Me & Them: Investigations into the Perceptual Generalisation of Self-Referential Prioritisation

A Thesis Submitted

In Partial Fulfillment of the Requirements

for the Degree of

Master of Science (by Research)

by

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July 2021

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CERTIFICATE

It is certified that the work contained in the thesis titled ***"Me & Them: Investigations into the Perceptual Generalisation of Self-Referential Prioritisation"*** by ***Neelabja Roy*** has been carried out under our supervision and that this work has not been submitted elsewhere for a degree.

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DECLARATION

This is to certify that the thesis titled "***Me & Them: Investigations into the Perceptual Generalisation of Self-Referential Prioritisation***" has been authored by me. It presents the research conducted by me under the supervision of Dr. Ark Verma and Dr. Harish Karnick. To the best of my knowledge, it is an original work, both in terms of research content and narrative, and has not been submitted elsewhere, in part or in full, for a degree. Further, due credit has been attributed to the relevant state-of-the-art and collaborations (if any) with appropriate citations and acknowledgements, in linewith established norms and practices.

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“*The only way to deal with an unfree world is to become so absolutely free that your very existence is an act of rebellion...*”

Albert Camus

Abstract

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Degree for which submitted: **Master of Science (by Research)**

Department: **Cognitive Science**

Thesis title: **Me & Them: Investigations into the Perceptual Generalisation of Self-Referential Prioritisation**

Thesis supervisor: **Dr. Ark Verma & Dr. Harish Karnick**

Month and year of thesis submission: **July, 2021**

It has been well demonstrated that participants respond faster and more accurately to stimuli associated with the Self, as opposed to stimuli associated with irrelevant others (such as strangers) or even close others (friends, mother) not only for stimuli like self-name, self-face, but also for arbitrary and neutral geometrical stimuli like a triangle, square, circle (Sui et al., 2012). In this thesis we investigate whether the relative prioritisation due to selfreference is limited to only specific singular stimuli (for e.g. one triangle, quadrilateral, pentagon) associated with the socially salient labels (self, friend, stranger), or whether participants can also generalise the learned associations and reference-prioritisation to an entire category of stimuli (say, all different types of triangles, or quadrilaterals, or pentagons) where a category is defined in terms of common simple visual features, (for e.g. no. of vertices=3). If so, the participants should hypothetically be able to extend preferential processing beyond a single familiar exemplar which is associated with a preferred social label, say 'Self', to a whole collective of familiar-unfamiliar exemplars sharing one or more common feature rules (count of vertices, shades of colour etc.) acting independently or in conjunction (as in Schäfer et al., 2016). Indeed, we found that the prioritisation for self-reference does generalise beyond a single exemplar to a whole family of new exemplars of

a specific stimulus-category with common feature(s) associated with the more salient and preferential social label, i.e. 'Self' with a group-level preference in prioritised processing. Following this, we investigate how this kind of association, namely, self-preference and its generalisation may affect a participant's behaviour in a completely different task, specifically one which also seeks to indirectly measure positive or inhibitory intergroup attitudes i.e. the manikin approach-avoidance task (Degner et al., 2016; Rougier et al., 2020). Participants were asked to either approach or avoid presented stimuli, using a manikin and key-press. The whole family of coloured shapes which were associated with 'Self' was found to be approached faster than when participants approached 'Strangers' and the same participants were also slower to avoid Self-related shapes than they were in avoiding shapes associated with Strangers. Thus, they also recorded an evident approach-bias for 'Self' being faster at approaching the whole collective of familiar-unfamiliar Self-associated shapes and comparatively slower at avoiding them and conversely they were slower at approaching the entire category of different Stranger-related shapes and faster in avoiding them.

These results demonstrate that the relative bias towards self-referential information may permeate the more generic processes of categorisation and group behaviour as well, wherein even neutral stimuli (or individuals) perceived to be related to the self are not only processed faster and more accurately as opposed to information perceived as not relevant to ourselves. The effect extends to implicit groups with clear positive approach behaviour towards the Self-group and avoidance tendencies to the Strangers group.

In future investigations, thus we intend to explore whether such pattern of behavioural responses also generalises to an ecological self-like categories or groups. For example, we will explore if we will have a similar or comparable response bias (similar to the self bias) when a stimulus is associated with congruent and incongruent groups (for example, same nationality, caste or religion as the subject versus a different one).

Acknowledgements

The cornerstones of my work have been my supervisors, Dr Ark Verma and Dr Harish Karnick, who have been immense pillars of support these past few years. As I developed this thesis with my questions, some of which were often wayward, they took utmost care towards curating my attempts into more constructive directions. I am most indebted for the space and the unending patience that was conceded to me to let me learn and apply independently, make mistakes and subsequently correct myself and learn more. Their constant presence, even if over a video call or text message, have been exceedingly reassuring. COVID-19 unsettled my life, work and the general society that was already conflicted and ailing. Amidst all that, Dr Karnick and Dr Verma were truly inspiring in how they stood with me, both emotionally and academically.

It is vital to express gratitude to Dr Devpriya Kumar, Dr Nisheeth Srivastava, Dr Nitin Gupta, Dr Bishakh Bhattacharya, Dr Narayanan Srinivasan who not only instructed beyond my doubts but were equally hard in pointing out my mistakes. I owe them a lot as an aspiring student and researcher. Thus, I have to thank the Department of Cognitive Science, IIT Kanpur for their continued support, and CGS staff Amitji, and Shalini, for making many logistical processes a lot easier. The participants of my behavioural studies made the thesis possible in the first place.

One cannot be more indebted than I am to my fellow travellers during my time in Cognitive Science - Aastha, Akshay, Harish, Rithwik, Oviya, Anjoom, Komal, Aditi, Anurag, Irfan, Vivek, Neetu, Anjali. I thank them for helping me breathe throughout this time to the extent that none will ever be able to appreciate. I can write pages about how each of them was so essential, but I will fail. I also want to thank Abhirup, Divya, Kaushik, Nidhi, Kshitij, Niraj, Sruzan, Vibhav, Karishma, Simantika, Arjun, Revathi who joined in my second year and enriched the journey. I would also be amiss if I do not acknowledge the contributions of my labmates Ranjith, Himanshu, Debaparna, Dipanjali, Pratham, and especially Niket towards my work.

However, this thesis was also made possible by many who were totally outside of it. Prakhar, my first and only roommate in life till now, deserves all the credit for helping me ease into a life that initially seemed impossible to fit into. Avideepda, Arindamda, Jaitra, Mainak, Debajyoti, Paras, Shivam, Joel, Akhil, Smith, Sana, Rishikesh, Subham, Rajorshi-da, Sourav-da, Ahilan and others, juniors like Richeek, Rahul, Yash, Rhythm, Manish, Nikunj all were also important constitutions who helped immensely. I also need to express my immense gratitude towards all the caretakers that kept the campus pleasant, the mess and canteen and cafe workers who went above and beyond themselves to keep me fed and healthy, and people like Dinesh *bhai* who extended me a lot of favour by happily cleaning my room twice weekly. Lastly, in forlorn remembrance, I also need to put all my gratitude to my Atlas bicycle that stayed as my closest companion through long distances in the rain and the sun.

On the last note, I must acknowledge my city and my friends back home in Kolkata who have been a calming anchor through some pretty tough times. I also owe my gratitude to all the frontline workers and volunteers fighting COVID-19 who have not only helped me and everyone else to stay safe and healthy. We lost many, but somehow we saved even more. In closing, I would additionally like to express my immense gratitude to the idea that embodies Indian Institute of Technology Kanpur and the vision of Pandit Jawaharlal Nehru to engender the notion of self-reliance in our country to empower even the most powerless with the access and tools of modern scientific education to embellish a modern scientific nation.

I thank everyone, who irrespective of themselves, took the pain of empowering me. . . .

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To

Carl Sagan, Rabindranath Thakur, Karl Marx,

whose lessons inspire my attempts at introspecting this vastly complicated world

Chapter 1

Starting the Journey: Introduction

In this thesis, we aimed to explore whether fundamental social categorisation and cognitive preferences between "Mine and Other" (possibly extended to "Us vs. Them") generalise when stripped off all other cultural priors.

Originally, we wanted to explore whether the self-prioritisation effect (Sui et al., 2012) generalises at the visual-perceptual level from specific shapes to a range of similar (based on one or more features) exemplars, and then whether the same advantage could be further extended across the more ecological socio-cultural categories like religion/ caste/ gender.

However, due to reasons beyond our control, we were only able to address the first set of generalisations and their effects in the current work.

1.1 Our Ecological Inspiration

In *'Behave'* (Sapolsky, 2017), Robert Sapolsky describes how just the act of categorisation, activates our insular biases, irrespective of the vagueness of the criteria used for categorisation. Children, three-four years old have been shown to classify people into groups based on race and gender, often negatively, thus starting an *Us vs. Them* categorisation emerging in the early stages of cognitive development and maturation. Even infants have been shown to demonstrate learning faces of their own race as compared to faces belonging to a different or the other race (Kelly et al., 2005). Sapolsky concludes that the significance of self-referential processing in perception can also be observed through the minimality of sensory variation required for the brain to process group-differences of stimuli, and in the sheer speed and almost-implicit automaticity of the same, and interestingly in the inclination to attribute group classification and preference to random and arbitrary differences.

1.2 Early Work

It becomes pertinent to ask what these preferences are, in the first place, their bare essentials and origins and many have analysed these questions from different research perspectives. Several studies (Pettigrew (1959) and later) have questioned the tendencies of discrimination/categorisation from the lenses of an individual-level analysis and explored if it is through specific socio-cultural learning processes that discriminatory attitudes are learnt when individuals interact with society and the environment. Experiments in Darley and Gross (1983), demonstrated that the processes of social perception which is hypothesised to underlie social discrimination can be studied. Dovidio et al. (2002) have also demonstrated that explicit and implicit racial biases of the Caucasians may be a good predictor of implicit and explicit response-biases associated with subtle stereotyping often observed during interracial interactions. More specifically, participants recorded faster responses to negative and positive words when preceded by a congruent subliminal presentation of black and white faces respectively and the opposite for incongruent presentations. Such a finding could be taken to conclude that implicit biases can be leveraged to test implicit discriminatory actions. Moreover, the repeated inconsistencies between a subject's explicitly egalitarian survey responses and their preferential attitudes when tested through experiments have necessitated the prioritisation of the measurement of the more subtle forms of discrimination in laboratory experiments rather than just testing overt explicit behaviours.

Several studies investigated how our brains, just based on very minimal cues (eg. racial or gender), can process images differently within a time window of milliseconds (Tajfel, 1978). Through "minimal group" paradigms, Tajfel (1970) demonstrated how even when the classifications are on somewhat flimsy differences, in-group advantages such as those manifested by higher levels of cooperation can develop. Pro-social behaviours and attitudes are attributed to group-identification where all the necessary resources for preferential activations are generalised to be favourably granted to all in-group members while the opposite is for the outgroup (Shutts (2015), Dunham et al. (2008)).

According to Robert Benchley, "*There are two kinds of people in the world, those who divide the world into two kinds of people and those who don't*". The former makes it vastly consequential to consider the repercussions when people do categorise an in-group "I/Me/Ours/Self" relative to an out-group "They/Theirs/Others".
Building on observed variations in behavioural responses to the divergent processing of 'self' versus 'others', may allow us to study the how the response-biases towards the *self* in comparison to *other* can generalise to even neutral and artificial settings devoid of ecological priors. Hence, the repercussions of the cognitive dominance and prioritisation for 'self'-referential encoding in relation to the 'other', as evidenced with even amnesic cases (Sui & Humphreys, 2013b) is interesting to us. Moreover, biases in processing for 'self' may not be limited to benefitting just the individual self, but also extend to all objects, people, social groups etc. that people may assign to the 'self-relevant category'. Indeed, several studies have shown advantages for processing of the self-schema extends to a wide range of self-relevant stimuli, e.g, faces, names, traits, objects owned etc. (Keyes and Dlugokencka (2014), Bredart (2016), Ma and Han (2010), Turk et al. (2008)). In the same vein, the advantage for the 'self' also extends to a group priority and manifests as previously observed in the 'group-reference effect' (Moradi et al. (2015), Johnson et al. (2002)) thus resulting in further differentiation between two collectives of stimuli.

1.2.1 Self

Studies like Han and Northoff (2009) and Zhu and Han (2008) note that the concept of 'Self' has been studied through various perspectives, such as neuroscience, psychology, philosophy etc. Many recent investigations under the tradition of *e*mbodied cognition have also encouraged a re-look at identity and the Cartesian mind-body dualist concepts of self (Da Rold (2018), Haosheng (2011)). Major philosophies like Buddhism have raised doubts regarding the existence of self ((Albahari, 2016), (Engler, 2003)). While some Nietzschean texts cast doubts about the existence of a 'soul' or 'self' and the basic mental faculties they were supposed to exercise (e.g. thinking, feeling etc.) (Anderson, 2017); some of his work appealed not only for the self but even to some of the traditional faculties, like free will, of which he is most sceptical elsewhere (Nietzsche et al., 1998). This diversity in interpretation has further ensured intense and constant questioning.

Similar questions have been raised for the agency of the 'self' in experimental psychology. Deliberations in developmental cognition have delved into the ontogenetic origin of self-experience Winnicott (1956), Rochat (2018). Our work is guided by the broader notion of 'self' situated within a socio-cultural context but not limited to the concept of an isolated self. The self-concept derives its definition of the constitution, identity and formation from all notions, beliefs, outlooks and perceptions that one holds towards one's self. W. Rogers (2003) proposed the self's existence in three forms: the conscious cognition of oneself as an individual or the personal self; the self, classified by the social context the individual gets situated in - or the social self, that self which is based on its relation to others - the relational self. Festinger (1954) proposes the social comparison theory (SCT), which relates the self-concept and its development to an individual's evaluative assessment of their attitudes and actions by measuring it either in a temporal comparison to their own past selves or in social comparison to a reference group of similar-or-dissimilar individuals in the process often reinforcing the behaviours they feel are affirmative and that is linked to their self-concept.

In parallel to SCT we have Tajfel et al. (1979)'s *social identification theory* (SIT) wherein the social groups one belongs to significantly affects how they behave and that feeds back to our identity and being. Rather than relating to individuals in a one-to-one interaction as in SCT, the SIT sees individuals mainly representing a social group in their identification and interaction with others and a consequent increase in positive self-esteem whose reinforcement furthers the formation and maturing of a more concrete self-concept. Bem (1972) in his self-perception theory suggests an understanding about the 'self' evolves by perceiving our actions in the world and our social behaviour tied up with our self-concept. Markus (1977) emphasised that a very important component of 'self' is one's past experiences - the deliberations and reflections on them enriching it, something akin to the introspection theory of Nisbett and Wilson (1977). These develop through the self-schema model, which is of utility when information related to the self needs processing. Guimond et al. (2007) have observed gender differences in determining the nature and appropriateness of our responses, our behaviour and interactions and thus most vitally, our own perception of ourselves. As Simone Beauvoir aptly puts it in the Second Sex (Beauvoir, 1953), "One is not born, but rather becomes, a woman."

Further, Marsella and Leong (1995) have argued that even after considerable psychological research into aspects of the self, explanations for the self that keep culture out of the equation cannot be universal. Mead (1934) have expressed the importance of social interaction in maturing the self as he believes that social interaction does form the self-concept, however, the social norms, beliefs and cultural patterns also play a role. Markus and Kitayama (1991) have proposed that there are differences between the way persons from an individualistic American society, that gives more value to independence and freedom which, in turn, see themselves compared to individuals from a collectivist society like Korea, where according to (Choi & Choi, 2002), people prioritise tradition and customs as more essential than just the singular self-concepts. This provides evidence for the belief that culture and cultural variations are the strongest influencers for one's self-concept. Indeed, people from individualistic cultures were observed to prioritise work and achievement, giving more value to developing an identity and distinction than being interested in relationships or family when resettling somewhere new (Boneva & Frieze, 2001) whereas people from more collectivistic cultures like that of South-East Asia, Africa and some Latin-American cultures give more impetus to a shared identity and inter-relatedness with other individuals who may be close to the self, say a friend, family member, or member of the same social group.

1.3 Our Work

Past research has established that participants demonstrate processing benefits in terms of better memory, focused attention, and enhanced perceptual processing for self–referential stimuli(Cunningham and Turk (2017)). However, one could argue that the advantages in processing for these stimuli might also be arising out of long-term familiarity and practice with these stimuli. More recently though, processing benefits have also been demonstrated when arbitrary geometrical stimuli (e.g either a triangle, square, circle) were associated with the self as compared to when these stimuli were linked with other socially relevant labels (e.g triangle = you, square = friend and circle = stranger). After the association phase participants were asked to match the correct "social–labels" with the correct shape in a simple perceptual matching task (Sui et al., 2012). Participants were found to be faster and more accurate at matching shapes paired with the self–referent label (you), as compared to shapes linked with either the friend, stranger or even with mother labels. Sui et al. (2012) concluded that forming self–referent associations with even arbitrary stimuli may modulate subsequent perceptual processing of stimuli.

These results have been replicated and extended across a range of studies (Sui and Humphreys (2013a); Sui et al. (2013) etc.). Further, Sui and Humphreys (2015) have suggested that the self may act as an integrating influence across perception, memory and decision making that may enhance or disrupt performance across task contexts.
However, such assumptions imply an almost global role of the 'self–concept' across various mental functions, and almost universally across participants. Not surprisingly, therefore, these conclusions have been challenged by several studies that have shown that the self–referential concept is influenced by cultural variables. e.g Sparks et al. (2016) showed

that Asian participants displayed no ownership related biases in the accuracy of recognition memory for self–owned vs. other-owned objects but studies like Golubickis et al. (2019) have demonstrated that an ownership bias for the *Self* compared to the mother was consistent across East and West.

The fact that the relative importance of the self–concept, and by deduction, self–referential processing may vary across cultures raises questions on claims about the universal role of the self in various aspects of cognition Sui and Humphreys (2015). However, this further underscores the need for more studies under differing task-paradigms to better our understanding of both self-prioritisation as well as its actual nature across cultures in this world.

In the current set of experiments, we wondered whether participants of experiments in Sui et al. (2012) merely formed associations with the specific shapes that they have been previously exposed to (e.g triangle, circle, square) or whether they analysed the target shapes for their properties e.g prominent visual features (say, number of vertices), and could use the analysis to categorise patterns that would not only allow them to distinguish these shapes from each other but also eventually lead to the self–referential processing advantage. If the participants were learning to categorise stimuli based on generalisation over these similarities in feature rules, it would follow that the self–referential advantage could in principle be available for not just a specific triangle or square, but to all triangles or quadrilaterals. Intuitively, according to Akrami et al. (2011), the same mechanism may underlie the findings for prejudice against all members of a particular collective.

Furthermore, since people do not typically use just one but several criteria for categorisation in ecological settings (Liberman, Woodward, et al., 2017) and use the same to organise social interactions, a relevant question could be: whether participants in a paradigm like that of Sui et al. (2012) are sensitive to not just isolated feature-rules (say, the number of vertices) acting independently but conjunctive rules as used in Schäfer et al. (2016) (say, filled colour and number of vertices) and still display a significant bias towards the preferred category. An example of such an instance could be differential reactions in even unrelated tasks like the Manikin Approach – Avoidance (Jan De Houwer & Hermans, 2001), which through a paradigm different from the simplistic perceptual match-judgement task, will be able to measure effects of self-reference within the framework of attitudinal-response. As Phaf et al. (2014) explains, the debate persists regarding whether valenced stimuli (positive or negative) prime the approach-avoidance tendencies directly (unintentional, implicit and stimulus-driven), or somewhat indirectly post subconscious or conscious evaluation.

However it remains consistent across multiple studies (Chen and Bargh (1999),Mogg et al. (2003), etc.) that the tendency significantly differs across perceived valence of the stimuli.

These questions, especially the ones regarding the generalisation of associated preferences, have not received much attention in the recent literature of self–referential processing across various cognitive domains. Further, insights from these questions may help in the understanding of how individuals may pick up relatively simple rules to categorise stimuli in social settings. One may conjecture that participants' categorisation of stimuli from relatively simple rules may underlie the manifestations of socially relevant phenomena like prejudice, stereotyping etc.

To sum up, in the current thesis we were interested in investigating (a) whether participants simply make associations with specific exemplars, or whether they learn to categorise based on commonality in simple rules (such as number. of vertices, colour etc.), and also (b) whether the self–prioritisation effect can extend beyond the specific familiar exemplar to generic categories having even novel target stimuli, that can be described by simple or conjunct rules and finally, (c) whether the divergent responses between the two categories (self and other(friend or stranger) also manifest in unrelated paradigms like an Approach Avoidance Manikin task (Neumann et al. (2004); Saraiva et al. (2013)) validating consequences of biased processing in ecologically valid contexts.

To investigate these questions, we conducted six different experiments across paradigms as suggested by Sui et al. (2012) and Jan De Houwer and Hermans (2001) testing for self–referential processing and differential inter-category response biases with our stimuli. These experiments allowed us to answer the questions and reach possible conclusions about whether participants did in fact associate preferences to rules, for categorisation of stimuli and reacting thereby. Moreover, our findings seem to validate this to be true, even with certain critical variations.

1.3.1 What If? – Problem statement

In the studies of Sui et al. (2012), participants were presented with single exemplars of each shape category and were found to process the more salient individual instances with better perceptual preference. In the current work, we have tried to build on these results and further investigate the exact nature of the perceptual preference and socially preferential processing in different task requirements. We explore whether such effects of perceptual salience continue to hold in the response tendencies for inter-category stimuli in different experimental contexts inspired by social environments. The essential question is:

Will subjects who are starved of any prior priming or cultural bias towards the presented stimuli make the consequent responses solely based on visual features of the stimuli and the saliences of the attached label affecting the efficiency of perceptual responses.

1.3.2 Hypothesises under Investigation

Associating a stimulus to the 'self'-label has been found to modulate its subsequent perceptual processing and thereby evoking a self-prioritisation effect, thus the critical importance of the association to the social label in influencing the preferential choice for stimuli-judgement. Our hypotheses are designed to test whether the said self-prioritisation effect holds with different neutral geometric-stimuli and their entire categories associated with either of the labels of *'Self', 'Friend', 'Stranger'*.

Table 1.1: Variables and hypotheses tested in this thesis

	Variables Studied	Tested Hypotheses
1A.	Single visual exemplars of 3 geometric shapes, each presented with a socially-salient label	+Shape Category will have a significant effect on perceptual preference with the ones with more salient association being processed better.
1B.	20 shape-exemplars of each of the 3 geometric categories pre-familiarised with the association to social labels	+The whole group of shapes associated with salient labels will continue to be preferred compared to those with none.
2A.	Pre-familiarisation with a small subset of 3 shape categories with social labels. Tested over a larger set of novel exemplars	+If the target-stimulus satisfies the defining feature of a shape category then a rule-based preference extends to all such (even novel) stimuli.
2B.	Pre-familiarisation with a small subset of 3 triadic colour classes with social labels. Tested over larger set of novel exemplars	+ If target colour-stimuli is judged abstractly similar to a category with defining feature, the preference for the group is generalised to the stimuli.
2C.	Pre-familiarisation with 3 small sets of coloured shapes paired with a label. Tested on a larger group of novel stimuli.	+Prioritised processing of class of target-stimuli sharing the conjuncion of two characteristic feature-rules of more salient category.
3.	Manikin Approach/avoidance actions for novel exemplars of 2 categories of label-associated coloured-shapes	+ Differential Approach-Avoidance tendencies should be reflected. Stronger approach tendency for more salient group.

