Understanding the Social and Perceptual Salience

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Abstract

The distinctive feature of stimuli related to self, as compared to the familiar or unfamiliar others, is supposed to be largely dependent on the social salience of the stimuli. 17 participants participated for the part of behavioural task only of experiment. To test the role of social salience by using novel arbitrary shapes, we found a rapid learning of self related visual associations relative to friend or other. Participants were supposed to learn the association of labels for self, friend and other with different geometrical shapes. Their task was to correctly judge the label-shape matching. We found evidence of substantial advantage of social salience of the self-relevant stimuli as compared to friend (familiar) or other (unfamiliar) even if the stimulus was irrelevant to the task at hand.

The effects of low frequency of repetitive Tanscranial Magnetic Stimulation (rTMS) at right and left posterior parietal cortex were also studied using the social salience and hierarchical levels of stimulus. 10 participants were administered low level of 1Hz rTMS before they identified local and global target levels of stimuli. We found a significant difference in the pre and post TMS performance of the subjects on congruency conditions. We also found right and left hemisphere differences on the category of shape but did not get significance for target level i.e., global to local interference.

Keywords: social salience, self-relevance, hierarchical levels, learning, association, congruency.

INTRODUCTION

Information related to the self i.e., names and faces, are highly distinguishable from those of others. Salience tends to help the perceiver to focus the attention on the particular aspects of stimuli and eventually, influencing the consequences of the judgements made by the perceivers.

Pryor and Kriss (1977) suggested that something is salient when it receives a disproportional amount of attention from the observer in relation to its context (p. 39).

Fiske and Taylor (1991) reported salience as an attention grabbing stimulus relative to other stimuli in the context and expectations of the individual while Smith and Mackie (2000) described salience as a cue's ability that attracts attention in its particular context. Our framing of salience construct includes that how we pay attention to a particular part of the stimuli.

Social Salience

The salience reflects the presence of biased processing of self- relevant information and eventually, the social salience of the stimulus allows the property of the stimulus (whether the stimulus is self-relevant or not) to be noticed (Gronau, Cohen, & Ben-Shakhar, 2003). Social salience is the individual's perception about any information related to the self (Sui & Humphreys, 2010).

The question of the significance of social salience has been studied and the research in cognition neuroscience has made several contributions to our understanding of social salience that how attention is guided and drawn to the idea of self.

An increasing number of studies have reported self-related or self- referential processing during the last decade (Phan et al, 2004; Kelley et al, 2002). Self-relevance stimulates the memory and referencing of any familiar other produces the similar effect like referencing self (Rogers at all, 1977). The property of self-relevance makes the stimuli prone to appeal individual's attention (Bargh, 1982) even the own name has also proved to be a special stimulus for attention (Wolford & Morrison, 1980). Similarly, recognition of one's own face has widely been studied and the self advantage in face recognition has been demonstrated ((Keenan, Gallup, & Falk, 2003, Tong & Nakayama, 1999). We may attend the details about ourselves because of high priority whereas the judgement of identity of others' faces require configuration (Keyes & Brady, 2010). A rapid learning has been reported of the social salience for self- related stimuli like self-faces relative to the other face (Ro, Russell, & Lavie, 2001).

There is evidence of better memory for the stimuli generated by us relative to the stimuli generated by others (Kesebir & Oishi, 2010; Klein, Loftus, & Burton, 1989) and self-related information presented as distractor has been demonstrated to be better attended relative to the information where distractors are associated with other people (Brédart, Delchambre, & Laureys, 2006). Self-referential effect while using self descriptive traits are better remembered as compared to the traits describing others (Rogers et al, 1977). Some studies have demonstrated a lower recall of intimate-other-reference judgements as compared to the self-reference judgements (Lord, 1980; Klein et al., 1989; Heatherton et al., 2006), whereas some other researches have provided evidence of diminished self-prioritization effects on memory when compared with the substance related to the intimate others (Bower and Gilligan, 1979).

All the previous researches have explored the effects of social salience by using stimuli that already have learned associations. This familiar and already established self-relevant information did not help to ascertain the speed of learning of stimuli that can become socially salient to allow the certain behaviour (Sui & Humphreys, 2010).

The present study is partially based on a research conducted by Sui and Humphreys (2010) in which they demonstrated how the social salience can be established by using novel images to perceptual matching task. Consistent with the studies of self prioritization in face perception (Keenan et al, 1999; keyes et al, 2010) and self-referential memory (Klein et al, 1989), they hypothesized that the association between self label and an arbitrary shape can lead to a self prioritization effect. Following the results of the study, we further extended the research by using the same arbitrary shapes while administering rTMS to explore the role of PPC in identification of global/local target.

Contrary to the previous studies of self-prioritization using familiar self-related stimuli (Kesebir & Oishi, 2010; Keyes et al., 2010; Sui et al, 2009) and keeping in view a previous research (Sui & Humphreys, 2010) we used novel geometrical images to represent self, friend or other to explore the social salience of self-related information to rule out the element of familiarity of stimuli.

Initially, we explored the speed of learning of social salience through associative learning while participants were required to associate geometric shapes to labels of either themselves (you), a familiar other (friend) or unfamiliar (other). Following the practise trials of learning the labels of 'you', 'friend', or 'other' with the particular geometrical shapes of circle, square or triangle, the participants were asked to judge whether the labels and shapes correspond correctly. The present study seeks to address three objectives. Firstly, to investigate the difference in the learning of self-relevant visual associations in comparison of visual association to other familiar or neutral people and secondly, to assess the social salience of stimuli to global/local task while using the novel associative learning approach. Third objective was to explore the role of posterior parietal cortex in determining whether the social salience of stimulus can influence attending the local or global information.

To examine a shape-label association, we conducted an experiment to measure firstly, the self prioritization on reaction time and accuracy of the responses in perceptual shape- label matching task. We examined this salience effects by using geometric shapes associated to 'self', 'friend', or 'other'. We expected a self- prioritization effect for the shape related to self that may trigger the self – related information. By using the precise salience of the stimulus and connecting it to the self, familiar or unfamiliar other we predicted distinctive learning for the self association relative to familiar or neutral other associations. We suggested that not only the stimulus but the association related to the stimulus determines the salience.

Perceptual Salience

It is very important to understand that how attribute of social salience can affect the perceptual process in the constantly changing environment. The perceptual salience is basically the information that captures the attention of the individual from a given situation or stimulus. In the neuroscience experiments, the properties of the images or stimulus become perceptually salient when they play a significant role in processing the information visually. It is an important component of visual attention and it contributes to the visual system to make a particular part of stimuli more significant relative to the other features. The visual system seems to be highly sensitive to these properties of the stimuli. Gestalts psychologists have presented various properties of the stimulus like proximity, symmetry and continuation that can become perceptually salient because of the visual processing system. But it is not clear that how these properties of the stimuli integrate to contribute to the overall perceptual salience.

