I Remember Me the Best, always? Evidence for Self-Prioritization in Working Memory Binding using a visuo-spatial working memory task.

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1. Introduction

It has now been fairly well-recorded that self-referent information like self-face, self-name and even neutral and socioculturally unrelated geometric shape (that has been paired with a 'self' label: Sui, He & Humphreys 2012) enjoys significant preferential processing over that of others almost 'ubiquitously' across a range of cognitive tasks (Sui & Humphreys, 2017). As investigations into the advantages of a stimuli's social salience in facets of exogenous attention and long-term memory (Kesebir & Oishi, 2010) become commonplace, attempting to understand its effects on aspects like Working Memory (WM) that functions as a critical component of our decision-making systems also assumes significance. WM involves especially attuned limited capacity systems dedicated to the temporary retention and active manipulation of information (Baddeley, 1986) in cognition for additional processing, cognitive control and action guidance (Baddeley, 2003). Drawing on how ecological self-bias influences exogenous attention, it becomes natural to ask how self-referent representations would modulate automatic internal attentional priority in WM maintenance over items that are not as socially salient. Whilst recording evidence for the same through a location probe task, the first of its kind to check for self-bias in WM, Yin et.al. (2019) posited how any evidence of such strong biases in WM could be indicative of undesirable ecological repercussions like facilitating unaccommodating self-serving decisions.

Over recent years, a growing appreciation for the role enacted by the hypothetical episodic buffer (as added in the WM model, Baddeley 2000) as a storage space for temporary representations like feature combinations (Burglen et al., 2004) has inspired researchers to explore WM for combinations of features such as object identities and their locations (Prabhakaran et al., 2000) that associatively embody a coherent representation of any stimuli or event. Thus, in addition to retaining information about different features, the aspect of 'memory binding' or the ability to establish associations between different features becomes a critical component of our memory processes (Burglen et al., 2004).

Therefore, we aimed to test for the mechanisms of self-referential prioritisations as modulated in a more complex WM binding task wherein the investigation of accurate mental representation is achievable with more ecologically relevant processing of visual stimuli requiring not only separate retention of individual features but also maintenance of the correct relationship between them. Thus, our study then looked at responses from participants who were first trained to associate social labels (you, friend, stranger) with arbitrary shapes, and then responded to a delayed match-to-sample WM task on shape identity, locations and both.

2. Methods

36 participants from IIT Kanpur (mean age= 26.77 SD=3.78; 6F, 30M) performed all the 5 blocks of the task. First was the association-learning stage wherein participants were had to associate two unique exemplars from each of the triangle, quadrilateral and pentagon classes to their respective social labels (‘you’, ‘friend’, ‘stranger’- as counterbalanced across participants). Then they had to do a confirmatory match-judgement task responding to whether the presented trials of different shape-label combinations were correct or not. After 8 consecutively correct answers, the last 3 stages containing WM tasks started. There two shapes (each belonging to any 2 of the 3 exemplar categories) appeared simultaneously in a 3x3 grid, each occupying a different cell (except center cell)**.** Over successive blocks, participants were asked to remember A) only the objects, B) only the locations occupied in a grid (single-feature conditions), or C) the objects and their associated locations in the grid (combination condition). The stimuli lasted for 1 second. A 3.5 second delay followed after which they had to respond to perform a simple arithmetic task (as interference) of judging a simple math equation to be correct or not. Finally, after a delay of around 2 seconds the participants would either be shown a black circular probe at any cell in the grid (a-location task), or a particular shape-exemplar at the center-cell (b-object task) or a particular shape at a particular (non-center) cell-location in the grid (c-combination task). On presentation of each probe, they had to respond with corresponding yes/no keypress to indicate whether the probe matches the location or the identity or the location+identity of the previous target shapes, as dependent on the block. Following a correct detection, one from any of the 3 labels would appear on the probe location and the participant has to respond whether the label matches the probe association or not.

