for the self, established ingroup and novel ingroup compared to stranger, established outgroup and novel outgroup stimuli using repeated measures ANOVAs on response time, accuracy, and sensitivity (*d*prime) scores. An alpha level of .05 was used for all tests and multiple comparisons were corrected with Bonferroni's adjustment.

FMRI acquisition and analysis

Data acquisition parameters

fMRI data were acquired on a Siemens Prisma 3T scanner using a 32-channel head coil. Multiband T2*-weighted echo planar imaging (EPI) volumes with blood oxygenation level dependent (BOLD) contrasts were acquired at an oblique angle of 30° with the following parameters: TR = 1570ms; TE = 30ms; flip angle = 90°, field of view = 216mm; voxel size = 2 x 2 x 2 mm. A high-resolution T1-weighted whole brain structural scan was acquired using a magnetization prepared rapid echo gradient (MPRAGE) sequence with 192

slices; slice thickness = 1mm; TR = 1900ms; TE = 3.97ms; field of view = 192x192 mm; voxel size = 1 x 1 x 1 mm resolution.

fMRI preprocessing

The imaging data were analysed using SPM12 (www.fil.ion.ucl.ac.uk/spm). The images were realigned, unwarped using a fieldmap, co-registered to each participant's own T1 scan and normalised to the group template. Movements between scans were inspected to make sure that they fell below 1.5mm. The T1-weighted scan for each participant was processed with spatial segmentation, bias correction and spatial normalisation to the MNI template with the same normalisation parameters that were used for the EPI scans. All images were spatially smoothed with a Gaussian kernel of 8mm FWHM.

fMRI contrasts

Before the study, first-level design matrices from a behavioural pilot (N = 6) were checked to make sure that there was independence between the experimental conditions within the GLM. No correlations between regressors in any conditions were above r=.03, meaning that the experimental conditions could be assessed separately.

The twelve task conditions were used to construct regressors in which event timings were convolved with the canonical haemodynamic response function in SPM. The onsets of each trial type were modelled as stick functions with 0 duration and missed and incorrect trials were modelled as regressors of no interest, along with six head motion parameters as residual effects of head motion.

For the first level, the mean estimated BOLD response for each task condition was computed for each participant. Contrast images from this first level were input into a second-level flexible factorial design. At this second level design, only matched trial types were included[36]. I used t-contrasts to assess brain regions that were associated with increased or decreased activity for own compared to other associations.

Main effects and interactions are reported at $p < .05$ family-wise error (FWE) corrected at the cluster level across the whole brain, or at $p < .05$ small volume corrected (SVC) at the voxel level using a combined mask of regions associated with self-prioritisation social processing (see section below).

Region of interest selection

Seven regions of interest (ROIs) were identified based on extensive reviews of social processing (Amodio, 2014; Cikara & Van Bavel, 2014) and previous work on self-bias effects in perceptual matching (Sui et al., 2013). Firstly, the left posterior superior temporal sulcus (lpSTS) and the vmPFC were implicated in the self-bias effect by Sui et al. (2013). I created two regions of interest based on this work by defining a 10mm sphere around the peak MNI coordinate that was found by Sui et al. (2013) for the vmPFC (x = -6, y = 54, z = 4) and the lpSTS (x = -58, y = -62, z = 14). In addition to these functional ROIs, five anatomical regions were identified based on prior work on social attention and group-related processing (Amodio, 2014; Cikara & van Bavel, 2014). These

[36] Only matched trials were included because the processing advantage for own vs. other associations was observed behaviourally only for matched trials, both in the current study and also in previous research (e.g., Moradi et al., 2015; Sui et al., 2012, 2013).

were the amygdala, the anterior cingulate cortex, the anterior insula, the fusiform gyrus and the ventral striatum. I created an anatomical region of interest (ROI) for the fusiform gyrus using the WFU PickAtlas toolbox within SPM12 and the amygdala and anterior insula masks were also created using the WFU PickAtlas toolbox. The ventral striatum ROI was from the Harvard-Oxford toolbox and the ACC gyrus was defined using a mask from Neubert et al. (2015). I combined these seven areas using the *imcalc* function in SPM to make a functional/anatomical mask of the seven regions of interest. This mask was then used as a small volume correction for each fMRI contrast.

Task conditions

The experiment was a 2 (shape condition: own vs other associated) x 3 (task type: personal/established group/novel group associations). Own-associated stimuli were self, established ingroup and novel ingroup shapes and other-associated stimuli were stranger, established outgroup and novel outgroup shapes. The personal task was self/stranger associations, the established group task was Oxford/Cambridge associations, and the novel group task was Team Green/Team Blue associations.

Results

Behavioural data

Response time advantages for own-associated compared to other-associated shapes

I first examined whether there was an overall response time advantage for own compared to other-associated shapes. There was a significant effect of match

condition, $F(1, 33) = 301.15$, $p < .001$, $\eta_p^2 = .901$, with faster responses for matched ($M = 573.10 \pm 10.41$) compared to mismatched ($M = 646.14 \pm 8.98$) trials. There was also a significant effect of shape, $F(1, 33) = 93.15$, $p < .001$, $\eta_p^2 = .738$, with faster responses for own ($M = 583.48 \pm 10.10$) than other ($M = 635.77 \pm 9.63$) associations. Further, there was a significant effect of task type, $F(2, 66) = 14.64$, $p < .001$, $\eta_p^2 = .307$. Pairwise comparisons revealed no significant difference between established group ($M = 595.51 \pm 10.22$) and personal ($M = 608.58 \pm 9.91$) associations ($p = .098$), but there were faster responses for established than novel group ($M = 624.77 \pm 9.85$) associations ($p < .001$), and for personal than for novel group associations ($p = .010$). Figure 5.1a, below, shows the response time scores for each shape condition.

I next examined whether there were differences in response time effects in the matched compared to the mismatched trials. There was a significant three-way interaction between match, shape and task, $F(2, 66) = 5.85$, $p = .005$, $\eta_p^2 = .151$. Paired samples t-tests showed that for matched pairs, self shapes ($M = 503.23 \pm 12.62$) were responded to significantly faster than stranger shapes ($M = 637.35 \pm 11.77$), $t(33) = 11.58$, $p < .001$, $d = 1.99$, established ingroup shapes ($M = 503.63 \pm 14.58$) were responded to significantly faster than established outgroup shapes ($M = 609.02 \pm 11.87$), $t(33) = 8.82$, $p < .001$, $d = 1.51$, and novel ingroup shapes ($M = 541.71 \pm 11.97$) were responded to significantly faster than novel outgroup shapes ($M = 643.67 \pm 12.50$), $t(33) = 8.30$, $p < .001$, $d = 1.42$. For mismatched pairs, stranger shapes ($M = 639.39 \pm 9.81$) were responded to significantly faster than self shapes ($M = 654.35 \pm 10.48$), $t(33) = 2.66$, $p = .012$, $d = .46$, but there were no differences between

established ingroup (M = 635.95 ± 10.62) and outgroup (M = 633.46 ± 9.37) shapes, $t(33) = .33$, $p = .742$, $d = .06$, nor between novel ingroup (M = 661.98 ± 11.07) and outgroup (M = 651.73 ± 9.92) shapes, $t(33) = 1.56$, $p = .129$, $d = .27$. See Figure 5.1a, below, for response time scores for each shape and match condition across the three task types.

Accuracy advantages for own-associated compared to other-associated shapes

There was no significant effect of match condition on accuracy, $F(1, 33) = 1.20$, $p = .167$, $\eta_p^2 = .057$ (matched M = 86.26 ± 1.42; mismatched M = 84.98 ± 1.64). There was, however, a significant effect of shape, $F(1, 33) = 30.86$, $p < .001$, $\eta_p^2 = .483$, with higher accuracy for own (M = 88.43 ± 1.28) than other conditions (M = 82.81 ± 1.78). Further, there was a significant effect of task type, $F(2, 66) = 4.79$, $p = .011$, $\eta_p^2 = .127$. Pairwise comparisons revealed no significant difference in accuracy between personal (M = 86.38 ± 1.41) and established group (M = 86.45 ± 1.53) associations (p = 1.00), nor between personal and novel group (M = 84.03 ± 1.71) associations ($p = .070$); however, accuracy was significantly higher for established group than for novel group associations ($p = .029$).

There was no significant interaction between task type and shape, $F(2, 66) = .39$, $p = .677$, $\eta_p^2 = .012$, nor between task type and match, $F(2, 66) = .16$, $p = .856$, $\eta_p^2 = .005$. There was, however, a significant interaction between match and shape, $F(1, 33) = 49.83$, $p < .001$, $\eta_p^2 = .602$. Paired samples t-tests showed that own-associated shapes were responded to with greater accuracy on matched trials (Self M= 93.77 ± 1.13; Stranger M= 80.67 ± 2.07; Established

ingroup *M*= 93.98 ± 1.19; Established outgroup *M*= 80.11 ± 2.61; Novel ingroup *M*= 91.67 ± 1.45; Novel outgroup *M*= 77.38 ± 2.60), $t(33) = 7.17$, $p < .001$, $d = 1.23$, but that other-associated shapes were responded to with greater accuracy on mismatched trials (Self *M*= 83.89 ± 2.15; Stranger *M*= 87.19 ± 1.59; Established ingroup *M*= 85.02 ± 1.75; Established outgroup *M*= 86.70 ± 1.88; Novel ingroup *M*= 82.28 ± 2.17; Novel outgroup *M*= 84.81 ± 1.98), $t(33) = 2.47$, $p = .019$, $d = .76$. There was no significant three-way interaction between match, shape and task, $F(2, 66) = .07$, $p = .931$, $\eta_p^2 = .002$. See Figure 5.1b, below, for accuracy scores for each shape and match condition across the three task types.

Dprime advantages for own-associated compared to other-associated shapes

As for previous chapters, I also used *d*prime scores to assess if perceptual sensitivity was increased for own compared to other associations. There was a significant main effect of task, $F(2, 66) = 3.97$, $p = .024$, $\eta p^2 = .107$, and also of shape condition, $F(1, 33) = 47.96$, $p < .001$, $\eta p^2 = .592$, but no significant interaction between the two, $F(2, 66) = .34$, $p = .711$, $\eta p^2 = .010$. There was no difference in sensitivity scores between personal ($M = 2.63 \pm .17$) and established group *(*$M = 2.76 \pm .20$) ($p = .768$) or personal and novel group ($M = 2.45 \pm .19$) ($p = .354$) tasks, but sensitivity was significantly higher for the established than for the novel group task ($p = .018$). Sensitivity was greater for own (Self *M*= 2.98 ± 0.18; Established ingroup *M*= 3.17 ± 0.22; Novel ingroup *M*= 2.81 ± 0.20) than for other (Stranger *M*= 2.28 ± 0.18; Established outgroup *M*= 2.35 ± 0.21; Novel outgroup *M*= 2.10 ± 0.19) shape conditions.

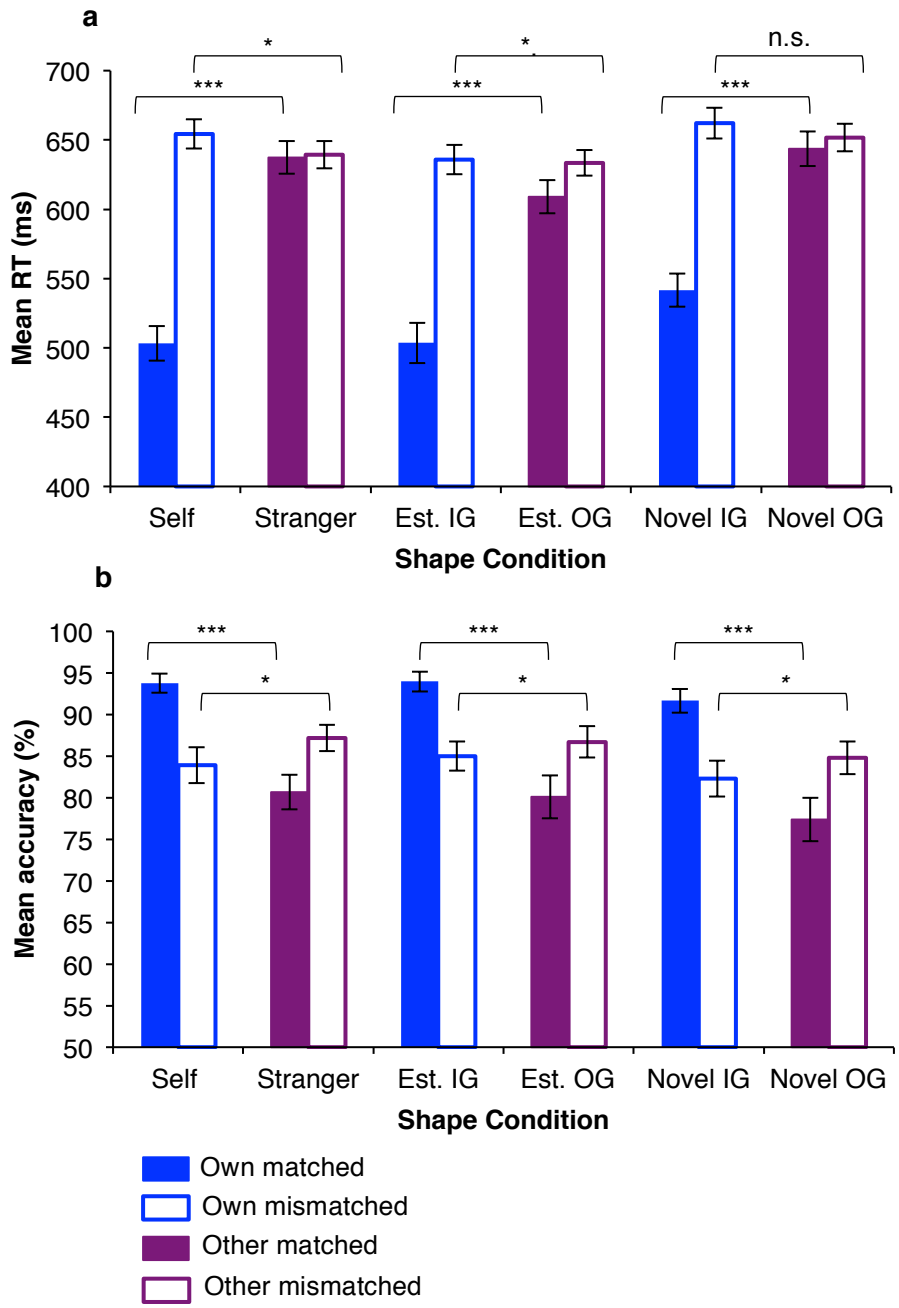


Figure 5.1: Mean response time (a) and accuracy (b) scores as a function of shape (own compared to other-associated), match condition and task (personal, established groups and novel groups). Error bars represent standard errors. Note: Est. denotes established; IG denotes ingroup and OG denotes outgroup. *** denotes $p<.001$, * denotes $p<.05$; n.s. denotes non-significant.

Statistical analysis of fMRI data

All of the reported neuroimaging results are FWE-corrected (cluster) for the whole brain, or small volume corrected (voxelwise) using a combined functional/anatomical mask of several regions associated with self

and social processing (see Methods). For the fMRI contrasts, I only included matched trials because the processing advantage for own vs. other associations is observed behaviourally only for matched trials, both in the current study and also in previous research (e.g., Moradi et al., 2015; Sui et al., 2012, 2013).

Main effects

Own associations > other associations

I first examined the main effect contrast of own-associated compared to other-associated shape conditions to test whether previous findings identifying higher responses for self compared to stranger within the vmPFC were replicated (e.g., Sui et al., 2013), and also to test whether there was a similar pattern for ingroup compared to outgroup conditions.

Consistent with previous findings (Sui et al., 2013) a cluster within the ventromedial prefrontal cortex (vmPFC) adjacent to the anterior cingulate cortex responded to own vs. other associations (Left x=-6, y=36, z=-12; t=4.53, Z=4.42, k=2017, p<.001; Right x=4, y=40, z=-12; t =4.45, Z=4.34 and x=4, y=62, z=2; t =4.46, Z=4.350, FWE-whole brain; see Figure 5.2 below).

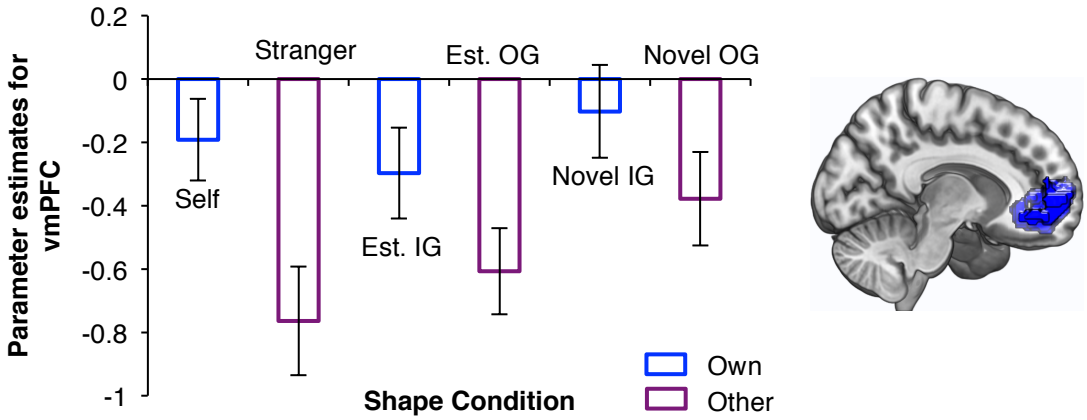


Figure 5.2: Area within the vmPFC that showed greater activity for responses to own compared to other associations (p<.001, FWE-whole brain corrected) and the parameter estimates for this cluster across the six social association conditions. Activation overlaid onto an anatomical scan. Error bars indicate standard error of the mean. *Note*: Est. denotes established (ingroup/outgroup); IG denotes ingroup and OG denotes outgroup.

Additionally, I observed an area within the left fusiform (Left, x=-32, y=-36, z=-14; t =4.87, Z=4.73, k=28, p=.002 FWE-small volume correction) and another portion of the vmPFC (x=2, y=60, z=4; t =4.27, Z=4.17, k=454, p=.023 FWE-small volume correction), extending to the ACC (Left, x=-6, y=44, z=4; t =4.18, Z=4.09, p=.031, FWE-small volume correction), using the combined functional/anatomical mask of the regions of interest.

On the basis of the significant main effect for own vs. other associations, I then tested the simple main effects for own compared to other associations separately for each social condition (self > stranger; established ingroup > established outgroup; novel ingroup > novel outgroup).

Self associations > stranger associations

For responses to self compared to stranger-matched shapes, I again observed increased activity in the ACC (x=4, y=32, z=0; t =4.39, Z=4.28, k=1233, p<.001, FWE-whole brain), extending to the vmPFC (Left, x=-8, y=46, z=4; t =4.29,

Z=4.19, See Figure 5.3a), and also an area of the posterior cingulate (Left, x=-8, y=-52, z=14; *t* =3.91, Z=3.83, k = 409, *p*=.002, FWE-whole brain; see Figure 5.3b). No other regions survived FWE-correction or the small volume correction using the combined functional/anatomical mask.

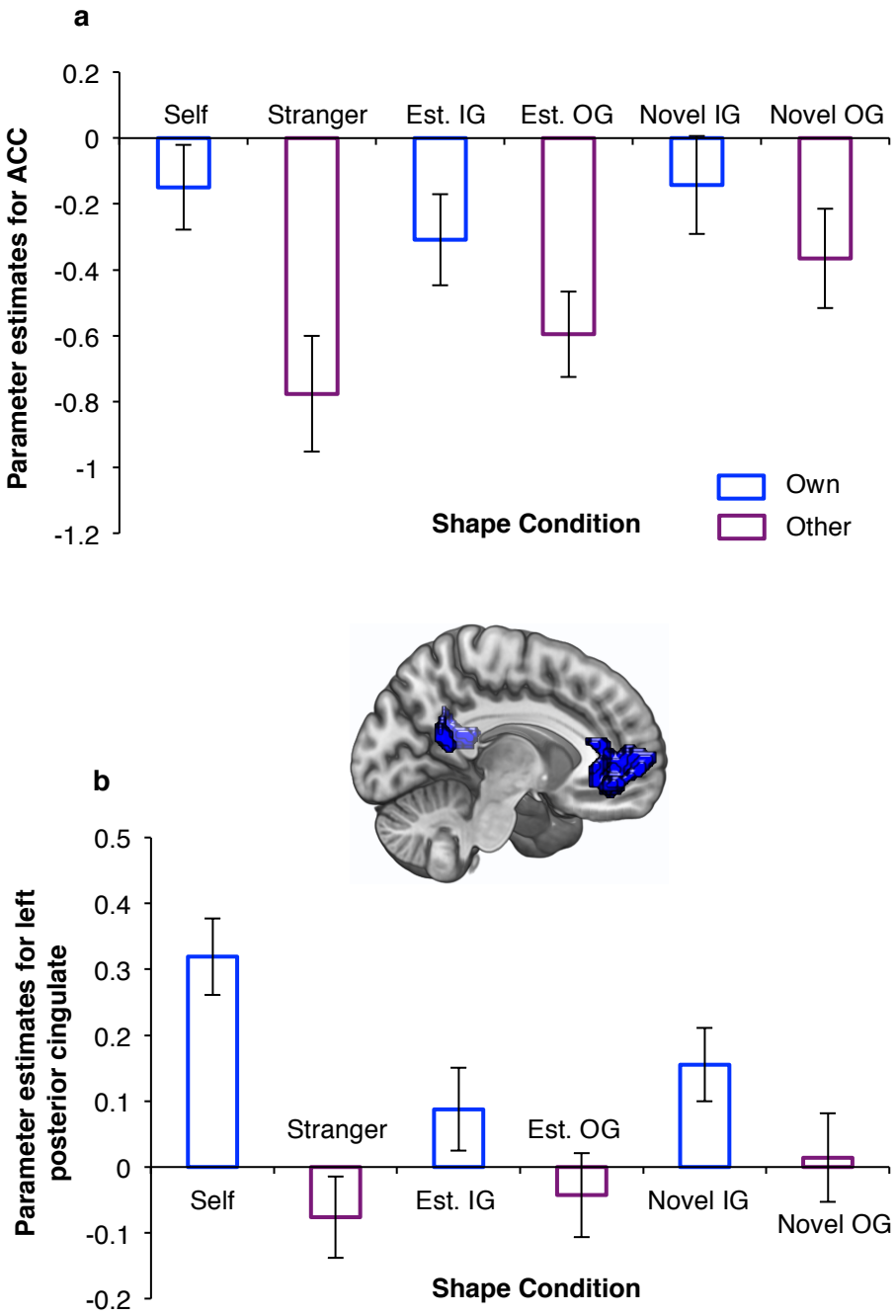


Figure 5.3: Parameter estimates for the clusters within the ACC (p<.001, whole brain corrected) (a) and the left posterior cingulate (p<.005, whole brain corrected) (b) observed for self associations compared to stranger associations across the six social association conditions, along with the activation overlaid onto an anatomical scan. Error bars indicate standard error of the mean. *Note*: Est. denotes established (ingroup/outgroup); IG denotes ingroup and OG denotes outgroup.