The research in neuroscience has studied the phenomenon of visual perceptual salience and presented various models to explain the issue. Itti and Koch (2000) has presented the attention model based on the construction of the saliency map.

In the present study we intended to explore that how social salience (manipulated through the self-bias) interacts with perceptual salience (manipulated through the use of local-global, hierarchical stimuli).

Subsequently, we set another objective of the study that was to examine the role of social salience in identification of hierarchical levels of the stimuli (global or local shape). In everyday life we find objects in various settings. These objects can be perceived as parts of the larger objects and these parts can be further part of another larger object. These hierarchical spatial relationships within the parts of the objects include global and local shapes of the object. The spatial relationships of a particular scene help the individual to view the hierarchy sub-scenes of the content (Winston, 1973: Palmer, 1975). Navon (1977) has explored the flexibility of visual attention through global/local task. He proposed his theory of global precedence claiming that the visual system accesses the global features or relationships of an object before the local features.

A very significant question in neurological studies is that how local elements in a visual image are incorporated to generate global perception. The question of relationship between the perceptions of parts versus whole has been studied from Gestaltism to most recent neurological studies. On the one hand, the Gestaltists' believe of perceiving the objects as whole and to see all information of the visual scenes right away has been contradicted in numerous studies and, on the other hand neurological studies have emphasized the requirement of exploring the attentional mechanisms involved in global or local priority of the perceptual system (Robertson et al., 1988).

Within this context, we suggest that the hierarchical levels i.e., global or local, are processed perceptually while assuming a link to the salience based selection. Previously, posterior parietal cortex has been suggested to be sensitive to the saliency of the stimulus (Gottlleb, Kusunock, & Golderg, 1998). Numerous studies also focusing the relations between attentional selection and difficulty of the task have demonstrated a clear distinction in the functions of different parts of the parietal cortex. Wojciulik and Kanwisher (1999) have provided evidence that distinct areas within the parietal cortex are related to attentioanl resources (posterior IPS) and to the task difficulty (the anterior parietal cortex).

Considerable research on global precedence has indicated that there are different factors that determine the respondents' ability to attend the global or local forms defined by various levels of hierarchical objects. Kinchla and Wolfe (1979) provided evidence of global or local advantage in object identification depending on the overall size of the stimuli. Similarly, local precedence advantage with central presentation and global precedence effects with peripheral presentation has been found by Lamb and Robertson (1988).

A large number of evidences have been reported in the neuropsychological literature indicating that the two hemispheres of the brain play different roles at identifying global/local features of the object (Mevorach, Humphreys & Shalev, 2006). Damage to the parietal lobe is revealed to disturb the attentional mechanism involved in the local or global level categorically (Rafal & Robertson, 1995).

Another attentional mechanism called regional attention is considered to be associated with the adjustment of size or attended region of space (LaBerge & Buchsbaum, 1990). Both, regional and categorical attentions contribute differently to local or global performance at identifying different levels of hierarchical objects.

In the present study global/local task was explored further through the use of hierarchical patterns. Apart from the first objective of the study mentioned earlier, the current study contains another objective i.e., how the PPC mechanism is involved in determining the attentional responses to saliency. Subsequently, we explored the inter-hemispheric function at identifying the social salience for self related information by comparing accuracy and reaction time across all the conditions in which self, friend and other were presented. For this objective and to explore the role of left and right posterior parietal cortex (PPC) in the selection of hierarchical patterns, rTMS was applied to the participants on left and right PPC before they engage in global/local part identification task. rTMS was administered in two sessions on two different days to manipulate the social salience of hierarchical levels of the stimuli related to self, familiar or unfamiliar other.

Hypotheses

The study comprised hypotheses as follows:

1. Social salience of stimuli can be more persuasive for the self-relevant information compared to stimuli related to familiar (friend) or unfamiliar (other).
2. Hierarchical levels of the stimuli can be processed perceptually while linking the salience based selection.
3. Repetitive transcranial magnetic stimulation with right or left hemisphere will interfere the attention towards more or less saliency respectively.

In line with previous evidences, we expected to find an advantage in learning the self-relevant stimuli. We also supposed to have higher accuracy and faster reaction time for global relative to local features of the stimuli particularly when the selection is salience based. Opposite roles of right and left hemisphere for salient stimuli were also expected.

Method

Experiment was designed to assess whether the self-related information through associative learning will lead to self prioritization and eventually, will exhibit greater accuracy and faster reaction time in the shape-label matching task. We hypothesized that the social salience of stimuli can be more persuasive for the self- relevant information compared to stimuli related to familiar (friend) or unfamiliar (other).

Participants:

For the present research we had two group of participants, one participated only for the behavioural part of experiment without rTMS and the other group of participants were administered rTMS immediately after the 1st part of behavioural task and before the beginning of global/local task.

Seventeen right handed volunteer students from the University of Birmingham served as participants in the behavioural part of the study (without rTMS). Three participants had to be excluded from the evaluated data of global/local task due to the technical problems. They ranged in age from 23 to 36 years (M = 22.36). All participants had normal or corrected to normal vision acuity. They were without any neurological or psychiatric history and were right handed. Consent was obtained from the participants before participation. The study was approved by a local ethics committee.

The behavioural part of the study comprised two stages, learning part and global/local part of the experiment.

Stimuli (Learning Part): The stimuli of the behavioural learning part of the experiment comprised simple geometric shapes of triangle, square and circle (see below). A small cross sign (0.8 ˚ x 0.8 ˚) was used as a fixation point. The width and height of the circle shape was 3.37° x 3.37°with a position of 11.11cm x 6.15 cm from top-left centre of screen. The height and width of the square and triangle stimuli was 2.98° x 3.37° with a position of 10.91° x 6.55° from top-left centre of screen.

All the stimuli of geometric shapes (circle, square, and triangle) were presented to the participants at the centre of the screen right above the fixation point whereas the labels of 'You', 'Friend', and 'Other' were exhibited below the fixation point. All stimuli were presented on a grey background while maintaining an equal distance from fixation point with the centre of the images i.e., 3.5°.

Stimuli (Local/Global Task)

The second stage of the experiment was comprised global/local task of the perceptual shape–label matching. Three sets of geometrical images (circle, square, and triangle) were used in this part of experiment. Stimuli patterns were created by placing local shapes of small size of circles, squares or triangles in a matrix to produce the global images (see shapes below). Subsequently, the circle made up of small circles and square made up of small squares (congruent) while circle made up of square and triangle, similarly, square made up of circles and triangles (incongruent) were used as stimuli. The shape of triangle made up of squares and circles was used as the neutral pattern.