1.3.3 Organisation of the Thesis

The current thesis is organised into six chapters. In this Chapter-1 we have introduced the background for the questions examined in the thesis. Chapter 2 reviews some of the relevant studies of self, self-reference and social attitudes to understand the relevance of the studies that we want to pursue. In the next three chapters i.e. chapters 3, 4 and 5; we presented the experiments conducted to test our hypotheses, wherein each chapter addresses the different aspects of self-reference that we explore. To elaborate, in Chapter 3, we study the effects of self-reference when the social association has to be generalised to a larger number of familiar stimuli. In Chapter 4, we explore whether the processing of whole groups of exemplars with one or more shared defining features will also result in a perceptual processing advantage and responses to a whole collective leading to rule-based generalisation. In chapter 5, we investigate whether this preferred social association generalises to levels of group preference and whether it can induce differential response activations in the approach-avoidance tendencies for different types of arbitrary visual stimuli. Finally, in Chapter 6 the concluding chapter, we discuss the results, the analyses and their interpretations and the limitations of our work. We also mention extensions that we were unable to address in the thesis but are very relevant to the questions answered in the thesis.

1.3.4 Contributions

We have found that:

1. There should be a generalisability of preference wherein participants can advantageously process a large group of familiarised self-associated neutral stimuli.

2. This generalisability of response-preference extends to advantageously processing even previously-unfamiliarised sets with exemplars defined by independent or conjunct features.

3. That such self-preferences in perceptual processing also induce varying Approach-Avoidance tendencies, wherein the more salient targets get treated with approach tendency (faster approach, slower avoidance) while the same is not true for the less prioritised one.

In the respective chapters, we have discussed the implications of the results and its analysis to try and gain an understanding of human behaviour and implicit social choices.

Chapter 2

Finding Ground: Literature Review

In the current chapter, we review some relevant literature for the questions we are exploring and the suggested answers for them.

2.1 The Notion of Self – Philosophical Underpinnings

The concept of the *self* has been the subject of exploration for plenty of centuries and the earliest quests for understanding the workings of the mind also probably engendered the first theories about the nature of the self. It is therefore not surprising that in the corridors of philosophy, the use of words for the *Self* have already often been interchanged with words like *Person* both in effect and with the implication of embodying the same essential idea.

Plato considered the soul as equivalent with his essential *self* and not excluded from it. Aristotle followed him to define that his *psyche* is the core of his existence and it is non-existent without the body (as he explained in his work, *De Anima*).
Both Western philosophy as well as Eastern philosophical traditions like Taoism, Confucianism and even Hinduism, have continuously prioritised mastering self-knowledge for enlightenment and development for redemption from misery. Buddhism had found its niche recognition as a school with its debates throwing up *self* to be a strong illusory and fictional psychophysical complex.

With the gradual emergence of modern science, spearheaded by the likes of Kepler and Galileo, the study of the Self has evolved too. Descartes, for example, replaced using the word 'soul' with 'mind' and equated the latter to be the same as the *self*. John Locke in his 'An Essay Concerning Human Understanding' (Locke, 1689), ushered in the wave of empiricism as he proposed a unified *self-concept* regarding how personal identity can be a consequence of psychological continuity founded on the integrating role of consciousness like memory. Such a proposal suddenly pushed the question of the convenient fictionality of 'self' to the fore. The proposition of the *self* being nothing, but a mere functional illusion was also subsequently argued by Hume (1739). Later, Hume further tried to explain the process of representations of one's own selves and others with a functional perspective of self in what can be regarded as an early attempt at a social concept of self.

Baldwin (1897) held that children become aware of others first. It is in the course of imitating them that they become aware of their own subjective existence. He concluded that the *'social self is born'*, in line with what Hegel (2018) claimed that self-consciousness arises through dynamic and reciprocal interactions and relationships with others. Barresi and Martin (2011) explained that this effect of Hegel and subsequently Marx aroused intrigue for the social genesis of '*self*' even in traditional phenomenological thought too. For instance, it was visible in the likes of Max Scheler, who was investigating social attitudes like empathy and sympathy, or Heidegger and Sartre, who emphasised how it can be only an abstraction to ideate an individual who is secluded from their worldly social implications. Finally, Dennett (1992)) also posited only a functional role of this sense of self by holding it as a 'centre of narrative gravity' where it forms a fictional abstraction in and for the narratives constructed for us. The learned narrative abilities deployed to comprehend our behaviour than help us to constitute more dynamic differentiations for a Self vs an Other. Harré (1991) furthermore contends that there is a significant effect of the mere presence of pronouns (I /You/ He/ Me) on the persistence of independent personal and otherised selves.

To summarise, it is critical to understand that even the most pedantic social action, may have necessitated self-consciousness to evolve as an illusion or otherwise as a key functional necessity for everyday activity. It is therefore only natural for the more systematic and scientific approaches to then focus on one of the most intriguing aspects of the *self*, as embedded in an already fascinating macrocosm of human cognition.

2.2 The 'Self' in the Brain

Though Dennett (1992) forewarns- "It is a category mistake to start looking for selves in the brain"- it is vital in examining the dynamics of processing '*self*', and the '*other*'.
Gallup (1998) inferred that frontal lobes are essential for processing what is self-related and what is not, as the beings with the most advanced frontal cortex demonstrated self-recognition, while those with the least-developed ones show inconsistencies in the same (Semendeferi et al., 1997). Several other studies (Ruby and Decety (2003),Kelley et al. (2002),Kjaer et al. (2002)) have noted instances of differential activation for the 'self' first-person perspective and 'other' second-person perspective in the frontal regions of the brain. Further, there is evidence of the activations of the medial prefrontal cortex as being key to self-reference (Murray et al., 2012). Northoff (2016) has suggested that a default activity of mPFC is consequent of the representation of ourselves. Sui et al. (2013) have also validated the role of mPFC in self-representation, consistent with other studies (C. Macrae et al., 2004). Further, Northoff and Bermpohl (2004) observed the involvement of cortical-midline-structures and especially the Ventromedial prefrontal cortex (VMPFC) in processing of self-referential information and subsequently discerning *self* vs the *other* in the world. Keenan et al. (1999) using a reaction time paradigm for recognising self-face compared to that of a friend, stranger or a celebrity implicated the dominance of right hemisphere dominance in self-face recognition. Finally, Vogeley and Gallagher (2011) noted how despite some seemingly special areas, a wider area may be identifiable for activations to self-referential information, instead of consistent well-defined ones.

2.3 Measures of Self-related Prioritisation

Researchers have examined the biases for self-referential processing in facets of perception, memory and attention. For instance, Sui and Humphreys (2017) note that the recent focus of research has been to explore how referring a task stimulus to oneself systematically biases one's performance manifested in terms of robust preferences. Likewise, researchers have relied on checking for self-prioritisation with a variety of stimuli such as faces, adjectives, names, self-owned objects etc. as a proxy to measure for effects of the abstract self-concept to generate indices that are more objective.

Self-reference has been shown to affect perceptual judgments of participants who responded faster and more accurately to their face than someone else's even when orientation was modulated (Ma & Han, 2010). Similarly T. B. Rogers et al. (1977) demonstrated self-preference when participants judged adjectives in relation to either themselves or others. In the same vein, self-preference in memory was also found in studies by Leshikar et al. (2014), Sui and Humphreys (2013b). Cunningham et al. (2008) which not only demonstrated self-preference effect active even in children but also brought to fore the binding effects self-reference with enhanced integration of the stimuli with the context in which it is encoded (Cunningham et al., 2014).

For stimuli that are Self-associated, the enhanced perceptual integration may further the propensity of assimilation to extended information like members of our own group (Swann et al., 2012) into the representations of our own selves (Aron and Aron (1996), Aron et al. (2004)). It seems that self-prioritisation may be able to expand because self-reference functions as that "glue" which not only tethers multiple conceptual elements from one's sensations together but also increases the linkages between different stages of processing (Liu et al. (2016), Sui and Humphreys (2017)). As the Cocktail Party Effect (Cherry, 1953), Moray (1959) demonstrated how the self-name when presented even in an unattended ear captured attention; thus showing that computation and reflection of self-reference even when devoid of any attentional scope.

Upon further studies, it was also found in eye-tracking that individuals experienced more difficulties in disengaging their attention from their own face as compared with others' faces (Devue et al., 2009). Several other studies (for e.g. Yang et al. (2013); Mack and Rock (1998); Shapiro et al. (1997)) have also reported evidence for the priority of self-reference in commanding attention and to being less susceptible to limits.

2.3.1 Self-reference Effect and its Generalisation

Given the evidence in favour of prioritised processing for self–referential information, there has been thus a continuous reassertion of how cognition, in general, may be biased towards information that is referent to self than those referring to others. It has been argued that humans, frequently and automatically, associate abstract or physical characteristics, external objects and even abstract concepts with their own selves in ownership and build self-connected representations between themselves and others, which then become critical for navigating the many social contexts and processing and relations with groups and kin. Such related elements are considered and often regarded to be '*self-relevant*' or '*self-referent*' and as studies like Gillihan and Farah (2005) assert such stimuli gain privileged cognitive processing and responses.

Information that is more socially relevant is prioritised in cognitive processing in terms of better memory, focused attention, decision-making, and enhanced perceptual processing for self–referential stimuli, e.g. self–name, self–face, self–referent adjectives, owned objects etc. (Tacikowski and Nowicka (2010); Cunningham and Turk (2017)).

These findings of self-referential advantages have been found to be interact with attention (Sui and Humphreys (2015); Keyes and Dlugokencka (2014)). For instance, preference for self-referent information has been evidenced in multiple paradigms of selective attention in varying sensory modalities (Bargh, 1982). The attention-grabbing capacity of self-referent stimuli has also been continually observed in the automatic processing of self-relevant information in the works of Alexopoulos et al. (2012) and the failure of its inhibition as in the works of Frings (2006). Distractors that are significant personally have been demonstrated to be more difficult to neglect in comparison to totally neutral ones (Wood & Cowan, 1995). Also, it has been observed that there is self-preferential bias in perceptual judgements and capturing of exogenous attention as in facial recognition, with own-faces facilitating recognition than other-faces (Sui et al., 2006) even when the required task is free from explicit face recognition where subjects are having to judge the orientation of faces (Keyes & Brady, 2010).

While multiple kinds of perceptual and attentional processes are evidently modulated by the self-reference effect, the concerned studies have mostly used stimuli like faces, belongings and names which are all laden with prolonged familiarity and training. It had thus made it harder to separate social reference effects from the influences of long-term familiarity and over-learning for these stimuli on processing and response performances.

2.3.1.1 Perceptual Effects from Simple Self Reference

To address these concerns, Sui et al. (2012) introduced a shape-label matching paradigm to investigate prioritised processing for self-association with arbitrary geometrical stimuli, assigned randomly to the *self* and other socially salient references such as the *friend*, *mother* etc. In the subsequent task participants were found to be significantly faster and more accurate for recognised matching shape-label pairs when they were associated with the self as compared to shapes associated with either the irrelevant others like*Stranger*, or the close others like the *Friend* or *Mother*; thus demonstrating robust self-prioritisation manifested for newly learned associations with arbitrary shape stimuli.

These findings have been subsequently re-validated through a large number of research studies (Sui et al. (2013), Sui et al. (2015), Wang et al. (2015)). Further, Sui and

Humphreys (2015) suggested that self-reference may act as an integrating influence across perception, memory and decision making that may enhance or disrupt performance across task contexts. More specifically, based on results from several studies, they argue for the special role of self–reference in information processing, where it is asserted that self–reference may help bind memories with their source, increase perceptual integration, modulate the coupling between attention and decision making and also the interactions between various brain regions processing different aspects of task–relevant stimuli. There have been additional investigations on the more subtle aspects of such perceptual preference. Schäfer et al. (2016) found prioritisation to hold even with feature conjunctions. The results from the work of Yin et al. (2018) recorded implicit preference for self-referential associations in the working memory of cognition, with the claim that they are the foundation of certain self-regarding biases in response choices. Manipulating the peripheral cues on their levels of personal reference preceding a target-orientation judgement task, C. N. Macrae et al. (2018) demonstrated a significant effect of self-reference in the accentuation of transitory attention towards presented stimuli. Liu and Sui (2016) comment how both social and perceptual saliency can influence the selection of visual targets in hierarchical stimuli even though a corroboration of their exact functional connections are not lucid yet. Investigating if the two factors link in an additive way, their results re-validate how both modulate a shared perceptual-selection process as they record an interaction of the perceptual saliency with the social saliency of the stimulus when explicit social categorisations are made necessarily relevant. Falbén et al. (2019) however asserted conditional automaticity of perceptual preference as their evidence recorded that self-referential prioritisation in performance is enhanced only when the task paradigm requires explicit focus and attention to the previously formed relevant salient associations. Stolte et al. (2017) postulated varying underlying mechanisms upon finding no correlation in self-bias to positive-valence in the match-judgement paradigm.

2.3.1.2 Group Level Effects and Generalisation Studies

Swann et al. (2012) had demonstrated that the capacity of self-reference to act as a perceptual glue also enables binding of information for the members of a self-relevant group, assimilating the representations for the members of the group into our self-representations. This can be supposed to be an enabler of the representation of self-hood in a group level reference. Indeed Johnson et al. (2002) were able to demonstrate better memory performance for adjectives encoded in terms of a group–reference, almost as well as self-reference and thus significantly more than when just based on semantic features. Also, in their study with perceptual match-judgement task, football fans prioritised stimuli just associated with their preferred club rather than the rival or neutral teams, Moradi et al. (2015) found a significance of in-group bias without the explicit familiarity of the stimuli being a major factor thus indicating that group identification is indeed influencing perceptual matching. Finally, Enock et al. (2017) corroborated an intersection between representations of the personal self and social self for in-group representations with similar underlying processes encouraging prioritised processing in perceptual judgement for both. They also considered group bias effects in such perceptual match-judgement tasks to probably be independent of the influences of affective-valence.

2.4 Convergence and Our Work

The shape-label perceptual association paradigm devised by Sui et al. (2012) has demonstrated the advantages for processing one's Self-concept even at the level of single, arbitrary geometric shapes reflecting a clear preference for self-associations, relative to Others. Johnson et al. (2002) were able to extend the findings for self-preference to how preference for self-related information can also be established at the larger level of a social group.

However, it is apparent that the mechanisms underlying the generalisability of such referential associations with the self have not been extensively researched. It will be interesting to investigate whether prioritised processing observed with single exemplars in Sui et al. (2012)'s paradigm could be extended to an entire category with many unique exemplars, that are newly associated with the self.

We investigate whether preferential responses as observed for simple geometric stimuli (Sui et al., 2012) would also extend to entire categories of stimuli, generalising prioritised processing for all exemplars sharing commonality in features with the more salient label, i.e., Self. So far, the nature of self-preference at the level of the neutral exemplars has only been tested with the paradigm of simple perceptual tasks; and should expectedly hold, even when generalised to the level of group reference, albeit differently under a different approach. Therefore, we found it appropriate to ask whether the same tendency for self-prioritisation would persist or vary in an entirely different paradigm. We examined if it also extends to another ecologically relevant measure of implicit response-tendencies, the approach-avoidance paradigm (Krieglmeyer & Deutsch, 2010). We employed the Manikin Approach avoidance Task of Jan De Houwer and Hermans (2001) to investigate inter-category attitudes for our stimuli-set of different rule-defined categories of stimuli newly associated with Self or Stranger.

We hope to investigate whether self-preferential processing observed for simple geometric stimuli like the ones used by Sui et al. (2012) would extend to entire categories of stimuli. Further, we also wanted to check whether the same tendency for self-prioritisation would extend to an ecologically valid task like the approach-avoidance manikin task as used by Jan De Houwer and Hermans (2001).

Several studies (Mogg et al. (2003); Krieglmeyer and Deutsch (2010) etc.) have validated manikin tasks as *Measures of Approach- Avoidance behaviour (MAAB)*. The study of Solarz (1960) pioneered how valence of stimuli facilitated respective approach-avoidance tendencies. Chen and Bargh (1999) also reasserted how a more preferable entity would foster approach behaviour while a lesser preferred or an aversive entity will elicit a tendency for avoidance. Faster RTs to approach than to avoid a target stimulus would thereby establish the significance of an approach tendency towards the presented stimulus. Conversely, the reverse condition will be reflected for such measures in approach and avoidance behaviours employed in several studies to investigate participants' attitudes towards such stimuli. For instance, Fishbach and Shah (2006) employed it for desires, Schoenmakers et al. (2008) for drugs, while other research-studies (Rinck & Becker, 2007) employed it for testing behavioural responses to spider-like phobic stimuli.

We expect that our set of studies would lead us to a better understanding with respect to the application of the reviewed pre-existing tools and approaches and also give us further clarity on how self-reference can be generalised to positive perceptual prioritisation of not only stimuli typically utilised in the labs but with more ecological tasks.

Chapter 3

‘Self Before Others’- The Self Prioritization Effect

There is significant evidence for preferential processing of information associated with the self (S. Klein (2012); Sui and Humphreys (2015)) as demonstrated by reduction in the attentional blink (Shapiro et al., 1997); in inattentional blindness (Mack & Rock, 1998) when processing one’s name against those of others and also in the faster responses for self-faces irrespective of their presented orientation (Keyes & Brady, 2010).

To address the concern about prolonged training effects with familiar stimuli, Sui et al. (2012) designed an associative learning paradigm wherein they asked the participants to associate single (specific) arbitrary geometric stimuli (circle, triangle, square) with social labels that referred to themselves (*you*), close others (best friend, mother) or irrelevant others (stranger/none). Following the formation of the shape-label associations, participants had to respond to whether the presented shape-label pairs were a correct/incorrect match. At the test trials, it was observed that participants responded fastest and most accurately for the *Self*-associated shape-label match, and were slowest and least accurate for *Stranger*-associated shape-label associations while *‘Friend’*-associated shape-label matches came in between in terms of both reaction times and accuracy. Hence, Sui et al. (2012) termed the findings as the self-prioritisation effect and thus validated the benefits of the self-referential processing bias even with arbitrary and neutral visual stimuli that were recently associated with *Self*, *‘Friend’* or *Stranger*. Based on subsequent findings, Sui and Humphreys (2017), proposed that the self-concept may function as a ‘stable anchor’ or an ‘integrative glue’ binding contents across sensory modalities and memory through multiple processing stages providing continuity of experience.

The proposal for the self-concept as an integrating factor in the scheme of cognition (perception, attention and working memory), is indeed fascinating. Interestingly, for the same to be true one may need to adopt a universal view of the 'self-concept' that would hold across the entire species, across different societies, cultures etc.

However, significant differences in the manifestation of the self-concept across varying cultural groups has been recorded ((Heine, 2002), Triandis (1989)). Western societies (the USA, West-Europe etc.) seem to encourage an independent 'self' - a unique, independent and autonomous entity defined through its distance from others while in contrast East Asian cultures, along with some African, Southern European and Latin–American cultures nurture an interdependent self, wherein the self is interconnected and interdependent with an individual's familial and social relationships (Markus & Kitayama, 1991). Given, the differential manifestations of the self-concept in individuals from these different kinds of societies; one may expect the nature of self-preferential processing may be different for them. Indeed, several studies, have shown that individuals from South-East Asian societies differ in manifestation of the self-referential bias as compared to individuals from Western Societies (see (Heine, 2002); Zhu and Li (2002); Han and Northoff (2009)).

But additionally, most of these comparative studies with collectivistic eastern cultures have been unfortunately limited to Chinese subjects. Recent work by Makwana and Srinivasan (2019) have recorded faster associations for self-association compared to friend or stranger using the paradigm of Sui et al. (2012) with Indian participants. Moreover, another study by Verma et al. (2021) also found self-referential bias for the *'self'* as compared to *friend* and *stranger*; but not with *'mother'* labels. Still, only a very limited number of studies have investigated the scope, role and extent of the self-referential processing with Indian participants. While both the above-cited studies have reconfirmed that participants from India, which is an instance of the Eastern, collectivistic society (Triandis (1989),Hofstede and Hofstede (1984)), also show biased processing for the *self* as compared to *friend* or *stranger*, we were interested in a slightly different question, we wanted to investigate whether the effect can be generalised both at the level of the stimulus as well as social categorisation.

Consequently, in the current set of experiments, we wanted to know whether preferential associations of social labels with specific regular shapes (e.g., triangle, quadrilateral, pentagon) could be generalised to a whole family of geometric stimuli of a particular category (many different triangles, many different quadrilaterals, many different pentagons etc.) which were explicitly paired with the social label. Eventually, we would want to investigate whether the preferential effect generalises at the level of the social groups or categories.

To begin with, we first decided to conduct a baseline replication task of Exp 1 from Sui et al. (2012) in our Experiment 1A with one unique exemplar associated with one of three labels. Next, we extend our investigation with Experiment-1B wherein we test if the self-prioritisation generalises to a larger stimuli set (20 each) of different exemplars for each shape instead of just one exemplar. Intuitively, an ecological extension of the findings from Exp 1 of Sui et al. (2012) would be if the self-prioritisation effect would generalise to a preference for one's own family member, co-religionist, caste, language, follower of the same football club etc. If participants demonstrated lesser RTs and higher accuracy for the whole family, it would imply that they were indeed able to associate the preferential social label with an entire collective. The question to ask then would be: Does the self-reference prioritisation effect extend from an individual level to a group level preference, something akin to the Group Reference Effect reported by Johnson et al. (2002) wherein participants demonstrated better recall of information when encoded in association with an entire group (comparable to a self-referential encoding) than when encoded with just semantics.

3.1 Experiment 1A

In this experiment, we compare the prioritisation for processing of neutral geometric stimuli associated with *Self*, to the ones with *Friend* and *Stranger*. Given the findings from previous studies (Sui et al. (2012); Makwana and Srinivasan (2019); Verma et al. (2021)), we expect a significant self-prioritisation for self-shape matches as opposed to friend-shape or strange-shape matches.

3.1.1 Method

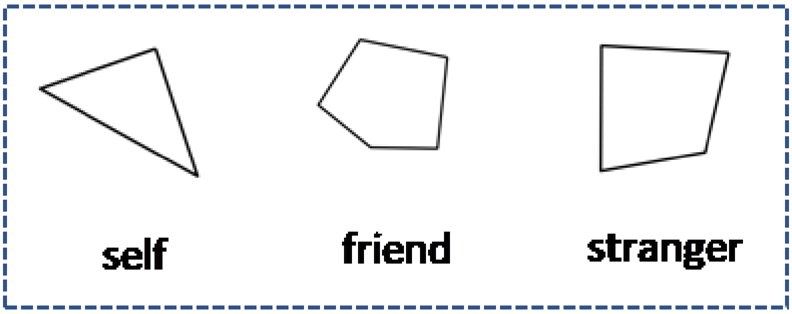
3.1.1.1 Participants

The sample size for this experiment was calculated using G*Power 3.1 software (Faul et al., 2007). power $= 0.9$, $\alpha = 0.05$; was estimated to be 18 for an effect size of $\eta^2 = 0.37$; based on a the design from Experiment 1 of Sui et al. (2012). Our participants were 18 students of Indian Institute of Technology, Kanpur (6 females; 22 to 32 years of age, M=24.78±2.48). All except one, of the participants were right-handed. All had normal or corrected-to-normal vision. Informed consent was obtained from all participants before the experiment according to procedures approved by the Institute Ethics Committee. All participants were duly compensated for participating in the experiment.