Ingroup associations > outgroup associations

There were no significant effects for established ingroup compared to established outgroup associations either at the whole brain correction or using the combined mask of functional and anatomical areas as a small volume correction. Similarly, there were no significant effects for responses to novel ingroup compared to novel outgroup associations either at whole brain correction or small volume correction.

When established and novel ingroup conditions were combined, no areas survived whole brain correction, but there was a cluster that survived the small volume correction using the combined mask in an anterior portion of the left fusiform area (Left x=-32, y=-34, z=-16; *t*=4.44, Z=4.33, k = 27, *p*=.012, FWE-small volume corrected). Figure 5.4, below, depicts the parameter estimates for this cluster of the left fusiform area, along with the observed cluster of activation.

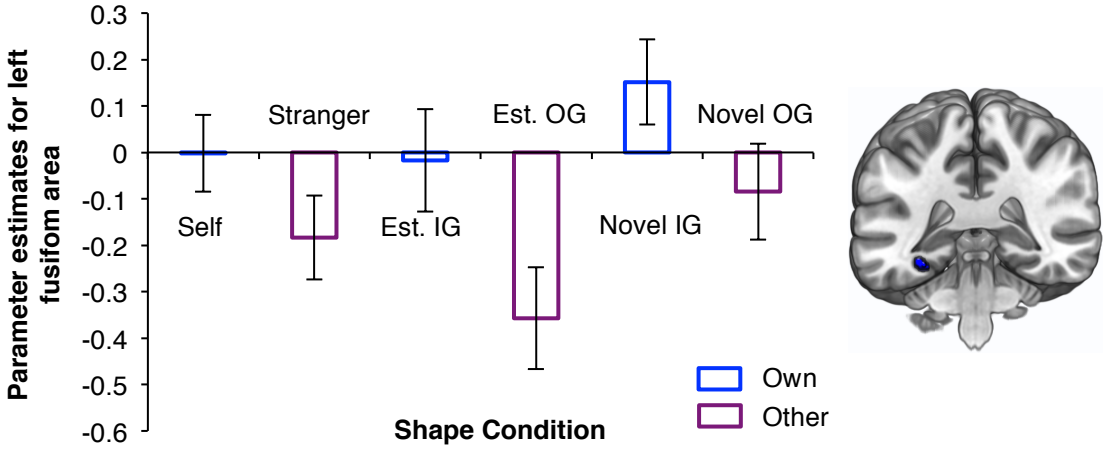


Figure 5.4: The area within the left fusiform area (p<.05, SVC) observed for the ingroup greater than outgroup contrast, and the parameter estimates for this cluster across the six social conditions. Activation overlaid onto an anatomical scan. Error bars indicate standard error of the mean. *Note*: Est. denotes established (ingroup/outgroup); IG denotes ingroup and OG denotes outgroup.

Other associations > own associations

For stranger, established outgroup and novel outgroup (other-associated) conditions compared to self, established ingroup and novel ingroup (own-associated) conditions, I observed significant whole-brain corrected regions in several cortical and subcortical areas including the left superior and inferior parietal lobule, the left middle frontal gyrus, the thalamus (bilateral) and the cerebellum (bilateral). There were also clusters surviving small volume correction in the anterior insula (bilateral), a posterior portion of the fusiform area (bilateral) and the anterior cingulate. Table 5.1, below, shows the whole brain and small volume corrected results for the other>own contrast.

Table 5.1: Main effects for other>own contrast, FWE-whole brain corrected at *p*<.001, or small volume corrected using the combined functional and anatomical mask with the regions of interest. L/R = left/right; k = cluster size in $2mm^3$ voxels, ext. = cluster extends into an additional region.

	Brain Region	L/R	Peak Voxel	k	t	z	*p*
Whole Brain	Superior parietal lobule	L	-34 -50 42	37924	8.83	*Inf.*	<.001
	ext. inferior parietal lobule	L	-42 -42 48		8.32	7.69	
	ext. middle frontal gyrus	L	-26 -2 54		8.31	7.69	
	L. thalamus	L	-10 -20 10	1200	6.15	5.87	<.001
	ext. r. thalamus	R	16 -22 14		4.96	4.81	
	Cerebellum	L	-32 -56 -32	652	4.99	4.84	0.007
	Cerebellum	R	38 -60 -58	270	4.08	3.99	0.033
Small Volume	Anterior insula	L	-30 26 2	575	7.31	6.87	<.001
	Anterior insula	R	32 24 2	454	6.93	6.55	<.001
	Fusiform	L	-18 -88 -8	114	5.9	5.66	<.001
	Fusiform	R	26 -82 -6	80	4.05	3.96	0.05
	Anterior cingulate	R	8 16 32	13	4.34	4.24	0.018

On the basis of this significant main effect, I then tested each simple effect separately (stranger > self; established outgroup > ingroup; novel outgroup > ingroup).

Stranger associations > self associations

The stranger > self contrast revealed several areas overlapping with those from the main effect: the right inferior frontal gyrus, the mid frontal gyrus (bilateral), the superior parietal lobule (bilateral), the left medial frontal gyrus, the right inferior parietal lobule, right precuneus, the left anterior insula, and the left thalamus (all FWE-whole brain corrected). In addition, the right anterior insula survived small-volume correction using the combined mask. Table 5.2, below, shows the whole brain and small volume corrected results for the stranger>self contrast.

Table 5.2: Simple effects for stranger>self contrast, FWE-whole brain corrected at *p*<.001, or small volume corrected using the combined functional and anatomical mask with the regions of interest. L/R = left/right; k = cluster size in $2mm^3$ voxels, ext. = cluster extends into an additional region.

	Brain Region	L/R	Peak Voxel	k	t	z	*p*
Whole							
Brain	Inferior frontal gyrus	R	46 10 4	770	4.24	4.14	<.001
	Mid frontal gyrus	L	-24 -6 54	8546	6.38	6.08	<.001
	ext. medial frontal gyrus	L	-4 4 52		5.47	5.27	
	ext. superior parietal lobule	L	-18 -62 58		5.45	5.26	
	Anterior insula	L	-30 26 2	550	6.26	5.97	0.003
	Superior parietal lobule	R	20 -64 56	1798	5.45	5.25	<.001
	ext. precuneus	R	16 -60 48		4.97	4.82	
	ext. inferior parietal lobule	R	36 -44 44		4.97	4.82	
	Thalamus	L	-12 -24 8	333	5.38	5.19	0.025
	Inferior frontal gyrus	L	-46 48 2	265	4.83	4.69	0.054
	Mid frontal gyrus	R	46 6 34	907	4.15	4.06	<.001
Small							
Volume	Anterior insula	R	32 24 2	303	5.8	5.57	<.001

Established outgroup associations > established ingroup associations

For responses to established outgroup compared to ingroup stimuli, I again observed several areas including the left superior parietal lobule, the left medial

frontal gyrus, left lingual, left precuneus, and right cerebellum. Additionally, an area in the left fusiform area and in the left anterior insula survived small-volume correction using the combined functional/anatomical mask. Table 5.3, below, shows the whole brain and small volume corrected results for the established outgroup>ingroup contrast.

Table 5.3: Simple effects for established outgroup>ingroup contrast, FWE-whole brain corrected at *p*<.001, or small volume corrected using the combined functional and anatomical mask with the regions of interest. L/R = left/right; k = cluster size in $2mm^3$ voxels, ext. = cluster extends into an additional region.

	Brain Region	L/R	Peak Voxel	k	t	z	p
Whole brain	Superior parietal lobule	L	-36 -54 50	2041	6	5.74	<.001
	Right cerebellum	R	4 -70 -24	1676	4.61	4.49	<.001
	ext. left lingual	L	-16 -90 -8		4.55	4.43	
	Medial frontal gyrus	L	-8 8 58	1301	4.55	4.43	<.001
	Precuneus	L	-6 -66 40	315	4.08	3.99	0.03
Small volume	Fusiform area	L	-18 -88 -8	6	4.1	4.01	0.042

Novel outgroup associations > novel ingroup associations

For novel outgroup compared to ingroup stimuli, I identified a similar set of regions including the left superior parietal lobule along with the thalamus (bilateral) and the left precuneus. No other regions survived FWE-whole brain correction or FWE-small volume correction using the combined functional/anatomical mask. Table 5.4, below, shows the results for the novel outgroup>ingroup contrast.

Table 5.4: Simple effects for novel outgroup>ingroup contrast, FWE-whole brain corrected at $p<.001$. L/R = left/right; k = cluster size in $2mm^3$ voxels, ext. = cluster extends into an additional region.

	Brain Region	L/R	Peak Voxel	k	t	z	p
Whole Brain	Superior parietal lobule	L	-32 -50 40	11549	5.54	5.33	<.001
	Thalamus	L	-12 -16 8	392	5.05	4.89	0.013
	ext. right thalamus	R	10 -22 8		3.89	3.82	
	Precuneus	L	-10 -52 -14	536	4.46	4.34	0.003

Established groups vs. novel groups

There were no neural areas that showed significantly increased activation for the established group compared to the novel group association task as a whole, nor for the novel group compared to the established group association task. There were also no interaction effects between established and novel ingroup-biases, either at the whole brain or the small volume correction. As there were no differences in neural responses for established and novel group conditions, these were combined for subsequent analyses.

Interaction effects: neural regions showing differential activity for self- and ingroup-biases

To examine differential neural effects for self- and ingroup-biases, two interaction contrasts were performed. The first tested for self associations>stranger associations and outgroup associations>ingroup associations. The second tested for stranger associations>self associations and ingroup associations>outgroup associations.

A differential neural effect for self compared to ingroup-biases was found for the first interaction contrast in a region of the left precuneus (Left, x=-8, y=-74, z=34; *t*=4.27, Z=4.17, k=567, *p*=.002, FWE-whole brain, Figure 5.5 below) that extended to the left cuneus (Left, x=-4, y=-84, z=26; *t*=3.59, Z=3.53). No other regions survived FWE-whole brain correction or the small volume correction using the combined functional/anatomical mask for either interaction contrast.

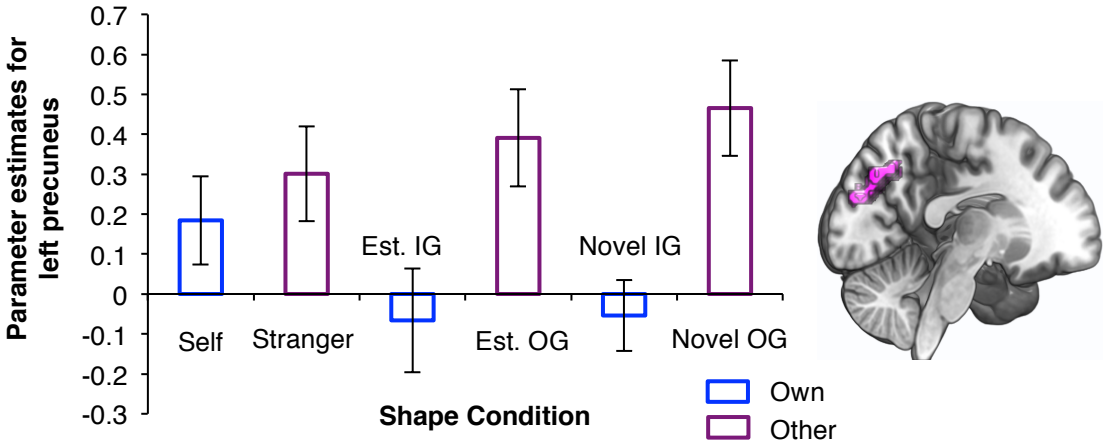


Figure 5.5: Area within the left precuneus that showed an interaction effect between self- and ingroup-biases, with responses greater for established and novel outgroup than ingroup associations ($p<.001$, FWE-whole brain corrected), but not for stranger than self associations. The parameter estimates for this cluster are shown across the six social association conditions. Activation overlaid onto an anatomical scan. Error bars indicate standard error of the mean. *Note*: Est. denotes established (ingroup/outgroup); IG denotes ingroup and OG denotes outgroup.

Testing overlap in the neural correlates of self- and ingroup-biases

Conjunction analysis for self- and ingroup-biases

In order to examine whether there were shared neural correlates for the self relative to stranger associations and the ingroup relative to outgroup associations, a conjunction analysis was used to test for areas that were sensitive to both self>stranger and also ingroup>outgroup. No areas survived

either FWE-whole brain correction or the small volume correction using the combined anatomical mask. I also lowered the threshold to an alpha of $p < .01$ and still observed no shared regions within this conjunction contrast.

Small volume correction for ingroup-bias using vmPFC cluster

The conjunction analysis described above did not show any shared neural correlates for responses to self and ingroup associated stimuli compared to stranger and outgroup associated stimuli. As an additional test of overlap in the neural processing of self and ingroup related biases, I saved the peak cluster within the ACC/vmPFC that was identified in the self>stranger contrast (x=4, y=32, z=0, depicted above in Figure 5.2) and applied this as a small volume correction to the ingroup>outgroup contrast. Here, I observed three voxels within this region of the ACC (Left x=-6, y=36, z=-12; *t*=3.28, Z=3.24, k=2, *p*=061; and Right x=2, y=36, z=-12; *t*=3.16, Z=3.11, k=1, *p*=.085; FWE-small volume corrected) and two voxels within the adjacent vmPFC (Right, x=4, y=62, z=2; *t*=3.20, Z=3.16, k=2, *p*=.076, FWE-small volume corrected), but these did not survive correction[37].

Testing overlap in the neural correlates of other associations

A second conjunction analysis was used to examine whether there were shared neural correlates for stranger compared to self and outgroups compared to ingroups. When stranger>self was combined with both outgroups>both ingroups, there were significant regions of the left (Figure 5.6a) and right (Figure

[37] I did not observe any voxels when established ingroup>outgroup and novel ingroup>outgroup contrasts were tested separately with this small volume correction.

5.6b) inferior parietal lobule, bilateral anterior insula (Figure 5.7), the left superior parietal lobule and the left middle frontal gyrus (see Table 5.5, below).

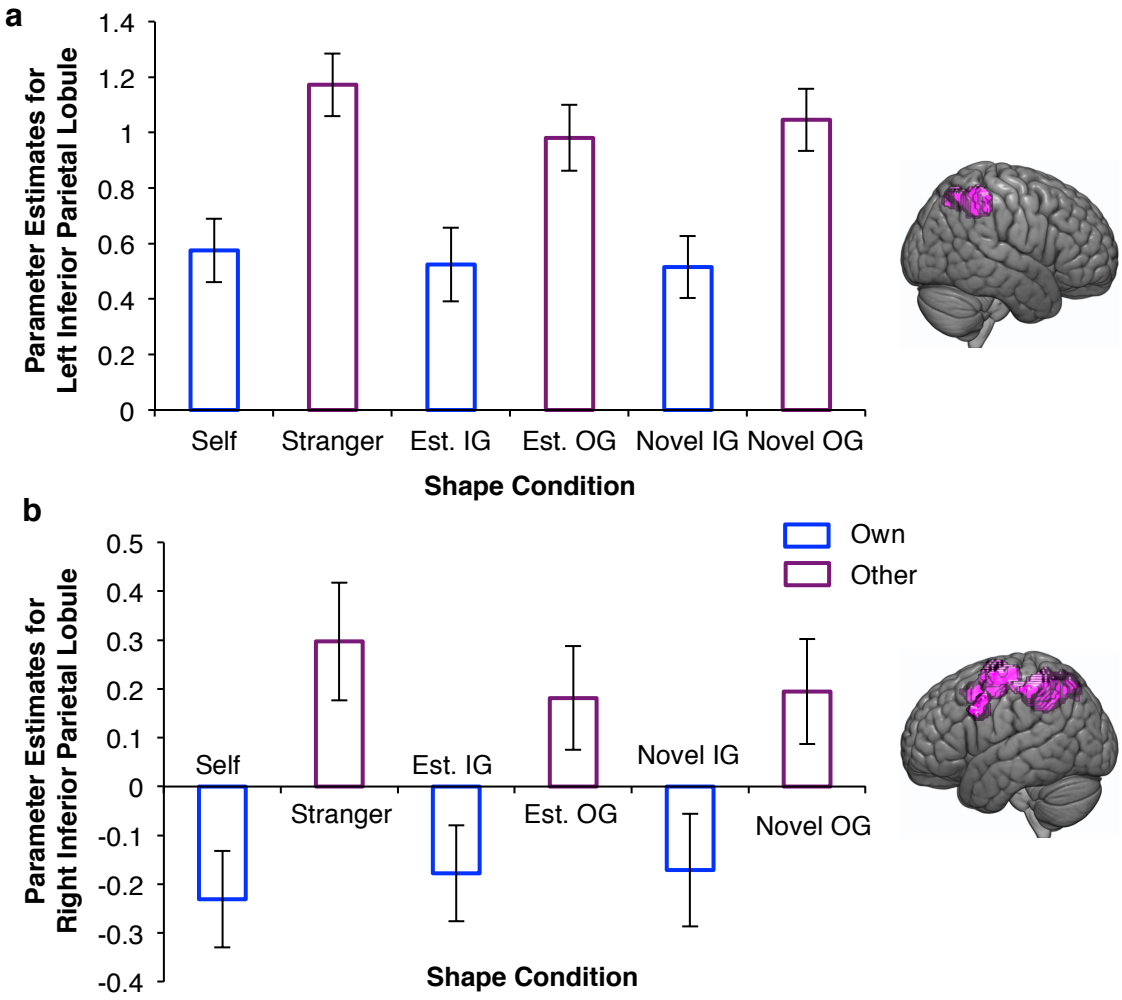


Figure 5.6: Area within the left (a) and right (b) inferior parietal lobule that showed greater activity for all other (stranger and outgroups) compared to own (self and ingroups) associations (conjunction analysis, $p<.001$, FWE-whole brain). The parameter estimates for these clusters are shown across the six social association conditions. Activation overlaid onto an anatomical scan. Error bars indicate standard error of the mean. *Note*: Est. denotes established (ingroup/outgroup); IG denotes ingroup and OG denotes outgroup.

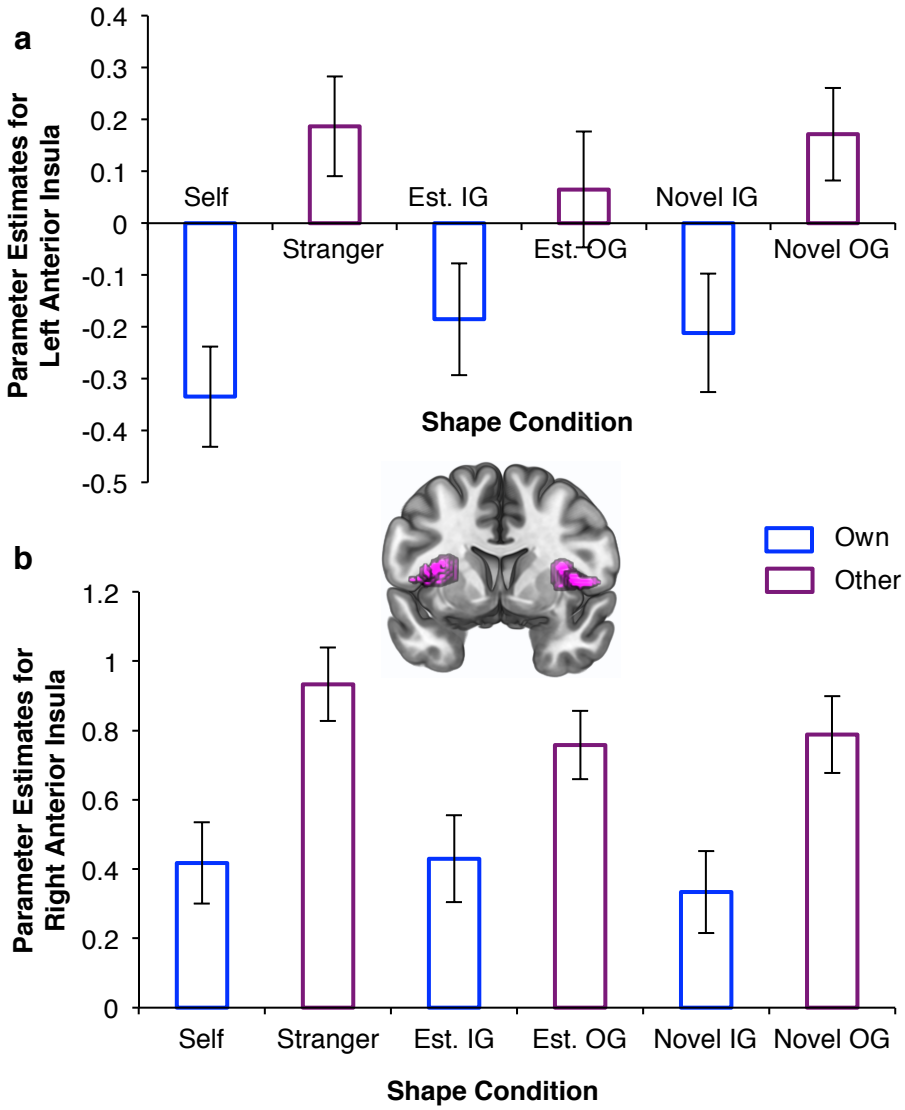


Figure 5.7: The left (a) and right (b) anterior insula showed significant responses for other compared to own associations across the three task conditions (conjunction analysis, $p<.001$, FWE-whole brain or SVC). The parameter estimates for these clusters are shown across the six social association conditions. Activation overlaid onto an anatomical scan. Error bars indicate standard error of the mean. *Note*: Est. denotes established (ingroup/outgroup); IG denotes ingroup and OG denotes outgroup.