Procedure:

E prime programme was used for the behavioural part of experiment. As mentioned earlier, this study employed two stages, a learning task and a global/local task. The first stage of the experiment consisted of a training session of 24 trials to introduce the participants with the labels in which the instructions were given to them to associate the shapes of circle, triangle, or square to 'Self', 'Friend', and 'Other'. For instance, a participant was instructed to imagine that circle represents 'you', square represents 'friend' and triangle represents 'others'. Participants were required to judge correct matching of the shape and the label. Feedback was provided to the participants to help them with their learning of shape-label pairings. Following the training session there were four subsequent experimental blocks (48 trials each).

Participants were seated in front of the computer display screen comfortably. Each trial began with a 2000 msec fixation point in the centre of the screen. Geometrical pattern appeared immediately after offset and was displayed for 1000 msec to the above of the fixation point. Participants were instructed to focus on the fixation point and to keep their eyes in the centre of the screen throughout the experiment session. In this part of experiment the participants were presented one shape with two different labels, one target and the other distracter. Eventually, a label-shape pairing ("You", "Friend" or "You", "Other"), one correct and the other incorrect label, was presented for the duration of 1000 msec. Participants were required to judge whether the shape correctly correspond to the left handed label by pressing the required key. Presentation of the stimulus was followed by a grey screen, during which the participants received the feedback of their response for 500 msec at the end of each trial. Participants were requested to respond as accurately and quickly as possible. The maximum response time was fixed for a limited period of 2000 msec to encourage the participants to response as quickly as possible. Each block included 48 trials and 12 practise trials. Subsequently, each participant performed 4 blocks of 48 trials (each condition) following the 12 practice trials with randomized setting of shape-label matching task. Thus there were 48 trials in each of the following condition, self correct match, self incorrect match, friend correct match, friend incorrect match, other correct match and other incorrect match.

Block order was counterbalanced across the subjects. The images were presented in a random order within each block. The association of the square and circle shapes to the self and friend were counterbalanced across the participants. Subsequently, all the conditions were counterbalanced.

Examples of Stimuli used in Learning Part of Behavioural Experiment

Figure 1

A shape of circle representing you with a distractor of other

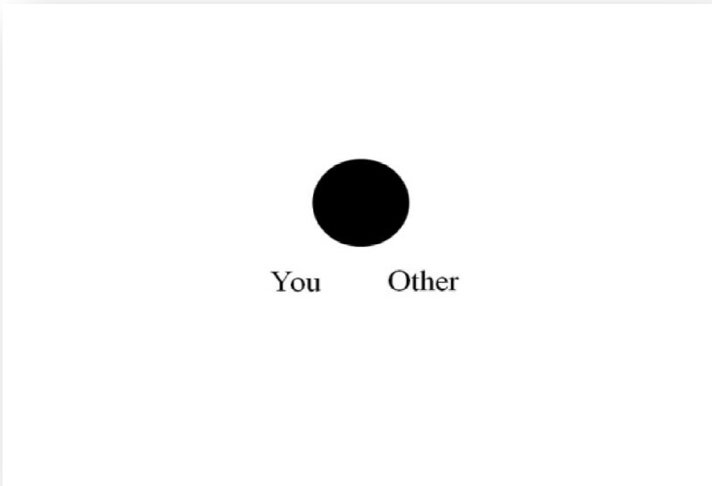


Figure 2

In this figure the shape of square represents friend and you is the distracto*r*.

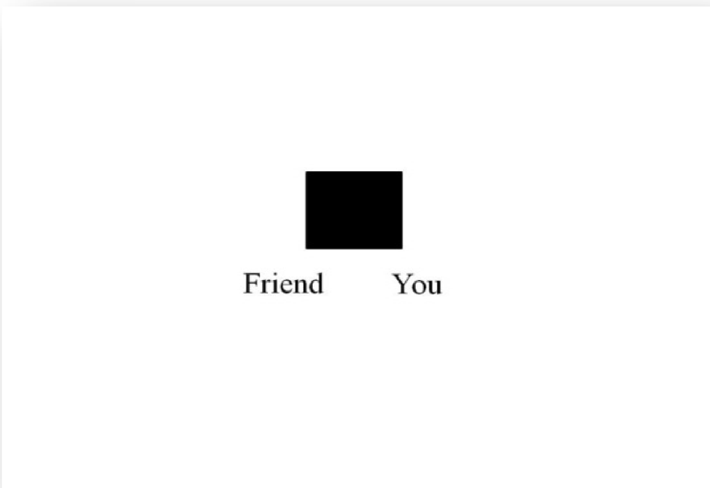
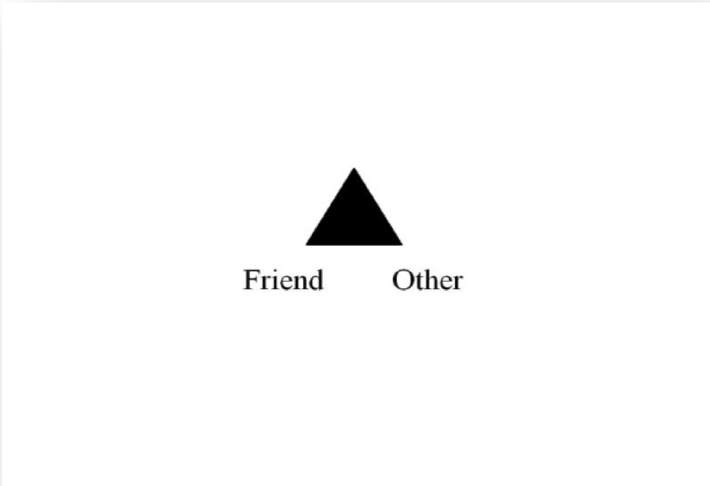


Figure 3

The figure shows a Triangle representing other with a distractor of friend



Local /Global Task

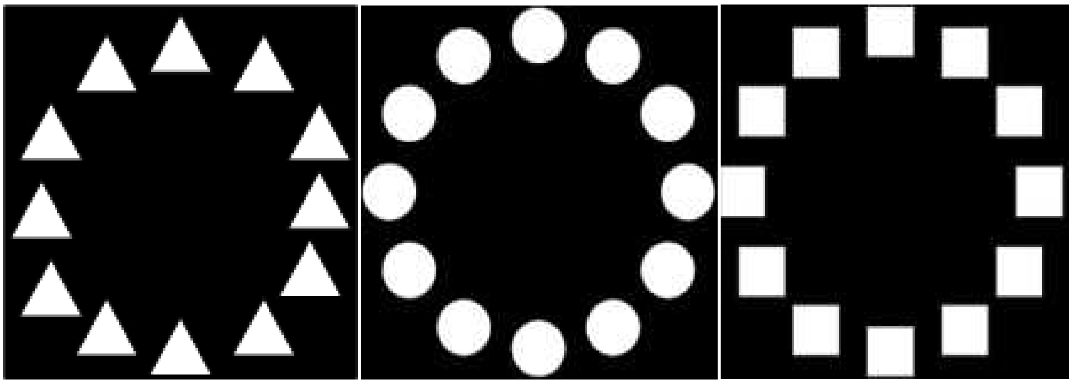
Immediately after the completion of learning part of experiment the local/global part begins in which the stimuli were presented on the computer screen. Each trial started with a white fixation cross point in the centre of the screen for 300 msec followed by the target image which was shown on the screen for 80 msec. The duration of the response interval was 200 msec participants were instructed to identify the required hierarchy of the shape as accurately and quickly as possible by pressing the right key on the keyboard. The shapes (see the examples below) could appear either up or down of the fixation point along the midline on the screen. Each run included four blocks, two with “global” targets and two with “local” targets. In the beginning of each block a written instruction of “global” or “local” appeared at the centre of the screen for the duration of 3000 msec. The order of the blocks and stimuli was counterbalanced between subjects and trials. Four 24 trials block was presented as practice session prior the actual experiment session.