3.1.1.2 Stimuli

In this experiment, we associate socially salient labels with a single exemplar of each of the three visual geometric categories. Thus, one of three geometric shapes (triangle, quadrilateral, and pentagon) each 3.8 x 3.8 degrees of visual angle, was presented above a fixation cross ($0.8° \times 0.8°$) displayed at the centre of the screen against a white background. The labels *'Self'*, *'Friend'*, or *'Stranger'*(3.1/3.6 x 1.6 degrees) associated with the shapes (counterbalanced across subjects) were displayed below the fixation cross. The distance between the centre of the word or the shape and the fixation-cross was around 3.5°. All stimuli were shown against a white background. All stimuli were no-fill and black-bordered and shown on a white background of a 15.6-inch monitor of Acer Predator Helios 300 (1,920 × 1080 px at 60 Hz) where the experiment was also run. The experiment was coded and run on python 3.7 using the Psychopy library for the GUI. An instance of the stimuli set is given in figure 3.1.

FIGURE 3.1: Stimuli Set for Experiment-1A



A stimulus instance for Experiment-1A. Any geometric shape can be paired with any of the social labels to be presented as the congruent pairing for a particular participant.

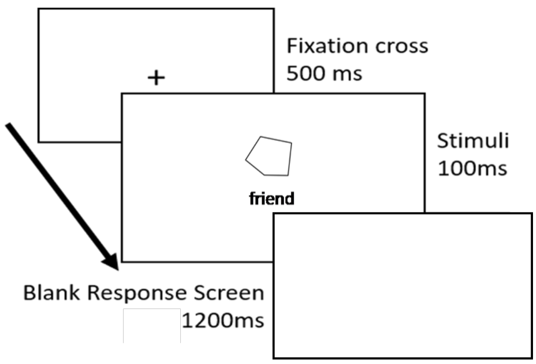
3.1.1.3 Procedure

The experiment was conducted in two separate stages. The first stage was the association or learning stage wherein participants were visually presented with, on a single screen, three geometric shapes (triangle, square and pentagon) with their associated social labels that were *'Self'*, *'Friend'*, *'Stranger'*. The participants were asked to memorise the presented shape-label associations and keep them in mind, before moving ahead to the second part - the match-judgement testing stage.

In the matching stage, participants were asked to respond to rapid presentations of various shape-label pairings to judge whether the presented shape–label pairing were actually the ones they formed in the association stage or not. Participants responded with a keypress of ‘Z’ for correct matches and ‘N’ for incorrect matches. Each trial would start with the black fixation cross on a white background for 500 ms. The pair of the shape-label was then presented for a span of 100 ms. This pairing could either be matched to the initial association, or it could be a non-matching shape-label combination. There was an equal number of matched and unmatched presentations for each shape-label pairing. The different combinations of shape-label pairings were counterbalanced across participants and presented at random. Immediately after the presentation of the target shape-label pairing for 100ms, a blank frame was presented for 1,200ms within which participants had to respond accurately and as quickly as possible. The flow is as shown in Figure 3.2.

The experimental stage only commenced after the participants had completed 48 practice trials of the task in which response-feedback (‘correct response’/‘incorrect response’/‘no response’) was shown for 500 ms after each trial in the training practice block. There was no response feedback in the test block. After this, each participant performed tests over 240 trials where there were 40 trials in each condition (*Self*–matched and non-matched; *Friend*-matched and non-matched; and *Stranger* matched and non-matched) and thus a total of 240 presentations in the testing-block in which participants recorded their match-judgement responses.

FIGURE 3.2: Experiment Flow for 1A



3.1.2 Results and Discussions

First, we cleaned the data by eliminating responses that were beyond two standard deviations of mean RTs for each category. For our analysis, we used ANOVA or the Analysis of variance which is a statistical analysis approach examining the variations in data to detect the systematic factors that have a statistical influence on the concerned dataset and the random factors that do not. The approach estimates and analyses the differences between the means of two or more variables and determines the possibilities of any statistical differences between the pairs in the same.

When there are two or more factors in an experiment then that experiment is said to have a factorial design. In this experiment, we had two within–subject variables were shape-category (with 3 factors, 'Self', 'Friend', 'Stranger') and match-judgement(with 2 factors, 'matching' and 'non-matching). We thus performed a Shape(3) x Match(2) i.e. 3 x 2 repeated-measures ANOVAs on response times and accuracy. Post hoc comparisons were also corrected using the Holm-Bonferroni method, and Cohen's d values are reported for effect-size measurements.

However, foremost importantly in this context, we also thus first obtained the measures of the descriptive statistics for our categories, i.e. the values of the means and Standard Deviations for RTs and accuracy. For RT, the category with the least mean-value can be said to have been processed faster on average with the lowest mean Response Time than those with larger mean-values. While for accuracy, the category with largest mean-value can be implied to have been processed more correctly on average with highest mean accuracy than those with lower means. Our ANOVA findings will then determine whether any difference or variation in means is statistically significant enough to be considered as credible effects or not.

The mean RTs and mean accuracy data along with their respective Standard Deviations (in brackets) for all the threes Shape Categories and all the two match-judgement conditions in Experiment 1A are shown in Table 3.1.

Table 3.1: Mean (and SD) of Reaction Time and Accuracy for Experiment 1A.

Condition	Category	MeanRT(ms)	Accuracy(%)
Matched	*Self*	621.91(105.08)	93.33 (6.5)
	Friend	675.15(118.07)	80.55 (16.5)
	Stranger	698.01(98.66)	76.94 (16.03)
Unmatched	*Self*	751.29 (98.31)	80.83 (16.26)
	Friend	733.59 (87.04)	82.91 (10.71)
	Stranger	749.823 (92.34)	84.30 (12.31)

Participants were fastest 621.91ms (SD = 105.08ms) and most accurate 93.33% (SD=6.5%) for the *Self*-match condition, and slowest 698ms (SD = 98.66ms) and least accurate 76.94% (16%) for *Stranger*-match condition. In the *Friend*-match condition, the mean RT was 675.15ms (SD = 118.07ms) and accuracy was 80.6 (16.6) %.

The results of the 3 (Shape: *Self, Friend, Stranger*) x 2 (Match: Matched, Non-matched) ANOVAs on Response Time (RT) repeated-measures ANOVA are detailed on both RTs and Accuracy are detailed in Table 3.2.

TABLE 3.2: Anova data for Reaction Time and Accuracy for Experiment 1A.

Metric	Condition	F	p	η_p^2
RT	Shape Category	F(2,34)=4.616	0.017	0.214
	Match Category	F(1,17)=80.96,	<0.001	0.915
	Shape x Match	F(2,34)=11.684	<0.001	0.407
Accuracy	Shape Category	F(2,34) = 5.977	0.006	0.260
	Match Category	F(1,17)=0.274	0.607	0.016
	Shape x Match	F(2,34)=9.477	<0.001	0.358

For the RT analysis, there was a significant main effect of Shape, F(2, 34) = 4.616, p=0.017, η_p^2 = 0.214 and match, F(1,17)= 80.96, p <0.001, η_p^2 =0.826. The interaction between Shape Category and Match was significant, F(2,34)=11.684, p<0.001, η_p^2 = 0.407.
For Accuracy, the main effect of Shape was significant F(2,34)=5.977 and p=0.006, η_p^2= 0.260; but that of Match wasn't significant (p=0.607); the interaction of Shape and Match was found to be significant, F(2,34)=9.477, p<0.001, η_p^2 = 0.358.

The post-hoc analysis revealed that the RTs in the match condition were faster than those in the unmatched condition, across conditions, t(17) = -8.998, p<0.001, d = -2.121. This analysis is in Table 3.3 and discussed thereafter.

TABLE 3.3: Post hoc analysis of accuracy & RT for Experiment 1A.

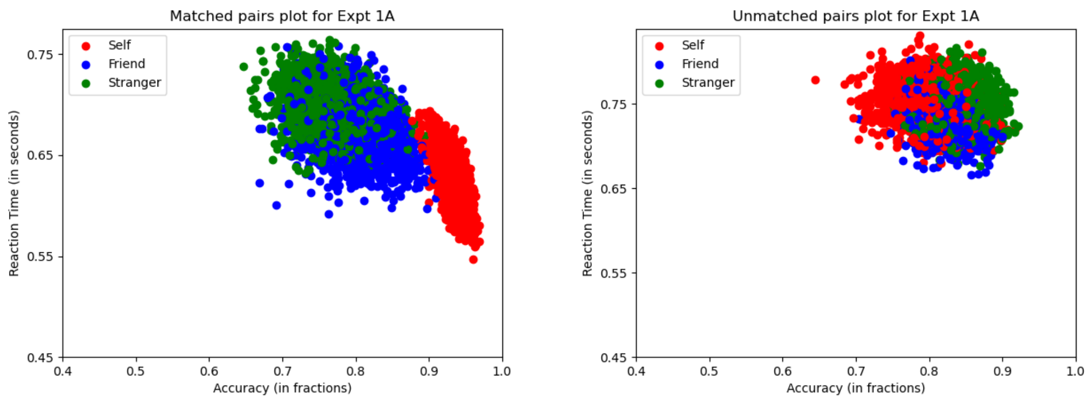
Metric	Difference Between	t	p_{holm}
RT	*Self*Match -*Stranger*Match	t(17) = -5.019	< .001
	*Self*Match -*Friend*Match	t(17) = -3.511	0.006
	*Friend*Match-*Stranger*Match	t(17) = -1.508	0.547
Accuracy	*Self*Match-*Stranger*Match	t(17) = 5.284	< 0.001
	*Self*Match-*Friend*Match	t(17) = 4.12	.002
	*Friend*Match-*Stranger*Match	t(17) = 1.164	1

Further, participants were significantly faster in the Self-matched vs. the Stranger-matched condition, t(17) = -5.019, $p_{holm} < 0.001$ and between the Self-matched vs. Friend-matched condition, t(17) = -3.511, $p_{holm} = 0.006$. However, there was no significant difference between the Friend-matched and the Stranger-matched conditions, t(17) = -1.508, $p_{holm} = 0.547$. We did not find any significant difference between any pair of the unmatched conditions (all p ¿ 0.05).

Participants were significantly more accurate for Self-matches relative to Stranger-matches, t(17)= 5.284, $p_{holm} < 0.001$. Also, participants were significantly more accurate for Self matches relative to Friend-matches, t(17) = 4.12, $p_{holm} = 0.002$. As with the RTs, there was no significant difference in participants' accuracy between Friend -matched and Stranger-matched condition, t(17) = 1.164, $p_{holm} = 1$. Again, we did not find any significance in any of the unmatched conditions with the accuracy data.

For a deeper understanding of the data, like Sui et al. (2012) we also applied the bootstrapped sample mean analysis procedure, to assess the overall effect of combining RTs and accuracy on the central tendencies and distribution of matching judgements in each condition (Davison & Hinkley, 1997). For each participant in each condition, Accuracy and RT were paired into a single data point (x, y) and a bootstrapped data set was created by re-sampling data with replacement, and keeping the sample size as the number of participants. The mean of this bootstrapped data set was plotted as a single point in the distribution (x, y). This was repeated 2,000 times to provide estimates of population mean and variation for each condition. We have plotted the resulting distributions for the matched and unmatched conditions in Figure 3.3.

FIGURE 3.3: Bootstrapped Sample Mean Distribution for Experiment-1A



(Left) Distinct Distribution for Matched-pair. (Right) Indistinct spread for Nonmatched-pairs.

As noticeable, the bootstrapped data shows clear differences between the distributions for *Self*-matches relative to *Friend*-matches and *Stranger*-matches, in that, the *Self*-matches can be seen to be clearly discernible at the bottom right corner of the distribution with the highest accuracy and fastest response times. The *Stranger*-matched responses fall in the upper left locations with higher RT and lower accuracy, while the *Friend*-matched responses are in the middle, even though both the spreads are not clearly distinguishable from each other as also demonstrated in the ANOVA and t-test results.

In addition, we also computed signal detection analytic measures based on the accuracy data to examined sensitivity and bias in response judgments. d'(d-prime) was calculated to indicate a measure of the sensitivity for the 3 categories and the criterion was calculated to determine the response biases towards the same. The d' and criterion values were subjected to 1-way ANOVA with the single within-subjects factor of shape (*Self, Stranger, Friend*). The ANOVA and the consequent post hoc analysis are in 3.4 and Table 3.5 respectively.

Table 3.4: 1 way Anova data for d' and criterion for Experiment 1A.

Metric	*Self*	*Friend*	*Stranger*	Anova on	F (2, 34)	p	η_p^2
d'	2.73(0.22)	2.09(0.24)	2.03(0.23)	Shape	3.48	<0.003	0.296
criterion	0.31(0.06)	-0.01(0.05)	-0.11(0.08)	Shape	10.076	< 0.001	0.372

The effect of Shape was significant here too, F (2,34) = 3.48, p< 0.003, $\eta_p^2 = 0.296$. The d' for *Self*-judgments was significantly higher than that for *Stranger* judgments, t(17)= 3.430, $p_{holm} = 0.005$, d = 0.808. The difference between the *Self*-judgment and the *Friend*-judgments was also significant, t(17) = 3.093, $p_{holm} = 0.012$, d = 0.729. The difference in discriminability between the *Friend* -judgment and the *Stranger*-judgments was not significant, as has been seen already, t(17) = 0.337, $p_{holm} = 0.738$, d = 0.079. The d' analyses show that participants were more sensitive to *Self* vs. *Friend* and *Self* vs. *Stranger* judgments. The higher values for *Self* indicated better performance in the responses with lower misses or false alarms than compared to responses to *Friend* and *Stranger*.

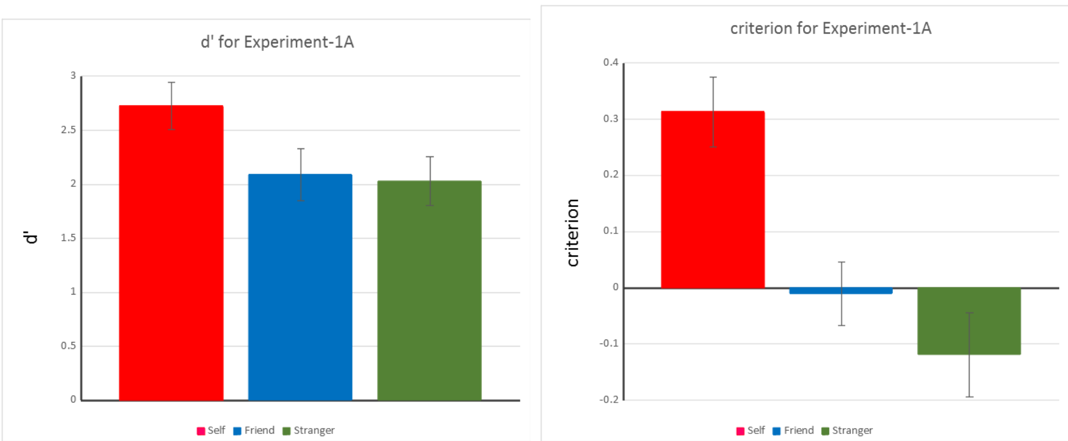
Our one-way ANOVA for criterion values with a single within-subjects factor, Shape (*Self, Friend, Stranger*), found significant a effect, F (2, 34) = 10.076, p<0.001, $\eta_p^2 = 0.372$. In the post-hoc analyses, criterion values were significantly higher for *Self*-judgments compared to *Friend*-judgments, t(17) = 3.233, $p_{holm} < 0.008$, d = .762 and for *Self*-judgments compared to *Stranger*-judgments, t(17) = 4.314, p_{holm}<0.001, d = 1.017. However, we again did not find a significant difference in the criterion values for Stranger-judgments relative to Friend judgments, t(17) = 1.081, $p_{holm} = 0.288$, d = 0.255.

TABLE 3.5: Post hoc analysis of d' & criterion values for Experiment 1B.

Metric	Difference Between	t	p_{holm}	d
d'	*Self* Match-*Stranger* Match	t(17) = 3.430	0.005	0.808
	Self Match-*Friend* Match	t(17) = 3.093	0.012	0.729
	Friend Match-*Stranger* Match	t(17) = 0.337	0.738	0.079
Criterion	*Self* Match-*Stranger* Match	t(17) = 4.314	0.001	1.017
	Self Match-*Friend* Match	t(17) = 3.233	0.008	0.762
	Friend Match-*Stranger* Match	t(17) = 1.081	0.288	0.255

The d' and criterion for *'Self', 'Friend', 'Stranger'* are represented in Figure 3.4

FIGURE 3.4: d' and Criterion for Experiment-1A



(Left) Bar Plot for d' measure with Standard Error bars (Right) Bar Plot for criterion measure with Standard Error bars

All-in-all, in experiment 1A, using the perceptual matching task paradigm as in Sui et al. (2012), we explored the relative difference in Self, Friend and Stranger associations when social salience is attached with just one single individual exemplar from each category. We used a slightly modified stimuli-set than in the original experiment, however, we still observed that our participants' responses were significantly faster and more accurate for the *self*-match judgement responses relative to the responses recorded for *Friend*-matches and *Stranger*-matches. Further, participants were also found to be differentially sensitive to *Self* vs. *Friend* vs Stranger matches, as evidenced by the t-tests and Signal Detection Theoretic measures with d' and criterion. The additional analysis in the respective ANOVA and Signal-Detection Theory tests showed little difference between responses for Friend s and Stranger s. This was similar to Sui et al. (2012)'s findings of no difference between familiar and unfamiliar associations in their Experiment-1. Hence, we were able to successfully replicate the earlier findings with our set of participants and stimuli and thus can be an appropriate starting baseline for our studies.

3.2 Experiment 1B

In Experiment 1B, we sought to investigate whether the self-preferential effect can be generalised to whole stimulus classes with many different exemplars instead of a single individual stimulus instance. such that a social label is familiarised to be associated with all the exemplars of a class of geometric figures of the same type e.g. triangle.

3.2.1 Method

3.2.1.1 Participants

Experiments 1B and 1A had the same set of participants.

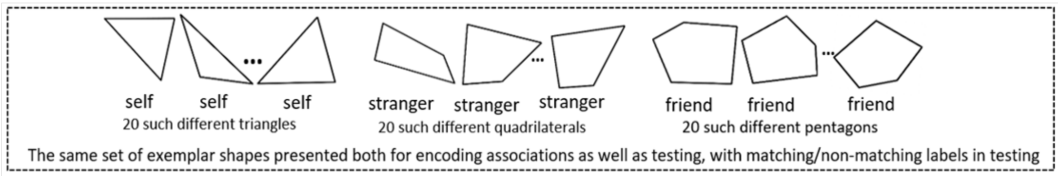
3.2.1.2 Stimuli

The parameters for the stimuli were similar to that of Experiment-1A. However, for Experiment 1B we had a much larger set of stimuli samples. Each social label was randomly paired with one of the three stimulus classes. We used three classes of similar shapes for each of the 3 different stimulus classes of triangle, quadrilateral and pentagon. Some exemplars of stimulus classes are shown in Figure 3.5. In Experiment 1B, each stimulus class consisted of 20 exemplars generated randomly with the same standard variations using MATLAB2016 such that we had 20 unique triangles, 20 unique quadrilaterals and 20 unique pentagons. During familiarisation, all 20 exemplars of a class paired with the social label were shown to the participants. In the test phase, the same stimulus classes were used as target stimuli for the match-recognition task.

3.2.1.3 Procedure

As in Experiment 1A, Experiment 1B also consisted of two stages. In the first association stage, participants underwent a full familiarisation exercise wherein they had to just observe and encode associations of the shape-label pairings (different triangles, quadrilaterals, pentagons with labels of *Self*, *Friend*, *Stranger* as assigned randomly across participants)

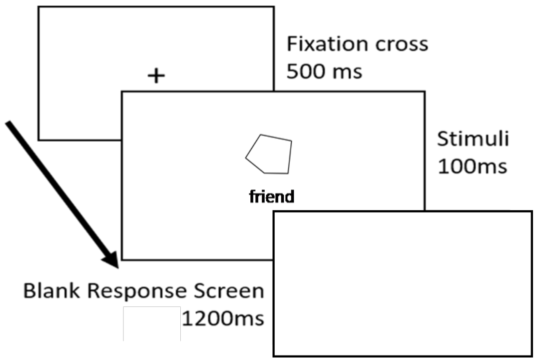
Figure 3.5: Stimuli Set for Experiment-1B



An instance of the sets of 20 possible stimuli of triangles, quadrilaterals, pentagons that can be paired with any of the social labels for a particular participant

that were presented to them individually for 1.5 seconds. The angle, size, visual degrees of stimuli remained like Experiment 1A. All the true shape-label pairings (20 from each shape-label pair category, and thus 60 in all) were shown twice in random order one after another over a total of 120 exposures and the participant was encouraged to attend to all the presented shape-label pairings carefully and encode them in memory.After this, following an initial practice block, participants performed a match-recognition task as in Experiment-1A, but this time over all possible combinations of shape and labels for each of 20 triangles, 20 quadrilaterals and 20 pentagons with each tagged with either of the three labels of *Self*, *Friend*, *Stranger*. There were 80 trials in each condition (*Self*–matched and non-matched; *Friend*-matched and non-matched and *Stranger*-matched and non-matched) arranged randomly with each of the 60 geometric exemplars being tested 4 times for congruent matches and 4 times for incongruent ones. Thus, the participants responded to a total of 480 trials with a short break in between. The shape-label combinations were presented for 100 ms followed by a blank response screen for 1200 ms in which the participant had to indicate their match-recognition judgement by a key-press of either 'Z' (match) or 'N' (no match) respectively.

Figure 3.6: Experiment Flow for 1B



3.2.2 Results and Discussion

The experiment had shape category and match judgement as the two within-subject variables. As in Experiment-1A, for this experiment too, first we cleaned the data by eliminating correct responses of each category that were beyond two standard deviations of the initial RT means. All other analyses of data followed the same processes as in Experiment 1A.

The mean RT and accuracy data for this experiment is shown in Table 3.6. The mean RT for the matching *Self*-label is 690.46 (SD=87.96) ms, and the accuracy was found to be 89.74% (8.22)%. The mean RT for the *Friend* and *Stranger* labels was found to be 716.35 (75.91)ms and 747.43 (94.10) ms, respectively. Similarly, the accuracy for the *Friend* was 85.78% (10.13%) and *Stranger*s processed with 79.29 (11.94)% accuracy.

TABLE 3.6: Mean (and SD) of Reaction Time and Accuracy for Experiment 1B.

Condition	Category	MeanRT(ms)	Accuracy(%)
Matched	*Self*	690.46 (87.96)	89.74 (8.22)
	Friend	716.35 (75.91)	85.78 (10.13)
	Stranger	747.43 (94.10)	79.29 (11.94)
Unmatched	*Self*	792.13(85.89)	82.07 (13.89)
	Friend	789.63 (80.96)	84.46 (10.57)
	Stranger	793.06 (84.01)	83.99 (12.23)

As earlier, we carried out a 3 (Shape:*Self, Friend, Stranger*) X 2 (Match: matched, unmatched) ANOVA on RT and accuracy data of Experiment 1B, which is reported in Table 3.7.