Table 5.5: Areas that showed significance for stranger>self and outgroup>ingroup within the conjunction contrast, FWE-whole brain corrected at $p<.001$, or small volume corrected using the combined functional and anatomical mask with the regions of interest. L/R = left/right; k = cluster size in $2mm^3$ voxels, ext. = cluster extends into an additional region.

	Brain Region	L/R	Peak Voxel	k	t	z	*p*
Whole Brain	Inferior parietal lobule	L	-26 -4 54	6622	6.02	5.76	<.001
	ext. to sup. parietal	L	-18 -64 56		5.25	5.08	
	Inferior parietal lobule	R	36 -44 44	1317	4.97	4.82	<.001
	Middle frontal gyrus	L	-46 30 30	267	4.92	4.77	0.053
	Anterior insula	L	-30 26 2	374	4.72	4.59	0.016
Small Volume	Anterior insula	R	32 24 2	374	4.44	5.57	0.008

The relationship between neural activity and behavioural advantages

Self compared to stranger: brain activity in the ACC/vmPFC and left posterior cingulate and the behavioural advantages

As described above, there was significantly greater activity in an area of the ACC extending to vmPFC and also in the posterior cingulate for responses to self compared to stranger associations. However, there was no significant relationship between the self advantage in response time for matched pairs and the differential ACC ($r(32)= .166$ [-.293, .527], $p = .348$) or posterior cingulate ($r(32)= .214$ [-.204, .525], $p = .224$) activity. Similarly, there was no significant relationship between the self advantage in accuracy compared to stranger and the differential ACC ($r(32)= .072$ [-.414, .544], $p = .685$) or left posterior

cingulate (r(32)= .153 [-.262, .487], p = .387) activity[38], nor the *d*prime self advantage and the differential ACC (r(32)= -.075 [-.462, .327], p = .673) or left posterior cingulate (r(32)= .127 [-.288, .519], p = .474) activity.

Ingroup compared to outgroup: brain activity in the left fusiform area and the behavioural advantages

As described above, there was a significant neural response for ingroups compared to outgroups in an anterior part of the left fusiform area. The differential neural activity within this area for ingroup and outgroup stimuli was marginally correlated with the behavioural advantage in response time for the ingroup (both established and novel combined), r(32)= .334 [-.069, .721], p = .054 (Figure 5.8a) and was significantly correlated with the behavioural advantage in accuracy, r(32)= .429 [.215, .634], p = .011 (Figure 5.8b) and in *d*prime, r(32)= .438 [.136, .669], p = .010[39]. This shows that those with a greater ingroup behavioural advantage had higher fusiform response to ingroup compared to outgroup.

[38] For the simple main effect of own (self, established ingroup and novel ingroup) compared to other (stranger, established outgroup and novel outgroup), there were significant correlations between the differential vmPFC activity (MNI peak -6 36 -12) for own compared to other associations and the behavioural advantages for own compared to other in response time, r(32)= .450 [.139, .697], p = .008, accuracy, r(32)= .433 [.125, .724], p = .010, and also *d*prime, r(32)= .533 [.246, .728], $p < .001$.

[39] There were no significant correlations between the differential activity in this region and the *self-advantage*s in response time, accuracy or *d*prime.

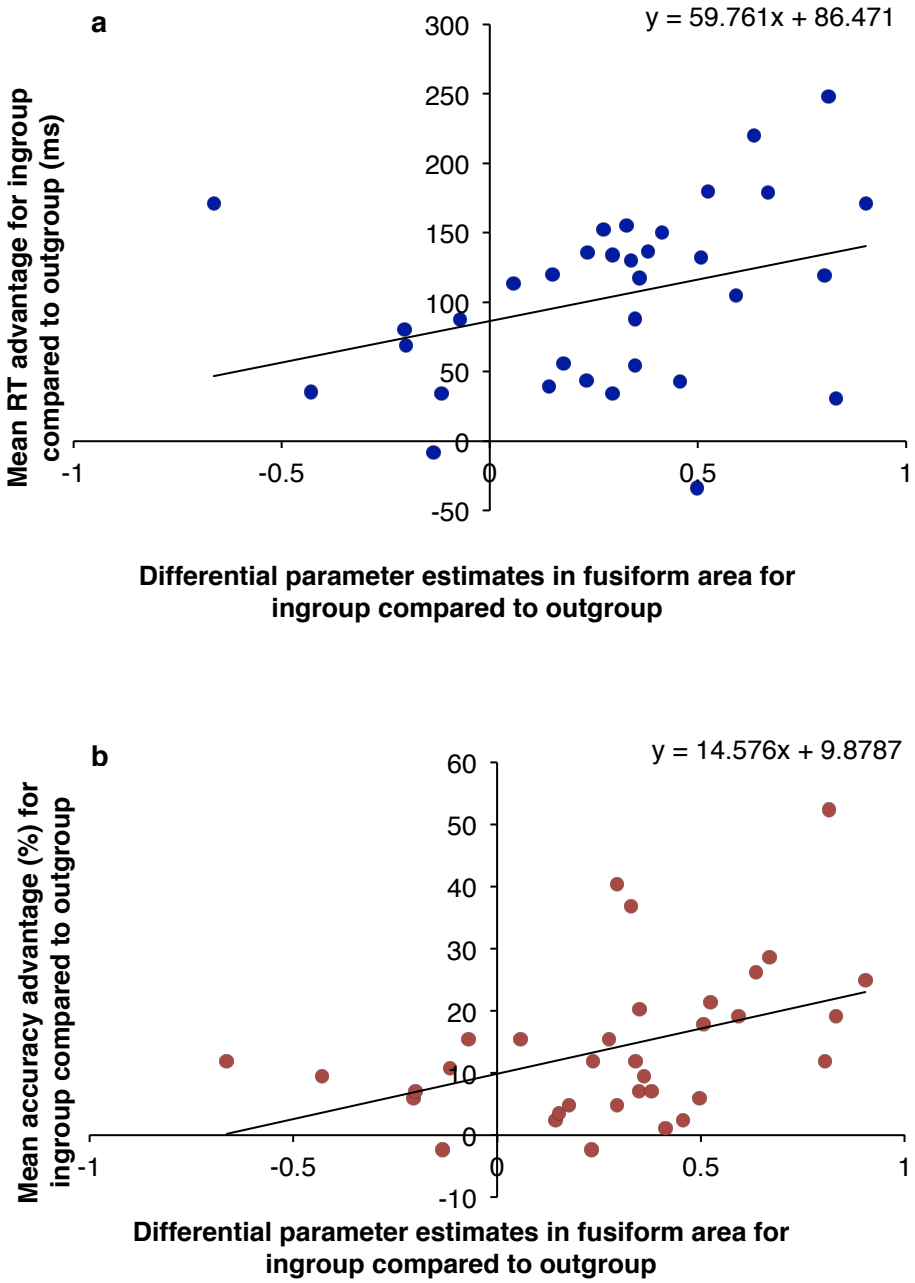


Figure 5.8: The positive relationship between the increased activity in the left fusiform area for ingroup compared to outgroup stimuli and the behavioural ingroup-advantage in response time ($r(32)= .334$, $p = .054$) (a) and accuracy ($r(32)= .429$, $p = .011$) (b).

Chapter discussion

Using fMRI, this experiment examined the neural correlates of perceptual biases for self and ingroup associated stimuli. Participants completed a version

of the perceptual matching task in which they learned to associate self, stranger, established ingroup, established outgroup, novel ingroup and novel outgroup labels with geometric shapes. Inside the scanner, they then responded to shape-label pairs as correct or incorrect within alternating blocks of personal, established group and novel group associations. Behaviourally, a robust advantage in response time, accuracy and sensitivity for own-associated compared to other-associated stimuli was demonstrated. The bias effects for self, established ingroup and novel ingroup stimuli were of a comparable magnitude, suggesting shared behavioural correlates for self and group advantages. At the neural level, there was significantly increased activity within the vmPFC/ACC for own compared to other matched pairs. Separate analyses of the simple effects by task type showed involvement of the vmPFC, ACC and posterior cingulate region for self compared to stranger matched pairs. There were no significant neural differences for ingroup compared to outgroup matched pairs. However, there was no significant interaction effect between neural activity associated with self-bias and ingroup-bias. Although there were no significant responses in the vmPFC, ACC or posterior cingulate for ingroup compared to outgroup stimuli, there was an increased response in the left fusiform area. A conjunction analysis for self compared to stranger and ingroup compared to outgroup contrasts did not reveal any overlapping regions. Furthermore, when the cluster of the vmPFC identified in the self-bias effect was applied as a small volume correction to the ingroup compared to outgroup contrast, there were three voxels within the ACC and two within the adjacent vmPFC, but these did not survive correction. Other-associated (stranger,

established outgroup and novel outgroup) compared to own-associated (self, established ingroup and novel ingroup) stimuli showed several overlapping regions within the inferior parietal lobule (bilateral), the left middle frontal gyrus, and the anterior insula (bilateral).

Within this discussion section, I begin by relating the findings regarding the neural correlates of the self- and ingroup-bias effects to prior research within this area. Next, I address the absence of a robust overlap in the neural regions associated with self compared to stranger and ingroups compared to outgroups, contrasting neural similarities for other compared to own associations. Following consideration of the implications of these neuroimaging results, I acknowledge some limitations of the study and make some suggestions for future research.

Neural correlates of the self-bias

The self compared to stranger contrast for matched pairs showed increased responses in the vmPFC, the ACC and the posterior cingulate. These results are consistent with a body of prior research demonstrating self-representation to be reflected in cortical midline structures such as these (reviewed in Musholt, 2013; see meta-analysis by Northhoff et al., 2006). The nature of the perceptual matching task, in that it requires abstract associations to the self, corresponds more closely to self reference than to the physical self (faces or bodily representations). These results, then, also complement those of Hu et al. (2016), who found the primary involvement of CMS within self-referential tasks, but a more widely distributed set of areas for tasks examining the physical self.

Importantly, the identification of significant vmPFC activity for self associations replicates previous work by Sui et al. (2013) and Yankouskaya et al. (2017), who demonstrated increased activity within this area for self compared to other-associated (friend and stranger) stimuli. However, Sui et al. also reported increased activity within the lpSTS for this contrast and this was not observed in the present experiment, even at small volume correction using the same peak MNI coordinates. This may be explained by the fact that the task itself in the present study was slightly different: only self and stranger associations were included, not familiar others (friends) as well. Sui et al. explained the involvement of the lpSTS in terms of it being part of a ventral attentional network triggered by salient, contextual stimuli (DiQuattro & Geng, 2011). The inclusion of only two associations rather than three in the present experiment may have made the task easier and so perhaps with less need for the recruitment of socially specific attention-related regions. I also did not observe a relationship between the differential vmPFC activity for self compared to stranger and the behavioural self-bias in response time, accuracy or sensitivity, also contrary to Sui et al. Again, this might reflect the slight differences within the task and the fact that results from Sui et al. were based on dynamic causal modelling which was not conducted in the present study. Overall, the identification of vmPFC, ACC and posterior cingulate is consistent with previous neuroimaging results regarding self-representation and self-biases, and confirmation of this provides a reliable foundation to provide comparison with ingroup-bias effects.

Comparing established and novel groups

There were no differences in neural responses to established compared to novel group association tasks, suggesting that these two types of social categories are processed similarly in the brain, at least for low-level perceptual bias effects. This is the first evidence allowing direct comparison of the neural responses for socially established and novel groups whilst using exactly the same target stimuli. Thus, these results are of methodological interest as they provide justification for the use of the minimal group paradigm in neuroimaging research to infer about other forms of real-world social categorisation.

Neural correlates of the ingroup-bias

I observed significantly increased activity within the left fusiform area for ingroup compared to outgroup stimuli. Prior research found higher fusiform involvement for both own compared to other race faces (Cunningham et al., 2004; Golby et al., 2001) and for novel ingroup compared to outgroup faces too (Van Bavel et al., 2008; Van Bavel et al., 2011). Previous studies within this area have shown that social categorisation affects the early perceptual processing of faces for ingroup and outgroup members, an argument supported by ERP evidence to show that the structural encoding of faces is enhanced for ingroup members at the very earliest stage of perception (Ratner & Amodio, 2013). The involvement of the left fusiform in the present results extends these previous findings on face perception to show that perceptual advantages for non-face stimuli are also underpinned to some degree by recruitment of the fusiform area. There was a positive relationship between the differential fusiform activity for ingroup and outgroup associations and the behavioural ingroup-biases in accuracy and

sensitivity. This supports the notion that perceptual advantages for ingroups are underpinned by the enhanced encoding of ingroup stimuli within the fusiform area.

Although I did not observe significant involvement of the vmPFC or the ACC (or the posterior cingulate) in the ingroup-advantage effect as demonstrated in the self-advantaged effect, purported differences between the neural correlates of each social condition were not supported by a statistical interaction. However, Moradi et al. (2017b) also observed no differential neural responses for ingroup compared to outgroup matched stimuli in the vmPFC when using a similar paradigm. As mentioned in the introduction, it was previously unclear whether the discrepancies shown in previous research relating to the neural basis for ingroup (Moradi et al., 2017b) and self (Sui et al., 2013) biases were rooted in slightly different task demands, or whether they were indicative of fundamental differences in self and group processing. The present results contribute to this line of enquiry because self- and ingroup-biases were measured with identical task parameters. While Moradi et al. demonstrated involvement of the lpSTS and left inferior frontal gyrus for ingroup shapes mismatched with outgroup badges, the present experiment draws no comparison here because the aims were only to examine the biases found for matched pairs.

Previous neuroimaging studies have often identified the important role of the amygdala as central for face categorisation tasks, whether these groups are pre-existing and static (for example, viewing own- and other-race faces: Cunningham et al., 2004; Hart et al., 2000) or novel and arbitrarily assigned

(Van Bavel et al, 2008). I did not observe any increased amygdala response either for ingroup than outgroup faces or the reverse. It has been suggested previously that amygdala involvement for other-race faces might reflect negative valence or threat stereotype, whilst to ingroup stimuli it might reflect high perceptual salience or motivational relevance (for example, Van Bavel et al., 2008). The task used for the current experiment differed from most of the prior research paradigms examining perceptual biases in social categorisation in that the target stimuli were neutral shapes to which social value was newly attached, rather than faces of group members. As we know the important role of the amygdala in responding to faces (Todorov, 2012), it may be that this area responds to ingroup/outgroup facial discrimination but not to other kinds of social stimuli. Thus, future studies would benefit from contrasting face to non-face social stimuli in order to isolate the nature of the amygdala response. Additionally, the outgroup exemplar within this experiment (the 'rival' university) does not contain the same negative threat stereotype that may elicit a fear response as, for example, Black faces might for White perceivers (e.g. Maner et al., 2005; Payne, 2001).

Distinct neural correlates for self- and ingroup-biases in the brain

As mentioned in the above section, areas identified in the self>stranger contrast were not observed for the ingroup>outgroup contrast. A conjunction analysis also provided more direct confirmation of there being no overlap in regions associated with self- and ingroup-biases, as no areas were identified for both contrasts even when the threshold was lowered to an uncorrected alpha of .01.

Furthermore, when the ingroup>outgroup contrast was small volume corrected with the cluster of activity within the vmPFC identified for the self-stranger contrast, only two voxels within the vmPFC and three in the ACC (bilaterally) were observed, but these did not survive correction. Whilst these results suggest somewhat distinct neural correlates underlying self and ingroup processing, as mentioned above, the non-significant statistical interaction between neural responses for self-bias and ingroup-bias means that conclusions regarding differential neural activity cannot be drawn.

The suggestion of at least somewhat different mPFC activity for ingroup-bias compared to self-bias (as shown by the conjunction analysis) contrasts to a conclusion drawn by Volz et al. (2009), who observed the involvement of a network centred on the medial prefrontal cortex when participants allocated points to minimal ingroups compared to outgroups. Based on the similarity between the network observed and those known to be involved for self reference, the researchers argued that aspects of self and ingroup draw on the same neural correlates, thus providing evidence for an overlap between self and ingroup within the brain. That no such similarities were observed in the present experiment is most likely to be explained by differences in the tasks themselves, with higher-level decision-making (point allocation) likely drawing on different networks than automatic responses in perceptual matching.

Although there is already a great deal of neuroimaging research relating to self and to ingroup processing, it has thus far been impossible to compare the neural regions implicated for self and ingroup across these studies because of the differences in the task paradigms used to measure self and ingroup

processing. The only study that attempted to utilise the same task stimuli to directly compare the overlap between self and ingroup representation measured neural responses to self, friend, ingroup and outgroup faces (Scheepers et al., 2013). This study found adjacent but not overlapping neural regions for self faces (compared to friend faces) and ingroup faces (compared to outgroup faces) amongst high ingroup identifiers in the right inferior frontal gyrus and the right inferior and superior parietal lobe. Although demonstrating distinct but also closely adjacent neural networks for the categorisation of self compared to friend and ingroup compared to outgroup, Scheepers et al. did not directly compare these two contrasts with a formal conjunction analysis, nor interaction contrasts. The differences observed could have been rooted in increased familiarity for self and friend faces rather than for newly-learned ingroup and outgroup faces. Also, it could be argued that friend is not quite equivalent to outgroup in the subtraction design. The present results expand upon these findings, examining the overlap between self and ingroup in lower-level perceptual bias effects, thus removing all familiarity with the target stimuli and also providing more equivalent social labels (stranger corresponding to outgroup, not friend). The recruitment of completely different neural areas across the two experiments (the present study and that of Scheepers et al.) again demonstrates the importance of paradigm and method of measurement.

Neural correlates of other compared to own associations

For other-associated (stranger, established outgroup and novel outgroup) compared to own-associated (self, established ingroup and novel ingroup) conditions, there were several areas that showed sensitivity both for the

stranger>self and outgroup>ingroup contrasts, including the inferior parietal lobule (bilateral), the left superior lobule and left middle frontal gyrus and the anterior insula (bilateral). These findings demonstrate that 'other' related processing draws on several similar areas. The inferior parietal regions have previously been shown to be involved in distinguishing self from other (Decety & Sommerville, 2003) and the present results show that this may be involved in intergroup as well as interpersonal distinction.

The anterior insula has previously been demonstrated to show greater responses to outgroup members than to ingroup members (Ronquillo et al., 2007) and the present findings extend from facial processing to perceptual matching of non-face stimuli. These results also suggest that the anterior insula responds to other people (i.e., stranger) compared to self and not just to others in a group setting (i.e., outgroups compared to ingroups). Sui et al. (2013) noted the recruitment of a similar frontoparietal control network for friend and stranger compared to self associations, and the possible increased saliency of unknown others and the established rival outgroup may also explain the involvement of these regions. Interestingly, the only area that responded significantly differentially to group versus personal associations was the left precuneus, which showed higher activation for outgroups compared to ingroups, but not for stranger compared to self. This interaction effect provides further evidence for at least partly distinct neural processes underlying personal and group effects within the matching task.

Limitations

This fMRI experiment had strengths in being uniquely able to compare three kinds of social biases (self, established ingroup and novel ingroup) using a subtraction design in which the two conditions (own and other) within each task type were exactly matched. With 34 participants and enough trials per condition to elicit robust behavioural effects, the study was also highly powered.

Despite providing a novel way to compare the neural basis of self- and ingroup-biases, it is important to note some limitations. Firstly, the matching task utilised is designed to measure basic effects of associating stimuli with labels of social relevance. Although removing familiarity from the target stimuli, the paradigm also removes any content that would traditionally be regarded as social (faces, names, personality attributes and so on).