On four blocks of 96 trials (each condition) participants were required to identify either global or local element of the shape while ignoring the other hierarchal level information. Subsequently, random trials comprised stimuli with same local and global elements (congruent trials) or different element at local and global hierarchy (incongruent trials) or the neutral stimuli. In the local target blocks, the participants were asked to detect the presence of local shape of the stimuli while ignoring the overall shape leading to neutral, congruent or incongruent conditions. For global part, the overall shape was supposed to be more salient than the local shapes which were considered to be the distractors in this case.

Examples of Stimuli Images for the Global/Local Task

Figure 4

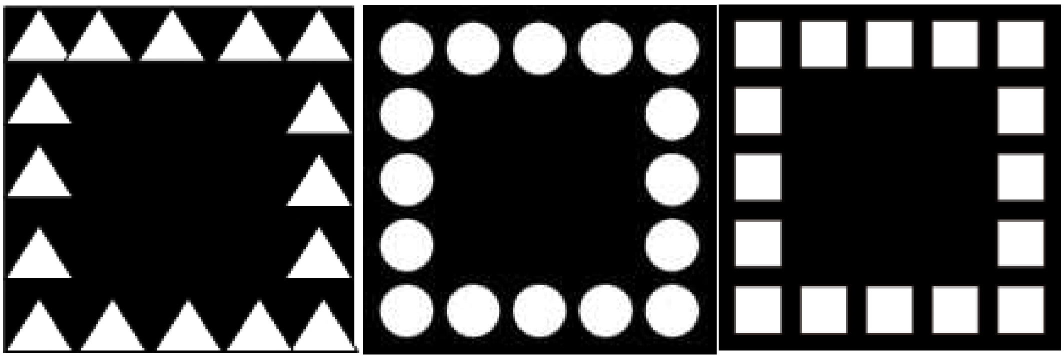
Incongruent ***Congruent*** ***Incongruent***



Circle as a global shape made up of triangles, circles and squares which constitute the local properties of the shape.

Figure 5

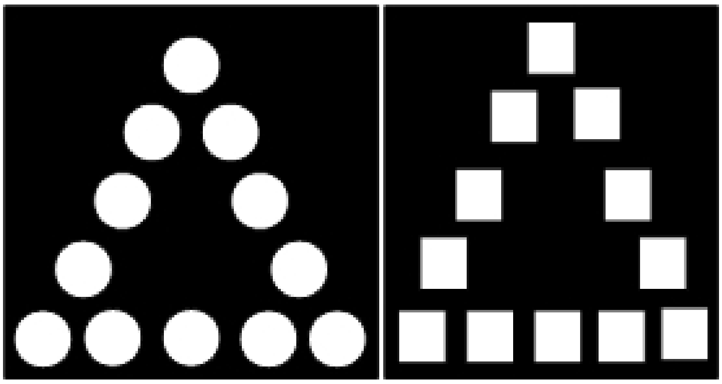
Incongruent ***Incongruent*** ***Congruent***



Square as a global shape made up of triangles, circles and squares which constitute the local properties of the shape.

Figure 6

Neutral Images



Triangle as a global shape made up of circles and squares which constitute local properties of the shape. Triangle shapes were only used at the local level of the experiment

TMS Evidence of Local Global Task:

***Participants*:**

10 participants from the University of Birmingham (except of 1 who was the visitor of a student, 2 males 8 females age ranged between 23-40; mean age was 26.6) were recruited to participate in the TMS and behavioural task of the experiment for course credit or cash payment. All the participants were tested twice in two separate sessions (on different days), one for the right hemisphere and the other for left hemisphere. All were right handed and had normal or corrected to normal vision. The participants were healthy without any neurological or psychiatric history of illness. Consent forms were obtained from them before the beginning of experiment and were also informed about the purpose of the study.

Stimuli: The stimuli patterns and experimental design was identical to experiment 1 except of introducing the magnetic stimulation between the learning and global/local task parts of experiment.

repetitive Transcranial Magnetic Stimulation (rTMS)

rTMS was used to stimulate neurons and cortical excitability in the targeted brain area i.e., right and left peripheral hemisphere. A 70-mm coil that was similar to the figure of eight was connected to MagStim Rapid2 stimulator to generate a magnetic field passing on the skull in a risk-free and painless way. The TMS coil was kept over p3 (left Posterior Parietal Cortex) and p4 (right Posterior Parietal Cortex) with electrode positions on the 10-20 elecrtoencephalogram (EEG) coordinate system. Participants received two 10 minute consecutive sessions of 1Hz frequency, 600 number of pulse. In total, rTMS lasted 20 minutes with a number of 1200 pulses. This electrical field was expected to affect the membrane of the targeted neurons which further lead to interfere and inhibition with the ongoing brain function of that particular area (Mevorach et al, 2005). The coil was held tangential to the head along a parasagittal line with the handle pointed to posteriorly. Initially, a single pulse of 50% power was administered to make the participant familiar with the magnetic stimulation.

Table 1

TMS Specification

Power	Frequency	Duration	Number of Pulses	Wait Time	Number of Trains	Total Number of Pulses
60%	1Hz	6.0 s	6	1.0 s	100	600

After completion of learning association task of the behavioural part, the participants received 2 consecutive sessions of rTMS of 100 trains each. Immediately following the magnetic stimulation either on right or left hemisphre, the participants performed global/local identification computer based task. Stimulation site order was not counterbalanced across the participants perfectly as only four out of ten received rTMS on left hemisphere in the first session.

Results

First of all, for simplicity, we combined Reaction Time and the response Accuracy in a single measure by using Inverse Efficiency Score (IES) technique (Townsend & Ashby, 1983) for each participant in all the experimental conditions. Subsequently, the IES, calculated by using the standard method of RT divided by Proportion of Correct response (ISE = RT/PA), were used as single dependent variable. Data reported in the Figures and Tables are the efficiency scores.