TABLE 3.7: Anova data for Reaction Time and Accuracy for Experiment 1B.

Metric	Condition	F	p	η_p^2
RT	Shape Category	F(2,34)=5.40	0.009	0.244
	Match Category	F(1,17)=184.15,	<0.001	0.915
	Shape x Match	F(2,34)=8.347	0.001	0.329
Accuracy	Shape Category	F(2,34) = 4.93	0.013	0.225
	Match Category	F(1,17)=0.625	0.440	0.035
	Shape x Match	F(2,34)=6.912	0.003,	0.289.

For the ANOVA of RT, significant effect was found for category shape F(2,34)=5.40, p=0.009 $\eta_p^2 = 0.244$ and also a significant effect for match with F(1,17)= 184.15, p <

0.001. η_p^2 =.915. The interaction of the shape category and matching judgement was also significant with F(2,34)=8.347, p= 0.001,η_p^2 = 0.329.

For ANOVAs of accuracy, we found that shape category had significant effect F(2,34) = 4.93 and p= 0.013, η_p^2 = .225. Though the Match Category did not show significance F(1,17)=0.625 and p=.440, interaction of shape category matching judgement was significant, F(2,34)=6.912, p=0.003, η_p^2 = 0.289.

Post hoc analysis showed that participants were significantly faster for match responses compared to the un-matched responses, t(17) = -13.570, $p < 0.001$, d = -3.199. The most-relevant comparisons are as shown in Table 3.8. Participants were significantly faster for *Self*-matches compared to the *Stranger*-matches, t(17) = -5.110, $p_{holm} < .001$. However, the difference between the *Self*-judgment and the *Friend*-judgments was not found to be significant although there was an evident trend with t(17) = -2.322, p_{holm} =.09. Also, participants were significantly faster for '*Friend*' matches relative to '*Stranger*' matches, t(17) = -2.787, p_{holm}= .035. We did not find any significant differences between *Self*, *Friend* and *Stranger* in the unmatched condition.

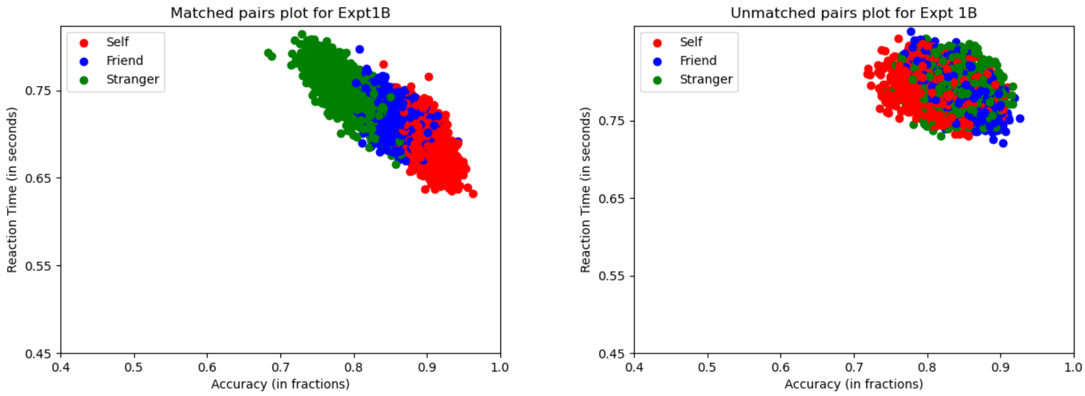
Participants were significantly more accurate for *Self*-matches relative to *Stranger*-matches, t(17) = 4.744, $p_{holm} < 0.001$ but for *Friend* matches relative to *Stranger* matches, the strength of difference was just above significance and again clearly reflected a trend, t(17) = 2.942, p_{holm} = .063. No significant difference in accuracy was found between the *Self*-match and the *Friend*-matched condition, t(17) = 1.801, p_{holm} = 0.685. There were no significant differences in accuracy in the unmatched condition between the *Self*, *Friend* and *Stranger* labels.

Table 3.8: Post hoc analysis of accuracy & RT for Experiment 1B.

Metric	Difference Between	t	p_{holm}
RT	*Self*Match-*Stranger*Match	t(17) = -5.110	< .001
	*Self*Match-*Friend*Match	t(17) = -2.322	.09
	*Friend*Match-*Stranger*Match	t(17) = -2.787	.035
Accuracy	*Self*Match-*Stranger*Match	t(17) = 4.744	< 0.001
	*Self*Match-*Friend*Match	t(17) = 2.942	.063
	*Friend*Match-*Stranger*Match	t(17) = 1.801	0.685

Also, bootstrapped sample means analysis was conducted for this data set by merging the Accuracy and RT performance of Experiment 1B and we plotted the resulting distributions for the matched and unmatched conditions as shown in Figure 3.7. Again it can be noted, that *Self*-match judgments fall in the lower right quadrant of the plot, whereas *Stranger*-category-match judgments fall in the upper left quadrant. The *Friend*-match judgments lie in the middle of the other two distributions.

FIGURE 3.7: Bootstrapped Sample Mean Distributions for 1B



(Left) Distribution for Matched-pair condition showing overlap between *Self* and *Friends* but possible distinction between *Self* and *Strangers*. (Right) An indistinct distribution for Nonmatched-pairs.

Finally, we performed the signal detection analysis and calculated the d' and criterion values for measures of sensitivity and bias in responses to *Self*, *Friend* and *Stranger* judgments. Findings from the 1-way ANOVA with a single within-subjects factor (*Self*, *Friend* and *Stranger*) and the consequent post hoc analysis are presented in Table 3.9 and 3.10 respectively.

TABLE 3.9: 1 way Anova data for d' and criterion for Experiment 1B.

Metric	*Self*	*Friend*	*Stranger*	Anova Criteria	F (2, 34)	p	η_p^2
d'	2.52(.24)	2.37(.23)	2.08(.22)	Shape Type	6.725	0.003,	0.283
criterion	0.19(.05)	0.03(.04)	-0.12(.06)	Shape Cat.	6.636	0.004	0.281

To elaborate, we found a significant effect of shape, F (2, 34) = 6.725, p = 0.003, η_p^2 = 0.283. Post hoc comparisons showed that participants were significantly more sensitive to *Self* vs. *Stranger* judgments, t(17) = 3.597, p_{holm} = 0.003, d = 0.848 and significance with *Friend* vs. *Stranger* judgments, t(17) = 2.417, p_{holm} = 0.042, d = 0.57. We did not find a significant difference in sensitivity between the *Self* vs. the *Friend* judgments, t(17) = 1.180, p_{holm} = 0.246, d = 0.278. The d' analyses show that participants were more sensitive to *Self* vs. *Stranger* and *Friend* vs. *Stranger* judgments. The higher values

TABLE 3.10: Post hoc analysis of d' & criterion values for Experiment 1B.

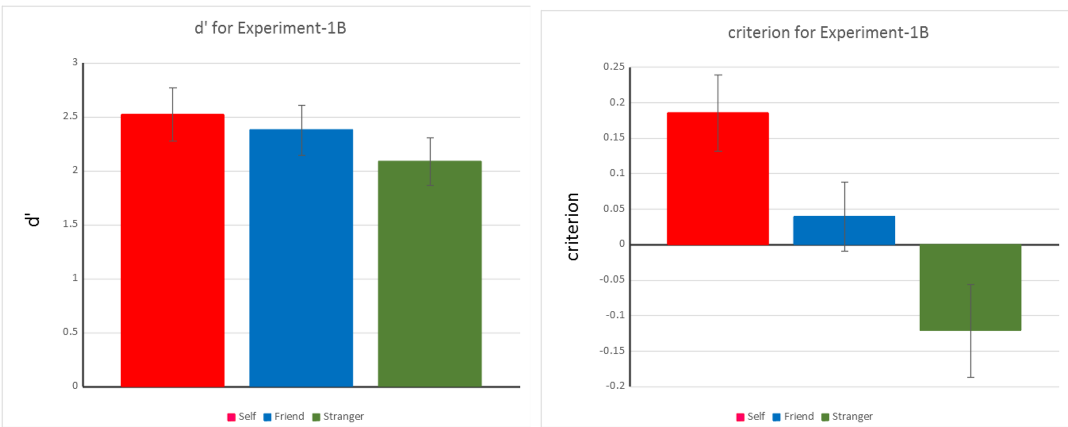
Metric	Difference Between	t	p_{holm}	d
d'	*Self* Match-*Stranger* Match	t(17) = 3.597	0.003	0.848
	Self Match-*Friend* Match	t(17) = 1.180	0.246	0.278
	Friend Match-*Stranger* Match	t(17) = 2.417	0.042	0.57
Criterion	*Self* Match-*Stranger* Match	t(17) = 3.642	0.003	0.858
	Self Match-*Friend* Match	t (17) = 1.734	0.130	0.409
	Friend Match-*Stranger* Match	t (17) = 1.908	.130	0.450

for *Self* indicated better performance in the responses with lower misses or false alarms. However, they were not significantly more sensitive to *Self* vs *Friend* judgments. This provided us with a unique and contrary finding to the pattern previously reported by Sui et al. (2012) and other studies in self-reference relative to *Friend*. It is something that we discuss later.

Similar single within-subjects ANOVA for criterion values also found a significant effect of shape (*Self*, *Friend*, *Strangers*), F (2,34) = 6.636, p =0.004 η_p^2=.281. In the post hoc analyses, criterion values were again significantly higher for *Self*-judgments compared to *Stranger*-judgments, t(17) = 3.642, p_{holm} = 0.003, d = .858. However, for *Friend*-judgments compared to *Stranger*-judgments, t (17) = 1.908, p_{holm} =.130 d = .450 and *Self*-judgments relative to *Friend*-judgments, t (17) = 1.734, p_{holm} = 0.130, d = 0.409 we did not record significant differences in criterion values.

The d' and criterion values as bar graph plots are in Figure 3.8

FIGURE 3.8: d' and Criterion for Experiment-1B



(Left) Bar Plot for d' measure with Standard Error bars (Right) Bar Plot for criterion measure with Standard Error bars

In summary, in Experiment-1B, we explored whether the self-reference effect would generalise to entire stimulus classes. We found that even when social salience of *'Self'* extended to a stimulus class of 20 exemplars, participants still demonstrated faster and more accurate responses for *Self*-matches relative to the responses for *Stranger*-matches. This self-reference prioritisation was significant as measured from ANOVAs and t-tests on RT, accuracy, d' and criterion measures.

Interestingly, for this experiment, participants were also found to be differentially sensitive to *Self* vs. *Friend* vs *Stranger* matches, as revealed by the criterion measure and sensitivity (d'). The response for *Self*-matches were better on average but they were not significantly faster or more accurate relative to *Friend*-matches. Both *Self* and *Friend*-matches tended to be faster and more accurate relative to *Stranger*-matches.

3.3 Comparative Analysis

A comparison of the RTs for *Self*-matches across experiments 1A and 1B, using an paired samples t-test (as reported in Table 3.11 revealed that the participants were significantly slower for *Self*-matches in experiment 1B (690 ms) as compared to experiment 1A (622 ms), t (17) = -4.657, $p < 0.001$, Cohen's d = -1.098. The accuracy for *Self*-matches was also significantly lesser in Experiment 1B than Experiment 1A with t(17)= 2.562, p=0.020 and Cohen's d= 0.604. Moreover, the d' did not reveal a significant difference ($p > 0.05$) but the criterion value was just significantly different (p=0.041). A similar paired sample t test analysis for RT in responses for *Stranger*-match and *Friend*-match across Experiment-1A with Experiment-1B also demonstrated significant statistical difference with t (17) = -2.503, p = 0.023, d = -0.590 for friend-match and t (17) = -4.356, p < 0.001, d = -1.027 for stranger-match respectively. However, the dependent variables of accuracy, d' and criterion values did not reveal a significant difference (p.s. > 0.05) across the two experiments when we applied the same independent samples t-test.

It seems that the results from experiment 1B are slightly different to findings from earlier studies using the *Friend* label as we recorded few variations from other studies especially in participants' sensitivity (d') to *Self* vs. *Friend* judgments when it came to processing and responding to a whole group of explicitly familiarised stimuli. Analyses comparing the *Self*-match condition in the two experiments revealed that possible proximity in discernability in *Self* vs *Friend* responses could be due to the relative drop in the accuracy to *Self*

TABLE 3.11: Comparative Analysis of Expt 1A with 1B with Paired Samples t-Test

Comparison	Group	Metric	t	p	Cohen's d
1A with 1B	*Self*	RT	t(17) = -4.657	< .001	-1.098
		Accuracy	t(17) = 2.562	0.020	0.604
		d'	t(17) = 0.820	0.423	0.193
		criterion	t(17) = 2.209	0.041	0.521
	Friend	RT	t(17) = -2.503	0.023	-0.590
		Accuracy	t(17) = -1.713	0.105	-0.404
		d'	t(17) = -1.374	0.187	-0.324
		criterion	t(17) = -0.617	0.545	-0.146
	Stranger	RT	t(17) = -4.356	< .001	-1.027
		Accuracy	t(17) =-0.666	0.514	-0.157
		d'	t(17) = -0.244	0.810	-0.058
		criterion	t(17) = 0.030	0.976	0.007

matches when participants are required to familiarise association of self-representation with 20 explicit exemplars as in Experiment 1B than just a single individual exemplar associated with the socially-important salience of *Self* as in experiment 1A.

However, what remains constant is that responses to *Self*-associated exemplars remain statistically significant compared to the *Stranger* associated ones across both the experiments thus still signifying special preference for self.

A further puzzle that persists as we compare the responses in the two experiments is whether the participants while associating or judging the presented shape-label pairings in Experiment 1B, are also generalising the presented instance to an abstract shape-category after which they are categorising which class they should classify the stimuli as. One would expect them to then take a larger time in responding to stimuli in Experiment 1B than in Experiment 1A where a label was associated with a single shape. Also, as the judgement in Experiment 1A would not include the cognitive step of generalising from the stimulus shape to the shape class, we do find evidence towards a higher average response time for all 3 shape-categories *Self, Friend, Stranger.* RTs are significantly higher in Experiment 1B.

Indeed, what becomes furthermore critical to find is if the difference between the RT across the two experiments for each of the categories i.e. the supposed delay is due to the possible additional step of abstraction and is same and similar across categories of *Self, Friend, Stranger.* This would be a strong indication that such an abstraction may probably be happening. Our data does point to such an observation. In our ANOVA (as reported in

Table 3.12), we found no significant difference in the across-experiment RT-differences for the three social labels and post hoc analysis (as in Table 3.13) could also not find any in between either of them, essentially implying consistent time-delay being utilised to process stimuli for all the three categories.

TABLE 3.12: Anova data for RT lag across two Experiments for all classes.

Metric	*Self* avg	*Friend* avg	*Stranger* avg	Anova On	F (2, 34)	p	η_p^2
RT-lag	-0.07(0.06)	-0.04(0.07)	-0.05(0.04)	Category	1.799	0.181	0.096

TABLE 3.13: Post hoc analysis of RT lags between Expt1A-1B across 3 categories

Metric	Difference Between	t	p_{holm}	Cohen's d
RT lag	*Self*lag, *Stranger*lag	t(17) = -1.848	0.220	-0.436
	*Self*lag, *Friend*lag	t(17) = -1.293	0.409	-0.305
	*Friend*lag, *Stranger*lag	t(17) = 0.555	0.582	0.131

3.4 General Discussion

The two experiments in this first study investigated the nature of the preferential processing of self-association compared to association with close-other (i.e. *friend*), and distant-other (i.e. *Stranger*) in varying processing contexts. . Our study demonstrates that in both the experiments there were significant advantages in the processing and responses to self-associated stimuli compared to that of strangers as manifested in their Reaction Times and Accuracy as well as the sensitivity (d') and criterion measures for both our experimental settings and participants. Exemplars of Self, whether it be one individual or be it a part of a collective group, are thus observed to be preferentially processed and prioritised by participants who even in the perceptual task with simple geometric shapes have clearly responded better for match-condition judgements of *Self* than for *Stranger*-associated information of even the most abstract and neutral nature.

The response variations recorded for match and non-match conditions reflect the general pattern found in 2AFC tasks, with responses recorded more efficiently in one than the other, as has been discussed as the polarity hypothesis(Proctor & Cho, 2006). Self-Referential advantages, as in Sui et al. (2012) have been consistently reflected significantly more efficiently for Self-associated responses only in match conditions. Series of follow-up studies have reaffirmed evidence for the same with responses not showing evidence of difference between inter-category responses in mismatched conditions, whilst demonstrating evidence of preference for the more social salience in matched-condition responses. Thus, in line with previous findings in related studies, all our critical comparisons are primarily between the 'match' responses across the experiments.

What is also observed on analysis of variances (ANOVAs) of the two experiments over *Self* vs *Friend* vs *Stranger* responses is that there are similar results on the significance of effects of shape, match and their interaction for RTs and accuracies in both the experiments.

Additionally, through the modified-replication of Sui et al. (2012) work in our Experiment-1A, we have also observed that the explicit difference between the sensitivity for *Self*-associated vs.*Friend*-associated was significant as were the differences between *Self*-association and *Stranger*-associations while there was no such difference in *Friend* vs *Stranger* association. The same was for RT, accuracy and criterion measure of responses. These are consistent with many of the previous research findings like that of Sui et al. (2012) and others that have reflected a preference for *Self*, relative to *Friend* (Jiang et al., 2019).

In Experiment-1B however, as we moved beyond the association of salience with a single exemplar to then having to establish an association with 20 shape-label associations for each category, we did notice some interesting variations in responses. As in Experiment-1A, we again recorded the significant effect of shape-category, match judgement and their interactions for Reaction Times, as well as recorded significance in shape-category, and the interaction of shape-category with match-judgement for accuracy. We also found a significant effect of shape for measures of sensitivity (d') and criterion values in Experiment-1A and Experiment-1B indicating that participants were indeed able to extend processing preferences and advantages to exemplars associated with the more salient labels, whether it be one individual exemplar or a collective group of similarly familiarised stimuli. In variables of accuracy, RT, d', the criterion in the post hoc analysis of Experiment-1B, we recorded responses to *Self*-associated exemplars to be significantly better than for *Stranger*-associated ones, however when compared to *Friend*-associations the differences were not significant.

While the differences between *Self* and *Friend* responses were significant when associated with single individual exemplars as in Experiment-1A, the observation of reduced (non-significant) differences in the processing for *Self*-associated and *Friend*-associated stimuli in our second experiment (Experiment-1B) is interesting. Part of the reason for such a pattern of findings may have to do with the fact, that the associations with these socially –

salient labels had to be formed with a larger collective of explicitly familiarised exemplars, not just a single individual exemplar as in Experiment-1A. The extra effort and the one-to-many mapping in this experiment may have led to an attenuated performance in terms of RTs and accuracy for all three labels. It is heartening therefore that the bias for self sustains at least in comparison to stranger-associated information, even in Experiment 1B.

The pattern of results that we have obtained is in line with our expectations, given the collectivistic nature of the Indian society (Li et al. (2006); Kapoor et al. (2003)), whereby a higher social salience may be allocated to not only the 'Self ' but also to close others e.g. family members or friends etc.

Liu and Sui (2016), while exploring the attentional processing of socially salient perceptual targets, had argued how social salience is the most important factor in modulation of attentional selection of target exemplars. They argued about the fact that the proximal importance to the associations with the social labels of Self and Friend can result in a lessening of the effects of self-preferential association depending on the contexts within which such processing happens.

Indeed, the increased RTs in Experiment 1B compared to Experiment 1A may indicate the possibility that subjects may have been using an intermediate abstraction step in Experiment 1B. This abstraction may have been formed during their association-learning stage. This can be experimentally validated if generalisation can induce any form of abstraction that can even go on to even attribute preference. All these reasons implied an interesting exploratory possibility for the next step which we have taken up to investigate in our next experiments testing the consequences of perceptual judgements when being tested with an unfamiliarised set of stimuli.

The critical takeaway, however, from experiment 1B is the finding that preference in processing can actually be generalised from one specific stimulus to a larger set of stimuli. Also, we noted that self-associated processing is influenced by the nature and constitution of the other categories that constitute the context of self–reference; as indicated by increased RTs and lowered accuracy in Exp 1B, thus highlighting the role of contexts in shaping the dynamics of self-related advantages which then also affects the consequent evaluation of salience associated with the respective social-categories. Similar findings regarding the influence of context have also been reported by Verma et al. (2021)

Finally, the caveats thrown up by the findings from these experiments necessitated further research to explore and re-validate the effects of varying social salience in self-referential processing and consequent advantage in responses through perceptual and attentional processing through a variety of tasks that can ascertain the scope and nature of the influences of social contextual variation in which the processing is situated.

Chapter 4

Me & Mine- Prioritization of the Entire 'Self-group'

The findings described in Chapter 3, demonstrated that participants significantly prioritise the processing of self-associated stimuli compared to those associated with labels *friend* and *stranger*, even when associations were made with an entire class of shapes with 20 exemplars. Such evidence implies that one was able to extend the benefits of preferential processing for self to an entire group of stimuli.

An extension of that enquiry, however, raises the natural question about whether the benefits of self-preferential processing extends to stimulus categories defined by certain rules or arbitrarily. These rules could be simple (for example the socially salient association (say for self, or friend) could be extended to all 3-sided figures (triangles)) - or the rules could be relatively more complex, composed of a combination of criteria (for example, 3-sided, red figures (red triangles)). Indeed, we are aware that individuals in the world not only utilise one but several criteria for categorisation in real settings (Liberman, Woodward, et al., 2017) and use the same to organise their social interactions.

If individuals are indeed able to extend the learned associations to entire categories; it would imply that in experimental paradigms such as the one used Sui et al. (2012), exposure to only a limited number of exemplars can still induce prioritised processing of potentially innumerable (or at least a very large number of) exemplars. In the same vein, it could be asked whether participants are similarly sensitive to not just variations of isolated rules (say the number of vertices or type of colour) but multiple such rules (say, both the filled colour and the number of vertices) existing independently or the two in conjunction to actively distinguish self–relevant shapes from other–relevant shapes. Though only Schäfer et al. (2016) has explored self-prioritisation from feature-conjunction of specific coloured shapes, there has been no exploration to empirically demonstrate these benefits from generalised self–referential processing to all unique attribute-sharing exemplars across various domains. Further insights in these may help in experimental demonstration of how individuals may pick up seemingly simple rules to categorise stimuli in social settings.

Hypothetically, if participants indeed were associating social preference to feature-rules which are common to the familiar exemplars, they would also then show significant self-preference priority when the subjects are exposed to be tested with a much wider set of unique unfamiliarised exemplars of the particular exemplar class. But to sum up, we were interested in empirically investigating (a) whether participants simply make associations with specific familiar exemplars, or whether they learn to categorise based on abstract rules (such as visual features), thus consequently (b) whether the self–referential advantage can then be extended beyond the familiar exemplar to the entire category of the target stimulus (say all triangles, quadrilaterals, pentagons or all shades belonging to the family of cyan, yellow, magenta) and finally, (c) whether such generalisation and preference continue to hold when target exemplars go beyond simple independent features to more complex conjunction of features (say a filled colour and number of vertices, e.g. a yellow quadrilateral).