The experiment benefitted from the use of university affiliation as the ingroup membership category because a level of intergroup competition was present (particularly owing to the historical rivalry between the two high profile universities included), without confounds such as obvious minority/majority group status or explicitly negative stereotypes of the outgroup. However, it of course has to be noted as well that university affiliation, and the Oxford vs. Cambridge friendly rivalry, is not comparable to historical social conflict between powerful and marginalised groups or groups that are more meaningful to individuals' worldviews, such as religions or political parties. Members of the outgroup university used within the present study are not overtly disliked, stereotyped or discriminated against. In this sense, this experiment is much

more concerned with ingroup favouritism than outgroup derogation, similar to previous work showing ingroup enhancement of but not outgroup disregard for novel faces (Van Bavel et al., 2011). Furthermore, university affiliation is an example of extended group alignment in which group members are part of a large collective and do not know one another personally, as opposed to local group alignment within a smaller collective such as, for example, a sports team (Swann et al., 2012). It would not be inconceivable that measuring these perceptual bias effects under alternative group dynamics might elicit different neural responses. It would be interesting in the future to look at whether any individual differences (such as group identity or self-esteem) predict more of an overlap in the neural regions associated with self- and ingroup-biases.

Conclusions

Overall, this experiment provided a novel way to compare directly self- and ingroup-biases in the brain. I show somewhat distinct processing of self- and ingroup-associated stimuli in vmPFC, even when the stimuli are matched exactly and the behavioural effects are comparable, and also overlap between the processing of other-associated compared to own-associated stimuli. Previous experiments within this thesis demonstrated robust self- and ingroup-prioritisation effects using the associative matching task and also provided some evidence for a positive relationship between self- and ingroup-biases (Experiment 1), that appeared to be stronger when the groups are novel (Experiments 4 and 6). However, this relationship was not always present (Experiment 3), with biases for established ingroups (unit and country) within military personnel being significantly related to one another, but with no

relationship to biases for the self. Using only behavioural evidence, it was previously difficult to ascertain how closely linked the mechanisms behind biases for the self and social ingroups were. The present neuroimaging results provide important insight regarding commonalities and distinctions between self- and ingroup-biases at the neural level.

Chapter 6: General discussion

Overview of thesis aims, methods and main results

Self- and ingroup-biases have received considerable attention across multiple domains within social cognitive neuroscience and research contributions within this area have been integral to our understanding of social cognition more broadly (e.g., Ruff & Fehr, 2014). Previous research has shown that preference and prioritisation for information relating to the self and social ingroups occurs across many kinds of cognitive processes. For example, biases for the self are shown in tasks ranging from object ownership to memory performance and facial recognition (e.g., Beggan, 1992; Rogers et al., 1977; Symons & Johnson, 1997; Tong & Nakayama, 1999; Turk et al., 2008). Similarly, ingroup favouritism has consistently been observed across a number of paradigms, from reward allocation and character judgements to more automatic effects of empathy and the perceptual encoding of faces (Hewstone et al., 2002; Hugenberg et al., 2010; Johnson et al., 2002; Leyens et al., 2000; Paladino et al., 2002; Tajfel, 1970; Tajfel et al., 1971). Furthermore, recent neuroimaging evidence has progressed in identifying some of the neural mechanisms that support self and ingroup processing (e.g., Amodio, 2014; Cikara & Van Bavel, 2014; Hu et al., 2016; Northoff et al., 2006). In this chapter, I provide a chronological summary of the aims and main results of each experiment within this thesis. I then address the five research questions identified in Chapter 1 and discuss the relevant experimental results in relation to each one. Following this, I present some general limitations to the research along with suggestions for future

directions. I then outline several implications of the research for social psychological theory and also present possible applications of the research with the focus on a military context. Lastly, I make some conclusions regarding the research findings as a whole. Broadly, I conclude that whilst perceptual biases for both the self and social ingroups are reliably elicited across a multitude of contexts and tend to be of a comparable magnitude to one another, they are underpinned at least in part by distinct cognitive and neural processes.

Throughout this thesis, I used modified versions of a perceptual matching task first developed by Sui et al. (2012) to examine the lower-level perceptual and attentional effects of social relevance. In this task, participants typically learn to associate geometric shapes with social labels (for example, square, circle and triangle with 'you', 'friend' and stranger') and then respond to randomly generated shape-label pairs as correctly or incorrectly matched. Previous research using this paradigm has found robust advantages in response time, accuracy and perceptual sensitivity measures for shapes associated with the self and with social ingroups and these effects held across multiple variations of the paradigm (e.g., Stolte et al., 2017; Sui et al., 2012; Sui & Humphreys, 2015). Furthermore, fMRI research found the self-bias effect to be underpinned within the vmPFC and the lpSTS, while no such pattern was observed for the ingroup-bias (Moradi et al., 2017b; Sui et al., 2013). The present thesis expanded upon this work by examining the relationships between self- and ingroup-biases in behavioural and neural responses along with testing the effects of different intergroup contexts.

The first two experiments within this thesis (Chapter 2) utilised a sample of college rowers with their own rowing team as the ingroup exemplar along with rival and neutral teams as the outgroups. In Experiment 1, participants completed two perceptual matching tasks, one with personal (self, friend and stranger) associations and the other with group (team, rival and neutral associations), the order of which was counterbalanced. In Experiment 2, self, stranger, team and rival associations were made within the same task and each shape association could be either matched with the correct label or mismatched with any one of the other labels. In both experiments, participants also completed questionnaires relating to group identification, identity fusion and self-construals. I found performance advantages for self and team shapes compared to friend, stranger, neutral and rival shapes, supporting results reported by Sui et al. (2012) and Moradi et al. (2015). The self- and ingroup-biases were of a similar magnitude, and a marginal positive relationship between the two was observed in Experiment 1 but not in Experiment 2. Furthermore, slower response times and higher error rates for self shapes matched with team labels than for self shapes matched with rival labels suggested an overlap in the representation of newly-learned self and ingroup stimuli. The greater difficulty shown in distinguishing self from team (measured by a difference in response time between self+*team* and self+*rival* pairs) was significantly positively associated with self-reported levels of identity fusion and group identification.

Experiment 3 (Chapter 3) further examined the relationship between self- and ingroup-prioritisation effects whilst also measuring the social biases

under different intergroup contexts by comparing responses for familiar and threatening outgroups. Military personnel completed three versions of the matching task, one for personal associations (self, friend and stranger), one for unit associations (unit, familiar unit and neutral group), and one for country associations, which also tested the effects of threat saliency (United Kingdom, America and ISIS). Self-reported measures of identity fusion, group identification and self-construals were also taken. Performance advantages were found for self compared to friend and stranger, unit compared to familiar and neutral outgroups, and country compared to ally and threat groups. Although performance was generally better for the group (unit and country) tasks than the personal task, the self- and ingroup-biases were of a similar magnitude and there were no differences in performance between the two 'other' conditions across the three tasks. There were no relationships between advantages for the self and for the ingroups (either unit or country), but there were significant positive correlations between advantages for the unit and for the country in both response time and sensitivity measures.

Experiments 4, 5 and 6 (Chapter 4) examined the effects of novel group allocation on early perceptual processing along with the relationships between biases for the self and novel ingroups. A minimal group paradigm, in which each participant was randomly allocated to one of two novel teams, introduced a social context in which nothing was known about the social categories at all and in which there was no historic sense of rivalry, threat or indeed friendship between the two groups. In Experiment 4, participants performed two versions of the matching task, one in which self and stranger associations were made

and the other in which novel ingroup and outgroup associations were made. In Experiment 5, self, stranger, novel ingroup and novel outgroup associated stimuli were presented within the same task and each shape condition could be correctly matched with the label or incorrectly matched with any of the other three labels. In Experiment 6, personal (self and stranger) and group (novel ingroup and outgroup) associations were responded to in alternating blocks of the same task. In each experiment, participants also completed self-reported measures of self-esteem and self-construals. There were advantages in response time and sensitivity for self and ingroup stimuli when personal and group shapes were responded to in separate tasks (Experiment 4) and in separate blocks of the same task (Experiment 6). However, when they were presented within the same task blocks, the prioritisation effects were only observed for self stimuli (Experiment 5). There were significant positive relationships between the self and ingroup response time biases in Experiments 4 and 6. Higher error rates for self shapes paired with ingroup than with outgroup labels in Experiment 5 also indicated a shared representation of newly-learned self and novel ingroup stimuli.

Experiment 7 investigated the neural correlates of perceptual biases for self and ingroup stimuli, focusing on the extent to which self- and ingroup-prioritisation effects are driven by common or distinct neural mechanisms. This experiment also compared neural responses for established social ingroups with those that are novel and arbitrarily assigned. Participants learned to associate self, stranger, established ingroup (Oxford University), established outgroup (Cambridge University), novel ingroup (Team Blue) and novel

outgroup (Team Green) labels with geometric shapes. Then, during fMRI, they responded to shape-label pairs in alternating blocks of personal, established group and novel group associations. Behaviourally, there were advantages in response times, accuracy scores and perceptual sensitivity for self and ingroup compared to stranger and outgroup stimuli, and these advantages were of a comparable magnitude. Neurally, there was significantly increased activity within the vmPFC/ACC for own compared to other matched shapes. Analysis of the simple effects found significant differences in the vmPFC/ACC and posterior cingulate for self compared to stranger matched shapes, but these differences were not significant for ingroup compared to outgroup matched shapes. However, there was no significant interaction to support statistical differential neural activity for self- and ingroup-biases. There was increased activity in the left fusiform area for ingroup (compared to outgroup) associated stimuli for both established and novel groups. Other-associated (stranger, established outgroup and novel outgroup), compared to own-associated (self, established ingroup and novel ingroup), stimuli showed overlapping regions within the inferior parietal lobule (bilateral), the left middle frontal gyrus, and the anterior insula (bilateral).

The experiments within this thesis were designed to empirically address five outstanding research questions, posed in the introduction to this thesis (Chapter 1), relating to the behavioural and neural consequences of self- and ingroup-biases in perception and attention. The results and implications relating to each of the questions are now more specifically addressed.

1. What is the relationship between perceptual prioritisation for the self and social ingroups?

As outlined above, the experiments within this thesis found cognitive performance to be enhanced at the perceptual level for both self and ingroup related stimuli, consistent with previous work by Moradi et al. (2015) and Sui et al. (2012). The effects were similar and comparable for both self and ingroup associations, which suggested the possibility of a common mechanism driving these two kinds of bias effects, consistent with the notion of an overlap between self and group as held by social identity theory and self-categorisation theory (Tajfel, 1982; Turner et al., 1987).

Previous research examining the relationship between self-biases and those for high reward and positive emotion found no significant relationships between the two and suggested that they were driven by distinct processes (Stolte et al., 2017; Sui & Humphreys 2015). Thus, it was unclear whether biases for ingroup stimuli were simply reflective of biases for self stimuli, or whether they too were distinct. Both Experiments 1 and 2 (Chapter 2) found significant performance advantages for self and ingroup associations and there was a marginal positive relationship between the self and ingroup response time biases for Experiment 1, suggesting the possibility of a common process. However, in Experiment 3, which examined the relationship between self- and ingroup-biases amongst military personnel, there was no such relationship between self and ingroup performance advantages. Instead, there was a positive relationship between the ingroup performance advantages for the unit and for the country, suggesting a common process for ingroup-prioritisation

distinct from self-prioritisation. In contrast, Experiments 4 and 6, using minimal groups, showed significant positive relationships between the biases for the self and for novel ingroups, suggesting that the self-bias was predictive of the ingroup-bias and thus a shared process for both.

These apparently inconsistent results may be best explained by distinct mechanisms for established and novel ingroup-prioritisation effects. For novel group allocation, ingroup-prioritisation effects might arise from the projection of the self onto the new group, known as self-anchoring (Cadinu & Rothbart, 1996; Van Veelen et al., 2015). This would explain the robust relationship between self- and ingroup-biases in these experiments. For established and ecologically meaningful social groups, on the other hand, ingroup-prioritisation may be independent of self-prioritisation, not relying on this self-anchoring mechanism. Indeed, this would be consistent with previous research suggesting that *self-anchoring* as a means to group affiliation is more common amongst novel groups, whilst *self-stereotyping* is more common amongst established groups (Robbins & Krueger, 2005; Van Veelen et al., 2015). However, conclusions are limited because the experimental designs did not directly test whether self-bias is a better predictor of novel than established group-biases.

Although evidence for a positive relationship between self- and ingroup-bias is mixed, in Experiment 2 there were slower response times and higher error rates for self shapes paired with (rowing) team labels than with rival labels, indicating greater difficulty in rejecting self+*team* as correct. The positive relationship between the strength of this effect (indexed by the difference in response time between self+*team* and self+*rival* pairs) and self-reported levels

of group identification and identity fusion, showed that individuals who had a higher sense of ingroup affiliation showed greater overlap in representations of self and ingroup stimuli at the perceptual level. Similarly, in Experiment 5, lower error rates for self shapes paired with novel outgroup labels than with novel ingroup labels, and for ingroup shapes paired with stranger labels than with self labels, also indicated greater difficulty in rejecting self+*ingroup* than self+*outgroup*. Results from Experiments 2 and 5 suggest an overlap in the representation of stimuli associated with the self and social groups.

In conclusion to this first research question, the evidence thus suggests overlapping representations of stimuli newly associated as belonging to the self and social groups, demonstrated by analyses of specific mismatched pairs both in Experiments 2 and 5. However, the relationships between self- and ingroup-biases varied between different group exemplars. It is likely that, behaviourally, biases for novel ingroups are reflective of biases for the self but that biases for established ingroups draw on distinct processes. Thus, whilst there is certainly an overlap in the representation of stimuli associated with the self and with ingroups, the performance advantages may be driven by at least partly distinct processes.

2. How does social context modulate ingroup-bias?

As well as examining the relationships between the self- and ingroup-biases in perceptual processing, this thesis also aimed to test whether particular intergroup dynamics modulated the ingroup-bias effects. Previous work by Moradi et al. (2015) found performance advantages for ingroup stimuli

compared to neutral and rival outgroups amongst football supporters, but found no difference between the two outgroups. From these results, it was unclear whether ingroup-biases would be shown under all social contexts, and whether there would be differences in perceptual processing for different kinds of outgroups. For example, are outgroups higher in familiarity given prioritisation in perception compared to unfamiliar ones in the same way that friends are prioritised compared to strangers (Sui et al., 2012)? Does outgroup threat affect perceptual processing in the same way that threat enhances saliency in other kinds of cognitive tasks (e.g., Devue et al., 2011; Ohman et al., 2001; Schmidt et al., 2012; Trawalter et al., 2008)?

Experiment 1 in this thesis found that for personal associations, response times were faster and sensitivity was enhanced for friend compared to stranger shapes, but there were no differences between rival team and neutral team shapes. Experiment 3 aimed to further examine whether more specific intergroup dynamics relating to the social categories used modulated the perceptual prioritisation effects. A sample of military personnel made associations of their own unit, a familiar unit and a neutral group in one matching task and of their country (UK) an ally group (America) and a threat group (ISIS) in another. This provided a way to more closely measure responses to friendly outgroups and those considered threats. Across both tasks, performance advantages were demonstrated for the unit and for the country compared to the two outgroups. There was no difference in performance between the familiar unit and neutral group, nor between the ally and threat group. The ingroup was shown perceptual prioritisation even in the

presence of a threat association, which was perhaps surprising given previous evidence showing higher attentional capture for stimuli associated with social threat (Capellini et al., 2016; Trawalter et al., 2008). Previous research in this area utilised images already associated with threat and so it may be that removing these specific visual features in the shape associations eliminated threat effects on perceptual saliency.

As there were no differences in responses to the different outgroup exemplars across Experiments 1 and 3, it is likely that the bias effects observed within this paradigm are reflective purely of a propensity to perceptually favour the ingroup rather than of any other more complex intergroup dynamics such as outgroup derogation or intergroup competition. Future research could examine social context more closely by measuring the biases in different intergroup situations such as during training compared to competition for sports teams, or before and after deployment amongst military personnel.

In conclusion to the second research question, biases in early perception for ingroup related stimuli are robust regardless of the other social categories included. Whether the outgroup exemplars were rival and neutral sports teams, familiar and neutral organisations, or friends compared to explicit threats, ingroups were always prioritised over outgroups and no distinction was made between the outgroups at the perceptual level. Thus, based on the research conducted so far, specific intergroup dynamics do not modulate performance in early visual perception within this paradigm.

3. How quickly does group affiliation affect early perceptual processing?

A wealth of previous research has found that ingroup favouritism is reliably elicited under 'minimal group' conditions in which group membership is randomly or arbitrarily assigned and the categories contain no social meaning at all (Allen & Wilder, 1975; Bourhis & Gagnon, 2001; Brewer & Silver, 1978; Doise et al., 1972; Mullen et al., 1992; Tajfel, 1970). There is also research evidence to suggest that minimal group allocation modulates early face representations (e.g., Ratner & Amodio, 2013; Ratner et al., 2014), demonstrating that even new social identities have perceptual effects. Experiments 4, 5 and 6 (Chapter 4) examined the effects of minimal group allocation on early perceptual prioritisation for non-face target stimuli. This provided a way to test how quickly group affiliation affects early perception and attention. Utilising minimal groups was of benefit both in providing insight into how quickly group affiliation affects early perceptual processing and also in creating a uniform way to measure attention across participants while controlling for potential confounding variables such as length of group membership, levels of ingroup identification and outgroup attitudes.

Experiments 1, 2 and 3 found reliable advantage effects for self and ingroup stimuli when the ingroup exemplars were established and a meaningful part of the individuals' identities. Participants within these experiments had belonged to their rowing teams or military units for at least three months (in most cases considerably longer), and the nature of both group memberships ensured these were a central aspect of the individuals' daily lives. Experiments

4, 5 and 6 examined whether comparable effects would be elicited when the ingroups were new and randomly assigned. Significant performance advantages for stimuli associated with the self and the novel ingroup were found when self and ingroup associations were responded to in separate tasks (Experiment 4) and in separate blocks of the same task (Experiment 6). These results demonstrated that even novel group allocation quickly enhances perception and captures attention for non-face, previously neutral stimuli. However, when self and ingroup pairs were presented together within the same task blocks, the prioritisation effects were only observed for the self (Experiment 5). As the ingroup-bias was present under exactly the same experimental design amongst college rowers in Experiment 2, these results suggest a difference in the mechanisms behind novel and established ingroup-prioritisation effects.

In conclusion to the third question, the data suggests that minimal group allocation quickly enhances low-level perceptual processing even to newly learned stimuli that lack any obvious social content. However, when in direct competition with a more meaningful entity (in this case, the self) minimal group affiliation does not hold enough inherent importance to retain perceptual prioritisation.

4. Do trait differences underlie the strength of perceptual prioritisation for the self and social groups?

Previous research evidence has shown that individual differences in self-esteem and self-construals modulate certain social bias effects. For example, previous

research found that implicit preferences for letters and numbers associated with one's own name were not found in individuals with low self-esteem (Jones et al., 2002). Also, biases in recognition memory for self-associated compared to other-associated objects (Cunningham et al., 2008) were present for Western, but not Asian participants, and Asian participants instead showed higher recognition accuracy for mother-owned than self-owned objects (Sparks et al., 2016). Similarly, unlike British participants, Chinese individuals did not show enhanced performance for facial orientation judgements of own compared to others' faces (Sui et al., 2009). As independent self-construals are associated with Western cultures and interdependent self-construals with non-Western cultures such as Asian ones (Triandis, 1989), these studies suggested that differences in self-construals modulate self-bias effects in memory and perception. I aimed to examine whether perceptual biases for self and ingroups within the matching paradigm are also underpinned by these individual differences, or whether these lower-level, automatic biases are separate from explicit attitudes towards the self and social groups.

As well as self-esteem and self-construals, there is some previous evidence to suggest that levels of ingroup identification may modulate ingroup-bias. Moradi et al. (2015) found that the satisfaction component of group identification (Leach et al., 2008) was positively correlated with perceptual prioritisation with the ingroup on the perceptual matching task. Further to group identification, as identity fusion measures the extent to which the personal self and the social self overlap, being completely at one when they fully overlap (Swann et al., 2012), this variable was also of interest in examining the relations

between self- and ingroup-biases. Using correlational and moderation analyses, the behavioural experiments (Experiments 1-6) within this thesis tested whether individual differences in self-esteem, self-construals, group identification and identity fusion modulated the self and ingroup performance advantages on the perceptual matching task.

Experiments 1, 2 and 3 included measures of group identification and identity fusion. Across these three experiments, utilising members of college rowing teams and also military personnel, there were no significant relationships between ingroup-bias and either component of group identification (self-investment or self-definition), nor with identity fusion. These results suggest that explicit levels of ingroup identification do not qualify the perceptual biases for the ingroup. These results contrast to those reported by Moradi et al. (2015), who found that self-reported satisfaction with the team predicted the performance advantage for the ingroup amongst a sample of football supporters. Even when correlations were run separately for each subcomponent of the group identification scale (Leach et al., 2008), as per Moradi et al., there were no significant relationships with performance advantages for the ingroups and satisfaction with the ingroup, or with any of the other four components of group identity (solidarity, centrality, individual self-stereotyping, ingroup homogeneity).

As noted in the discussion section of Chapter 3, this discrepancy might be explained in terms of a qualitative difference in supporting a team from an outside perspective (as for football supporters) and partaking as an active member of a team (as for the rowers and military personnel). Although group

identification and identity fusion did not modulate the ingroup-bias, both were positively correlated with the overlap between self and group representation observed in the analysis of the mismatched pairs in Experiment 2. The more difficult participants found it to discriminate self from ingroup (i.e., the slower they were for self+*team* pairs than self+*rival* pairs), the higher the self-reported levels of group identity (both self-investment and self-definition) and identity fusion. Therefore, individual differences in explicit identification with the ingroup predicted an overlap between self and ingroup at the perceptual level.