In order to assess the hypotheses of the study various further statistical analyses were performed. Within subject and between subject one way, three way and four way repeated measures of analysis of variance (ANOVA) were performed for data with and without rTMS on the experimental conditions of relative salience of stimuli, hierarchical levels of the stimuli i.e., local versus global identification and congruent, incongruent and neutral aspects of stimuli. *t* test was also computed to analyze the differences of social salience of stimuli in identification of target level i.e., global versus local, and to specify the difference in the role of right and left hemisphere on selection based information.

Differences in the Effect of Shape (Learning Associates)

The efficiency mean time taken to complete the one-way repeated-measures ANOVA was 870 msec for the condition of you shape; 1002 msec on the second shape condition of friend; and 1045 msec on the third shape condition of other.

Evaluation of learning associates (without rTMS) on one way repeated measures of analysis of variance (ANOVA) presented an evidence for the presence of significant main effect of category of shape ($F(2, 20) = .03$, $p<.05$).

***t* - Test**

t-analysis was also carried out on the efficiency scores of learning associates to explore the differences on the basis of the experimental condition of shape. You shape, was expected to be benefited more as compared to the friend or other shape in learning matched associate task**.**

t- test results indicate a significant difference in the self matched judgements relative to the matched judgements for other, ($t = 2.477$, df = 16, $p< .025$). Although the results with friend and you shape condition are not significant but indicate a clear difference in means of these conditions. The response accuracy was higher and reaction time was faster in identifying self shape than friend or the other shapes. The results confirm our first hypothesis that social salience of stimuli can be more persuasive for the self-related information compared to stimuli related to familiar (friend) or unfamiliar (other), as shown in Table 2.

Table 2

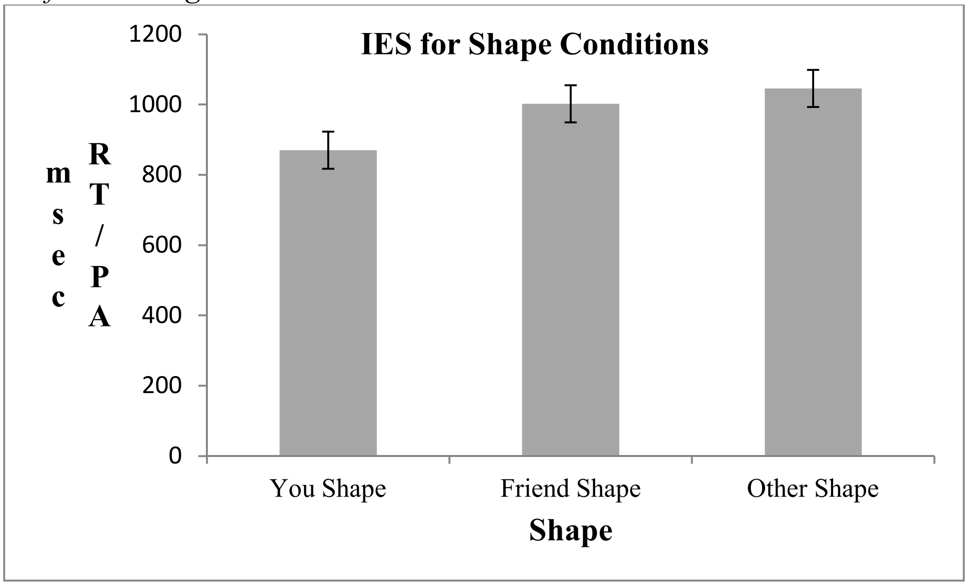
Mean and Standard Deviation for Learning Association Task without rTMS

Condition	**No of Participants**	**Mean**	**Standard Deviation**
You Shape	17	870.24	166.32
Friend Shape	17	1002.06	307.31
Other Shape	17	1045.71	307.87

Table 2 indicates the mean differences and standard deviations for the condition of shape in the learning association task for the behavioural part of experiment without rTMS. The lower mean value for the self shape indicates smaller reaction time and larger accuracy than for the familiar or unfamiliar and lower mean value for familiar than for neutral associations.

Figure 7

Efficiency score differences in the shapes of You, Friend and Other for learning Associates



Note: IES = Inverse Efficiency Score

Figure 7 shows a significant difference in IES (reaction time divided by response accuracy) of different experimental condition of shape. Response accuracy is larger and reaction time is faster for you (self) than friend or other associations and it was larger for friend (familiar) than for other (neutral). Subsequently, there was an advantage to the self matched judgements as compared to the judgements related to familiar and neutral associations. Familiar matched judgement also proved to be more benefited relative to neutral matched judgements.

Differences in the Effects of Social Salience of Stimulus, Congruency and Hierarchical Levels (PreTMS)

Efficiency scores on global versus local identification task, pre-rTMS as baseline, were analyzed using a three way repeated measures analysis of variance (ANOVA) with hierarchical levels (local more salient versus global more salient), congruency of the shape (congruent, incongruent, or neutral), and social salience of the stimuli (you and friend) factors. Descriptive Data analyses in the pre-TMS condition showed significant differences in the relative saliency of shape category. The computation of three way repeated measures of analysis (ANOVA) revealed a significant main effect of congruency condition of the stimuli; $F = 12.148$, $P < .001$, indicating that the manipulation of social salience of stimuli and the congruency put a strong effect on the target level identification. Moreover, there was a significant interaction between target level identification and congruency; $F = 5.683$, $p < .011$.

Table 3

Mean (ISE) and SD of congruency condition as a function of Global-Local Task and You Shape condition

Hierarchal Level	Condition	Congruency	Mean	SD
Global	You Shape	Congruent	541.	75.29
		Incongruent	625.	161.07
		Neutral	620.	140.62
Local	You Shape	Congruent	570.	110.18
		Incongruent	675.	191.97
		Neutral	615.	116.14

The table 3 indicates that the self matched judgement was more accurate and faster at both local and global level when presented in congruent form. Global precedence (541 ms/IES and 570 ms/IES for global and local respectively) was found for you shape. Global precedence was also observed (625 ms/IES and 675 ms/IES for global and local respectively) for you shape when presented in incongruent condition.

Figure 8

IES of Congruency condition for "You" shape on Hierarchal levels of stimuli.