To investigate these questions, across the three separate stages of this experimental study, we duly familiarised a set of participants with specific shape stimuli or specific colour stimuli in the association phase but exposed them to a larger set of previously unseen exemplars from each of the categories in the test phase. We also validated through coloured-shapes if participants can continue to categorise and prioritise when the presented exemplars varied with the conjunction of the two rules of categorisation viz. colour and number of vertices. The experiments equipped us to test the questions outlined above and make conclusions about whether participants were forming broad and explicit associations with all the presented or familiarised exemplar-label pairs or were in-fact learning rules for the association, categorisation, and consequently prioritisation of even novel stimuli. The findings indicate the latter to be true, which are discussed later in more detail.

In the current study, we systematically put these ideas to test in a series of experiments, i.e., 2A, 2B, and 2C. Indeed, a mechanism that allows for the generalisation of these associations may also be responsible for consequent prioritisation for such categories. The same mechanism may also underlie the findings of an ecological parallel of in-group favouritism/bias for all or most of its members (say all males, or all females) (Akrami et al., 2011).

4.1 Second Experiment

Here, we describe three experiments i.e., 2A, 2B and 2C. In experiment 2A we study whether the self-preference effect generalises to a category defined by a simple rule in the shape domain. This is an extension of experiment 1B where in the familiarisation phase participants were shown only a small subset (3 in number) of the larger collective of possible stimuli as paired with the social label. The difference here is that the test phase will include stimuli that have not been seen in the training phase, unlike in Experiment 1B where all 20 exemplars of a shape category were shown to the participants. In experiment 2B we study whether the effect generalises to a different category defined by colour. Finally, in experiment 2C we study whether the effect generalises to a slightly more complex rule defined by the conjunction of the rules followed in the previous two experiments, i.e. rules defining shape (Exp 2A) and colour (Exp 2B). Figure 4.1 gives instances of the stimulus sets in the three experiments.

We expect, based on the results from Experiment 1B that we should see significant self-preference in each of the three experiments.

4.2 Experiment 2A

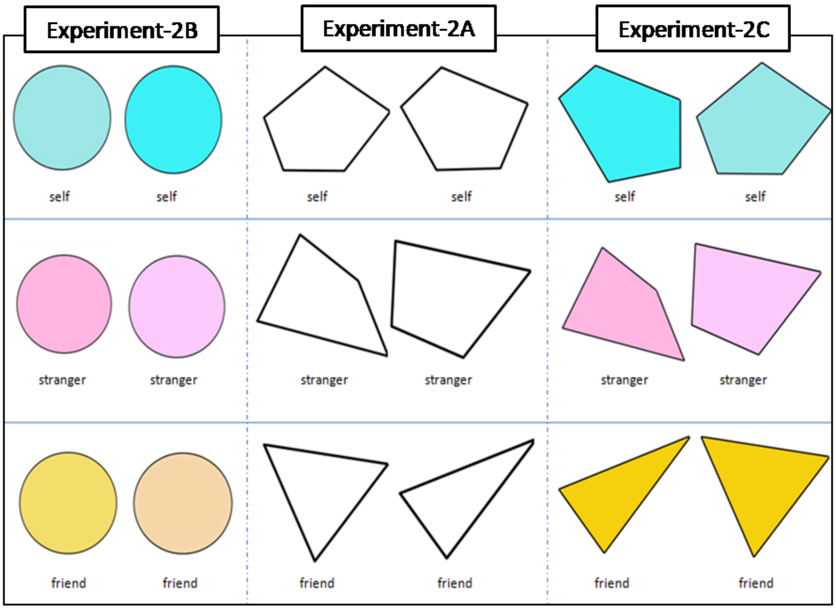
In Experiment-2A we test whether the Self Reference Effect persists when the associated exemplars and target exemplars belong to the same stimulus category (triangle or quadrilateral or pentagons i.e. the same number of vertices or number of edges), although the target exemplars have never been explicitly associated with the social labels.

4.2.1 Method

4.2.1.1 Participants

The sample size adequate for this experiment was estimated to be 18, as in Experiment-1, which we based on a 3 x 2 within-subjects ANOVA structure, for an effect size of $\eta^2 =$

FIGURE 4.1: Stimuli-types for the 3 different studies (2A, 2B, 2C) in Experiment-2



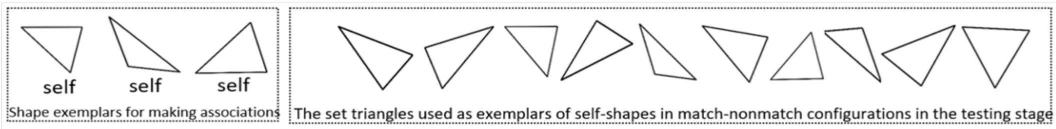
Instances of the type of stimuli used for the studies in Experiment-2. Samples of just 2 exemplars are shown from the stimulus set. In Experiment-2A (Middle), families of 3 kinds of geometric shapes (triangle, quadrilateral, pentagon) are used associated with the social labels. (left) In Experiment-2B, coloured patches of different shades of 3 primary triadic colours (Cyan, Magenta, Yellow) are used. In Experiment (2C) where there is the conjunction of two rules for exemplars, families of coloured shapes of different geometries and colours are used. Cyan Triangle associated with *Self*, Magenta Quadrilateral associated with *Stranger* and Yellow triangles associated with *Friend* is an example.

0.37 from Experiment 1 of Sui et al. (2012), power = 0.9, $\alpha = 0.05$, using G*Power 3.1 software (Faul et al., 2007). Our participants for Experiment-2A, as well as 2B and 2C, were 20 college students of Indian Institute of Technology, Kanpur (two women; 19 to 32 years of age, M=25.25 $\pm$2.78). All except one of the participants were right-handed. All had normal or corrected-to-normal vision. Informed consent was obtained from all before the experiment according to procedures approved by the institute ethics committee. All the participants were duly compensated for time spent participating in the experiment.

4.2.1.2 Stimuli

Triangles, Quadrilaterals and Pentagons were chosen as geometric shape stimuli for this experiment. There were 10 variations of each of the 3 kinds, all of whom were different from other exemplars of the same shape-category conforming to the same standards across the groups. All the shapes were generated in MATLAB2016. An instance of the stimuli set is shown in Figure 4.2. The geometric shapes (one either from the 10 triangles, 10 quadrilaterals, or 10 pentagons) each 3.8 x 3.8 degrees of visual angle, were presented above a fixation cross (0.8° × 0.8°) displayed at the centre of the screen against a white background. The labels (*'Self', 'Friend', 'Stranger'*) (3.1/3.6 x 1.6 degrees) with associated shapes counterbalanced across subjects was displayed below the fixation cross. Distance between the centre of the word or the shape and fixation-cross was around 3.5°. All stimuli were shown against a white background. All stimuli are generated using MATLAB and displayed on a white background on a 24" 120 Hz monitor on which the experiment was run. The experiment was coded and run on python 3.7 using the PsychoPy library as GUI.

FIGURE 4.2: Stimuli Set for Experiment-2A



Families of Geometric-shape Exemplars of triangles, a limited subset of which has been pre-familiarised with associations of *Self* (Left) while the actual match recognition task is then performed on a much larger collection of exemplars, even novel ones, sharing the same defining feature. Similarly, there will be similar families of different quadrilateral and pentagons respectively associated with 'Friend' or '*Stranger*s'.

4.2.1.3 Procedure

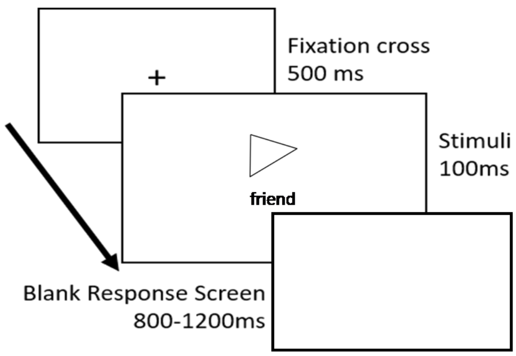
This experiment, like the previous ones, had two stages: the association learning stage and then the testing stage. In the association-learning stage, participants were exposed to a screen on which there was a visual presentation of a very limited subset (three in number) of the three categories of geometric shapes (triangle, quadrilateral, and pentagon) attached with either one of the *'Self', 'Friend', 'Stranger* labels. The exemplar-label pairings were randomised and counterbalanced across participants. Likewise, the randomised pairing presented to a particular participant at this stage is the congruent matched pairing for that particular participant. The participant is encouraged to properly encode and remember the presented exemplar-label associations before moving ahead to the testing (match-judgement) stage.

In the match-recognition test, the participants were asked to respond to fast presentations of various exemplar-label pairs (shapes above, and labels below the fixation cross) and judge whether the presented pairing matched the original associations or not. The presented exemplars were from a larger class with unfamiliarised exemplars of the shape—categories, each tagged with either the congruent or the incongruent social label from Self, Friend, Stranger. Participants had to respond with the keypress of 'Z' (match) and 'N' (not matched) using a keyboard connected to the display monitor and judge whether the displayed pair was congruent or not when compared with the previously learned associations.

The experiment's progression was similar to that in Experiment-1. Each trial would start with a black fixation cross on a white background for 500 ms. The shape-label pair was then presented for 100 ms. This pairing could either be congruent or incongruent. The different pairings were counterbalanced across participants and presented at random. Immediately after stimulus presentation, a blank frame was shown for a random duration between 800- 1200ms within which the participant had to respond accurately and quickly with a judgement. The flow of the test stage is shown in 4.3

The main match-recognition test stage commenced after a participant completed 48 practice trials of the task. Feedback ('correct'/ 'incorrect'/ 'no response') was shown for 500 ms after each presentation in the training practice blocks but not in the test block itself. After this, each participant performed the test over 240 trials with 40 trials in each condition (*Self*–matched, non-matched; *Friend*-matched, non-matched and *Stranger* matched, non-matched).

FIGURE 4.3: Experiment Flow for 2A



4.2.2 Results and Discussion

The analysis was the same as in Experiment 1. We cleaned the data by eliminating correct responses of each category that were beyond two standard deviations of the initial RT means. Experiment-2 had Target-category (Shape, in Expt 2A) and Match-judgement as two within-subject variables. Within the shape category, three variable ANOVAs were performed on Response Times and Accuracy. Post-hoc comparisons are corrected using the Holm-Bonferroni method and Cohen's d value is reported. The mean RTs (and SD)

TABLE 4.1: Mean (and SD) of Reaction Time and Accuracy for Experiment 2A.

Condition	Category	MeanRT(ms)	Accuracy(%)
Matched	*Self*	512.27 (111.88)	85.37 (12.28)
	Friend	574.73 (127.11)	68.87 (24.52)
	Stranger	585.95 (130.20)	62.75 (25.42)
Unmatched	*Self*	629.02 (136.70)	68.12 (17.35)
	Friend	633.06 (150.23)	72.62 (15.14)
	Stranger	608.72 (139.6)	73.00 (17.53)

and accuracy data for experiment 2A are shown in Table 4.1. Participants were fastest 512.27 (111.88) ms and most accurate 85.37 (12.28) % for the *Self*-match condition, and slowest 585.95 (130.20)and least accurate 62.75 (25.42) % for *Stranger*-match condition. In the Friend-match condition, the mean RT was 574.73 (127.11) ms and accuracy was 68.87 (24.52) %.

For this experiment too, we carried out the 3 (Shape: *Self, Friend, Stranger*) x 2 (Match: matched, unmatched) ANOVAs on response times (RT) and accuracy as in Table 4.2. The post-hoc analysis is shown in Table 4.3.

TABLE 4.2: Anova data for Reaction Time and Accuracy for Experiment 2A.

Metric	Condition	F	p	η_p^2
RT	Shape Category	F(2,38) = 4.697	0.015	0.198
	Match Category	F(1,19)=44.394	0.001	0.700
	Shape x Match	F(2,38)=12.448	0.001	0.396
Accuracy	Shape Category	F(2,38) = 6.836	0.003	0.265
	Match Category	F(1,19)=0.092	0.765	0.005
	Shape x Match	F(2,38)=11.354	<0.001	0.374

With RTs, there was a significant main effect of Shape, F(2,38) = 4.697, p = 0.015, η_p^2 = 0.198 and match, F(1,19)=44.394, p<0.001, η_p^2 = .700. The RTs in the match condition were faster than those in the unmatched condition, t(19) = -6.663, p <0.001, d = -1.490. The interaction between shape and match was significant, F(2,38)=12.448, p< 0.001, η_p^2 = .396. Participants were significantly faster in the *Self*-matched vs. the *Stranger*-matched condition, t(19) = -4.940, p_{holm} <0.001. Unlike Experiment-1B, we found significant effect for the *Self*-matched vs. the *Friend*-matched condition, t(19) = -4.187, p_{holm} < 0.001. However, there was no significant difference between the *Friend*-matched and the *Stranger*-matched conditions, t(19) = -0.752, p_{holm} =0.908. We did not find a significant difference between any pair of unmatched conditions (all p > .05).

For ANOVAs of accuracy, shape category was significant F(2,38) = 6.836 and p= 0.003., η_p^2= .265. Even though the main effect Match Category wasn't significant (p=0.765), interaction of shape category and matching judgement was significant F(2,38) = 11.354, p<0.001, η_p^2 = .374

Participants were significantly more accurate for *Self*-matches relative to *Stranger*s-matches, t(19)=5.823, $p_{holm} < 0.001$, as well as significantly more accurate for *Self*-matches relative to *Friend*-matches, t(19) = 4.247, $p_{holm} < 0.001$. As with the RTs, there was no significant difference in participant's accuracy between *Friend*-matched and *Stranger*-matched condition in this task, t(19) = 1.576, $p_{holm} = 0.954$. As with RT data, we did not find any significant difference between any of the unmatched conditions with the accuracy data.

Table 4.3: Post hoc analysis of Accuracy & RT for Experiment 2A.

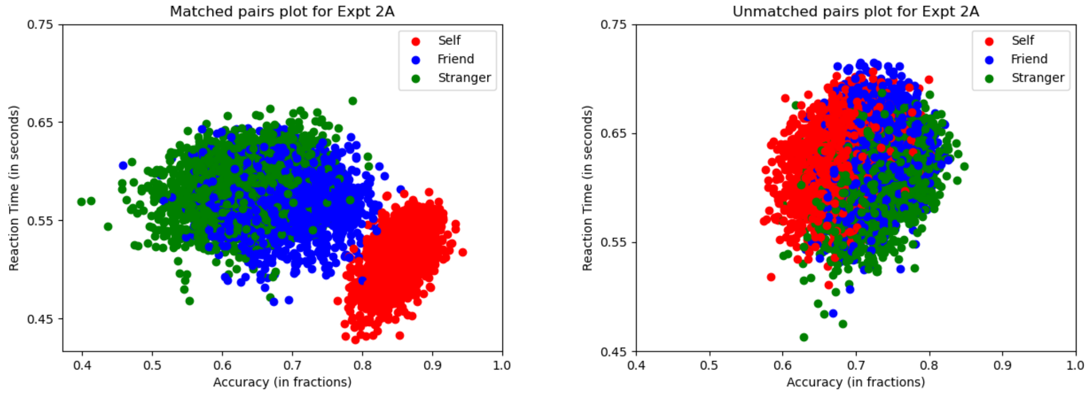
Metric	Difference Between	t	p_{holm}
RT	*Self*Match - *Stranger*Match	t(19) = -4.940	< 0.001
	*Self*Match - *Friend*Match	t(19) = -4.187	< 0.001
	*Friend*Match - *Stranger*Match	t(19) = -0.752	0.908
Accuracy	*Self*Match - *Stranger*Match	t(19)=5.823	< 0.001
	*Self*Match - *Friend*Match	t(19) = 4.247	< 0.001
	*Friend*Match - *Stranger*Match	t(19) = 1.576	0.954

We performed the bootstrap sample mean analysis repeated 2,000 times to provide estimates of population mean and variation for each condition. We have plotted the resulting distributions for the matched and unmatched conditions in the figure below. The bootstrapped plot in Figure 4.8 shows that the self-match is discernible relative to the *Friend*-match and *Stranger*- match conditions.No such difference within categories is observed for the non-match cases for which the distributions largely overlap.

Again, we did SDT (signal detection theory) analyses for accuracy data to get a measure of sensitivity and response bias. We calculated d' and criterion values for *Self*, *Friend*and *Stranger* judgments across participants and carried out a 1-way ANOVA with a single within-subjects factor, Target Category (*Self, Friend, Stranger*). We report the findings in Table 4.4 and the post hoc analysis in Table 4.5 and present the values in a bar plot in Figure 4.5.

The effect of shape was significant, F (2,38) = 6.7999, p = 0.003, η_p^2 = 0.264. The d' for *Self*-judgments was significantly higher than that for *Stranger* judgments, t(19) = 3.623, p_{holm} = 0.003, and its difference with *Friend*-judgements was also significant at t(19) = 2.405, p_{holm} = 0.042. The difference in discriminability between the *Friend*-judgment and

FIGURE 4.4: Bootstrapped Sample Mean Analysis Distributions of Experiment-2A



(Left) Distribution for Matched-pair condition with distinct distribution for *Self* relative to others. (Right) An indistinct distribution for Nonmatched-pairs.

TABLE 4.4: 1 way Anova data for d' and criterion for Experiment 2A.

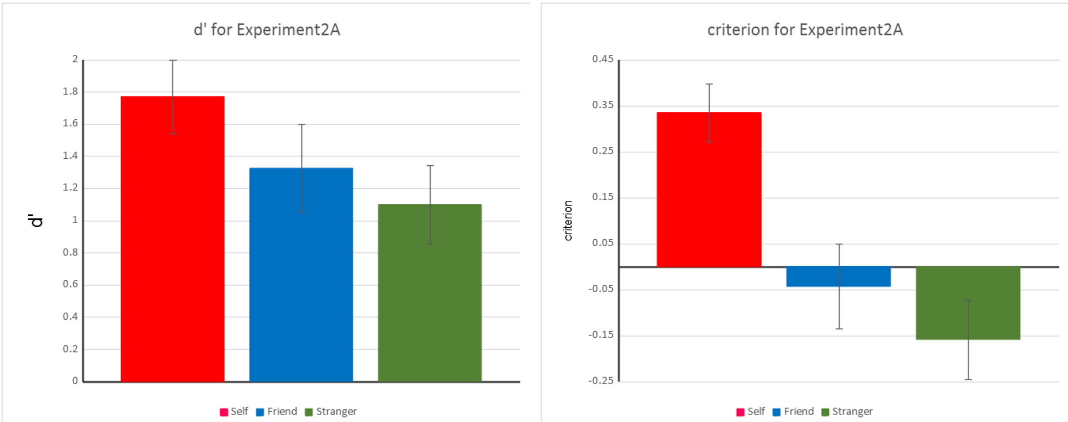
Metric	*Self*	*Friend*	*Stranger*	Anova Criteria	F (2, 38)	p	η_p^2
d'	1.76(.23)	1.32(.27)	1.09(.24)	Shape Type	6.799	0.003	0.264
criterion	0.33(.06)	-0.04(.09)	-0.15(.08)	Shape Cat.	15.325	<0.001	0.446

TABLE 4.5: Post hoc analysis of d' & criterion values for Experiment 2A.

Metric	Difference Between	t	p_{holm}	Cohen's d
d'	*Self* Match - *Stranger* Match	t(19) = 3.623	0.003	0.810
	Self Match - *Friend* Match	t(19) = 2.405	0.042	0.538
	Friend Match - *Stranger* Match	t(19) = 1.218	0.231	0.272
Criterion	*Self* Match - *Stranger* Match	t(19) = 5.292	<0.001	1.183
	Self Match - *Friend* Match	t(19) = 4.054	<0.001	0.907
	Friend Match - *Stranger* Match	t(19) = 1.238	0.223	0.277

the *Stranger*-judgments was not significant, t(19) = 1.218, $p_{holm} = 0.231$. The d' analyses show that participants were more sensitive to *Self* vs. *Friend* and *Self* vs. *Stranger* judgments with lower misses or false alarms indicated by a higher d' value for the more salient label The criterion values for the *Self*, *Friend* and *Stranger* judgments from a similar ANOVA with a single within-subjects factor of shape-association (*Self, Friend, Stranger*) demonstrated a significant effect of shape (*Self, Friend, Stranger*), F (2, 38) = 15.325, $p < 0.001$, $\eta_p^2 = 0.446$. In the post-hoc analyses, criterion values were significantly higher for *Self*-judgments compared to *Stranger*-judgments, t(19) = 5.292, $p_{holm} < 0.001$, and for *Self*-judgments compared to *Friend*-judgments, t (19) = 4.054, $p_{holm} < 0.001$. However, no significant difference was observed in the criterion values for *Stranger*-judgments relative to *Friend*judgments, t (19) = 1.238, p_{holm} = 0.223.

FIGURE 4.5: d' and Criterion for Experiment-2A



(Left) Bar Plot for d' measure with Standard Error bars (Right) Bar Plot for criterion measure with Standard Error bars

We found *Self* associated RTs were significantly faster and more accurate than both *Friend* and *Stranger*s.

4.3 Experiment 2B

In Experiment-2B we investigate whether there is self-preference when the stimulus class varies only in the colour domain (note that in Experiment 2A variation was in the domain of shapes) domain. The colour varies between shades of cyan, magenta, yellow. As in experiment 2A, participants will need to make associations with hitherto unexposed/unfamiliarised stimuli in the test phase, which would belong to the same category as the exposed stimuli based on one rule, that of having the same colour.

4.3.1 Method

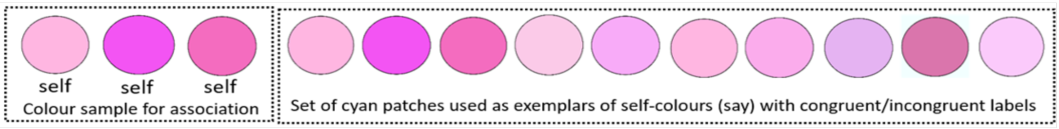
4.3.1.1 Participants

The participants of Experiment 2A also participated in Experiment 2B.

4.3.1.2 Stimuli

Circular coloured patches of different shades of the three colours cyan, magenta and yellow were chosen as the visual stimuli for this experiment. There were 10 variations of each of the 3 kinds, (hex-codes as obtained from https://www.colourhexa.com/) with all of them different from the other exemplars of the same colour-category conforming to the same standards of equidistant limits across the groups as the luminosity was controlled by the colourimeter. All the circular coloured patches were generated in MATLAB2016. One colour patch from either of the colour categories (from the 10 shades of cyan, 10 shades of magenta, or 10 shades of yellow) each 3.8 x 3.8 degrees of visual angle, was presented above a fixation cross (0.8° × 0.8°) displayed at the centre of the screen against a white background. The label (*'Self'*, *'Friend'*, or '*Stranger*' (3.1/3.6 x 1.6 degrees)), with associated shapes counterbalanced across subjects, was displayed below the fixation cross. The distance between the centre of the word and the coloured patch and fixation-cross was around 3.5°. All stimuli were shown against a white background. All stimuli were generated using MATLAB and displayed on a white background on a 24" 120 Hz monitor. The experiment was coded and run on Python 3.7 using the PsychoPy library for the GUI. An instance of the stimulus set is shown in Figure 4.6

FIGURE 4.6: Stimuli Set for Experiment-2B

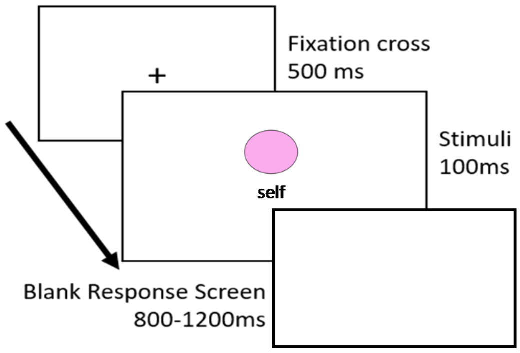


Family of coloured-patch exemplars of magenta shades. A limited subset was used for pre-familiarised associations (Left) while the actual match recognition task was performed on a much larger collection of exemplars, even novel ones, sharing the same defining feature.