Experiments 3, 4 and 6 also measured whether the self-bias was associated with levels of independent and interdependent self-construals using correlation analyses. There were no significant relationships between the self and ingroup performance advantages in response time or sensitivity and self-reported levels of independent or interdependent self-construals. Furthermore, self-construals did not moderate the relationship between the self- and ingroup-biases. These results suggest that perceptual prioritisation for the self and social ingroups are not qualified by views of the self as autonomous from or as connected with other people. These results contrast to previous work that found self-construals to modulate bias effects (Sparks et al., 2016; Sui et al., 2009). Both of these studies utilised Asian (Chinese) participants and British participants as groups holding higher levels of interdependent and independent self-construals respectively. However, the studies within this thesis did not compare responses between cultures and instead utilised the natural variance of these measures within individuals independent of cultural background. Future

work could directly compare cross-cultural differences in self- and ingroup-biases and the relations between the two.

Finally, Experiments 4 and 6 tested whether self-reported levels of self-esteem modulated the self- and novel ingroup-advantages. Previous research found that trait self-esteem scores significantly predicted the amount of favouritism (in the form of ascribing positive and negative traits and behaviours) towards novel ingroups (Gramzow & Gaerter, 2005) and that preference for novel ingroups was less likely amongst individuals with low self-esteem (Cadinu & Rothbart, 1996). This led the researchers to suggest that ingroup favouritism for novel groups may arise from the projection of a more positive self-view. However, Experiments 4 and 6 found no significant relationships between levels of self-esteem and perceptual prioritisation for the self or novel social ingroups. Furthermore, self-esteem did not moderate the relationship between the two bias effects. As noted in the general discussion of Chapter 4 (Experiments 4, 5 and 6), most individuals within the experiments had fairly high self-esteem and none would have been classed as holding low self-esteem according to the original scale recommendations (Rosenberg, 1965). Future research would benefit from measuring self- and ingroup-prioritisation effects amongst samples with greater variance within self-esteem measures. On a similar note, it would be interesting to measure whether these biases differ amongst clinical samples such as patients with depression compared with healthy controls.

In conclusion to question four, there is no evidence to suggest that any individual trait differences in group identification, self-construals or self-esteem underpin biases for the self and social ingroups. Although the sample sizes

were relatively small for typical correlational analyses of this kind, they should have been sufficient to detect potential relationships or even trends. However, null effects should of course be interpreted with caution.

5. What are the commonalities and distinctions in the neural regions that underpin biases for the self and social ingroups?

The behavioural experiments within this thesis (Experiments 1-6) measured the similarities and overlap between perceptual prioritisation for the self and social ingroups. There was evidence for a relationship between self- and ingroup-biases (Experiment 1) that appeared stronger for novel ingroups (Experiments 4 and 6) and also for an overlap in the representation of self and ingroup stimuli (Experiments 2 and 5), but there were no significant relationships between self- and ingroup-biases for the military personnel in Experiment 3. Thus, whilst providing important insight into the nature of these social biases, the behavioural studies did not provide conclusive answers about the common and distinct mechanisms underlying the prioritisation effects. Previous neuroimaging work had identified the vmPFC and the lpSTS as areas underpinning the self-bias effect in perceptual matching (Sui et al. 2013), however Moradi et al. (2017b) found no such pattern of activity for ingroup-biases.

Experiment 7 was designed to measure directly the neural correlates of self- and ingroup-prioritisation in order to provide clearer insight into the commonalities and distinctions between the mechanisms that underlie biases for both established and minimal groups. The use of minimal groups has been beneficial to neuroimaging research as these designs allow for control of

variables such as group status, social context, pre-existing stereotypes, group identification and even the visual features of the target stimuli (Cikara & Van Bavel, 2014). However, results for novel group processing have not always mirrored those from established groups (e.g., Van Bavel et al., 2008). Experiment 7 also aimed to compare neural responses for socially established and novel ingroups in order to assess whether they are processed in similar or distinct ways in the brain.

As outlined above, during fMRI, participants completed a version of the perceptual matching task in which they learned to associate self, stranger, established ingroup, established outgroup, novel ingroup and novel outgroup labels with geometric shapes and then responded to shape-label pairs within alternating blocks of personal, established group and novel group associations. There was significantly increased activity within the vmPFC/ACC for own compared to other matched shapes. Analyses of the simple effects showed significantly increased vmPFC, ACC and posterior cingulate activity for self compared to stranger but not for ingroup compared to outgroup, however the interaction effect was not significant and thus conclusions of differential neural responses in these areas for self- and ingroup-biases cannot be drawn. A conjunction analysis for contrasts comparing self to stranger and ingroup to outgroup did not reveal any overlapping regions. Furthermore, when the cluster of the vmPFC identified in the self-bias effect was applied as a small volume correction to the ingroup compared to outgroup contrast, there were three voxels within the ACC and two within the adjacent vmPFC, but these did not survive correction.

For both ingroups compared to both outgroups (novel and established), there was increased activity in the left fusiform area. Thus, whilst the neural correlates of the established and novel ingroup-biases were similar, they were at least in part distinct from those of the self-bias. However, other-associated (stranger, established outgroup and novel outgroup) compared to own-associated (self, established ingroup and novel ingroup) stimuli showed overlapping regions within the inferior parietal lobule (bilateral), the left middle frontal gyrus, and the anterior insula (bilateral). This overlap indicated common regions associated with other processing, whether interpersonal or intergroup. Interestingly, the only area that revealed significantly different responses to group compared with personal associations was the left precuneus, which showed higher activation for outgroups compared to ingroups, but not for stranger compared to self. This interaction gave further evidence for at least partly distinct neural processes underlying personal and group associations within the matching task. A specific discussion of these neuroimaging results in relation to prior social neuroscience research is presented in the discussion section of Chapter 6 (Experiment 7).

The social neuroscience approach holds that social behaviour may be better understood at multiple levels of analysis by measuring neural and other biological mechanisms that underlie social attitudes and behaviours (Cacioppo et al., 2000; Cacioppo & Cacioppo, 2013). Adopting this perspective within the present thesis has allowed for an important distinction in the mechanisms behind self- and ingroup-prioritisation that would have been more difficult to identify with only behavioural evidence. Understanding the mechanisms behind

self- and ingroup-biases may be beneficial in, for example, informing targeted intervention (e.g., Amodio, 2014). If self- and ingroup-prioritisation effects are driven at least in part by distinct mechanisms, then this suggests that changing ingroup-biases at the perceptual level may be done independently of altering fundamental self-prioritisation. The findings also show that similar behaviours can be driven by different patterns of neural activity.

In conclusion to question five, the fMRI results show that behavioural advantages for the self and social ingroups are underpinned in part by distinct neural mechanisms, even though the behavioural effects were comparable and the stimuli used were exactly matched across the conditions. However, there were also neural commonalities between the patterns observed for self- and ingroup-biases and in the processing of stranger and outgroup stimuli. These neuroimaging results provide valuable insight into the more specific neural mechanisms that underlie the self- and ingroup-bias effects.

Limitations and directions for future research

General limitations

The empirical research presented in this thesis benefitted from utilising multiple methods including behavioural measures and neuroimaging to provide a novel examination of the relations between self and ingroup representations in brain and behaviour. However, as for almost every piece of experimental research, there are some limitations within the present thesis that must be acknowledged. Several shortcomings with regards to specific experiments have been

addressed throughout the empirical chapters and here I discuss outstanding critiques as a whole.

The perceptual matching task adapted from Sui et al. (2012) used throughout is advantageous because it allows for the exact measurement of behavioural advantages for self and ingroup stimuli whilst keeping the methods of measurement and the target stimuli exactly the same across different group exemplars and contexts. However, it is designed to measure basic attentional prioritisation effects of stimuli that are newly associated with social relevance. In removing familiarity from the target stimuli, the paradigm also removes any content that would traditionally be regarded as social (such as faces, names, personality attributes and so on). Thus, it could be argued that this is not a typical social cognition task and inferences to other kinds of social domains may be limited, and should be made with caution. For example, measuring attentional biases for ingroup stimuli may not inform us about more meaningful complex intergroup dynamics such as attitudes to specific outgroups, prejudice and stereotyping of certain outgroup members and their groups as a whole, and the corresponding behaviour of discrimination that might occur in real world settings. To relate this task to social cognition more broadly, it would be beneficial for future research to examine whether the low-level attentional biases measured throughout this thesis predict other sorts of social biases such as in the perceptual encoding of faces. However, although it may be reductionist compared to real-life social stimuli, the task allows for greater experimental control and it is reasonable to assume that humans do not develop completely different mechanisms to deal with other types of social stimuli. The task is

powerful in demonstrating how few trials it takes to tag self and social meaning to abstract stimuli, which is interesting for aspects of everyday life. The experiments using this paradigm show that social affiliation influences early perception, and future work should examine if and how these changes in perception in turn influence higher-level intergroup dynamics (e.g., Xiao et al., 2016).

Additionally, the research may have been improved by including control experiments that measure responses to completely non-social stimuli (for example, matching shapes to the names of animals) in order to directly compare social associations with non-social associations and test for effects of familiarity with or preference for the stimuli. However, previous control experiments conducted by Moradi et al. (2015; 2018) included animal and vegetable associations with different levels of familiarity and found no significant effects of familiarity on performance. Similarly, Sui et al. (2012) showed that altering word usage frequency and word length did not change the self-bias effects.

The present experiments benefitted from the inclusion of a variety of participant samples, testing the research questions amongst both students and also military personnel who had different socioeconomic backgrounds and education levels. However, it should be noted that intergroup dynamics come in many more complex and nuanced forms. The present experiments did not examine ingroup-biases in the context of powerful compared to marginalised group members, for example, or for groups that might be more meaningful to individuals' specific worldviews, such as religions or political parties. The

instances of outgroups chosen for these experiments were not overtly disliked (except probably in the case of the threat group in Experiment 3), stereotyped or discriminated against. Therefore, the findings may be informative with relation to ingroup favouritism, but not to more egregious outgroup derogation (e.g., Brewer, 1999).

Directions for future research

The results reported throughout this thesis provide a good foundation for several avenues of further research. Firstly, it would be interesting to examine the process of group affiliation by measuring the self- and ingroup-prioritisation effects within a longitudinal experimental design. In utilising, for example, new military recruits and measuring the relations between self- and ingroup-biases at regular time intervals over a long-term period, further insight could be provided into the development of group affiliation and even identity fusion.

Another interesting line of research would be to examine how these lower-level attentional biases are related to other forms of social dynamics and intergroup biases. For example, intergroup contact theory holds, very broadly, that under particular conditions, positive experiences with outgroup members may benefit attitudes towards the outgroup as a whole, while negative contact experiences may have the opposite effect (Allport, 1954; Brown & Hewstone, 2005; Pettigrew, 1998). It would be interesting to examine whether contact experiences with outgroup members would reduce prioritisation for the ingroup at the perceptual level. This would provide a better understanding of the interaction between ingroup-biases in perception and attention and higher-level

intergroup dynamics. On a similar note, future research could examine whether these perceptual biases in social associations predict real life decision-making, such as in relation to pro-social behaviours towards ingroups and outgroups.

Additional methodologies might be of benefit in further understanding the relationships between and mechanisms behind self- and ingroup-prioritisation. Whilst the fMRI experiment (Experiment 7) provided insight into the neural regions underpinning the performance advantages, the use of ERP recordings during the same paradigm could provide more information about the commonalities and distinctions between the specific neural time-courses in responses to self and ingroup compared to other-associated stimuli. For example, Ratner and Amodio (2013) demonstrated that novel ingroup faces elicited larger N170 amplitudes (known to be involved in the structural encoding of faces) than outgroup faces, suggesting that novel group allocation affects early face perception. Would we find similar ERP evidence for the enhanced perceptual encoding of newly learned, non-face stimuli as well? Additionally, whilst the present fMRI study provided some preliminary evidence for a neural dissociation between self- and ingroup-bias, lesion studies could provide more conclusive evidence on this matter. For example, would patients with damage to the vmPFC show reduced self-bias but normal ingroup-biases?

Finally, the experiments within this thesis have focused on how learning to associate social relevance with previously neutral stimuli affects perception but have not examined how these associations are learned and whether this learning differs between social conditions. A recent study by Lockwood et al. (Under Review) utilised an associative learning framework along with fMRI to

examine self and other ownership acquisition over time. Here, participants repeatedly encountered abstract fractal pictures and learned whether they belonged to themselves, a close friend or a stranger by indicating whom they thought each picture belonged to and receiving feedback after each response. An associative learning model was used to calculate parametric values of ownership associative strength and also the size of ownership prediction errors. Participants demonstrated a strong initial preference to indicate that pictures belonged to themselves, were faster and more accurate responses when learning about self-owned than other-owned objects, and higher learning rates for the self. The researchers also found that several areas within the medial prefrontal cortex tracked ownership strength between objects and agents. This approach is highly beneficial in providing a deeper understanding of the associative mechanisms that mediate the process of acquiring a sense of ownership. It would be interesting to use a similar computational approach to examine the process of ingroup ownership acquisition too. This approach could provide insight not only regarding abstract object ownership but also for more concrete social phenomena, such as how specific traits and characteristics come to be associated with different social ingroups and outgroups.

Implications and applications

The research findings reported in this thesis have implications for both social psychological theory and application to real world group affiliations. Expanding on previous social psychological theory such as social identity theory and its successors including self-categorisation theory, the findings provide

experimental evidence for an overlap between the self and social ingroups, whilst also showing them to be separate and distinct, particularly with relation to their underlying neural substrates. Both social identity theory and self-categorisation theory hold that personal and social identities exist within each individual and that these identities are separate, as expanded upon by Turner's principle of functional antagonism (Turner et al., 1987) but also closely tied together (Tajfel & Turner, 1979). The experimental findings within the present thesis provide empirical evidence to support the notion that the cognitive integration between the self and social ingroups exists not only for identities comprising personality attributes and attitudes, but also for more automatic perceptual prioritisation of self and ingroup information. The differential relationships between biases for the self and social ingroups for established and novel group exemplars also provides insight into the mechanisms that underlie the cognitive integration of the ingroup to the self under different social contexts (i.e., self-stereotyping compared to self-anchoring).

The robust effects of self and ingroup relevance on perceptual processing suggest that social affiliation affects the basic visual construction of how we experience the world. As discussed in Chapter 1, group-related biases in perception have important consequences for intergroup relations. For example, biases in perception that lead to the misidentification of innocuous tools as weapons when carried by Black people (Correll et al., 2002; Correll et al., 2015; Eberhardt et al., 2004) have severe consequences for discriminatory behaviours towards these individuals. While the experiments within this thesis do not examine perceptual biases for stereotypic associations and rather

focussed on cognitive prioritisation effects, they do offer further evidence for the notion that basic perception and visual attention is largely affected by social relevance. Thus, it is important to keep in mind that perception is altered at many levels by group categorisation and it may be of benefit for novel interventions pertaining to intergroup biases to target the perceptual level. As well as informing social psychology of the importance of lower-level perception, this line of research is of use in informing cognitive psychology of the great importance of social factors in shaping perceptual and attentional cognitive processes.

Results from this work may be of interest to several kinds of group and team settings such as military contexts and sports environments. Military units often have to think and act in group-oriented ways, making decisions to best benefit the unit they are working with whilst leaving self-interests aside. Results from the present experiments suggest that prioritisation effects for the self and social groups are fundamental to human cognition. Even in settings that place high importance on the social ingroup, such as within a military unit, self-prioritisation effects are not reduced compared with settings that place more importance on the self, such as within student samples. The capacity for cognitive prioritisation for both the self and social groups is likely to be of benefit within a military context, for which group interests are as important (if not more so) than self interests.

Perhaps of most interest are the findings from Experiments 4 and 6 (and the behavioural results from Experiment 7), showing minimal group affiliation can enhance perceptual prioritisation in the same way as established group

affiliation does. This could be of benefit in planning the 'Future Operating Environment'[40], for which it is expected that future military operations and headquarters will be geographically dispersed because of the utilisation of online connectivity and more advanced technology. 'Group identity' within a military context may change when personnel working together are not located in the same place and communicate entirely through digital means. Understanding the effects of new group affiliations for which there is no knowledge of current or past members may be beneficial in anticipation of this new way of working.

Conclusions

Self- and ingroup-biases in perception are fundamental to human cognition and are stable and robust across many contexts. Taken together, the findings of this thesis suggest that: 1) Whilst self- and ingroup-biases are driven at least in part by distinct processes, there is overlap in the representation of items associated with the self and the ingroup for both established and novel groups. 2) Biases in early perception for ingroup related stimuli are robustly observed regardless of the other social categories included in the task that compete for attention. Specific intergroup dynamics do not modulate performance in early visual perception within this paradigm. 3) Even minimal group allocation can quickly enhance low-level perceptual processing to stimuli that are newly learned and lacking in any obvious social content. However, when in direct competition with more something more meaningful (such as, the self), minimal group affiliation does not have as strong a hold on attentional capture as established groups do.

[40] Explained by technical advisor at the DSTL

4) Individual trait differences in group identification and perceptions of the self are unlikely to underpin the self and ingroup perceptual prioritisation effects. 5) The behavioural advantages for the self and social ingroups are underpinned at least in part by distinct neural mechanisms, however there are also commonalities in patterns demonstrated for self and ingroup processing, along with processing relating to other people and other social groups.

Overall, these key findings provide a novel perspective on the relations between self and ingroup representation in both brain and behaviour by utilising methods that are more typically associated with cognitive psychology and applying them to social psychological questions. The results have implications for social psychological theory and intervention as well as applications to dynamics of group affiliation in organisational settings.

References

Allen, V. L., & Wilder, D. A. (1975). Categorization, belief similarity, and intergroup discrimination. *Journal of Personality and Social Psychology*, *32,* 971-977. https://doi.org/10.1037/0022-3514.32.6.971

Allport GW. 1954. *The Nature of Prejudice.* Reading, MA: Addison-Wesley

Amodio, D. M. (2014). The neuroscience of prejudice and stereotyping. *Nature Reviews Neuroscience*, *15,* 670-682. https://doi.org/10.1038/nrn3800

Amodio, D. M., & Frith, C. D. (2006). Meeting of minds: The medial frontal cortex and social cognition. *Nature Reviews Neuroscience*, *7,* 268-277. https://doi.org/10.1038/nrn1884

Anderson, B. A., Laurent, P. A., & Yantis, S. (2011). Value-driven attentional capture. *Proceedings of the National Academy of Sciences*, *108,* 10367-71. https://doi.org/10.1073/pnas.1104047108

Apps, M. A. J., & Tsakiris, M. (2014). The free-energy self: A predictive coding account of self-recognition. *Neuroscience and Biobehavioral Reviews*, *41,* 85-97. https://doi.org/10.1016/j.neubiorev.2013.01.029

Aron, A., Aron, E. N., & Smollan, D. (1992). Inclusion of Other in the Self Scale and the Structure of Interpersonal Closeness. *Journal of Personality and Social Psychology, 63,* 596-612. https://doi.org/10.1037/0022-3514.63.4.596

Ashburn-Nardo, L., Voils, C. I., & Monteith, M. J. (2001). Implicit associations as the seeds of intergroup bias: How easily do they take root? *Journal of Personality and Social Psychology*, *81,* 789-799. https://doi.org/10.1037/0022-3514.81.5.789

Barnett, V., & Lewis, T. (1978). *Outliers in statistical data.* New York: Wiley.

Baumeister, R. F., Tice, D. M., & Hutton, D. G. (1989). Self-presentational motivations and personality differences in self-esteem. *Journal of*

Personality, *57,* 547-579. https://doi.org/10.1111/j.1467-6494.1989.tb02384.x

Beggan, J. K. (1992). On the social nature of nonsocial perception: The mere ownership effect. *Journal of Personality and Social Psychology*, *62,* 229-237. https://doi.org/10.1037/0022-3514.62.2.229

Bernstein, M. J., Young, S. G., & Hugenberg, K. (2007). The cross-category effect: Mere social categorization is sufficient to elicit an own-group bias in face recognition. *Psychological Science*, *18,* 706-712. https://doi.org/10.1111/j.1467-9280.2007.01964.x

Besta, T., Gómez, A., & Vázquez, A. (2014). Readiness to deny group's wrongdoing and willingness to fight for its members: the role of Poles' identity fusion with the country and religious group. *Current Issues in Personality Psychology, 2,* 49-55.

Billig, M., & Tajfel, H. (1973). Social categorization and similarity in intergroup behaviour. *European Journal of Social Psychology*, *3,* 27-52. https://doi.org/10.1002/ejsp.2420030103

Bishop, S. J. (2008). Neural mechanisms underlying selective attention to threat. *Annals of the New York Academy of Sciences*, *1129,* 141-152. https://doi.org/10.1196/annals.1417.016

Blaine, B., & Crocker, J. (1993). Self-esteem and self-serving biases in reactions to positive and negative events: An integrative review. In R. F. Baumeister (Ed.), *Plenum series in social/clinical psychology. Self-esteem: The puzzle of low self-regard* (pp. 55-85). New York, NY, US: Plenum Press.

Bourhis, Richard, and Andre Gagnon. 2001. Social Orientations in the Minimal Group Paradigm. In R. Brown and S. Gaertner (Eds.) *Intergroup Processes: Blackwell Handbook in Social Psychology, Vol. 4*. (pp. 89-111). Oxford: Blackwell.

Brewer, M. B. (1979). In-group bias in the minimal intergroup situation: A cognitive-motivational analysis. *Psychological Bulletin*, *86,* 307-324. https://doi.org/10.1037/0033-2909.86.2.307

Brewer, M. B. (1991). The social self: On being the same and different at the same time. *Personality and Social Psychology Bulletin*, *17,* 475-482. https://doi.org/10.1177/0146167291175001

Brewer, M. B. (1999). The psychology of prejudice: Ingroup love or outgroup hate? *Journal of Social Issues*, *55,* 429-444. https://doi.org/10.1111/0022-4537.00126

Brewer, M. B., & Gardner, W. (1996). Who is this "we"? Levels of collective identity and self representations. *Journal of Personality and Social Psychology*, *71,* 83-93. https://doi.org/10.1037/0022-3514.71.1.83

Brewer, M. B., & Silver, M. (1978). Ingroup bias as a function of task characteristics. *European Journal of Social Psychology, 8,* 393-400. https://doi.org/10.1002/ejsp.2420080312

Brown, D. E. (1991). *Human universals*. New York, NY: McGraw-Hill.