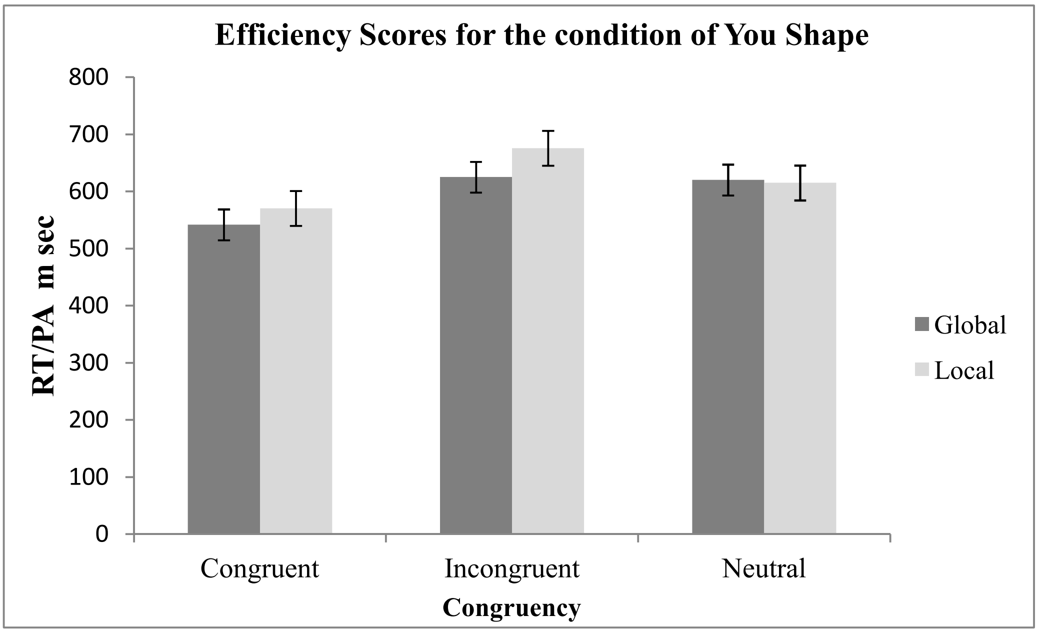


Figure 8 shows mean differences for congruent, incongruent and neutral at both local and global level for the shape of you. The self matched judgement was more accurate and faster at both local and global level when presented in congruent form relative to incongruent and neutral level.

Table 4

Mean (ISE) and SD as a function of Global-Local Task and Friend Shape Condition

Hierarchal Level	**Condition**	**Congruency**	**Mean**	**SD**
Global	Friend Shape	Congruent	583	84.44
		Incongruent	621	106.37
		Neutral	648	140.62
Local	Friend Shape	Congruent	575	140.62
		Incongruent	700	174.89
		Neutral	636	140.25

Table 4 shows mean difference in IES of different experimental conditions for the shape of friend. Response accuracy is larger and reaction time is faster for congruent condition than for incongruent or neutral conditions. Table also shows an advantage to the global matched responses as compared to the local conditions.

Figure 9

IES of Congruency condition for Friend shape on Hierarchal levels of stimuli.

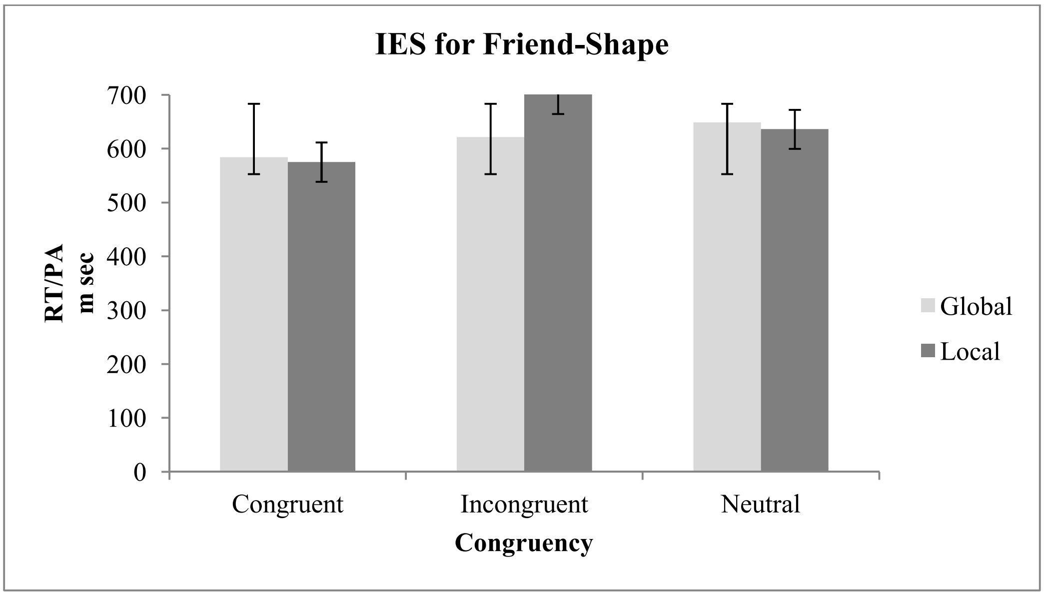


Figure 9 shows a significant difference in IES of different experimental condition of shape. Response accuracy is larger and reaction time is faster for you (self) than friend or other associations and it was larger for friend (familiar) than for other (neutral). Subsequently, there was an advantage to the self matched judgements as compared to the judgements related to familiar and neutral associations. Familiar matched judgement also proved to be more benefited relative to neutral matched judgements.

Figure 10

Differences in you and friend shape at Local and Global Level

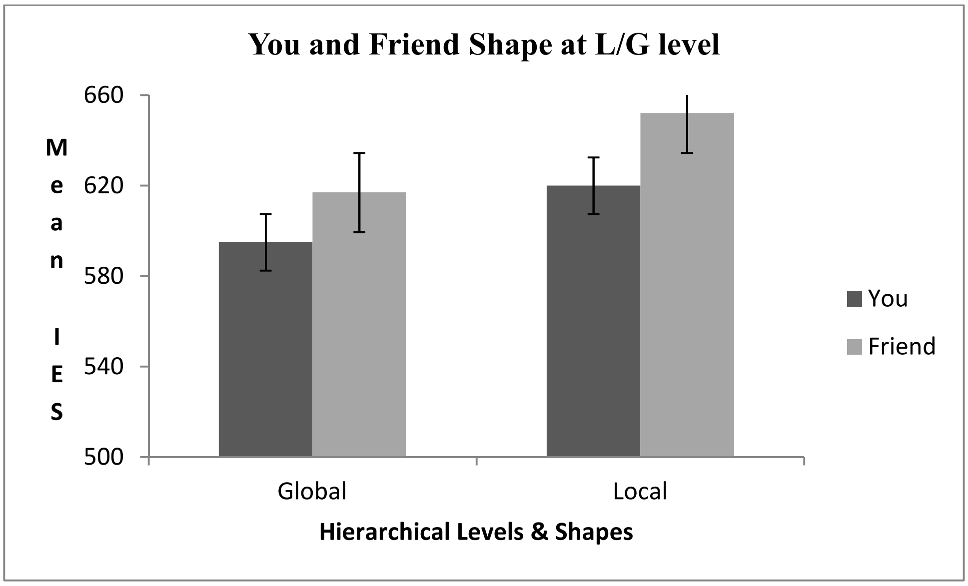


Figure 10 indicates a significant difference in efficiency scores for you and friend shapes at local and global level. A faster reaction time for you (self) than friend associations at both, local and global, shows the priority of self association.