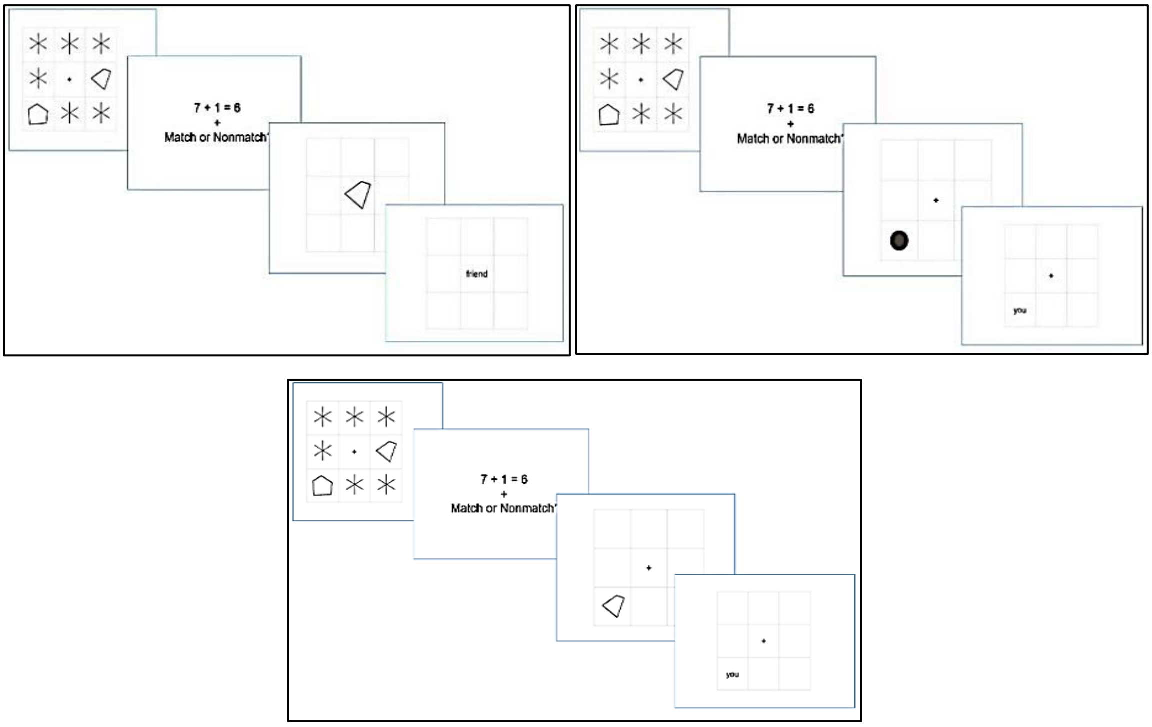

Figure: The flow of the Identity Probe (Top-left), Location Probe (Top-right) and Identity Location Probe (Bottom) block of the task

3. Results

On performing a repeated measure ANOVA with the single factor, association (Self, Friend, Stranger), we did not find any significant effect in the accuracies for stimuli associated with social labels across the location, identity or the location-identity tasks with just the probe matching response, and hence the analyses reported henceforth is based on reaction times.

For the reaction time data (as in Table), we find that the participants responded to self-associated exemplars significantly faster across all blocks of the experiment than stranger-associated exemplars.

Table: Mean & SD of Reaction Time data for location, Identity, IdentityLocation

label	condition	Mean	SD	N
Self	Location	0.748	0.116	36
	Identity	0.884	0.156	36
	IdentityLocation	0.774	0.124	36
Friend	Location	0.772	0.113	36
	Identity	0.899	0.147	36
	IdentityLocation	0.82	0.13	36
Stranger	Location	0.78	0.118	36
	Identity	0.929	0.18	36
	IdentityLocation	0.833	0.144	36

More specifically, for the location task, the effect of self - association was significant, with $F(2, 70)= 4.722$, $p=0.012$, with a significant difference between responses for self and stranger – associated stimuli, $t=-2.951$, $p_{holm}=0.013$ & cohen's $d=-0.278$ but not between self and friend responses $t=-2.218$, $p_{holm}=0.060$ & $d=-0.209$.

For the identity task, there was again a significant effect of association $F(2,70)=3.373$, $p=0.040$, with self-matched trials being significantly faster than stranger-matched ones $t=-2.554$, $p_{holm}=0.038$ & $d=-0.281$, while there was again no difference between response times to self as compared to friend – matched trials.

Finally, for the location – identity task (or the binding task) in which both identity and location had to be correctly reported, the significant effect of self – association persisted for response times $F(2,70)=6.043$ ($p=0.004$) with faster responses to the self-associated match probes than friends $t= -2.570$, $p_{holm}=0.025$ & $d=-0.339$) or strangers $t=-3.312$, $p_{holm}=0.004$ & $d=-0.437$ and mutually thereby $t=-0.743$, $p_{holm}=0.46$ & $d=-0.098$.

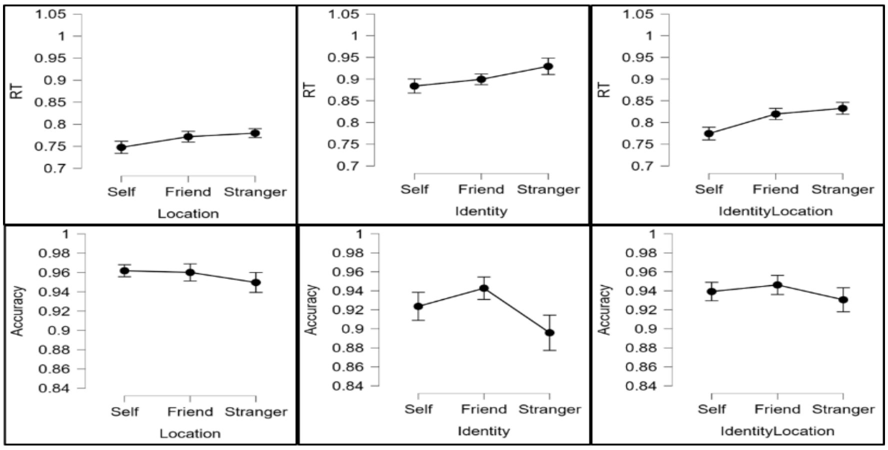

Figure: RT Accuracy plots (means and SE) for Location, Identity, IdentityLocation blocks

4. Discussion

In the current study, we find an evidence for significant of self-prioritization in various aspects of a visuo-spatial WM task. More specifically, in the block where we expected to observed WM binding (i.e., location – identity task), we again find faster retrieval for self-referential items compared to the other categories. Our results are in line with Yin et al 2019's assertions about the self-prioritization effect being reflected in the location probe task even when two other stimuli associated with socially salient labels are presented simultaneously, implying that the preference is emergent from preferential processing and bottom-up capture of attention to the self-associated stimuli.

In the stimulus-identity task, the preference with faster RTs for the correct self-match responses can be interpreted as being indicative of the preferential processing of the identity of stimuli during the encoding of information. Preferential processing of shape-label has been already documented with a whole host of other tasks, but this evidence points to their active preferential treatment in encoding in multiple combination of resource-constrained situations. Finally, in the combination situation, whilst having to deal with both the object and the location information, the persistence for self-preference points to how, despite the difficulty of WM binding in combination (as asserted by Burglen et al 2004), the self-preference indicates preference for the self.

References

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