Brown, R., & Hewstone, M. (2005). An integrative theory of intergroup contact. *Advances in Experimental Social Psychology*, *37,* 255-343. https://doi.org/10.1016/S0065-2601(05)37005-5

Cacioppo, J. T., & Cacioppo, S. (2013). Social neuroscience. *Perspectives on Psychological Science*, *8,* 667-669. https://doi.org/10.1177/1745691613507456

Cacioppo, J. T., Berntson, G. G., & Decety, J. (2010). Social neuroscience and its relationship to social psychology. *Social Cognition*, *28,* 675-685.

Cacioppo, J. T., Berntson, G. G., Sheridan, J. F., & McClintock, M. K. (2000). Multilevel integrative analyses of human behavior: Social neuroscience and the complementing nature of social and biological approaches. *Psychological Bulletin*, *126,* 829-843. https://doi.org/10.1037/0033-2909.126.6.829

Cadinu, M., Latrofa, M., & Carnaghi, A. (2013). Comparing self-stereotyping with in-group-stereotyping and out-group-stereotyping in unequal-status groups: The case of gender. *Self and Identity*, *12,* 582-596.

Cadinu, M. R., & Rothbart, M. (1996). Self-anchoring and differentiation processes in the minimal group setting. *Journal of Personality and Social Psychology*, *70,* 661-677. https://doi.org/10.1037/0022-3514.70.4.661

Capellini, R., Sacchi, S., Ricciardelli, P., & Actis-Grosso, R. (2016). Social threat and motor resonance: When a menacing outgroup delays motor response. *Frontiers in Psychology*, *7*, 1697. https://doi.org/10.3389/fpsyg.2016.01697

Cherry, E. C. (1953). Some experiments on the recognition of speech, with one and with 2 ears. *Journal of the Acoustical Society of America*, *25,* 975-979. https://doi.org/10.1121/1.1907229

Cikara, M., & Van Bavel, J. J. (2014). The neuroscience of intergroup relations: An integrative review. *Perspectives on Psychological Science*, *9,* 245-274. https://doi.org/10.1177/1745691614527464

Coats, S., Smith, E. R., Claypool, H. M., & Banner, M. J. (2000). Overlapping mental representations of self and in-group: Reaction time evidence and its relationship with explicit measures of group identification. *Journal of Experimental Social Psychology*, *36,* 304-315. https://doi.org/10.1006/jesp.1999.1416

Correll, J., & Park, B. (2005). A model of the ingroup as a social resource. *Personality and Social Psychology Review*, *9,* 341-59. https://doi.org/10.1207/s15327957pspr0904_4

Correll, J., Park, B., Judd, C. M., & Wittenbrink, B. (2002). The police officer's dilemma: Using ethnicity to disambiguate potentially threatening individuals. *Journal of Personality and Social Psychology*, *83,* 1314-1329. https://doi.org/10.1037/0022-3514.83.6.1314

Correll, J., Wittenbrink, B., Crawford, M. T., & Sadler, M. S. (2015). Stereotypic vision: How stereotypes disambiguate visual stimuli. *Journal of Personality*

and Social Psychology, *108,* 219-233. https://doi.org/10.1037/pspa0000015

Cunningham, S. J., Turk, D. J., Macdonald, L. M., & Neil Macrae, C. (2008). Yours or mine? Ownership and memory. *Consciousness and Cognition*, *17,* 312-318. https://doi.org/10.1016/j.concog.2007.04.003

Cunningham, W. A., Johnson, M. K., Raye, C. L., Gatenby, J. C., Gore, J. C., & Banaji, M. R. (2004). Separable neural components in the processing of black and white faces. *Psychological Science*, *15,* 806-813. https://doi.org/10.1111/j.0956-7976.2004.00760.x

Decety, J., & Sommerville, J. A. (2003). Shared representations between self and other: A social cognitive neuroscience view. *Trends in Cognitive Sciences*, *7,* 527-33. https://doi.org/10.1016/j.tics.2003.10.004

Devue, C., Belopolsky, A. V., & Theeuwes, J. (2011). The role of fear and expectancies in capture of covert attention by spiders. *Emotion*, *11,* 768-775. https://doi.org/10.1037/a0023418

Diehl, M. (1990). The minimal group paradigm: Theoretical explanations and empirical findings. *European Review of Social Psychology*, *1,* 263-292. https://doi.org/10.1080/14792779108401864

Diener, E., & Diener, C. (1996). Most people are happy. *Psychological Science*, *7,* 181-185. https://doi.org/10.1111/j.1467-9280.1996.tb00354.x

DiQuattro, N. E., & Geng, J. J. (2011). Contextual knowledge configures attentional control networks. *Journal of Neuroscience*, *31,* 18026-18035. https://doi.org/10.1523/JNEUROSCI.4040-11.2011

Drwecki, B. B., Moore, C. F., Ward, S. E., & Prkachin, K. M. (2011). Reducing racial disparities in pain treatment: The role of empathy and perspective-taking. *Pain*, *152*, 1001-1006. https://doi.org/10.1016/j.pain.2010.12.005

Dunbar, R. I. M. (1998). The social brain hypothesis. *Evolutionary Anthropology*, *6,* 178-190. https://doi.org/10.1002/(SICI)1520-6505(1998)6:5<178::AID-EVAN5>3.0.CO;2-8

Eberhardt, J. L., Goff, P. A., Purdie, V. J., & Davies, P. G. (2004). Seeing Black: Race, crime, and visual processing. *Journal of Personality and Social Psychology, 87,* 876-893. https://doi.org/10.1037/0022-3514.87.6.876

Farnham, S. D., Greenwald, A. G., & Banaji, M. R. (1999). Implicit self-esteem. In D. Abrams & M. A. Hogg (Eds.), *Social identity and social cognition* (pp. 230-248). Malden: Blackwell Publishing.

Fasig, L. G. (2000). Toddlers' understanding of ownership: Implications for self-concept development. *Social Development*, *9,* 370-382. https://doi.org/10.1111/1467-9507.00131

Fennell, M. J. V. (1997). Low self-esteem: A cognitive perspective. *Behavioural and Cognitive Psychotherapy*, *25,* 1-25. https://doi.org/10.1017/S1352465800015368

Gaertner, L., & Insko, C. A. (2000). Intergroup discrimination in the minimal group paradigm: Categorization, reciprocation, or fear? *Journal of Personality and Social Psychology*, *79,* 77-94. https://doi.org/10.1037/0022-3514.79.1.77

Gardner, W. L., Gabriel, S., & Lee, A. Y. (1999). "I" value freedom, but "we" value relationships: Self-construal priming mirrors cultural differences in judgment. *Psychological Science*, *10,* 321-326. https://doi.org/10.1111/1467-9280.00162

Gertler, B. (2011). *Self-Knowledge*. London: Routledge.

Golby, A. J., Gabrieli, J. D. E., Chiao, J. Y., & Eberhardt, J. L. (2001). Differential responses in the fusiform region to same-race and other-race faces. *Nature Neuroscience*, *4,* 845-850. https://doi.org/10.1038/90565

Golubickis, M., Falben, J. K., Cunningham, W. A., & Neil Macrae, C. (2018). Exploring the self-ownership effect: Separating stimulus and response biases. *Journal of Experimental Psychology: Learning Memory and Cognition*, *44,* 295-306. https://doi.org/10.1037/xlm0000455

Gómez, Á., Brooks, M. L., Buhrmester, M. D., Vázquez, A., Jetten, J., & Swann, W. B. (2011). On the nature of identity fusion: Insights into the construct

and a new measure. *Journal of Personality and Social Psychology*, *100,* 918-33. https://doi.org/10.1037/a0022642

Gómez, Á., Morales, J. F., Hart, S., Vázquez, A., & Swann, W. B. (2011). Rejected and excluded forevermore, but even more devoted: Irrevocable ostracism intensifies loyalty to the group among identity-fused persons. *Personality and Social Psychology Bulletin*, *37,* 1574-1586. https://doi.org/10.1177/0146167211424580

Gómez, Á., & Vázquez, A. (2015). The power of 'feeling one' with a group: identity fusion and extreme pro-group behaviours *International Journal of Social Psychology, 30*, 481-511. https://doi.org/10.1080/02134748.2015.1065089

Gramzow, R. H., & Gaertner, L. (2005). Self-esteem and favoritism toward novel in-groups: The self as an evaluative base. *Journal of Personality and Social Psychology*, *88,* 801-815. https://doi.org/10.1037/0022-3514.88.5.801

Green, D. M., & Swets, J. A. (1966). *Signal detection theory and psychophysics*. *New York Wiley*. https://doi.org/10.1901/jeab.1969.12-475

Greenwald, A. G., & Farnham, S. D. (2000). Using the implicit association test to measure self-esteem and self-concept. *Jounal of Personality and Social Psychology*, *79,* 1022-1038. https://doi.org/10.1037//0022-3514.79.6.I022

Greenwald, A. G., McGhee, D. E., & Schwartz, J. L. (1998). Measuring individual differences in implicit cognition: the implicit association test. *Journal of Personality and Social Psychology*, *74,* 1464-1480. https://doi.org/10.1037/0022-3514.74.6.1464

Gusnard, D. A., Akbudak, E., Shulman, G. L., & Raichle, M. E. (2001). Medial prefrontal cortex and self-referential mental activity: Relation to a default mode of brain function. *Proceedings of the National Academy of Sciences*, *98*, 4259-4264. https://doi.org/10.1073/pnas.071043098

Hart, A. J., Whalen, P. J., Shin, L. M., McInerney, S. C., Fischer, H., & Rauch, S. L. (2000). Differential response in the human amygdala to racial

outgroup vs ingroup face stimuli. *NeuroReport*, *11,* 2351-5. https://doi.org/10.1097/00001756-200008030-00004

Harter, S. (1993). Causes and consequences of low self-esteem in children and adolescents. In R. F. Baumeister (Ed.), *Plenum series in social/clinical psychology. Self-esteem: The puzzle of low self-regard* (pp. 87-116). New York, NY, US: Plenum Press.

Heider, F. (1958). *The psychology of interpersonal relations.* New York: Wiley.

Heider, F. (1976). A conversation with Fritz Heider. In J. H. Harvey, W. J. Ickes, & R. F. Kidd (Eds.) *New directions in attribution research* (Vol. 1, pp. 47–61). Hillsdale, NJ: Erlbaum.

Heine, S. J., Markus, H. R., Lehman, D. R., & Kitayana, S. (1999). Is there a universal need for positive self-regard? *Psychological Review*, 106, *766-94*. https://doi.org/10.1037/0033-295X.106.4.766

Hewstone, M. (1990). The 'ultimate attribution error'? A review of the literature on intergroup causal attribution. *European Journal of Social Psychology*. https://doi.org/10.1002/ejsp.2420200404

Hewstone, M., Rubin, M., & Willis, H. (2002). Intergroup bias. *Annual Review of Psychology*, *20*, 311-335. https://doi.org/10.1146/annurev.psych.53.100901.135109

Hinkle, S., & Brown, R. J. (1990). Intergroup comparisons and social identity. In D. Abrams, & M. A. Hogg (Eds.), *Social identity theory: Constructive and critical advances* (pp. 48-70). New York: Springer Verlag.

Hogg, M. A., & Turner, J. C. (1987). Intergroup behaviour, self-stereotyping and the salience of social categories. *British Journal of Social Psychology*, *26,* 325-340. https://doi.org/10.1111/j.2044-8309.1987.tb00795.x

Hoorens, V., Nuttin, J. M., Herman, I. E., & Pavakanun, U. (1990). Mastery pleasure versus mere ownership: A quasi-experimental cross-cultural and cross-alphabetical test of the name letter effect. *European Journal of Social Psychology*, *20,* 181-205. https://doi.org/10.1002/ejsp.2420200302

Hu, C., Di, X., Eickhoff, S. B., Zhang, M., Peng, K., Guo, H., & Sui, J. (2016). Distinct and common aspects of physical and psychological self-representation in the brain: A meta-analysis of self-bias in facial and self-referential judgements. *Neuroscience and Biobehavioral Reviews, 61,* 197-207. https://doi.org/10.1016/j.neubiorev.2015.12.003

Hugenberg, K., Young, S. G., Bernstein, M. J., & Sacco, D. F. (2010). The categorization-individuation model: An integrative account of the other-race recognition deficit. *Psychological Review*, *117*, 1168–1187. https://doi.org/10.1037/a0020463

Humphreys, G. W., & Sui, J. (2016). Attentional control and the self: The Self-Attention Network (SAN). *Cognitive Neuroscience*, *7,* 5-17. https://doi.org/10.1080/17588928.2015.1044427

Johnson, J. D., Simmons, C. H., Jordan, A., MacLean, L., Taddei, J., Thomas, D., & Reed, W. (2002). Rodney King and O. J. revisited: The impact of race and defendant empathy induction on judicial decisions. *Journal of Applied Social Psychology, 32*, 1208-1223. http://dx.doi.org/10.1111/j.1559-1816.2002.tb01432.x

Jones, J. T., Pelham, B. W., Carvallo, M., & Mirenberg, M. C. (2004). How do I love thee? Let me count the Js: Implicit egotism and interpersonal attraction. *Journal of Personality and Social Psychology*, *87,* 665-83. https://doi.org/10.1037/0022-3514.87.5.665

Jones, J. T., Pelham, B. W., Mirenberg, M. C., & Hetts, J. J. (2002). Name letter preferences are not merely mere exposure: Implicit egotism as self-regulation. *Journal of Experimental Social Psychology*, *38*, 170–177. https://doi.org/10.1006/JESP.2001.1497

Kahneman, D., Knetsch, J. L., & Thaler, R. H. (1991). Anomalies: The endowment effect, loss aversion, and status quo bias. *Journal of Economic Perspectives*, *5,* 193-206. https://doi.org/10.1257/jep.5.1.193

Kawakami, K., Williams, A., Sidhu, D., Choma, B. L., Rodriguez-Bailón, R., Cañadas, E., …Hugenberg, K. (2014). An eye for the I: Preferential

attention to the eyes of ingroup members. *Journal of Personality and Social Psychology*, *107,* 1-20. https://doi.org/10.1037/a0036838

Kelley, A. W. M., Macrae, C. N., Wyland, C. L., Caglar, S., Inati, S., & Heatherton, T. F. (2002). Finding the self? An event-related fMRI study. *Journal of Cognitive Neuroscience*, *14,* 785-94. https://doi.org/10.1162/08989290260138672

Keyes, H., & Brady, N. (2010). Self-face recognition is characterized by "bilateral gain" and by faster, more accurate performance which persists when faces are inverted. *Quarterly Journal of Experimental Psychology*, *63,* 840-7. https://doi.org/10.1080/17470211003611264

Kihlstrom, J. F., Beer, J. S., & Klein, S. B. (2002). Self and identity as memory. In M. R. Leary, & J. Tangney (Eds.), *Handbook of self and identity* (pp. 68–90). New York: Guilford Press.

Kircher, T. T. J., Senior, C., Phillips, M. L., Benson, P. J., Bullmore, E. T., Brammer, M., …David, A. S. (2000). Towards a functional neuroanatomy of self processing: Effects of faces and words. *Cognitive Brain Research*, *10,* 133-144. https://doi.org/10.1016/S0926-6410(00)00036-7

Kitayama, S., & Karasawa, M. (1997). Implicit self-esteem in Japan: Name letters and birthday numbers. *Personality and Social Psychology Bulletin*, *23*, 736-742. https://doi.org/10.1177/0146167297237006

Knetsch, J. L. (1989). The endowment effect and evidence of nonreversible indifference curves. *The American Economic Review*, *79*, 1277-1284. https://doi.org/10.2307/1831454

Knetsch, J. L., & Sinden, J. A. (1984). Willingness to pay and compensation demanded: Experimental evidence of an unexpected disparity in measures of value. *The Quarterly Journal of Economics*, *99,* 507-521. https://doi.org/10.2307/1885962

Koster, E. H. W., Crombez, G., Van Damme, S., Verschuere, B., & De Houwer, J. (2004). Does imminent threat capture and hold attention? *Emotion*, *4,* 312-317. https://doi.org/10.1037/1528-3542.4.3.312

Kuiper, N. A. (1978). Depression and causal attributions for success and failure. *Journal of Personality and Social Psychology*, *36,* 236-46. https://doi.org/10.1037/0022-3514.36.3.236

Latrofa, M., Vaes, J., Cadinu, M., & Carnaghi, A. (2010). The cognitive representation of self-stereotyping. *Personality and Social Psychology Bulletin*, *36,* 911-22. https://doi.org/10.1177/0146167210373907

Launay, J., Tarr, B., & Dunbar, R. I. M. (2016). Synchrony as an adaptive mechanism for large-scale human social bonding. *Ethology*, *122,* 779-789. https://doi.org/10.1111/eth.12528

Leach, C. W., van Zomeren, M., Zebel, S., Vliek, M. L. W., Pennekamp, S. F., Doosje, B., …Spears, R. (2008). Group-level self-definition and self-investment: A hierarchical (multicomponent) model of in-Group identification. *Journal of Personality and Social Psychology*, *95*, 144-65. https://doi.org/10.1037/0022-3514.95.1.144

LeDoux, J. E. (1996). *The emotional brain: The mysterious underpinnings of emotional life.* New York, NY, US: Simon & Schuster.

Lee, Y. T., & Seligman, M. E. P. (1997). Are Americans more optimistic than the Chinese? *Personality and Social Psychology Bulletin*, *23*, 32-40. https://doi.org/10.1177/0146167297231004

Legrand, D., & Ruby, P. (2009). What Is self-specific? Theoretical investigation and critical review of neuroimaging results. *Psychological Review*, *116,* 252-82. https://doi.org/10.1037/a0014172

Leyens, J.-P., Paladino, P. M., Rodriguez-Torres, R., Vaes, J., Demoulin, S., Rodriguez-Perez, A., & Gaunt, R. (2000). The emotional side of prejudice: The attribution of secondary emotions to ingroups and outgroups. *Personality and Social Psychology Review*, *4*, 186-197. https://doi.org/10.1207/S15327957PSPR0402_06

Lieberman, M. D., Hariri, A., Jarcho, J. M., Eisenberger, N. I., & Bookheimer, S. Y. (2005). An fMRI investigation of race-related amygdala activity in

African-American and Caucasian-American individuals. *Nature Neuroscience*, *8,* 720-2. https://doi.org/10.1038/nn1465

Locksley, A., Ortiz, V., & Hepburn, C. (1980). Social categorization and discriminatory behavior: Extinguishing the minimal intergroup discrimination effect. *Journal of Personality and Social Psychology*, *39*, 773-783. https://doi.org/10.1037/0022-3514.39.5.773

Lovie, P.(1986). Identifying outliers. In A. D. Lovie (Ed.), *New developments in statistics for psychology and the social sciences* (pp. 44-69). British Psychological Society: London.

Macmillan, N. A. (1993). Signal detection theory as data analysis method and psychological decision model. In G. Keren & C. Lewis (Eds.), *A handbook for data analysis in the behavioral sciences: Methodological issues* (pp. 21-57). Hillsdale, NJ, US: Lawrence Erlbaum Associates, Inc.

MacRae, C. N., Heatherton, T. F., & Kelley, W. M. (2004). A self less ordinary: The medial prefrontal cortex and you. In M.S. Gazzaniga (Ed.) *The Cognitive Neurosciences (3rd Editions)* (pp. 1067-1075). Cambridge:MIT Press.

Macrae, C. N., Visokomogilski, A., Golubickis, M., Cunningham, W. A., & Sahraie, A. (2017). Self-relevance prioritizes access to visual awareness. *Journal of Experimental Psychology: Human Perception and Performance*, *43,* 438-443. https://doi.org/10.1037/xhp0000361

Macrae, C. N., Visokomogilski, A., Golubickis, M., & Sahraie, A. (2018). Self-relevance enhances the benefits of attention on perception. *Visual Cognition*. https://doi.org/10.1080/13506285.2018.1498421

Malpass, R. S., & Kravitz, J. (1969). Recognition for faces of own and other race. *Journal of Personality and Social Psychology*, *13*, 330-334. https://doi.org/10.1037/h0028434

Maner, J. K., Kenrick, D. T., Backer, D. V., Robertson, T. E., Hofer, B., Neuberg, S. L., … Schaller, M. (2005). Functional projection: How fundamental social motives can bias interpersonal perception. *Journal of Personality*

and Social Psychology, *88,* 63-78. https://doi.org/10.1037/0022-3514.88.1.63

Markus, H. R., & Kitayama, S. (1991). Culture and the self: Implications for cognition, emotion, and motivation. *Psychological Review*, *98,* 224-253. https://doi.org/10.1037/0033-295X.98.2.224

Marr, D. (1982). V*ision: A computational investigation into the human representation and processing of visual information.* New York, NY: W. H. Freeman.