Differences in the Effect of Shape (rTMS First session)

To test the judgement efficiency in each association condition (you, friend or other) in the rTMS first session, one way repeated measures of analysis of variance (ANOVA) were computed for a single efficiency measure (RT / Accuracy). The results revealed a significant main effect of shape condition, F (2, 8) = 8.783, $p < .011$ reflecting different levels of accuracy and RT in learning for the self association compared to familiar and other shapes. A benefit for self associations relative to friend or other and a friend (familiar) association priority over other (unfamiliar) associations was also found.

t-Test

We conducted a separate *t* test for Efficiency scores of learning associate session to find out the significant differences on the basis of social salience experimental conditions (you, friend, or other). The self association was expected to be benefited more from the learning as compared to the familiar or unfamiliar other. The participants were also expected to reflect a benefit for friend association compared to other association.

t- test results indicate a significant advantage for self association , (t = 3.856, df = 9, p< .004) as compared to friend association. Results also reflect an advantage of self compared to other (unfamiliar) association (t = 3.414, df = 9, p< .008). Although the results with friend compared to other association were not significant but indicated a clear difference in means of these conditions, as shown in Table 5.

Figure 11

Mean of Efficiency Scores of Shape-Label Matching Task

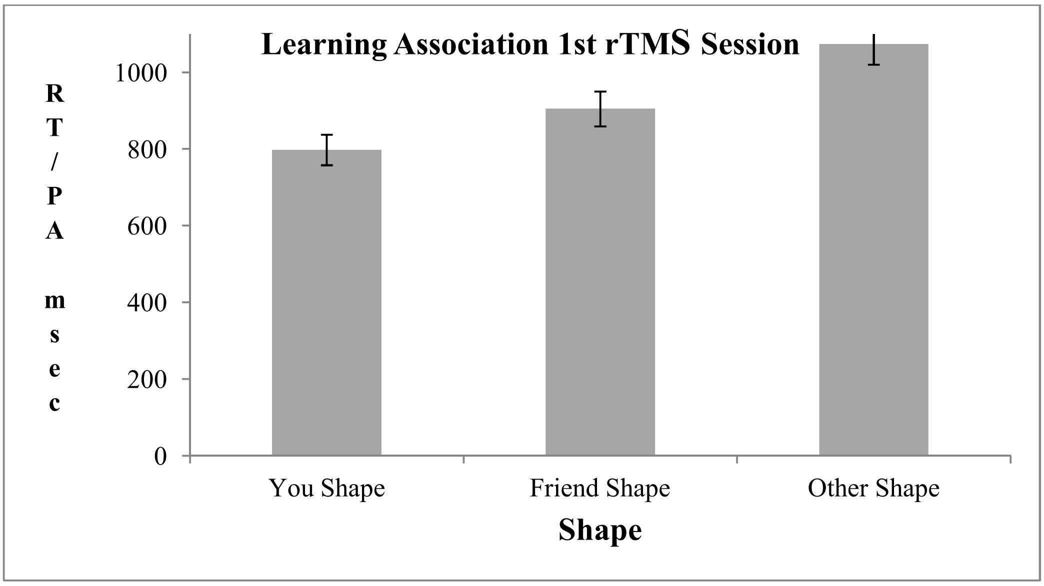


Figure 11and Table 5 indicates the clear efficiency score differences in shape learning association. You shape has proved to be benefited from the learning association relative to friend and neutral association.

Table 5

Mean of Efficiency Scores of rTMS First Session of Learning Associates

Condition	Number of participants	Mean	SD
You Shape	10	746	196
Friend Shape	10	876	236
Other Shape	10	1003	278

Differences in the Effect of Shape (rTMS 2nd session)

One way repeated measures of analysis of variance (ANOVA) were computed for a single efficiency measure (RT / Accuracy) on rTMS second session data to test the self advantage effect. The results revealed a significant main effect of shape condition, F (2, 8) = 6.351, $p < .009$ reflecting accuracy and RT differences in learning for the self association compared to friend (familiar) and other (unfamiliar) associates.

***t*-Test**

Furthermore, we conducted a separate *t* test for Efficiency scores of learning associate on rTMS second session to find out the significant differences on the basis of social salience experimental conditions (self, familiar, or unfamiliar). The participants were supposed to be benefited more from the learning for self association compared to the familiar or unfamiliar association. The participants were also expected to reflect a benefit for friend association compared to other association.

The results of *t*- test results revealed a significant advantage for self association, (t = 2.392, df = 9, $p< .040$) as compared to friend association. Results also reflect an advantage of self compared to other (unfamiliar) association (t = 3.808, df = 9, $p< .004$). Although the results with friend compared to other association were not significant but a clear difference in means of these conditions has been shown (Table 6).

Table 6

Mean of Efficiency Scores of rTMS Second session of Learning Associates

Condition	Number of participants	Mean	SD
You Shape	10	744	142.82
Friend Shape	10	818	272.16
Other Shape	10	935	173.51

Table 6 indicates mean efficiency score differences on you, friend and other shape for the 2nd rTMS session. The mean results revealed an advantage for self associations over the friend or other associations and a friend (familiar) association priority over other (unfamiliar) associations was also found.

Differences in the Effects of Social Salience of Stimulus, Congruency and Hierarchical Levels and Location (rTMS Sessions)

To test the brain processes involved in attentional response to the saliency of the stimuli, repeated Transcranial Magnetic Stimulation (rTMS) was administered to 10 participants. We tested whether the social salience of stimuli is related to global versus local visual brain processing by inducing repeated Transcranial Magnetic Stimulation (rTMS). We applied rTMS (immediately after learning association behavioural task) either over a right peripheral hemisphere or left hemisphere to identify its role in the selection of salient based information. Immediately after receiving rTMS, the participants were supposed to identify the global or local level of the stimuli.

The efficiency scores of rTMS on right and left hemisphere were analyzed using a four way repeated measures analysis of variance (ANOVA) with target levels (local versus global), congruency of the shape (congruent, incongruent, or neutral), social salience of the stimuli (you, friend or other shape), and location of the hemisphere (right or left) as factors. A significant main effect of location was found, $F(1, 9) = 9.17$, $p < .014$, reflecting diverse role of right and left hemisphere in the selection of saliency of the stimuli. There is also a significant effect of congruency, $F(1, 9) = 23.24$, $p < .001$. A significant effect for the interaction between the target level identity i.e., global/local and congruency i.e., congruent, incongruent and neutral, $F(1, 9) = 9.35$, $p < .002$, was also found. The main effect of target level was not significant as there was no difference in the identification of global versus local target. However, the interaction between target level and congruency indicated that the main effect of congruency depends somehow on the target level as well.