4.3.1.3 Procedure

This experiment has the same structure as Experiment 2A. In the association stage, participants were exposed to a very limited subset of the three classes of colour-stimuli (cyan, magenta, yellow) attached with one of the *'Self', 'Friend', 'Stranger'* labels. These randomised and counterbalanced pairings were to be treated as the congruent pairing for the particular participant in question. The experimenter encouraged participants to properly encode and remember the presented associations before moving ahead to the testing match-judgement stage. After the participants confirmed that they properly remembered the associations, the participants were asked to respond to fast presentations of various congruent or incongruent colour-label pairs (coloured patches above, and labels below the fixation cross) and judge whether the presented exemplar-label combination matched the original associations or not. The presented colours were from the larger family of unseen exemplars of the colour—categories, each tagged with a congruent or incongruent social label chosen from *'Self'*, *'Friend'*, *'Stranger'*. Participants responded with the keypress of 'Z' (for a match) and 'N' (for no-match) using a keyboard connected to the display monitor. The progression of the experiment was the same as Experiment 2A. Each trial would start with the black fixation cross on a white background for 500 ms. The pair of exemplar-label was then presented for a span of 100 ms. This pairing could be congruent or incongruent with the initial association. The different pairings were counterbalanced across participants and presented at random. Immediately after stimulus presentation for 100ms, a blank frame was shown for a random duration between 800-1200ms in which participants had to respond accurately and quickly. The test stage commenced after the participants completed 48 practice trials of the task. Feedback ('correct'/'incorrect'/'no response') was shown for 500 ms after each presentation in the training practice blocks but not shown in the test block itself. After this, each participant performed tests over 240 trials where there were 40 trials in each condition arranged and presented in random order (*Self*–matched, non-matched; *Friend*-matched, non-matched and Stranger matched, non-matched). The flow of the experiment is shown in Figure 4.7.

FIGURE 4.7: Experiment Flow for 2B



4.3.2 Results and Discussion

We followed the same procedures for cleaning and analysis of data as in Experiment 2A. For Experiment 2B, as shown in Table 4.6 we observed that participants were again the fastest 478.74 (115.36) ms and most accurate 84.00% (SD=6.5%) in responding to stimuli in the *Self*-match condition, and slowest 550.77 (162.50) ms and least accurate 66.25 (22.68) %

for the *Stranger*-match condition. For the *Friend*-match the mean RT was 527.61 (140.35) ms and accuracy was 74.00 (22.39) %.

TABLE 4.6: Mean (and SD) of Reaction Time and Accuracy for Experiment 2B

Condition	Category	MeanRT(ms)	Accuracy(%)
Matched	*Self*	478.74 (115.36)	84.00 (19.72)
	Friend	527.61 (140.35)	74.00 (22.39)
	Stranger	550.77 (162.50)	66.25 (22.68)
Unmatched	*Self*	589.41 (154.89)	71.87 (15.15)
	Friend	586.47 (153.89)	70.25 (18.19)
	Stranger	586.97 (154.43)	74.25 (19.89)

A 3x2 ANOVA with within-subjects factor Target-category (by Colour in Experiment 2B)(*Self, Friend, Stranger*) and match condition(Match,Non-matched) is shown in Table 4.7. There was a significant effect of Type category for RT's, F(2,38) = 5.596, p=0.007, η_p^2 = 0.228 and also for the match condition F(1,19)=44.836, p=0.000, η_p^2 =0.702. The RTs in the match condition were faster than those in the unmatched condition, t(19) = -6.696, $p_{holm} < 0.001$, d = -1.497. The interaction of the Type category and the matching judgement also had a significant effect with F(2,38)=6.021, p= 0.005. η_p^2 = 0.241. We also conducted a post-hoc analysis (shown in 4.8) to check for the factors behind the statistical significance. Participants were significantly faster in the *Self*-matched vs. the *Friend*-matched condition, t(19) = -3.202, p_{holm} = 0.016. and between the *Self*-matched vs. the *Stranger*-matched condition, t(19) = -4.720, $p_{holm} < 0.001$. However, there was no significant difference between the *Friend*-matched and the *Stranger*-matched conditions, t(19) = -1.518, p_{holm} =0.533. We did not find any significant difference between any pair of unmatched conditions (all p > .05).

For the ANOVAs with accuracy, type category had a significant effect F(2,38)=6.44 and p= 0.004 η_p^2 = 0.253. Even though Match Condition was not significant (p=.517), the interaction of the type category and matching judgement was again significant, F(2,38) = 9.252, p<0.001 η_p^2 = 0.327. Participants were significantly more accurate for *Self*-matches relative to *Stranger*-matches, t(19) = 5.475, $p_{holm} < 0.001$. Also, participants were found to be significantly more accurate for *Self* matches relative to *Friend*-matches, t(19) = 3.085, p_{holm}=0.04. As with the RTs, there was no significant difference in participant's accuracy between *Friend*-matched and the *Stranger*-matched response, t(19) = 2.391, p_{holm} = 0.212.

Table 4.7: Anova data for Reaction Time and Accuracy for Experiment 2B.

Metric	Condition	F	p	η_p^2
RT	Type Category	F(2,38) = 5.596	0.007	0.228
	Match Category	F(1,19)=44.836,	0.000	0.702
	Type x Match	F(2,38)=6.021	0.005	0.241
Accuracy	Type Category	F(2,38) = 6.44	0.004	0.253
	Match Category	F(1,19)=0.436	0.517	0.022
	Type x Match	F(2,38)=9.252	<0.001,	0.327

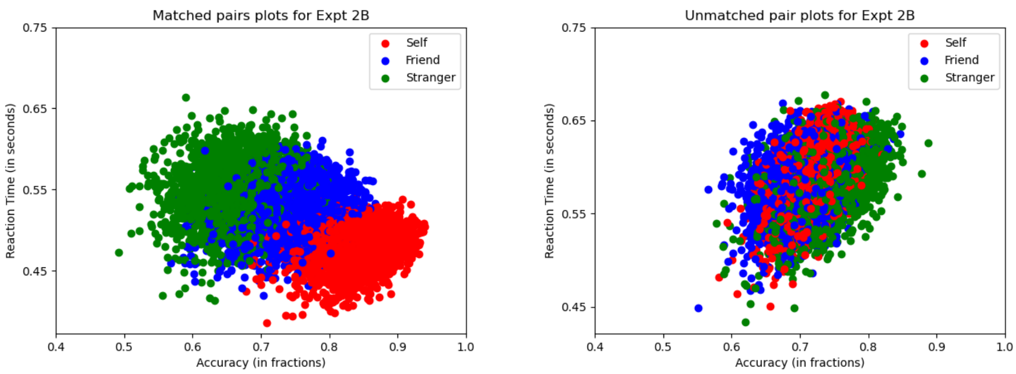
Table 4.8: Post hoc analysis of Accuracy & RT for Experiment 2B.

Metric	Difference Between	t	p_{holm}
RT	*Self* Match - *Stranger* Match	t(19) = -4.720	< 0.001
	Self Match - *Friend* Match	t(19) = -3.202,	0.016
	Friend Match - *Stranger* Match	t(19) = -1.518	0.533
Accuracy	*Self* Match - *Stranger* Match	t(19) = 5.475	< 0.001
	Self Match - *Friend* Match	t(19) = 3.085	0.04
	Friend Match - *Stranger* Match	t(19) = 2.391	0.212

As with RT data, we did not find any significant difference between any of the unmatched conditions with the accuracy data.

We repeated the bootstrapped sample mean analysis which showed differences between the distributions for *Self*-matches relative to *Friend*-matches and *Stranger*- matches as shown in Figure 4.8. The *Self*-matches are more accurate and faster than the *Friend*and *Stranger*-matches.The distributions for *Friend* relative to stranger-matches are not distinct.

Figure 4.8: Bootstrap of matched and unmatched of Experiment-2B



(Left) Distribution for Matched-pair condition with distinct distribution for Self relative to others. (Right) An indistinct distribution for Nonmatched-pairs.

We performed SDT analysis based on accuracy data to explore the sensitivity and response bias. We calculated *d'* and criterion for *Self*, *Friend* and *Stranger* judgments (Figure 4.9) and carried out a 1-way ANOVA with a single within-subjects factor, Type Category (*Self, Friend, Stranger*) as reflected in Table 4.9. The post hoc analysis is in Table 4.10.

TABLE 4.9: 1 way Anova data for d' and criterion for Experiment 2B.

Metric	*Self*	*Friend*	*Stranger*	Anova Criteria	F (2, 38)	p	η_p^2
d'	1.88(.25)	1.39(.24)	1.31(.28)	Type Cat.	8.232	0.001	0.302
criterion	0.29(.07)	0.08(.09)	-0.14(.07)	Type Cat.	12.873	<0.001	0.404

TABLE 4.10: Post hoc analysis of d' & criterion values for Experiment 2B.

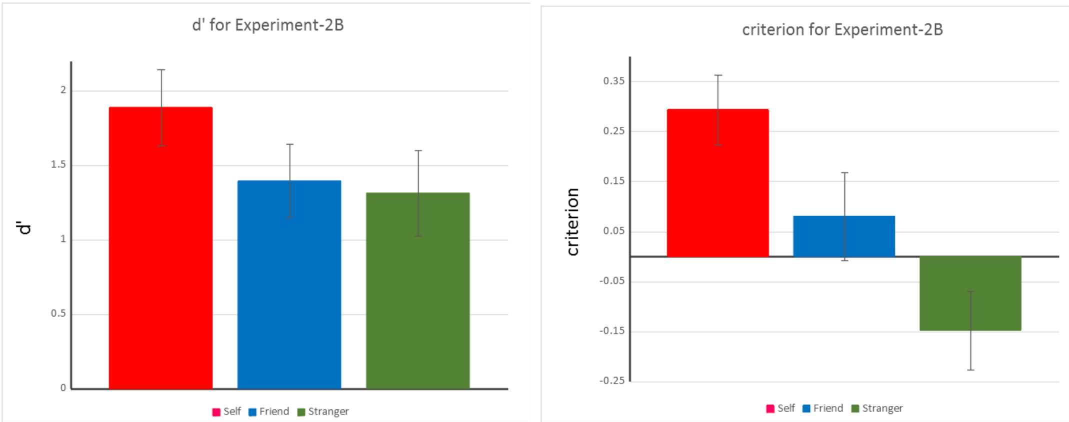
Metric	Difference Between	t	p_{holm}	Cohen's d
d'	*Self*Match - *Stranger*Match	t(19) = 3.750	0.002	0.838
	*Self*Match - *Friend*Match	t(19) = 3.217	0.005	0.719
	*Friend*Match - *Stranger*Match	t(19) = 0.532	0.598	0.119
Criterion	*Self*Match - *Stranger*Match	t(19) = 5.073	<0.001	1.134
	*Self*Match - *Friend*Match	t(19) = 2.455	0.025	0.549
	*Friend*Match - *Stranger*Match	t(19) = 2.619	0.025	0.586

The effect of target-category (type) was significant, F (2,38) = 8.232, p = 0.001, $\eta_p^2 = 0.302$. The d' for *Self*-judgments was significantly higher than that for *Stranger* judgments, t(19) = 3.750, $p_{holm} = 0.002$, and with *Friend*-judgements at t(19) = 3.217, $p_{holm} = 0.005$. The difference in d' between the *Friend*-judgments and *Stranger*-judgments was not significant, t(19) = .532, $p_{holm} = 0.598$.In this instance too, higher d' values demonstrate lower false alarms for *Self* than compared to responses to *Friend* and *Stranger*. We computed criterion values for the *Self*, *Friend* and *Stranger* judgments and carried out a similar ANOVA with a single within-subjects factor label type. We found a significant effect of label type (*Self, Friend, Stranger*), F (2, 38) = 12.873, p $<$ 0.001, $\eta_p^2 = 0.404$.

In the post hoc analyses, criterion values were significantly higher for *Self*-judgments compared to *Stranger*-judgments, t(19) = 5.073, $p_{holm} < 0.001$, and for *Self*-judgments compared to *Friend*-judgments, t (19) = 2.455, p_{holm} =0.025. The difference in criterion values for *Stranger*-judgments relative to *Friend* judgments was also significant, t (19) = 2.619, $p_{holm} = 0.025$.

In summary, we found that our participants' responses were significantly faster and more accurate for *Self*-matches relative to *Friend*-matches and *Stranger*-matches. Further implications of the results are discussed later in this chapter.

FIGURE 4.9: d' and Criteron of Experiment-2B



(Left) Bar Plot for d' measure with Standard Error bars (Right) Bar Plot for criterion measure with Standard Error bars

4.4 Experiment 2C

In Experiment-2C we investigate whether the self-preference effect persists when the associated stimulus belongs to a stimulus class defined by a conjunctive rule. The two parts of the conjunct are the geometric shapes (triangles, quadrilaterals, or pentagons) and the colour (magenta, cyan or yellow) where the shape is filled with the requisite shade of the colour. As with the two previous experiments, participants will be exposed to new previously unexposed exemplars which are defined by the conjunctive rule, as specified.

4.4.1 Method

4.4.1.1 Participants

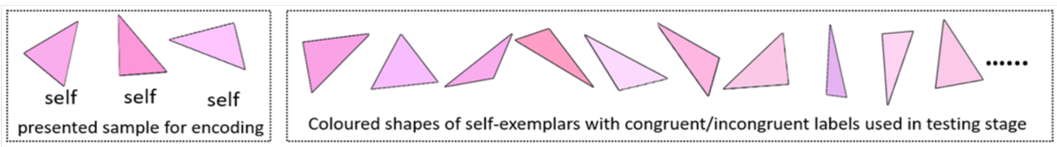
The participants of Experiment 2A, 2B also participated in Experiment 2C.

4.4.1.2 Stimuli

Here the target stimuli were colour-filled geometric shapes associated with social labels of *'Self'*, *'Friend'*, *'Stranger'*. So the different shapes from each of the three geometric shape categories (triangle, quadrilateral, pentagon) were combined with each of the different shades of the three colour-categories (cyan, magenta and yellow) to produce colour-shape combinations which have served as the perceptual stimuli. The geometric shapes of the exemplars were similar to those generated and used in Experiment 2A while the colours were those generated and used in Experiment 2B. The new colour-filled shapes were generated using MATLAB2016.

Each colour-filled geometric shape (from the families of magenta-triangle, yellow-triangle, cyan-triangle, magenta-quadrilateral, yellow- quadrilateral, cyan- quadrilateral, magenta-pentagon, yellow- pentagon, cyan- pentagon) each 3.8 x 3.8 degrees of visual angle, was presented above a fixation cross (0.8° × 0.8°) displayed at the centre of screen against a white background. The labels of *'Self'*, or *'Friend'*, or *'Stranger'* (3.1/3.6 x 1.6 degrees) with associated shapes counterbalanced across subjects was displayed below the fixation cross. The distance between the centre of the word or the shape and fixation-cross was around 3.5°. All stimuli were shown against a white background. A very limited subset of exemplars was presented for familiarisation and then tested on a larger unseen set of exemplars. All stimuli were generated using MATLAB and displayed on a white background on a 24" 120 Hz monitor. The experiment was coded and run on Python 3.7 using the PsychoPy library for the GUI. An example of a particular combination of coloured shapes is shown in Figure 4.10.

FIGURE 4.10: Stimuli Set for Experiment-2C

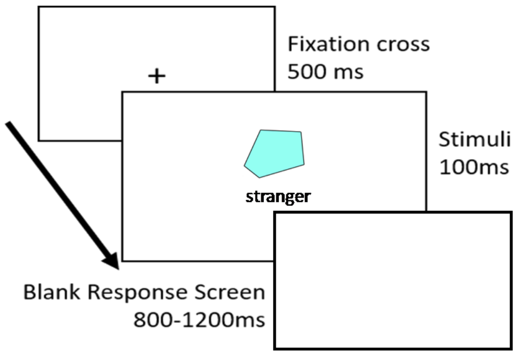


Families of Coloured-shape Exemplars of magenta-triangles, a limited subset of which has been refamiliarised with associations (Left) while the actual match recognition task is then performed on a much larger collection of exemplars, even novel ones, sharing the same two defining features. Similarly there could have been non-overlapping combinations of yellow-quadrilateral, cyan-pentagon which would be respectively associated with either of 'Friend' or 'Stranger'

4.4.1.3 Procedure

The flow (Figure 4.11) is the same as in Experiment 2A, 2B but for coloured shapes.

FIGURE 4.11: Experiment Flow for 2C



4.4.2 Results and Discussion

First, we duly cleaned the data by eliminating correct responses of each category that were beyond two standard deviations of the initial means. The experiment had shape-category and matching judgement as the two within-subject variables. Within the shape category, three variable ANOVAs were performed on response time and accuracy. Post hoc comparisons were corrected using the Holm-Bonferroni method. The mean RTs and accuracy data for experiment 2C are shown in Table 4.11. Participants were fastest 489.53 (110.17) ms and most accurate 91.37 (7.79)% for the *Self*-match condition, and slowest 568.78 (136.44)ms and least accurate 74.00 (15.07)% for *Stranger*-match condition. In the *Friend*-match condition, the mean RT was 530.81 (131.86) ms and accuracy was 80.12 (18.66) ms.

TABLE 4.11: Mean (and SD) of Reaction Time and Accuracy for Experiment 2C.

Condition	Category	MeanRT(ms)	Accuracy(%)
Matched	*Self*	489.53 (110.17)	91.37 (7.79)
	Friend	530.81 (131.86)	80.12 (18.66)
	Stranger	568.78 (136.44)	74.00 (15.07)
Unmatched	*Self*	586.05 (132.48)	74.99 (18.38)
	Friend	584.93 (137.96)	76.22(17.93)
	Stranger	591.59 (133.22)	75.31 (18.89)

We analysed the data using a 3 (Type category:*Self, Friend, Stranger*) x 2(Match Condition: Match, Non-match) ANOVA for both RTs and accuracy and the results are in Table 4.12. The post hoc analysis is in Table 4.13.

We observed a significant effect of category type for RTs, F(2,38) = 8.963, p<0.001 η_p^2 = .321 as also a significant effect of category match at F(1,19)= 25.137, p<0.001, η_p^2 =

.570. The RTs in the match condition were faster than those in the unmatched condition, t(19) = -5.014, p <0.001, d = -1.121. The interaction of the type category and matching judgement was also significant F(2,38)=9.163, $p < 0.001 . \eta_p^2 = .325$. Participants were significantly faster in the *Self*-matched vs. the *Stranger*-matched condition, t(19) = -5.990, p_{holm} <0.001, and between the *Self*-matched vs. the *Friend*-matched condition, t(19) = -3.120, p_{holm} = 0.021. The difference between the *Friend*-matched and the *Stranger*-matched conditions was also significant, t(19) = -2.87, p_{holm} =0.037. We did not find any significant difference between any pair of the unmatched conditions (ps > .05).

For ANOVAs of accuracy, type category was significant with F(2,38)= 10.398and p= 0.000, $\eta_p^2 = 0.354$. Matching judgement was marginally significant F(2,38)=4.657 and p=.044, $\eta_p^2 = 0.197$. Their interaction was significant - F(2,38)=13.294, p<0.001, $\eta_p^2 = 0.412$. Participants were significantly more accurate for *Self*-matches relative to *Stranger*-matches, t(19) = 6.742, $p_{holm} < 0.001$, as well as for *Self* matches compared to *Friend*-matches, t(19) = 4.365, $p_{holm} < 0.001$. However for accuracy, there was no significant difference in participant's response-correctness between *Friend*-matched and the *Stranger*-matched conditions, t(19) = 2.377, $p_{holm} = 0.200$. As with RT data, we did not find any significant difference between any of the unmatched conditions with the accuracy data.

TABLE 4.12: Anova data for Reaction Time and Accuracy for Experiment 2C.

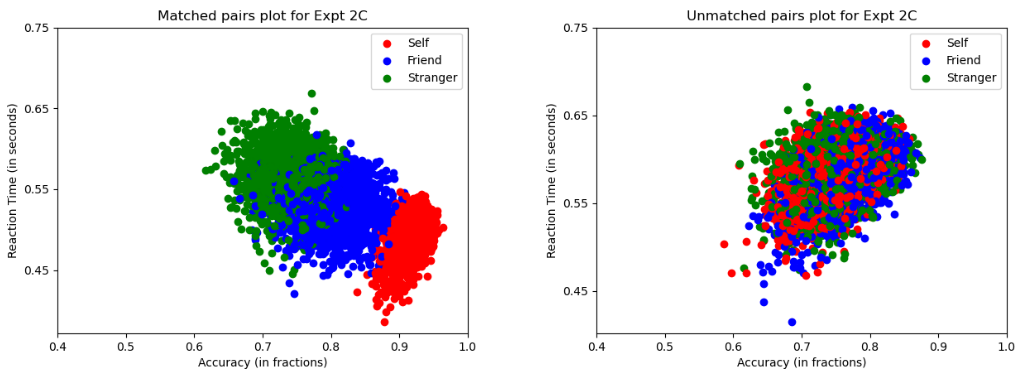
Metric	Condition	F	p	η_p^2
RT	Target Category	F(2,38)=8.963	<0.001	0.321
	Match Category	F(1,19)= 25.137	<0.001	0.570
	Target x Match	F(2,38)=9.163	< 0.001	0.325
Accuracy	Target Category	F(2,38)= 10.398	0.000	0.354
	Match Category	F(2,38)=4.657	0.044	0.197
	Target x Match	F(2,38)=13.294	<0.001	0.412

TABLE 4.13: Post hoc analysis of Accuracy & RT for Experiment 2B.

Metric	Difference Between	t	p_{holm}
RT	*Self*Match - *Stranger*Match	t(19) = -5.990	< 0.001
	*Self*Match - *Friend*Match	t(19) = -3.120	0.021
	*Friend*Match - *Stranger*Match	t(19) = -2.87	0.037
Accuracy	*Self*Match - *Stranger*Match	t(19) = 6.742	< 0.001
	*Self*Match - *Friend*Match	t(19) = 4.365	< 0.001
	*Friend*Match - *Stranger*Match	t(19) = 2.377	0.200

In the bootstrapped sample mean analysis, the data is visualised as distributions for both the matched and unmatched cases. We see in Figure 4.12 that the distributions are distinct and the *Self*-matches can be seen to be more accurate and faster than the *Friend* and *Stranger*s-matches.

FIGURE 4.12: bootstrap of matched vs unmatched in Experiment 2C



(Left) Distribution for Matched-pair condition with distinct distributions for *Self* relative to others. (Right) Overlapping distributions for non-matched-pairs.