McClelland, J. L., & Rumelhart, D. E. (1981). An interactive activation model of context effects in letter perception: I. An account of basic findings. *Psychological Review*, *88*, 375-407. https://doi.org/10.1037/0033-295X.88.5.375

McConnell, A. R. (2011). The multiple self-aspects framework: Self-concept representation and its implications. *Personality and Social Psychology Review*, *15,* 3-27. https://doi.org/10.1177/1088868310371101

Meissner, C. A., & Brigham, J. C. (2001). Thirty years of investigating the own-race bias in memory for faces: A meta-analytic review. *Psychology, Public Policy, and Law*, *7*, 3-35. https://doi.org/10.1037/1076-8971.7.1.3

Mezulis, A. H., Abramson, L. Y., Hyde, J. S., & Hankin, B. L. (2004). Is there a universal positivity bias in attributions? *Psychological Bulletin*, *130,* 711-47. https://doi.org/10.1037/0033-2909.130.5.711

Moradi, Z. Z., Manohar, S., Duta, M., Enock, F., & Humphreys, G. W. (2018). In-group biases and oculomotor responses: beyond simple approach motivation. *Experimental Brain Research*, *236*, 1347-1355. https://doi.org/10.1007/s00221-018-5221-7

Moradi, Z., Duta, M., Hewstone, M., Yankouskaya, A., Enock, F., & Humphreys, G. W. (2017a). The rival doesn't catch my eyes: In-group relevance modulates inhibitory control over anti-saccades. *Visual Cognition*, *25,* 366-380. https://doi.org/10.1080/13506285.2017.1310163

Moradi, Z., Mantini, D., Yankouskaya, A., Hewstone, M., & Humphreys, G. W. (2017b). Changes in intrinsic functional connectivity and group relevant salience: The case of sport rivalry. *Behavioural Brain Research*, *332,* 126-135. https://doi.org/10.1016/j.bbr.2017.04.045

Moradi, Z., Sui, J., Hewstone, M., & Humphreys, G. W. (2015). In-group modulation of perceptual matching. *Psychonomic Bulletin and Review*, *22,* 1255-1277. https://doi.org/10.3758/s13423-014-0798-8

Mullen, B., Brown, R., & Smith, C. (1992). Ingroup bias as a function of salience, relevance, and status: An integration. *European Journal of Social Psychology*, *2,* 103-122. https://doi.org/10.1002/ejsp.2420220202

Mummendey, A., & Otten, S. (1998). Positive–negative asymmetry in social discrimination. *European Review of Social Psychology*, *9,* 107-143. https://doi.org/10.1080/14792779843000063

Mummendey, A., Simon, B., Dietze, C., Grünert, M., Haeger, G., Kessler, S., … Schäferhoff, S. (1992). Categorization is not enough: Intergroup discrimination in negative outcome allocation. *Journal of Experimental Social Psychology, 28*, 125-144. https://doi.org/10.1016/0022-1031(92)90035-I

Musholt, K. (2013). A philosophical perspective on the relation between cortical midline structures and the self. *Frontiers in Human Neuroscience*, 7, 536. https://doi.org/10.3389/fnhum.2013.00536

Neubert, F.-X., Mars, R. B., Sallet, J., & Rushworth, M. F. S. (2015). Connectivity reveals relationship of brain areas for reward-guided learning and decision making in human and monkey frontal cortex. *Proceedings of the National Academy of Sciences of the United States of America*, *12,* E2695-704. https://doi.org/10.1073/pnas.1410767112

Northoff, G., & Hayes, D. J. (2011). Is our self nothing but reward? *Biological Psychiatry*, *69,* 1019-2. https://doi.org/10.1016/j.biopsych.2010.12.014

Northoff, G., Heinzel, A., de Greck, M., Bermpohl, F., Dobrowolny, H., & Panksepp, J. (2006). Self-referential processing in our brain -- A meta-

analysis of imaging studies on the self. *NeuroImage*, *31,* 440-57. https://doi.org/10.1016/j.neuroimage.2005.12.002

Nosek, B. A., Greenwald, A. G., & Banaji, M. R. (2007). The Implicit Association Test at Age 7: A Methodological and Conceptual Review. In J. A. Bargh (Ed.), *Frontiers of social psychology. Social psychology and the unconscious: The automaticity of higher mental processes* (pp. 265-292). New York, NY, US: Psychology Press.

Notebaert, L., Crombez, G., Van Damme, S., De Houwer, J., & Theeuwes, J. (2011). Signals of threat do not capture, but prioritize, attention: A conditioning approach. *Emotion*, *11,* 81-89. https://doi.org/10.1037/a0021286

Nuttin, J. M. (1985). Narcissism beyond gestalt and awareness: The name letter effect. *European Journal of Social Psychology*, *5*, 353-361. https://doi.org/10.1002/ejsp.2420150309

Ochsner, K. N., Beer, J. S., Robertson, E. R., Cooper, J. C., Gabrieli, J. D. E., Kihsltrom, J. F., & D'Esposito, M. (2005). The neural correlates of direct and reflected self-knowledge, *28,* 797-814. *NeuroImage*. https://doi.org/10.1016/j.neuroimage.2005.06.069

Öhman, A., Flykt, A., & Esteves, F. (2001). Emotion drives attention: Detecting the snake in the grass. *Journal of Experimental Psychology: General*, *130,* 466-78. https://doi.org/10.1037/0096-3445.130.3.466

Onorato, R., & Turner, J. (2004). Fluidity in the self concept: the shift from personal to social identity, *European Journal of Social Psychology*, *34,* 257-278. https://doi.org/10.1002/ejsp.195

Otten, S. (2004). Self-anchoring as predictor of in-group favoritism: Is it applicable to real group contexts? *Current Psychology of Cognition, 22*, 427-443.

Otten, S., & Epstude, K. (2006). Overlapping mental representations of self, ingroup, and outgroup: Unraveling self-stereotyping and self-anchoring.

Personality and Social Psychology Bulletin, 32, 957-69. https://doi.org/10.1177/0146167206287254

Otten, S., & Moskowitz, G. B. (2000). Evidence for implicit evaluative in-group bias: Affect-biased spontaneous trait inference in a minimal group paradigm. *Journal of Experimental Social Psychology, 36,* 77-89. https://doi.org/10.1006/jesp.1999.1399

Otten, S., & Wentura, D. (1999). About the impact of automaticity in the minimal group paradigm: Evidence from affective priming tasks. *European Journal of Social Psychology, 29,* 1049-1071. https://doi.org/10.1002/(SICI)1099-0992(199912)29:8<1049::AID-EJSP985>3.0.CO;2-Q

Otten, S., & Wentura, D. (2001). Self-anchoring and in-group favoritism: An individual profiles analysis. *Journal of Experimental Social Psychology*, *37*, 525-532. https://doi.org/10.1006/jesp.2001.1479

Paladino, M.-P., Leyens, J.-P., Rodriguez, R., Rodriguez, A., Gaunt, R., & Demoulin, S. (2002). Differential association of uniquely and non uniquely human emotions with the ingroup and the outgroup. *Group Processes & Intergroup Relations*, *5*, 105-117. https://doi.org/10.1177/1368430202005002539

Paris, W. D., Budapest, G. C., Konstanz, H. D. D., Bristol, C. G., Oregon, K. L., & Stirling, A. O. (1972). An experimental investigation into the formation of intergroup representations. *European Journal of Social Psychology*, *2*, 202-204. https://doi.org/10.1002/ejsp.2420020208

Payne, B. K. (2001). Prejudice and perception: The role of automatic and controlled processes in misperceiving a weapon. *Journal of Personality and Social Psychology*, *81,* 181-92. https://doi.org/10.1037/0022-3514.81.2.181

Pelham, B. W., Carvallo, M., & Jones, J. T. (2005). Implicit egotism. *Current Directions in Psychological Science, 14,* 106-110. https://doi.org/10.1111/j.0963-7214.2005.00344.x

Pelham, B. W., Mirenberg, M. C., & Jones, J. T. (2002). Why Susie sells seashells by the seashore: Implicit egotism and major life decisions. *Journal of Personality and Social Psychology*, *82,* 469-487. https://doi.org/10.1037/0022-3514.82.4.469

Perdue, C. W., Dovidio, J. F., Gurtman, M. B., & Tyler, R. B. (1990). Us and them: Social categorization and the process of intergroup bias. *Journal of Personality and Social Psychology*, *59*, 475-486. https://doi.org/10.1037/0022-3514.59.3.475

Peterson, C., & Seligman, M. E. P. (1987). Explanatory style and illness. *Journal of Personality*, *55,* 237-265. https://doi.org/10.1111/j.1467-6494.1987.tb00436.x

Pettigrew, T. F. (1998). Intergroup contact theory. *Annual Review of Psychology, 49,* 65-85. https://doi.org/10.1146/annurev.psych.49.1.65

Phelps, E. A., Ling, S., & Carrasco, M. (2006). Emotion facilitates perception and potentiates the perceptual benefits of attention. *Psychological Science*, *17,* 292-299. https://doi.org/10.1111/j.1467-9280.2006.01701.x

Platek, S. M., Keenan, J. P., Gallup, G. G., & Mohamed, F. B. (2004). Where am I? The neurological correlates of self and other. *Cognitive Brain Research*, *19,* 114-12. https://doi.org/10.1016/j.cogbrainres.2003.11.014

Rabbie, J. M., & Horwitz, M. (1969). Arousal of ingroup-outgroup bias by a chance win or loss. *Journal of Personality and Social Psychology*, *13,* 269-277. https://doi.org/10.1037/h0028284

Ratcliff, R. (1985). Theoretical interpretations of the speed and accuracy of positive and negative responses. *Psychological Review*, *92,* 212-25. https://doi.org/10.1037/0033-295X.92.2.212

Ratcliff, R. (1993). Methods for dealing with reaction time outliers. *Psychological Bulletin*, *114,* 510-532. https://doi.org/10.1037/0033-2909.114.3.510

Ratner, K. G., & Amodio, D. M. (2013). Seeing “us vs. them”: Minimal group effects on the neural encoding of faces. *Journal of Experimental Social Psychology*, *49,* 298-301. https://doi.org/10.1016/j.jesp.2012.10.017

Ratner, K. G., Dotsch, R., Wigboldus, D. H. J., van Knippenberg, A., & Amodio, D. M. (2014). Visualizing minimal ingroup and outgroup faces: Implications for impressions, attitudes, and behavior. *Journal of Personality and Social Psychology*, *106*, 897–911. https://doi.org/10.1037/a0036498

Richeson, J. A., Baird, A. A., Gordon, H. L., Heatherton, T. F., Wyland, C. L., Trawalter, S., & Shelton, J. N. (2003). An fMRI investigation of the impact of interracial contact on executive function. *Nature Neuroscience*, *6,* 1323-8. https://doi.org/10.1038/nn1156

Robbins, J. M., & Krueger, J. I. (2005). Social projection to ingroups and outgroups: A review and meta-analysis. *Personality and Social Psychology Review*, *9,* 32-47. https://doi.org/10.1207/s15327957pspr0901_3

Rogers, T. B., Kuiper, N. A., & Kirker, W. S. (1977). Self-reference and the encoding of personal information. *Journal of Personality and Social Psychology*, *35,* 677–688. https://doi.org/10.1037/0022-3514.35.9.677

Ronquillo, J., Denson, T. F., Lickel, B., Lu, Z. L., Nandy, A., & Maddox, K. B. (2007). The effects of skin tone on race-related amygdala activity: An fMRI investigation. *Social Cognitive and Affective Neuroscience*, *2,* 39-44. https://doi.org/10.1093/scan/nsl043

Rosenberg, M. (1965). *Society and the adolescent self*. *New York*. https://doi.org//S0034-98872009000600009

Ruff, C. C., & Fehr, E. (2014). The neurobiology of rewards and values in social decision making. *Nature Reviews Neuroscience*, *15,* 549-562. https://doi.org/10.1038/nrn3776

Rule, N. O., Garrett, J. V., & Ambady, N. (2010). On the perception of religious group membership from faces. *PLoS ONE*. https://doi.org/10.1371/journal.pone.0014241

Sartre, Jean-Paul. *Being and Nothingness* (trans. Hazel E. Barnes). New York: Washington Square Press, 1956.

Scheepers, D., Derks, B., Nieuwenhuis, S., Lelieveld, G.-J., Van Nunspeet, F., Rombouts, S. A. R. B., & de Rover, M. (2013). The neural correlates of in-

group and self-face perception: is there overlap for high identifiers? *Frontiers in Human Neuroscience*, *7,* 528. https://doi.org/10.3389/fnhum.2013.00528

Schmidt, L. J., Belopolsky, A. V., & Theeuwes, J. (2012). The presence of threat affects saccade trajectories. *Visual Cognition*, *20,* 284-299. https://doi.org/10.1080/13506285.2012.658885

Schmidt, L. J., Belopolsky, A. V., & Theeuwes, J. (2015). Attentional capture by signals of threat. *Cognition and Emotion*, *29,* 687-694. https://doi.org/10.1080/02699931.2014.924484

Schupp, H. T., Junghöfer, M., Weike, A. I., & Hamm, A. O. (2003). Emotional facilitation of sensory processing in the visual cortex. *Psychological Science : A Journal of the American Psychological Society, 14,* 7-13. https://doi.org/10.1111/1467-9280.01411

Shankar, S., Stevenson, C., Pandey, K., Tewari, S., Hopkins, N. P., & Reicher, S. D. (2013). A calming cacophony: Social identity can shape the experience of loud noise. *Journal of Environmental Psychology*, *36,* 87-95. https://doi.org/10.1016/j.jenvp.2013.07.004

Sheng, F., & Han, S. (2012). Manipulations of cognitive strategies and intergroup relationships reduce the racial bias in empathic neural responses. *NeuroImage*, *61,* 786-97. https://doi.org/10.1016/j.neuroimage.2012.04.028

Shriver, E. R., Young, S. G., Hugenberg, K., Bernstein, M. J., & Lanter, J. R. (2008). Class, race, and the face: Social context modulates the cross-race effect in face recognition. *Personality and Social Psychology Bulletin*, *34,* 260-74. https://doi.org/10.1177/0146167207310455

Singelis, T. M. (1994). The measurement of independent and interdependent self-construals. *Personality and Social Psychology Bulletin*, *20*, 580-591. https://doi.org/10.1177/0146167294205014

Smith, E. R., Coats, S., & Walling, D. (1999). Overlapping mental representations of self, in-group, and partner: Further response time

evidence and a connectionist model. *Personality and Social Psychology Bulletin*, *25,* 873-882. https://doi.org/10.1177/0146167299025007009

Smith, E. R., & Henry, S. (1996). An in-group becomes part of the self: Response time evidence. *Personality and Social Psychology Bulletin*, *22,* 635-642. https://doi.org/10.1177/0146167296226008

Sparks, S., Cunningham, S. J., & Kritikos, A. (2016). Culture modulates implicit ownership-induced self-bias in memory. *Cognition*, *153,* 89-98. https://doi.org/10.1016/j.cognition.2016.05.003

Stolte, M., Humphreys, G., Yankouskaya, A., & Sui, J. (2017). Dissociating biases towards the self and positive emotion. *Quarterly Journal of Experimental Psychology*, *70,* 1011-1022. https://doi.org/10.1080/17470218.2015.1101477

Stroop, J. R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology, 18,* 643-662.

Sui, J., Enock, F., Ralph, J., & Humphreys, G. W. (2015). Dissociating hyper and hypoself biases to a core self-representation. *Cortex*, *70*, 202-12. https://doi.org/10.1016/j.cortex.2015.04.024

Sui, J., He, X., & Humphreys, G. W. (2012). Perceptual effects of social salience: Evidence from self-prioritization effects on perceptual matching. *Journal of Experimental Psychology: Human Perception and Performance*, *38,* 1105-17. https://doi.org/10.1037/a0029792

Sui, J., & Humphreys, G. W. (2015). The interaction between self-bias and reward: Evidence for common and distinct processes. *Quarterly Journal of Experimental Psychology*, *68,* 1952-64. https://doi.org/10.1080/17470218.2015.1023207

Sui, J., Liu, C. H., & Han, S. (2009). Cultural difference in neural mechanisms of self-recognition, *4,* 402-11. *Social Neuroscience*. https://doi.org/10.1080/17470910802674825

Sui, J., Liu, M., Mevorach, C., & Humphreys, G. W. (2015). The salient self: The left intraparietal sulcus responds to social as well as perceptual-salience

after self-association. *Cerebral Cortex*, *25*, 1060-1068. https://doi.org/10.1093/cercor/bht302

Sui, J., Rotshtein, P., & Humphreys, G. W. (2013). Coupling social attention to the self forms a network for personal significance. *Proceedings of the National Academy of Sciences*, *110,* 7607-12. https://doi.org/10.1073/pnas.1221862110

Sui, J., Sun, Y., Peng, K., & Humphreys, G. W. (2014). The automatic and the expected self: Separating self- and familiarity biases effects by manipulating stimulus probability. *Attention, Perception, and Psychophysics, 76,* 1176-84. https://doi.org/10.3758/s13414-014-0631-5

Sui, J., Zhu, Y., & Han, S. (2006). Self-face recognition in attended and unattended conditions: An event-related brain potential study. *NeuroReport*, *17,* 423-7. https://doi.org/10.1097/01.wnr.0000203357.65190.61

Sumner, W. G. (1906). *Folkways.* New York: Ginn.

Swann, W. B., Buhrmester, M. D., Gómez, A., Jetten, J., Bastian, B., Vázquez, A., … Zhang, A. (2014). What makes a group worth dying for? Identity fusion fosters perception of familial ties, promoting self-sacrifice. *Journal of Personality and Social Psychology*, *106,* 912-26. https://doi.org/10.1037/a0036089

Swann, W. B., Gómez, Á., Dovidio, J. F., Hart, S., & Jetten, J. (2010). Dying and killing for one's group: Identity fusion moderates responses to intergroup versions of the trolley problem. *Psychological Science, 21,* 1176-83. https://doi.org/10.1177/0956797610376656

Swann, W. B., Gómez, Á., Seyle, D. C., Morales, J. F., & Huici, C. (2009). Identity Fusion: The Interplay of personal and social in extreme group behavior. *Journal of Personality and Social Psychology*, *96,* 995-1011. https://doi.org/10.1037/a0013668

Swann, W. B., Jetten, J., Gómez, Ã., Whitehouse, H., & Bastian, B. (2012). When group membership gets personal: A theory of identity fusion. *Psychological Review*, *119,* 441-56. https://doi.org/10.1037/a0028589

Sweeney, P. D., Anderson, K., & Bailey, S. (1986). Attributional style in depression. A meta-analytic review. *Journal of Personality and Social Psychology*, *50,* 974-91. https://doi.org/10.1037/0022-3514.50.5.974

Symons, C. S., & Johnson, B. T. (1997). The self-reference effect in memory: A meta-analysis. *Psychological Bulletin*, *121*, 371-394. https://doi.org/10.1037/0033-2909.121.3.371

Tajfel, H. (1970). Experiments in intergroup discrimination. *Scientific American*, *223,* 96-102. https://doi.org/10.1038/scientificamerican1170-96

Tajfel, H. (1982). Social psychology of intergroup relations. *Annual Review of Psychology*, *33,* 1-39. https://doi.org/10.1146/annurev.ps.33.020182.000245

Tajfel, H., & Billic, M. (1974). Familiarity and categorization in intergroup behavior. *Journal of Experimental Social Psychology*, *10,* 159-170. https://doi.org/10.1016/0022-1031(74)90064-X

Tajfel, H., & Turner, J. C. (1979). An integrative theory of intergroup conflict. In W. G. Austin, & S. Worchel (Eds.), *The social psychology of intergroup relations* (pp. 33-37). Monterey, CA: Brooks/Cole.

Tajfel, H., Billig, M. G., Bundy, R. P., & Flament, C. (1971). Social categorization and intergroup behaviour. *European Journal of Social Psychology*, *1,* 149-178. https://doi.org/10.1002/ejsp.2420010202

Tarr, B., Launay, J., & Dunbar, R. I. M. (2016). Silent disco: dancing in synchrony leads to elevated pain thresholds and social closeness. *Evolution and Human Behavior*, *37,* 343-349. https://doi.org/10.1016/j.evolhumbehav.2016.02.004

Tarrant, M., Dazeley, S., & Cottom, T. (2009). Social categorization and empathy for outgroup members. *British Journal of Social Psychology*, *48,* 427-46. https://doi.org/10.1348/014466608X373589

Taylor, S. E., & Brown, J. D. (1994). Positive illusions and well-being revisited: separating fact from fiction. *Psychological Bulletin*, *116,* 21-7. https://doi.org/10.1037/0033-2909.116.1.28

Taylor, S. E., Klein, L. C., Lewis, B. P., Gruenewald, T. L., Gurung, R. A. R., & Updegraff, J. A. (2000). Biobehavioral responses to stress in females: tend-and-befriend, not fight-or-flight. *Psychological Review*, *107,* 411-29. https://doi.org/10.1037/0033-295X.107.3.411

Tiger, L. (1979). *Optimism: The biology of hope*. New York: Simon & Schuster.

Todorov, A. (2012). The role of the amygdala in face perception and evaluation. *Motivation and Emotion*, *36,* 16-26. https://doi.org/10.1007/s11031-011-9238-5

Tong, F., & Nakayama, K. (1999). Robust representations for faces: Evidence from visual search. *Journal of Experimental Psychology: Human Perception and Performance*, *25,* 1016-35. https://doi.org/10.1037/0096-1523.25.4.1016

Trafimow, D., Triandis, H. C., & Goto, S. G. (1991). Some tests of the distinction between the private self and the collective self. *Journal of Personality and Social Psychology, 60,* 649-655. https://doi.org/10.1037/0022-3514.60.5.649

Trawalter, S., Todd, A. R., Baird, A. A., & Richeson, J. A. (2008). Attending to threat: Race-based patterns of selective attention. *Journal of Experimental Social Psychology*, *44,* 1322-1327. https://doi.org/10.1016/j.jesp.2008.03.006

Triandis, H. C. (1989). The self and social behavior in differing cultural contexts. *Psychological Review, 96,* 506-520. https://doi.org/10.1037/0033-295X.96.3.506

Triandis, H. C., McCusker, C., & Hui, C. H. (1990). Multimethod probes of individualism and collectivism. *Journal of Personality and Social Psychology*, *59,* 1006-1020. https://doi.org/10.1037/0022-3514.59.5.1006

Truong, G., & Todd, R. M. (2017). SOAP Opera: Self as object and agent in prioritizing attention. *Journal of Cognitive Neuroscience, 29*, 937-952. https://doi.org/10.1162/jocn_a_01083

Tsakiris, M. (2008). The self-other distinction: Insights from self-recognition. In *Enacting intersubjectivity: A cognitive and social perspective on the study of interactions*, *41,* 85-97.