The SDT analysis on accuracy data for d' and criterion to study sensitivity and response-bias for *Self*, *Friend* and *Stranger* judgments in a 1-way ANOVA with a single within-subjects factor, Target category (*Self, Friend, Stranger*) is reported in Table 4.14. The post hoc analysis is reported in Table 4.15.

TABLE 4.14: 1 way Anova data for *d'* and criterion for Experiment 2C.

Metric	*Self*	*Friend*	*Stranger*	Anova Criteria	F (2, 38)	p	η_p^2
d'	2.99(.21)	1.91(.28)	1.58(.26)	Target Type	9.379	0.003	0.330
criterion	0.36(.06)	0.09(.07)	-0.04(.05)	Target Cat.	20.258	<0.001	0.516

TABLE 4.15: Post hoc analysis of *d'* & criterion values for Experiment 2C.

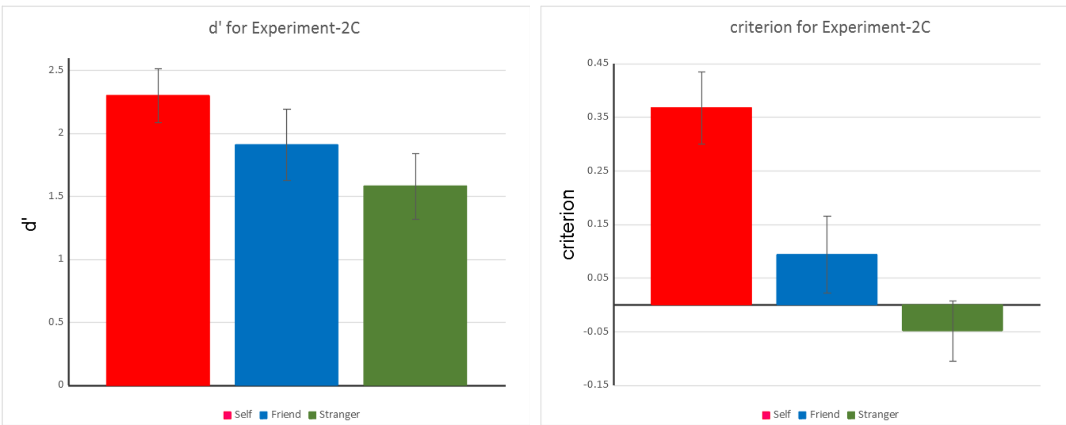
Metric	Difference Between	t	p_{holm}	Cohen's d
d'	*Self*Match - *Stranger*Match	t(19) = 4.324	<0.002	0.967
	*Self*Match - *Friend*Match	t(19) = 2.381	0.045	0.532
	*Friend*Match - *Stranger*Match	t(19) = 1.943	0.06	0.434
Criterion	*Self*Match - *Stranger*Match	t(19) = 6.262	<0.001	1.400
	*Self*Match - *Friend*Match	t(19) = 4.118	<0.001	0.921
	*Friend*Match - *Stranger*Match	t(19) = 2.144	0.038	0.479

It showed that the effect of Target Category was significant in d', F (2,38) = 9.379, p < 0.001, $\eta_p^2 = 0.330$. The *d'* for *Self*-judgments was significantly higher than that for *Stranger* judgments, t(19) = 4.324, $p_{holm} < 0.002$, and while its difference with *Friend*-judgements was marginally significant at t(19) = 2.381, $p_{holm} = 0.045$, the difference in discriminability between a *Friend*-judgment and a *Stranger*-judgment just missed being significant, t(19) = 1.943, $p_{holm} = 0.06$. Like all previous instances, the d' analyses show that participants were more sensitive to *Self* vs. *Friend* and *Self* vs. *Stranger* judgments. There were higher values for *Self* indicating better performance in the responses with lower misses or false alarms than compared to responses to *Friend* and *Stranger*.

Again, for the *Self*, *Friend* and *Stranger* judgments, we measured criterion values and performed a similar ANOVA with a single within-subjects factor, shape (*Self, Friend, Stranger*) which revealed a significant effect of shape (*Self, Friend, Stranger*), F (2, 38) = 20.258, p <0.001, $\eta_p^2 = 0.516$. In the post hoc analyses, criterion values were significantly higher for *Self*-judgments compared to *Stranger*-judgments, t(19) = 6.262, $p_{holm} < 0.001$ and also significant for *Self*-judgments compared to *Friend*-judgments, t (19) = 4.118, $p_{holm} < 0.001$. However, the difference in the criterion values for *Stranger*-judgments and *Friend* judgments were also marginally significant, t (19) = 2.144, $p_{holm} = 0.038$.

The *d'* and criterion findings are plotted in a bar graph in Figure 4.13.

FIGURE 4.13: d' and Criterion for Experiment-2C



(Left) Bar Plot for d' measure with Standard Error bars (Right) Bar Plot for criterion measure with Standard Error bars

Experiment 2 establishes that the self-preferential effect is fairly robust. It is present even when *Self* is associated with a perceptual class defined by a conjunctive rule. The difference between *Self* and *Friend* and *Friend* and *Stranger* are not as consistent though the *Self Friend* distinction holds in most cases. Our findings replicate, with our set of participants and stimuli, the findings in Sui et al. (2012), with faster reaction times and more accuracy for *Self*-associated perceptual matches relative to other matches.

4.4.3 Comparative analysis

We compared the differences between the responses across the experiments in this study to see if they exhibit a pattern.The details are in Table 4.16.

We compared the *Self*-match conditions in these experiments. A comparison of the RT across experiments 2A and 2B and 2C, comparing measures in 2A with 2B, 2B with 2C, 2A with 2C using paired samples t-test which demonstrated no significance for *Self*-matches. Similarly, we also compared the *Friend*-match and *Stranger*-match conditions across the three experiments for RTs and did not find any significant differences for them either (All $p > 0.05$). For Accuracy measures using the paired sample t-tests, we see no significant difference for either of *Self, Friend, Stranger* between the two experiments 2A and 2B. On comparing 2A with 2C we see that the accuracy difference for all of the three categories being significant while when comparing 2B with 2C only Stranger-responses were marginally significantly different ($p=0.046$).

4.5 Discussion

In the current chapter, we built on our findings from Experiment-1 to study the robustness of the self-preferential effect by generalising the associated stimulus to new unseen exemplars defined by only a single simple rule across the shape (experiment 2A) and colour (experiment 2B) dimensions and on a combination of simple rules to form another conjunctive rule that used both shape and colour (experiment 2C).

Across all the three experiments if the target-stimuli, even if novel, shared one or more prominent visual-characteristics that are common with the pre-familiarised exemplars belonging to the most-salient collective i.e., *Self*, then the processing advantages indeed extended to all such exemplars for all four measures: accuracy, RT, sensitivity (d') and criterion. Across experiments, all Self-associated exemplars were processed significantly faster and accurately in matched-conditions compared to *Friends* and *Stranger*. The variation in the response-pattern between matched and non-matched conditions, as discussed in the previous experiment remained true

Table 4.16: Comparative Analysis between 2A, 2B, 2C with Paired Samples Test

Comparison	Group	Metric	t	p	Cohen's d
2A with 2B	*Self*	RT	t(19) = 1.190	0.249	0.266
		Accuracy	t(19) = 0.290	0.775	0.065
		d'	t(19) = -0.487	0.632	-0.109
		criterion	t(19) = 0.559	0.583	0.125
	Friend	RT	t(19) = 1.456	0.162	0.326
		Accuracy	t(19) = -0.968	0.345	-0.217
		d'	t(19) = -0.290	0.775	-0.065
		criterion	t(19) = -1.235	0.232	-0.276
	Stranger	RT	t(19) = 0.907	0.376	0.203
		Accuracy	t(19) =-0.569	0.576	-0.127
		d'	t(19) = -0.834	0.414	-0.187
		criterion	t(19) = -0.112	0.912	-0.025
2A with 2C	*Self*	RT	t(19) = 1.526	0.143	0.341
		Accuracy	t(19) = -2.707	0.014	-0.605
		d'	t(19) = -3.680	0.002	-0.823
		criterion	t(19) = -0.451	0.657	-0.101
	Friend	RT	t(19) =1.919	0.070	0.429
		Accuracy	t(19) =-3.276	0.004	-0.733
		d'	t(19) = -4.012	$<$ .001	-0.897
		criterion	t(19) = -1.752	0.096	-0.392
	Stranger	RT	t(19) = 1.029	0.317	0.230
		Accuracy	t(19) = -2.732	0.013	-0.611
		d'	t(19) =-2.777	0.012	-0.621
		criterion	t(19) = -1.357	0.191	-0.303
2B with 2C	*Self*	RT	t(19) = -0.423	0.677	-0.094
		Accuracy	t(19) = -1.716	0.102	-0.384
		d'	t(19) = -1.785	0.090	-0.399
		criterion	t(19) = -0.875	0.392	-0.196
	Friend	RT	t(19) = -0.091	0.928	-0.020
		Accuracy	t(19) = -1.531	0.142	-0.342
		d'	t(19) = -2.368	0.029	-0.529
		criterion	t(19) = -0.203	0.841	-0.045
	Stranger	RT	t(19) = -0.420	0.679	-0.094
		Accuracy	t(19) = -2.134	0.046	-0.477
		d'	t(19) = -1.619	0.122	-0.362
		criterion	t(19) = -1.632	0.119	-0.365

These findings suggest that the *Self*-preferential effect is robust since it persists across different degrees of generalisation for the associated perceptual stimulus. It also shows that this association is learned rather quickly. Similar findings have been reported earlier by Johnson et al. (2002), where they demonstrate that participants have better memory for adjectives encoded in terms of self-group reference, rather than just based on semantic features.

Researchers have proposed that the ability to form abstract social categories may help people navigate the complex social world by structuring their thoughts, beliefs and actions according to group memberships (Liberman, Woodward, et al., 2017). As noted in Medin et al. (1987), the organisation of natural categories by family resemblance (Rosch & Mervis, 1975), has been widely argued in ecological categorisation theory. In such a categorisation, members share features that may be neither singly necessary nor defining for the category. However, in Experiment 2, all the exemplars with a generalised association to a particular social label shared the same defining visual features constant across the collective.

Studies like Sloman and Rips (1998), Smith and Sloman (1994) have supported the view that in generalisation of concepts in our cognition there is an amalgamation of both similarity-based categorisations (assessing the similarity with known exemplars) and rule-based computation (judgement from using abstract rules). The same is followed in how some hybrid combination between similarity and rule-based judgements is essential to many psychological models of classification (Erickson & Kruschke, 1998).
Our work did not explicitly involve any investigation into ascertaining the exact methods that the participants may have employed for the perceptual judgement of even novel stimuli.

However, what remained of significance from this study was the evidence that prioritisation for exemplars associated with the most salient label of *Self* persisted upon extension to the whole category, irrespective of whether similarity or rule-based processing was applied for such generalisation. This provides a window to explain the possibility of the *Self* versus *Stranger* differences, even at such primitive level, to be at the root of far more complex behaviours like stereotyping or likewise. It may also explain the ease in over-identification of the self-group as the in-group (Knight, 2015) and consequent attribution of preference for the same. It is, however, necessary to study whether the preference for self-association does carry over to other graded social labels like family, same linguistic group, same caste, same religion etc to establish a stronger ecologically valid claim.

Chapter 5

Me and Them - Approaching the Self and (not) the Other

5.1 Experiment-3

5.1.1 Introducton

In experiment 3 we wanted to investigate whether the self-preference effect could manifest in more ecological social settings with artificial stimuli devoid of any external or physical social cues or primed biases. We hoped that this experiment would enable us to tease out further such consequential implicit self-referential preferences in socially relevant behaviour even at that most basic level of cognition.

However, before we can claim that self-association with abstract stimuli can be a factor that may reflect in the more overt and complicated inter-group attitudes and behavioural differences with real-world social groups like gender or race, we wished to investigate if association with neutral and primitive visual stimuli like those used in previous experiments can demonstrate noticeable differences in responses gauged via explicit indirect measures of inter-category tendencies in experimental settings.

Paradigms like the affective priming paradigm or Race IAT, Go/No-Go Association Task, First Person Shooter task, Anti- saccade tasks are known to gauge inter-group attitudes. However for our questions regarding the collections of neutral visual exemplars associated with social salience that could induce behavioural facilitative or hesitative attitudes, we followed the theorising suggested by Solarz (1960) in a seminal study which evidenced that positivity in the valence of stimuli fosters approach tendencies, whereas avoidance is facilitated by negatively valenced ones. Therefore, we utilised the Approach Avoidance Task (AAT) used as an indirect measure of inter-category attitudes where approach-avoidance tendencies towards or away from target-stimuli are measured as in the Lever task (Chen & Bargh, 1999), the Manikin task (Jan De Houwer & Hermans, 2001), the Joystick task (Rinck & Becker, 2007) or Modified keyboard task (Vaes et al., 2003). In such tasks, a faster approach Response Time for target stimuli compared to that for avoidance represents an approach bias toward that exemplar, while an avoidance tendency will be seen if stimuli are approached slower than they are avoided. Heuer et al. (2007) had employed the AAT paradigm to demonstrate significant avoidance tendencies for potentially intimidating social stimuli in the form of emotional facial expressions. Similarly, A. Klein et al. (2011) used the Approach-Avoidance Task to evaluate automatic behavioural avoidance tendencies in children showing an automatic avoidance tendency in response to spider pictures, but not to pictures of butterflies or neutral pictures. Saraiva et al. (2013) manipulated reference-frames and muscle-specificity and reaffirmed how positive stimuli tend to facilitate approach tendencies, while negatively-valenced stimuli induce defensive actions like avoidance. Further, Degner et al. (2016) applied the approach-avoidance paradigm to measure automatic inter-group evaluations of real-world categories and consequent attitudes and behaviour among ethnic majority and minority groups. Their study hypothesised the segregation of minority groups to be a probable critical contributor towards group evaluations, and hence reaffirmed the utility of the approach-avoidance task in measuring social attitudes as their participants also demonstrated approach-avoidance tendencies towards target-majority as per the nature of their segregation. Finally, inspecting the ability of AAT paradigms to measure intergroup attitudes beyond the confounds of cultural knowledge, Rougier et al. (2020) demonstrated using Visual Approach/Avoidance by the Self Task (VAAST) that despite the across-participant variabilities in inter-group attitudes, both non-dominant as well as dominant groups exhibited a significant ingroup bias and that compatibility scores in VAAST predicted trustworthiness measures of ingroup/outgroup, thereby asserting how approach-avoidance paradigms can be extremely relevant to assess personal attitudes towards different social categories in many dynamic experimental settings.

Based on the studies described above, in Experiment 3, we explored whether the self-prioritisation effect persists if we use an approach-avoidance task similar to the ones used above. However, to keep things slightly simple, in this experiment we used only two social labels - ‘Self’ and ‘Stranger’. More specifically, we adopted the paradigm from the Manikin Approach Avoidance Task as used by Jan De Houwer and Hermans (2001) whose participants used keypresses to move a manikin towards or away from a stimulus on the screen. Its validity and reliability to assess impulsive approach-avoidance tendencies have been well recorded to be more sensitive than the Joystick task (Mogg et al. (2003), Krieglmeyer and Deutsch (2010)).

5.1.2 AAT Experiment

We expected a significant approach effect for the entire group of Self- referent exemplars relative to the exemplars of Stranger resulting in a difference between the RTs for approaching or avoiding the exemplars for *Self versus Stranger*.

5.1.3 Method

5.1.3.1 Participants

We collected data from 34 students (mean age = 22.7 years, SD = 1.69 years) of the Indian Institute of Technology Kanpur. All but one participants were right-handed. All had normal or corrected-to-normal vision. Informed consent was obtained from all participants before the beginning of the experiment following the norms approved by the institute ethics committee.

5.1.3.2 Stimuli

Our target stimuli were coloured shapes as in Experiment 2C except that we used shades belonging to only two colour-categories (cyan, yellow) filling geometric shapes from any two of either of the three shape-categories (i.e. any two of triangle, quadrilateral, pentagon) selected randomly for the participants. The experiment was coded using Psychopy and Python 3.7, and owing to COVID-19 related complications, it was conducted online over the internet using Pavlovia. The participants undertook the experiments on their laptops or workstations placed on a stable surface like a table in an isolated, silent and dark room. The conditions were verified by the experimenter using the webcam that constantly monitored the participant over video conference platforms like Zoom or Skype.

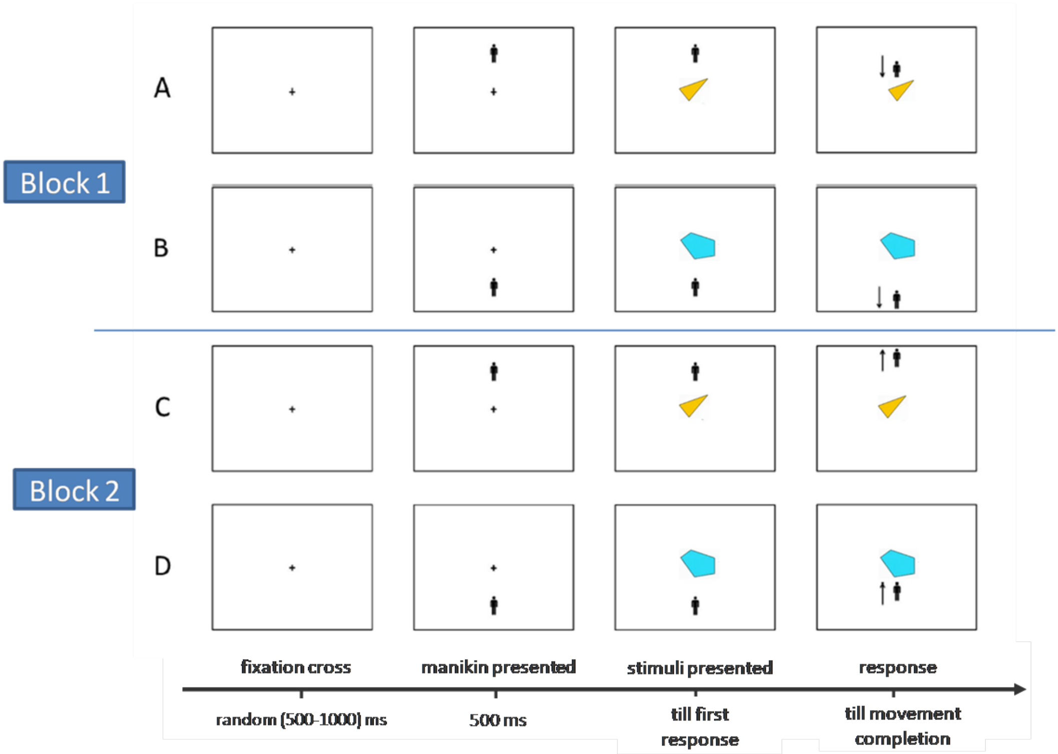
5.1.3.3 Procedure

The experiment was divided into 5 stages. To accustom the participants to the manikin and its movement, Stage-I required the participants to move the manikin up and down an empty screen by pressing 'Y' and 'B' respectively for a short span. Following other Manikin-based studies, participants were encouraged to think that they are also moving along with the manikin. In an extension of this habituation process with the paradigm, Stage-II exposed the participants to a demo of the approach-avoidance test. In place of exemplars as targets, participants responded to text-instructions of 'approach' or 'avoid' moving a manikin which is randomly presented above or below the text then nearer or farther from it by the required keypress. The paradigm was the same as the main experiment described next. Stage-III was an association-learning stage as described in Experiment 2. They had to familiarise and encode two classes of a small sample (3 unique ones) of coloured shapes (as in Experiment-2C) associated with either of the social labels of 'Self ' or 'Stranger'. In Stage-IV, as a filtering criterion to ensure that subjects have remembered the associations, a short and simple association-matching task was conducted. Over 24 trials, subjects could take their time to indicate by pressing the corresponding number key whether a presented exemplar matched either of 3 options '1. Self 2. Stranger 3. Neither'. The main Stage-V of the task, as shown in Figure 5.1, commenced after this.

In this main Manikin Approach Avoidance task of the experiment, after a fixation cross followed by a manikin either above or below the fixation cross, the subjects were shown random presentations with even previously unfamiliarised stimuli of either Self or Stranger collection of exemplars. The subjects had to either move the manikin closer (approach) the target stimulus or move away (avoid) depending on the category of the given stimulus. They had to again move as fast and as accurately as possible and the RTs were recorded as the duration between the onset of the stimulus to the first correct keypress as per the required condition.

The manikin appeared in either the lower or upper half of the screen and the participants had to respond by keypresses ('Y' or 'B') to move the manikin up or down to approach or avoid. In one block they had to avoid the shapes which have been associated with '*Self*' and approach those associated with '*Stranger*' while in the next block they had to do just the reverse. The order of the presentation of the stimuli was randomised and the order of the blocks was counterbalanced across participants.

FIGURE 5.1: The flow of Approach-Avoidance Movements in Stage-V of Experiment 3



Block 1: *Self*-matched exemplars approached, and *Stranger* avoided. Block 2: the converse. A. Trial where participants approach colour-shape stimuli of *Self* with manikin at top. B. The *Stranger*-associated stimuli where participants avoid it with the Manikin presented below the exemplar in the lower half. C. Participants required to avoid *Self*-associated coloured-shapes. D. Participants approach *Stranger*-associated exemplars.

The presented target-stimulus was present on the screen till the approach or avoidance movements were completed. The main test block started after completion of the practice trials, which lasted for 12 trials in each block, where a very faint destination marker aided the participants in indicating where exactly to reach while approaching or avoiding. No such markers were available during the testing trials. The conditions thus were *Self*-approach, *Self*-avoid, *Stranger*-approach, *Stranger* avoid. There were 120 trials in all in the testing block for each participant with 30 trials for each condition and the two blocks, *Self*-Approach with *Stranger*-Avoid and *Stranger*-approach with *Self*-Avoid of 60 trials each, separated by a break.

5.1.4 Results

For the analysis, we appropriately removed all incorrect reactions from our data (initial press of response-key for approach when required to avoid, and vice versa). We have used the average RT of the first keypresses, as a dependent variable (Jan De Houwer & Hermans, 2001) to measure response differences across participants. To trim RTs off momentary inattention and anticipatory responses, we eliminated responses beyond (faster or slower) two standard deviations from the mean. The mean RT data for the experiment is in Table 5.1.

The mean RT (and SD) for the approach-movement towards the exemplar-stimuli associated with *Self* was 0.691 (.227) ms, and for *Stranger* it was 0.813 (.226) ms for all instances of approaching the exemplars, irrespective of whether the initial starting-position of the manikin is above or below the target stimulus. Conversely for avoidance-movement towards the exemplar-stimuli associated with *Self*, the reaction time for first movement was 0.866 (.284) seconds, and for *Stranger* it was 0.729 (.193) seconds.

TABLE 5.1: Mean RT (and SD) of Approach and Avoid Movements for *Self* and *Stranger*

Mean RT (SD) for action	Manikin-Position	*Self*	*Stranger*
Approach	Both positions	0.719 (.239)	0.819 (.221)
Avoid	Both positions	0.860 (.270)	0.754 (.101)
Approach	Below Stimuli	0.685 (.232)	0.806 (.238)
Avoid	Below Stimuli	0.853 (.286)	0.735 (.194)
Approach	Above Stimuli	0.752 (.273)	0.838 (.216)
Avoid	Above Stimuli	0.878 (.302)	0.773 (.233)

The First two rows contain the respective RTs over all the trials, while the next 4 consider the initial position of the manikin. All the data are in seconds.