Turk, D. J., Cunningham, S. J., & Macrae, C. N. (2008). Self-memory biases in explicit and incidental encoding of trait adjectives. *Consciousness and Cognition*, *17*, 1040-1045. https://doi.org/10.1016/j.concog.2008.02.004

Turk, D. J., van Bussel, K., Waiter, G. D., & Macrae, C. N. (2011). Mine and me: Exploring the neural basis of object ownership. *Journal of Cognitive Neuroscience, 23,* 3657-68. https://doi.org/10.1162/jocn_a_00042

Turner, J. C., Hogg, M. A., Oakes, P. J., Reicher, S. D. & Wetherell, M. S. (1987). *Rediscovering the social group: A self-categorization theory.* Oxford and New York: Basil Blackwell.

Turner, J. C., Oakes, P. J., Haslam, S. A., & McGarty, C. (1994). Self and collective: cognition and social context. *Personality and Social Psychology Bulletin, 20,* 454-463. https://doi.org/10.1177/0146167294205002

Uddin, L. Q., Lacoboni, M., Lange, C., & Keenan, J. P. (2007). The self and social cognition: the role of cortical midline structures and mirror neurons. *Trends in Cognitive Sciences*, *11,* 153-7. https://doi.org/10.1016/j.tics.2007.01.001

Van Bavel, J. J., & Cunningham, W. A. (2009). Self-categorization with a novel mixed-race group moderates automatic social and racial biases. *Personality and Social Psychology Bulletin, 35,* 321-35. https://doi.org/10.1177/0146167208327743

Van Bavel, J. J., Packer, D. J., & Cunningham, W. A. (2008). The neural substrates of in-group bias: a functional magnetic resonance imaging investigation. *Psychological Science, 19,* 1131-9. https://doi.org/10.1111/j.1467-9280.2008.02214.x

Van Bavel, J. J., Packer, D. J., & Cunningham, W. A. (2011). Modulation of the fusiform face area following minimal exposure to motivationally relevant faces: Evidence of in-group enhancement (not out-group disregard). *Journal of Cognitive Neuroscience, 23,* 3343-54. https://doi.org/10.1162/jocn_a_00016

Van Veelen, R., Otten, S., & Hansen, N. (2013). Social identification when an in-group identity is unclear: The role of self-anchoring and self-stereotyping. *British Journal of Social Psychology, 52*, 543-62. https://doi.org/10.1111/j.2044-8309.2012.02110.x

Van Veelen, R., Otten, S., Cadinu, M., & Hansen, N. (2015). An integrative model of social identification: Self-stereotyping and self-anchoring as two cognitive pathways. *Personality and Social Psychology Review*, *20*, 3-26. https://doi.org/10.1177/1088868315576642

Vázquez, A., Gómez, Á., Ordoñana, J. R., & Paredes, B. (2015). From interpersonal to extended fusion: relationships between fusion with siblings and fusion with the country. *Revista de Psicología Social*, *30*, 512-530. https://doi.org/10.1080/02134748.2015.1093755

Virk, K. (2018, July 27). *Drill music video stop and search by armed police*. Retrieved from https://www.bbc.co.uk/news/newsbeat-44982560

Volz, K. G., Kessler, T., & von Cramon, D. Y. (2009). In-group as part of the self: In-group favoritism is mediated by medial prefrontal cortex activation. *Social Neuroscience*, *4,* 244-60. https://doi.org/10.1080/17470910802553565

Wang, H., Humphreys, G., & Sui, J. (2016). Expanding and retracting from the self: Gains and costs in switching self-associations. *Journal of Experimental Psychology: Human Perception and Performance, 42,* 247-56. https://doi.org/10.1037/xhp0000125

Wicklund, R. A., & Gollwitzer, P. M. (1982). *Symbolic self-completion.* Hillsdale, NJ: Erlbaum.

Wolford, G., & Morrison, F. (1980). Processing of unattended visual information. *Memory & Cognition*, *8*, 521–527. https://doi.org/10.3758/BF03213771

Wood, N., & Cowan, N. (1995). The cocktail party phenomenon revisited: How frequent are attention shifts to one's name in an irrelevant auditory channel? *Journal of Experimental Psychology: Learning, Memory, and Cognition, 21,* 255-60. https://doi.org/10.1037/0278-7393.21.1.255

Xiao, Y. J., Coppin, G., & Van Bavel, J. J. (2016). Clarifying the role of perception in intergroup relations: Origins of bias, components of perception, and practical implications. *Psychological Inquiry, 27,* 357-365. https://doi.org/10.1080/1047840X.2016.1237822

Xu, X., Zuo, X., Wang, X., & Han, S. (2009). Do you feel my pain? Racial group membership modulates empathic neural responses. *Journal of Neuroscience, 29,* 8525-9. https://doi.org/10.1523/JNEUROSCI.2418-09.2009

Yan, L., Wang, Z., Huang, J., Sun, Y. H. P., Judges, R. A., Xiao, N. G., & Lee, K. (2017). Own-group face recognition bias: The effects of location and reputation. *Frontiers in Psychology*, *8,* 1734. https://doi.org/10.3389/fpsyg.2017.01734

Yankouskaya, A., Humphreys, G., Stolte, M., Stokes, M., Moradi, Z., & Sui, J. (2017). An anterior-posterior axis within the ventromedial prefrontal cortex separates self and reward. *Social Cognitive and Affective Neuroscience, 12,* 1859-1868. https://doi.org/10.1093/scan/nsx112

Appendix A:

Full self-report scales and scoring for each measure used for Experiments 1-6

Group Identification Scale (Leach et al., 2008)

Included in Experiments 1, 2 and 3

Below is a list of statements relating to your relationship with your rowing team. Read each one as if it referred to you and then circle the number that best matches your agreement or disagreement with each statement based on the 7-point rating scale below. Please respond to every statement.

1	2	3	4	5	6	7
Strongly disagree	Disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Agree	Strongly agree

1	I feel a bond with my rowing team.	1	2	3	4	5	6	7
2	I feel solidarity with my rowing team.	1	2	3	4	5	6	7
3	I feel committed to my rowing team.	1	2	3	4	5	6	7
4	I am glad to be a member of my rowing team.	1	2	3	4	5	6	7
5	I think that my rowing team have a lot to be proud of.	1	2	3	4	5	6	7
6	It is pleasant to be a member of my rowing team.	1	2	3	4	5	6	7
7	Being in my rowing team gives me a good feeling.	1	2	3	4	5	6	7
8	I often think about the fact that I am in my rowing team.	1	2	3	4	5	6	7
9	The fact that I am in my rowing team is an important part of my identity.	1	2	3	4	5	6	7
10	Being in my rowing team is an important part of how I see myself.	1	2	3	4	5	6	7
11	I have a lot in common with the average member of my rowing team.	1	2	3	4	5	6	7
12	I am similar to the average member of my rowing team.	1	2	3	4	5	6	7
13	Members of my rowing team have a lot in common with each other.	1	2	3	4	5	6	7
14	Members of my rowing team are very similar to each other.	1	2	3	4	5	6	7

******Rowing team*** is replaced with any other example of ingroup, such as *military unit* in Experiment 3**

Scoring: Items 1, 2 and 3 are summed to give a score for solidarity; items 4, 5, 6 and 7 are summed to give a score for satisfaction; items 8, 9 and 10 are summed to give a score for centrality; items 11 and 12 are summed to give a score for individual self-stereotyping; items 13 and 14 are summed to give a score for ingroup homogeneity. Solidarity, satisfaction and centrality make up self-investment; individual self-stereotyping and ingroup homogeneity make up self-definition.

Identity Fusion Scale (Gómez et al., 2011)

Included in Experiments 1, 2 and 3

Below is a list of statements relating to your relationship with your rowing team. Read each one as if it referred to you and then circle the number that best matches your agreement or disagreement with each statement based on the 7-point rating scale below. Please respond to every statement.

1	2	3	4	5	6	7
Strongly disagree	Disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Agree	Strongly agree

1	I am one with my rowing team.	1	2	3	4	5	6	7
2	I feel immersed in my rowing team.	1	2	3	4	5	6	7
3	I have a deep emotional bond with my rowing team.	1	2	3	4	5	6	7
4	My rowing team is me.	1	2	3	4	5	6	7
5	I'll do more for my rowing team than other members of the team would do.	1	2	3	4	5	6	7
6	I am strong because of my rowing team.	1	2	3	4	5	6	7
7	I make my rowing team strong.	1	2	3	4	5	6	7

******Rowing team* **is replaced with any other ingroup, such as** *military unit* **in Experiment 3**

Scoring: Scores from each question are summed to give a total fusion score.

Personal Distance Scale (Sui et al., 2012)

Included in Experiments 1 and 2

Please mark two points on the lines below to indicate where the two people in each question fall in relation to one another. The first mark represents the first person, and the second mark represents the second person.

For example, person 1 and person 2

_____×_____×_____

1. Stranger and self

_____

2. Self and friend

_____

3. Friend and stranger

_____

4. Friend and self

_____

5. Stranger and friend

_____

6. Self and stranger

_____

Note: The group version shows names of ingroups and outgroups instead of self, friend and stranger in each question. For example:

1. Rival team and own team

_____

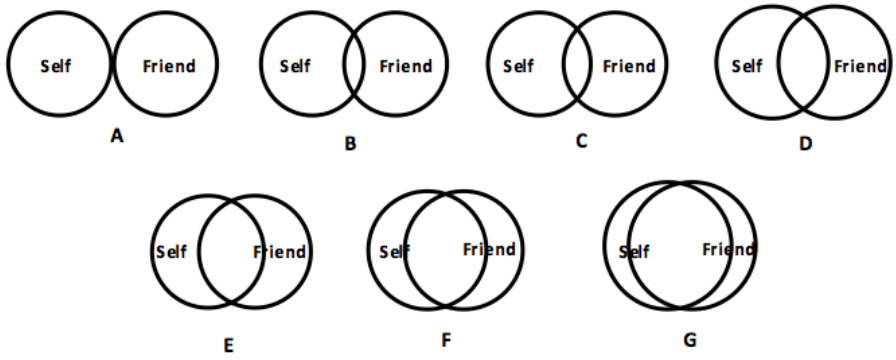
Scoring: The distance in mm between the two people (or social groups) in each question represents the perceived subjective distance between them.

Inclusion of the other in the self scale (Aron et al., 1992)

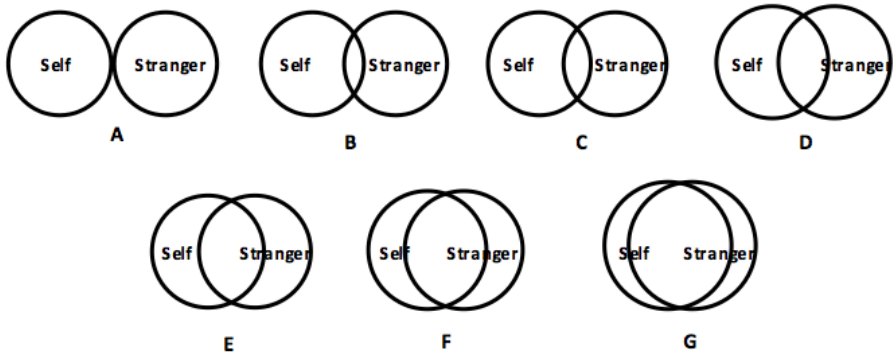
Included in Experiments 1, 2 and 3

Also modified to measure overlap between social groups

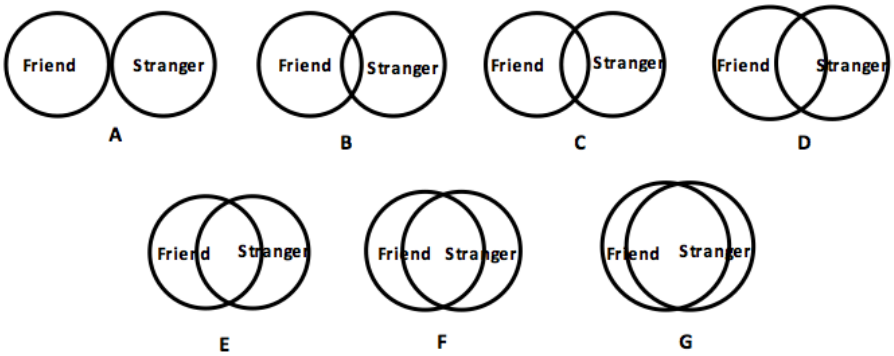
1. Please circle the picture below that best describes your relationship with your best friend.



2. Please circle the picture below that best describes your relationship with a stranger.



3. Please circle the picture below that best describes your best friend's relationship with a stranger.



Note: The group version shows names of ingroups and outgroups instead of self, friend and stranger in each question.

Scoring: A = 1, B = 2, C = 3, D = 4, E = 5, F = 6, G = 7. The higher the number chosen for each question, the greater the perceived overlap between the two individuals or groups included.

Self-construals scale (Singelis, 1994)

Included in Experiments 3, 4, 5 and 6

Listed below are a number of statements. Please circle the number that best matches your agreement or disagreement with each statement based on the 7-point rating scale.

1	2	3	4	5	6	7
Strongly disagree	Disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Agree	Strongly agree

1	I enjoy being unique and different from others in many respects	1	2	3	4	5	6	7
2	I feel comfortable using someone's first name soon after I meet them, even when they are much older than I am	1	2	3	4	5	6	7
3	Even when I strongly disagree with group members, I avoid an argument	1	2	3	4	5	6	7
4	I have respect for the authority figures with whom I interact	1	2	3	4	5	6	7
5	I do my own thing, regardless of what others think	1	2	3	4	5	6	7
6	I respect people who are modest about themselves	1	2	3	4	5	6	7
7	I feel it is important for me to act as an independent person	1	2	3	4	5	6	7
8	I will sacrifice my self-interest for the benefit of the group I am in	1	2	3	4	5	6	7
9	I'd rather say "no" directly, than risk being misunderstood	1	2	3	4	5	6	7
10	Having a lively imagination is important to me	1	2	3	4	5	6	7
11	I should take into consideration my parents' advice when making education/career plans	1	2	3	4	5	6	7
12	I feel my future is intertwined with the future of those around me	1	2	3	4	5	6	7
13	I prefer to be direct and forthright when dealing with people I've just met	1	2	3	4	5	6	7
14	I feel good when I cooperate with others	1	2	3	4	5	6	7
15	I am comfortable with being singled out for praise or rewards	1	2	3	4	5	6	7
16	If my brother or sister fails, I feel responsible	1	2	3	4	5	6	7
17	I often have the feeling that my relationships with others are more important than my own accomplishments	1	2	3	4	5	6	7
18	Speaking up during a class (or a meeting) is not a problem for me	1	2	3	4	5	6	7
19	I would offer my seat in a bus to my professor (or my boss)	1	2	3	4	5	6	7
20	I always act in the same way no matter who I am with	1	2	3	4	5	6	7
21	My happiness depends upon the happiness of those around me	1	2	3	4	5	6	7
22	I value being good in health above everything	1	2	3	4	5	6	7
23	I will stay in a group if they need me, even when I am not happy with the group	1	2	3	4	5	6	7
24	I try to do what is best for me, regardless of how that might affect others	1	2	3	4	5	6	7
25	Being able to take care of myself is a primary concern for me	1	2	3	4	5	6	7
26	It is important to me to respect decisions made by my group	1	2	3	4	5	6	7
27	My personal identity, independent of others, is very important to me	1	2	3	4	5	6	7
28	It is important for me to maintain harmony within my group	1	2	3	4	5	6	7
29	I act in the same way at home as I do at university or work	1	2	3	4	5	6	7
30	I usually go along with what others want to do, even when I would rather do something different.	1	2	3	4	5	6	7

Scoring: Items for which the number is in bold (1, 2, 5, 7, 9, 10, 13, 15, 18, 20, 22, 24, 25, 27, 29) are summed for independent self-construal scores, items for which the numbers are not in bold (3, 4, 6, 8, 11, 12, 14, 16, 17, 19, 21, 23, 26, 28, 30) are summed for interdependent self-construal scores.

Self-esteem scale (Rosenberg, 1965)

Included in Experiments 4, 5 and 6

Below is a list of statements that refer to your general feelings about yourself. Please indicate how much you agree or disagree with each statement by circling the most appropriate number.

		Strongly disagree	Disagree	Agree	Strongly agree
1	On the whole, I am satisfied with myself.	1	2	3	4
2	At times, I think that I am no good at all.	1	2	3	4
3	I feel that I have a number of good qualities.	1	2	3	4
4	I am able to do things as well as most other people.	1	2	3	4
5	I feel I do not have much to be proud of.	1	2	3	4
6	I certainly feel useless at times.	1	2	3	4
7	I feel that I'm a person of worth, at least on an equal plane to others.	1	2	3	4
8	I wish I could have more respect for myself.	1	2	3	4
9	All in all, I am inclined to feel that I am a failure.	1	2	3	4
10	I take a positive attitude towards myself.	1	2	3	4

Scoring: Items for which the number is bold are reverse-scored (2, 5, 6, 8, 9). Scores for each item are then summed to give a total self-esteem score, with higher scores indicating greater self-esteem.

Appendix B:

Correlations between self- and ingroup-biases and self-report measures in Experiment 3

Descriptive statistics for self-report data

The mean scores of the self-reported measures of identity fusion with the unit, ingroup identification with the unit (self-investment and self-definition) and self-construals (independent and interdependent) are shown in Table B.1. below, along with the correlation coefficients between each component of these scales.

Table B.1: Mean identity fusion, group identification and self-construal scores, along with correlation coefficients for the relationship between each component of these scales. *Note. SD*s in parentheses. IF denotes identity fusion; SI, self-investment; SD, self-definition; Ind., independent self-construal; and Int., interdependent self-construal.

		Correlation *r* (*p*)				
	Mean (*SD*)		**SI**	**SD**	**Ind.**	**Int.**
IF	23.98 (10.28)	-	.764* [650, .855] (<.001)	.333 [.096, .538] (.021)	.226 [-.017, .438] (.126)	.240 [-.131, .534] (.105)
SI	13.88 (4.19)		-	.521* [.295, .717] (<.001)	.427* [177, .616] (.003)	.144 [-.164, .467] (.333)
SD	8.63 (2.89)			-	.043 [-.250, .337] (.774)	.137 [-.201, .468] (.358)
Ind.	74.38 (9.40)				-	.171 [-.189, .502] (.250)
Int.	69.06 (10.02)					-

Identity fusion, group identification and bias for the unit

Response time bias

There were no significant relationships between the response time advantage for the unit and identity fusion with the unit, $r(38) = -.068$ [-.365, .293], $p = .675$, self-investment with the unit, $r(38) = .062$ [-.224, .366], $p = .703$, or self-definition with the unit, $r(38) = .025$ [-.214, .277], $p = .878$.

Sensitivity bias

There were also no significant relationships between the sensitivity advantage for the unit and identity fusion with the unit, $r(38) = .109$ [-.159, .376], $p = .502$, self-investment with the unit, $r(38) = .141$ [-.101, .366], $p = .385$, or self-definition with the unit, $r(38) = .022$ [-.239, .280], $p = .892$[41].

Self-construals and biases for the self, unit and country

Response time bias

There was a marginal relationship between the response time advantage for the self and independent self-construal, $r(35) = .321$ [-.018, .578], $p = .053$, but there was no significant relationship between the response time advantage for the self and interdependent self-construal, $r(35) = .048$ [-.290, .361], $p = .780$.

There were no significant relationships between the response time advantage for the unit and either independent self-construal, $r(37) = -.065$ [-.416, .278], $p = .692$, or interdependent self-construal, $r(37) = -.044$ [-.326, .258], $p = .790$.

[41] When the ingroup identification scores were broken down into the five subcomponents of solidarity, satisfaction, centrality, individual self-stereotyping and ingroup homogeneity, there were no significant relationships between any of these individual scores and the advantage for the unit in either response time or in sensitivity.

There were also no significant relationships between the response time advantage for the country and either independent self-construal, $r(39) = -.169$ [-.406, .048] $p = .291$, or interdependent self-construal, $r(39) = .055$ [-.260, .355], $p = .731$.

Sensitivity bias

There were no significant relationships between the sensitivity advantage for the self and either independent self-construal, $r(35) = .207$ [-.176, .532], $p = .218$, or interdependent self-construal, $r(35) = .205$ [-.097, .450], $p = .224$.

There were no significant relationships between the sensitivity advantage for the unit and either independent self-construal, $r(37) = -.153$ [-.425, .163], $p = .351$, or interdependent self-construal, $r(37) = -.014$ [-.288, .271], $p = .932$.

There were also no significant relationships between the sensitivity advantage for the country and either independent self-construal, $r(39) = -.146$ [-.434, .141], $p = .362$, or interdependent self-construal, $r(39) = .073$ [-.207, .374], $p = .651$.