At first, we carried out a 2 (Stimuli Category: *Self*, *Stranger*) X 2 (Movement-type: Approach, Avoid) ANoVA on the Reaction-Time data to find the saliency of factors. We report the finding in Table 5.2 In the 2 x 2 ANOVA on the RTs, the main effects of Movement-type, F(1, 33)= 9.864, p = 0.004, $\eta_p^2 = 0.032$ and the interaction between Stimuli Category (TargetCategory) and Movement Type were significant F (1, 33)= 19.535, $p < 0.001$, $\eta_p^2 = 0.235$. Post-hoc analysis showed that participants were significantly faster for all approach movements than avoidance ones, t = -3.141, $p_{holm} = 0.004$, d = -0.539.

TABLE 5.2: Anova data for Reaction Time for Experiment 3.

Metric	Condition	F	p	η_p^2
RT	Movement Type	F(1,33)=9.864	0.004	0.230
	Stimuli Category x Movement Type	F(1,33)= 19.535	<0.001	0.372
	Stimuli Category	F(1,33)=0.031	0.862	0.001

In the Post Hoc Comparisons of Target Category x Movement Type, that we report in Table 5.3 we saw that participants were significantly faster for all approach movements of *Self* compared to the approach movements for *Stranger* t = -3.416, $p_{holm} < .005$ implying that the family of *Self*-associated exemplars were approached significantly faster than *Stranger* were. The approach RTs was significantly faster for *Self* compared to the avoidance responses for *Self*-exemplars themselves, t = -5.368, $p_{holm} < 0.001$ further implying how *Self* was approached faster and avoided slower. Participants were also significantly slower in avoiding *Self*-exemplars than they were in avoiding exemplars associated with *Stranger* t = 3.627, $p_{holm} = 0.003$ thus indicating that participants avoided *Stranger*-associated-exemplars with significantly more rapidity than they did for *Self*. However, our participants were recorded to be just-significantly slower for approaching *Stranger*-associated stimuli than they were in avoiding them t = 2.485, $p_{holm} = .048$ and thus avoided *Stranger* exemplars faster than they approached it.

Table 5.3: Post hoc Comparison of Response Time for Target x Action in Experiment 3.

Metric	Difference Between	t	p_{holm}
RT	*Self* Approach - *Stranger* Approach	t(33) = -3.416	< .005
	Self Approach - *Self* Avoid	t(33) = -5.368	< 0.001
	Self Avoid - *Stranger* Avoid	t(33) = 3.627	0.003
	Stranger Approach - *Stranger* Avoid	t(33) = 2.485	.048

Thus, we see that across the trials and participants, the *Self*-related exemplars have been approached with significantly faster RTs and avoided with significantly slower RT than *Strangers* related exemplars. *Self*-related exemplars were also approached significantly faster than they were avoided, while the opposite, significantly slower approach than to avoid was recorded for *Stranger*-associated exemplars.

We also did a post-hoc analysis with the additional variable - the Manikin position (above or below the target stimulus) i.e. Position Of Player x Target Category x Movement Type. We report the findings in Table 5.4. Here we found that with the manikin positioned below the target-stimulus, participants were significantly faster to approach *Self* than they were in approaching *Stranger* t=-3.317, p_{holm}=0.029 as well as significantly slower to avoid *Self* than they were in avoiding *Stranger* t(33)=3.220, p_{holm}=0.038. Participants were also significantly faster in approaching the exemplars of *Self* than they were in avoiding them t=-4.746, p_{holm} <0.001. When positioned above the stimulus, participants approached *Self*-associated-exemplars faster than they avoided the same t=-3.591, p_{holm} =.013 but not significantly faster than when approaching *Stranger* exemplars in this state (p_{holm}=0.294). A clear absence of significance between approach-avoidance of *Stranger*-exemplar was noted when above the stimulus but for the lower half, there was an evident tendency (p_{holm}=0.08).

TABLE 5.4: Post hoc analysis for Experiment 3 with Initial Position considered.

Metric	Position	Difference Between	t	p_{holm}
RT	Below Target	*Self* Approach - *Stranger* Approach	t(33) = -3.317	0.029
		Self Avoid - *Stranger* Avoid	t(33) = 3.220	0.038
		Self Approach - *Self* Avoid	t(33) = -4.746	<0.001
		Stranger Approach - *Stranger* Avoid	t(33) = 2.002	0.626
	Above Target	*Self* Approach - *Stranger* Approach	t(33) = -2.375	0.294
		Self Approach - *Self* Avoid	t(33) = -3.591	.013
		Stranger Approach - *Stranger* Avoid	t(33) = 1.853	0.803
		Self Avoid - *Stranger* Avoid	t(33) = 2.899	0.086

However, our actual measure is to understand the explicit approach-avoidance tendencies for the two classes of stimuli related to either *Self* or *Stranger*. Thus to understand the actual approach-avoidance tendencies, following the method applied by Degner et al. (2016) and others, we calculated the tendency measure as the AAT score through the difference between the mean latencies of avoidance and approach reaction times (thus AAT Score= Avoidance RT - Approach RT) separately for each of *Self* and *Stranger* as AAT scores for every condition. Thus when the scores are higher (and positive, meaning more time to avoid and lesser time to approach), they indicate a relative prevalence of approach tendencies as compared to avoidance bias for that particular stimuli or class of stimuli. Thus the more positive the AAT score, the greater is the avoidance tendency. The collective of stimuli with a lesser AAT score can be thus considered as being treated with a lesser approach tendency. The avoidance tendencies can be indicated by significantly lower and negative AAT scores where avoidance is faster for the target-exemplar than the approach movements, making the subtraction result negative. The observed scores (in ms) and the corresponding SD values are presented in Table 5.5

The positivity of the AAT Score for *Self*-referenced exemplars and the negativity of the AAT Score for *Stranger*-associated ones does indicate Approach favourability for *Self* than for *Strangers* and inversely, more avoidance bias for *Strangers* than for *Self*. However, to get a better understanding, we conducted an ANOVA and post-hoc analysis on the AAT Score data.

With a 2 (Target category: *Self*, *Stranger*) x 2 (Position: Above, Below) repeated measures

TABLE 5.5: AAT Scores for *Self* & *Stranger* for Conditions

Category	Condition	AAT Score
Self	Both positions	0.140 (0.181)
Stranger	Both positions	-0.065 (.117)
Self	Upper Half	0.139 (.207)
Stranger	Upper Half	-0.065 (.145)
Self	Lower Half	0.168 (.266)
Stranger	Lower Half	-0.061 (.171)

The First two rows contain the respective overall AAT scores while the rest correspond to the initial position of the manikin. All the data are in seconds.

ANOVA for the AAT scores for approach/avoidance tendencies. The ANOVA and post-hoc analysis findings are reported in Table 5.6 and Table 5.7 respectively. We only found the main effect of Stimuli Category F (1, 33)= 19.842, $p < 0.001$, $\eta_p^2 = 0.375$. AAT score for *Self* was significantly more positive than that of *Stranger* scores overall t(33)=4.454, $p_{holm} < 0.001$. When manikin is above target-stimuli, AAT scores for *Self* remained significantly greater than that of *Stranger* t(33)=3.489, p_{holm}=0.003 as well as when the initial-manikin-position is below the exemplar, t(33)=3.905, p_{holm}=0.001. There was no difference between the upper and lower half AAT scores individually for both *Self* and *Stranger*.

TABLE 5.6: Anova data for AAT Score for Experiment 3

Metric	Condition	F	p	η_p^2
AAT Score	Target Category	F(1,33)=19.842	< 0.001	0.375
	Position	F(1,33)= 0.423	0.520	0.013
	Target Category x Position	F(1,33)=0.139	0.712	0.004

TABLE 5.7: Post hoc analysis of AAT score across categories and positions

Difference Between	t	p_{holm}
Self AAT-Score Overall, *Stranger* AAT Overall	t(33)=4.454	< 0.001
Self AAT Above Stimuli, *Stranger* AAT Above Stimuli	t(33)=3.489	0.003
Self AAT Below Stimuli, *Stranger* AAT Below Stimuli	t(33)=3.905	0.001
Self AAT Above Stiwmuli, *Self* AAT Below Stimuli	t(33)=-0.694	0.981
Stranger AAT Above Stimuli, *Stranger* AAT Below Stimuli	t(33)=-0.107	0.981

Since a negative value of the AAT score reveals a clear avoidance tendency, while a positive value indicates a preference for approach, a neutral score should indicate the absence of any approach/avoidance bias, we also conducted six one-sample Student t-tests to explore if each of the three AAT scores (for upper-half, lower-half, both-position) for both of *Self* and *Stranger* were greater or lesser than a comparison score of 0. The findings are reported in Table 5.8 We found that for the all-case-condition, the AAT score for the family of *Self*-associated-exemplars was significantly greater than 0 and thus significantly positive, t(33)=4.520, p< 0.001, d=.775. *Self*-associated responses were significantly positive for upper-half movement-conditions, t(33)=3.910, p<0.001, d=0.671 as well as for lower-half conditions t(33)=3.680, p< 0.001, d=0.631. For the family of exemplars *'Stranger'*-associated exemplars over the whole experiment, the AAT scores were significantly lesser than 0 and hence significantly negative t(33) = -3.236, p = .001, d=-0.555, for upper half t(33) = -2.625, p =.007, d=-0.450 as well as significantly negative for lower-half conditions, t(33) = -2.078, p = .023, d=-0.447.

TABLE 5.8: One Sample t-test comparing AAT Score with neutral score of 0

Position	Difference Between	t	p_{holm}	Cohen's d
Overall	*Self* AAT-Score > 0	t(33)=4.520	< 0.001	0.775
	Stranger AAT-Score < 0	t(33) = -3.236	0.001	-0.555
Above Stimuli	*Self* AAT-Score > 0	t(33)=3.910	<0.001	0.671
	Stranger AAT-Score < 0	t(33) = -2.625	.007	-0.450
Below Stimuli	*Self* AAT-Score > 0	t(33)=3.680	<0.001	0.631
	Stranger AAT < 0	t(33) = -2.078	0.023	-0.447

Thus we observe significant bias towards approach tendencies for the collective of exemplars associated with *Self* and avoidance bias for the collective associated with *Stranger*.

5.2 Discussion

Using an Approach-Avoidance Task (AAT), we explored the implicit response tendencies in our participants towards two different categories of visual exemplars, abstract and neutral in nature, and with a limited subset that was pre-familiarised to be associated with the salience of labels. Then, the responses were tested on larger collectives with novel stimuli sharing prominent defining features common to either of the two categories. The idea was to investigate whether the tendencies for self-prioritisation as observed in Sui et al. (2012)

and for our previous experiments, would manifest in a slightly different, and arguably more ecologically valid task.

As is typical of most AAT measures (Krieglmeyer and Deutsch (2013), Moors and De Houwer (2001)) for even unrelated, unassociated and random stimuli which still reveal more rapid approach responses than avoidance, we also observed faster Reaction Times for all approach movements than we did for avoidance ones.

We observed that apart from the effect of the Movement Type, the interaction of the Movement Type with the Target-stimuli also significantly influenced the responses. Participants had approached the entire collectives of Self -salient coloured-shapes with significantly faster RT than they approached the ones associated with *Stranger*. Comparing with similar studies like Veenstra and de Jong (2010), Neimeijer et al. (2017), our finding has indicated the possibility of an explicitly more positive impulsive behaviours association with *Self* than for *Stranger*.

As the AAT Scores reveal, the RTs away from Self associated exemplars were significantly slower than in approaching them. On the other hand, participants were significantly faster in avoiding Stranger-exemplars than in avoiding Self -exemplars indicating a comparatively more aversive attitude towards *Stranger* than for *Self*. The Post-Hoc analysis of responses to the *Stranger*-associated exemplars also recorded a just-significant latency for overall approach movements than for avoidance ones. The significantly negative AAT score meant an avoidance tendency was for *Stranger*-associated exemplars.

Such an avoidance tendency has also been recorded in studies (like that of A. Klein et al. (2011);Saraiva et al. (2013); Heuer et al. (2007)) where negatively-valenced stimuli as such a visual target would foster evasive or defensive actions and attitudes while the reverse is true for positive stimuli (Bradley et al. (2001)). Even though the possibility of a non-positive valence attributed to Stranger may have been reflected in our findings we are not aware of any correlational study or any further analysis with valenced comparisons as in Stolte et al. (2017) and Enock et al. (2017) which could assert the mutual exclusivity of the influence of emotional valence and Self -bias in the simple perceptual match-judgement task.

In this study, the difference in the AAT scores between the collectives of exemplars associated with *Self* and *Stranger* was also significant, implying there is a considerable contrast in the Approach-Avoidance tendencies and association-valence for *Self* vs *Stranger*-associated stimuli.

However, apart from the constraints from our experimental limitations, when the manikin was above the stimulus in the upper half of the screen, the response latencies for approach-avoidance were not significantly consistent even though when considered across all trials in the experiment the difference was very significant. This may be attributed to incongruency in habituated reference frames and movements as was also noticed with the work of (Saraiva et al., 2013)

We believe that any assertions for the significance of the manikin-position need to be further investigated. Moreover, even though the *Stranger* exemplars displayed significant avoidance tendencies overall with significance in its AAT score, the observation that for *Stranger*-approach vs *Stranger*-avoid in the post-hoc analysis of Stimulus Category x Movement Type, we could find a just-significance (p=.048), should remind us to be careful in claiming confirmation of negative association towards *Stranger* salience throughout

However, we can assert from our data that the *Stranger*-association is treated with a non-positive response tendency especially when compared to *Self*-associated exemplars which have been established to be treated with a positive approach tendency and processing.

Even though studies like Rougier et al. (2020) applied Approach-Avoidance paradigm to assess correlated personal attitudes like ingroup bias, we fully acknowledge that the AAT task is limited in explaining the cognitive underpinnings behind such behavioural approach-avoidance tendencies. To consider what was noted by Phaf et al. (2014), whether negatively or positively valenced stimuli unintentionally or evaluatively induces the facilitative or hesitative movement-reactions is still being studied with the significance in effect often confounded with the nature of evaluation (implicit or explicit) or the variation in instructions regarding the self or the stimulus object in question.

However, unlike our Experiments-1 and Experiment-2, this study shows a self-preference effect over arbitrary perceptual exemplars associated with social labels *'Self'* and *'Stranger'*, embedded in a more ecological setting. Interestingly, even in the current setting which was devoid of any other cultural primes, we still recorded evidence for positive approach bias and tendencies for the family of coloured-shape exemplars associated with *Self* in stark and significant difference to those exemplars that were associated with *Stranger*. Our results become more relevant with the realisation that evident and significant approach-avoidance tendencies to the collectives constituted by even novel stimuli sharing defining features common to previously-familiarised exemplars associated with salient 'Self' or 'Stranger' labels, implies that apart from preferences in perceptual processing (as in Experiments 1 & 2), preferential attitudes can also possibly be extended to unfamiliar stimuli described by the feature-rules common to exemplars of the more salient category. Such a finding may lead one to conclude that self-prioritisation biases may not only manifest lower-level cognitive decisions as manifested in perceptual preferences, better attentional allocation or better memory, but rather in relatively more complex behaviour as reflected in the approach-avoidance tendencies towards an entire class of stimuli. Further research is needed to investigate whether these preferential biases also translate to more generic biases present for other social categories like religion, caste, language group etc.

Chapter 6

Recounting the Journey- Conclusions & Future Work

6.1 Conclusions

Social relations engender from years of priming and habituation. How complex contradictory behaviour such as discrimination has coexisted with acts of cooperation remains one of the fascinating facets of social cognition. The same individual often interacts in widely different ways depending on the entity he is interacting with and the context of interaction.

One simple question in this context is whether there is a *Self* versus *Other* bias in processing and decision making. If indeed such a bias exists, a further question could be asked regarding the robustness of this bias.

With our set of experimental studies, presented in the current thesis, we wanted to examine whether the self-referential bias, observed in processing visual stimuli can carry over when the social category *Self* is associated with more complex visual exemplars and entire categories of visual stimuli.

We used visual stimuli of three kinds: a) individual instances of geometric shapes (replication study Experiment 1A) b) sets of geometric shapes (Experiment 1B) c) classes of geometric shapes defined by simple rules (Experiments 2A and 2B) and conjunct rules (Experiment 2C) over attribute dimensions (shape, colour). Participants were familiarised with all the stimuli (Experiment 1B) or with only a subset of stimuli (Experiments 2A, 2B and 2C) and it was found that participants were indeed able to extend the self-referential advantage to entire sets of stimuli and entire categories of stimuli defined either by simple or by conjunct rules (where familiarisation is only with a subset of the class). The self-advantage was present both for speed (RTs) and accuracy in all cases.

Finally, in Experiment 3, we investigated whether the self-advantage would carry over a different task i.e., the Approach- avoidance task (AAT). Consistent with our expectations, the self-bias in processing was found to be pretty robust and manifested in the AAT as well.

6.2 Interpretation

The category-level processing of recognising, learning, associating social representations and consequently generalising preference, immediately to familiar or unfamiliar collectives of exemplars in different experimental settings is interesting.

In that process, it seemed apparent that the participants were either looking for a common-feature in all the familiarised exemplars of a target category (e.g. In Experiment 1B - the same number of vertices=3 or 4 or 5 for many different triangles, quadrilaterals, and pentagons respectively) or for the gross-similarity of a presented exemplar with other familiarised exemplars of a collective associated with a social-salience (e.g. all shapes which had similarly 3 vertices).

In the current work, we could conveniently choose varying exemplars of each family or collective to be similar to the other exemplars of the same category by one or more common defining feature-rule(s) shared amongst them. As mentioned earlier, in Experiment-1A, the preferential benefits in perceptual responses got reflected when participants recognised match-judgements of self significantly better than that of friend or stranger in terms of significance in all dependent measures, thus revalidating most other previous studies with this approach for our experimental settings. In Experiment-1B, where participants were explicitly familiarised with 20 exemplars of specific categories of shapes, significant benefits for the whole group of self-associated stimuli relative to that of strangers was still evidenced in RT, Accuracy and sensitivity (d') and criterion measures. In line with our hypothesis, all the associated-exemplars of self, whether it be single-shapes as in Experiment-1A or be it the entire collective group of shapes as in Experiment-1B, were prioritised in perceptual match-judgements against the salience of distant Others i.e. Strangers even for the most abstract stimuli devoid of any cultural priors.

Moving further, in Experiment-2 we demonstrated how the self–preferential responses evidenced with only single-shapes (Experiment-1A) and then generalised to groups of specific explicitly-familiarised exemplars in something akin to a group-reference effect (1B), could also be extended to collectives with even various unfamiliar stimuli, albeit belonging to the same category, by virtue of common visual characteristics. More specifically, the findings suggest that one can also attach self-referent prioritisation to one or more learnt feature-rules shared amongst group-exemplars either independently (Experiment 2A, 2B) or in conjunction (as in Experiment 2C).

These findings elucidated how one can also analyse presented stimuli for similarity of visual features with other presented exemplars and thereby extend preferences beyond specific familiarised exemplars. The subsequent findings add support to the fluidity of this self-referential processing in dynamic social settings at the levels of wider collectives or larger groups of feature-sharing exemplars.

Participants have already shown better memory for adjectives encoded in terms of group–reference, rather than based on just semantic features (Johnson et al., 2002). Our findings just extend the same line of investigation to assert that self-reference at the group-level can also be realised from preferential processing for all exemplars bearing trait-based similarities to initially associated exemplars. Further, our findings also point to the plausibility of constructing abstract social categories just by anchoring them with the self relative to the other thereby inducing preferential processing for all target-stimuli of the self-group vs friend-group or stranger-group.

Indeed, many studies like that of Solarz (1960) and others have already noted how perception of positive valence has an approach tendency, while an entity with negative valence has a bias towards aversive or avoidance reactions. So finally, building on our previous findings, we used the Manikin paradigm first suggested by Jan De Houwer and Hermans (2001) to test approach-avoidance movements over two sets of stimuli with novel exemplars, and found significant evidence for a robust Approach Bias for *Self*-associated as opposed to stranger-associated stimuli; implying that participants processed them with a positive bias compared to those associated with *Stranger*. The converse was true in the case of avoidance tendencies, i.e. Stranger-exemplars showed more avoidance effect than Self-exemplars, implying an inhibitory reaction for the former.

Previous literature (Saraiva et al. (2013), Heuer et al. (2007)) has already established significant avoidance tendencies for threatening or negatively-valenced stimuli, as such a visual target that would foster evasive or defensive actions and attitudes while the reverse is true for positive stimuli (Bradley et al., 2001). Even though we cannot claim that stranger-associated stimuli would induce threatening impressions or negative valence, we can claim that self-salient stimuli significantly induced positive approach-tendencies while the Stranger-associated stimuli induced avoidance ones. The choice of appropriate responsive actions for certain perceptual stimuli is the cornerstone of everyday emotional and social inter-relations and interactions. Paladino and Castelli (2008) demonstrated effects of approach/avoidance through a minimal group paradigm (i.e., "yellow" group vs. "red" group). Ours is a novel attempt to employ just the salience of social associations (Self or Stranger) with totally neutral and arbitrary exemplar-collectives and even novel stimuli that still produce significant differences in the approach avoidance effects. In our opinion, our findings add some evidence to study inter-category attitudes even at the simplest perceptual level.

6.3 Limitations

All our experiments aimed to record instantaneous reactions to our target-stimuli to look for inherent and implicit response biases and thus encouraged immediate responses. Our experiments could naturally not exert full control on the exact approach the participants may have adopted intrinsically for the purposes of encoding the association. It is possible that different tactics may have influences of even possible confounding factors like order effects. We were more concerned about the actual manifestation of prioritised preference on instantaneous response. This also implied that participants were not able to consciously self-correct their immediate reactions to an external stimulus as they would in actual real-world social settings. There is need for caution and more evidence before we generalise our findings to real-world behaviour. We did not address whether group-categorisation was similarity-based or rule-based strategies. Our work also keeps away from the debate regarding the role of attention vs self-bias in the course of attribution of perceptual processing. Further research is needed to tease out the exact distinctions in their roles.

6.4 Future Work

Due to circumstances beyond our control our studies remained limited to simple neutral visual stimuli stripped off any cultural, situational priming. We were restricted from testing generalisation of self-prioritization is present with ecological social labels such as family members, religion, caste, language etc. Another potential direction is to locate the neuro-locus of the self-prioritization effect using neuro-imaging. This may give pointers to the participation of processes that are known to be located in those brain areas.

Thus, future research should focus on experiments that test whether self-prioritization extends to social labels in more ecological real-world settings and categories to try and determine if the differences in processing efficiency of our cognition is skewed towards positive social behaviours of relatedness, empathy, sympathy for the familial in-group while progressively more antipathetic behaviours like stereotyping, prejudice, discrimination etc. towards the out-group.

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1. Roy, N. & Karnick, H. & Verma, A. (2020). Evidence of Self Referential Prioritization on the basis of Visual Features: Attributing Salience to Rule - Learning. In S. Denison., M. Mack, Y. Xu, & B.C. Armstrong (Eds.), Proceedings of the 42nd Annual Conference of the Cognitive Science Society (p.1423). Cognitive Science Society. [*Abstract Publication*]

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