Table 7

*Mean Efficiency Scores and Standard Deviation on Global Local Task (**rTMS right hemisphere)***

Location	Target Level	Condition	Congruency	Mean	SD
Right Hemisphere	Global	You-Shape	Congruent	546	127
			Incongruent	589	127
			Neutral	591	152
		Friend-Shape	Congruent	551	105
			Incongruent	584	126
			Neutral	646	221
	Local	You-Shape	Congruent	548	102
			Incongruent	620	111
			Neutral	576	82
		Friend-Shape	Congruent	544	65
			Incongruent	612	77
			Neutral	583	64

Table 7 reveals efficiency mean scores (in msec) and SD for you and friend shape as a function of congruency and hierarchical levels of the stimuli on right hemisphere. The subjects have shown larger response accuracy and faster reaction time for self than for friend or other category. The efficiency score was also larger for the congruent associations along the global condition as compared to incongruent and neutral at local level.

Figure 12

IES for Learning Association for the Shape of You rTMS Right Hemisphere

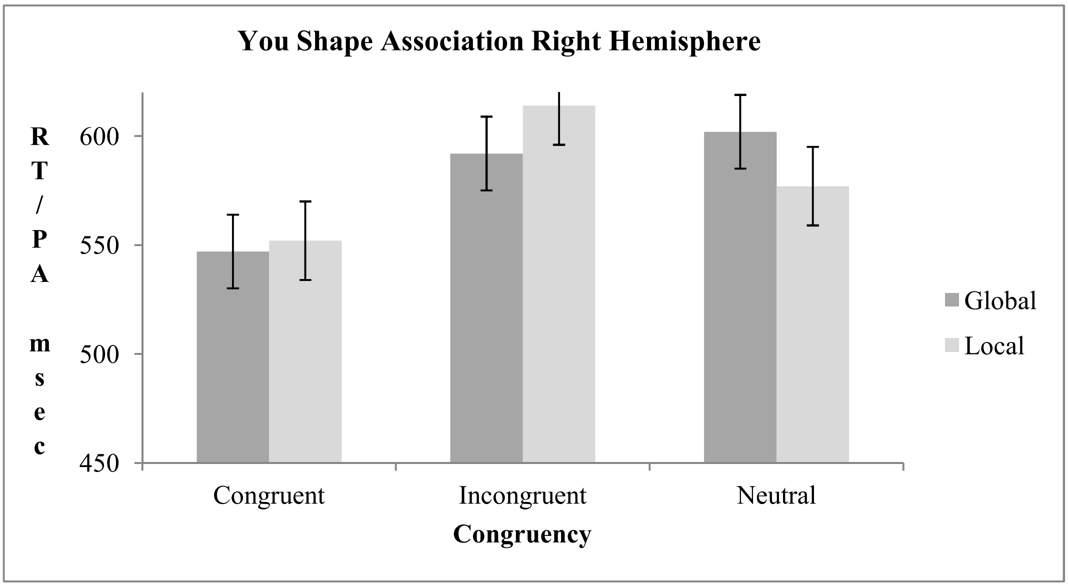


Figure 12 shows a significant difference in IES for different experimental condition of you shape on the right hemisphere. Response accuracy is larger and reaction time is faster for you (self) shape when responses are to be made on congruent condition relative to incongruent or neutral conditions.

Figure 13

IES for Learning Association for the Shape of Friend rTMS Right Hemisphere

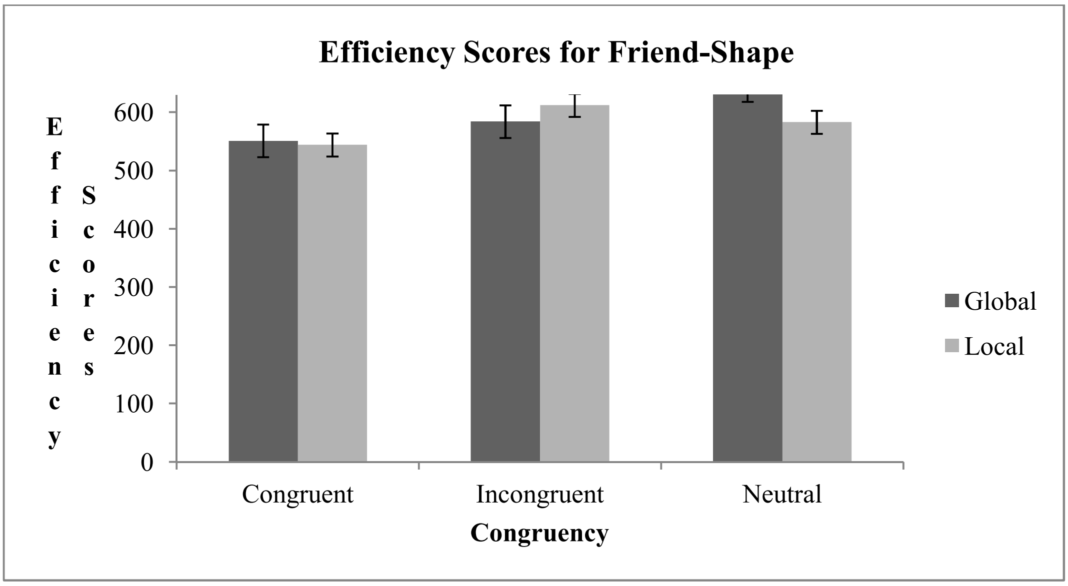


Figure 13 shows a significant difference in IES for different experimental condition of friend shape on the right hemisphere. Response accuracy is larger and reaction time is faster for friend shape when responses are to be made on congruent condition relative to incongruent or neutral levels.

Table 8

Mean Efficiency Scores and Standard Deviation on Global Local Task (rTMS leftt hemisphere) No. of Participants 10.

Target Level	Condition	Congruency	Mean	SD
Global	You-Shape	Congruent	496	95
		Incongruent	592	129
		Neutral	566	107
	Friend-Shape	Congruent	509	103
		Incongruent	558	115
		Neutral	557	116
Local	You-Shape	Congruent	516	105
		Incongruent	575	113
		Neutral	563	129
	Friend-Shape	Congruent	525	85
		Incongruent	575	105
		Neutral	537	80

Table 8 indicates efficiency mean scores on you and friend shape as a function of congruency and hierarchical levels of the stimuli for left hemisphere. The subjects have shown larger response accuracy and faster reaction time for self than for friend or other category. The efficiency score was also larger for the congruent associations along the global condition as compared to incongruent and neutral at local level.

Figure No 14

IES for Learning Association for the Shape of You rTMS Left Hemisphere

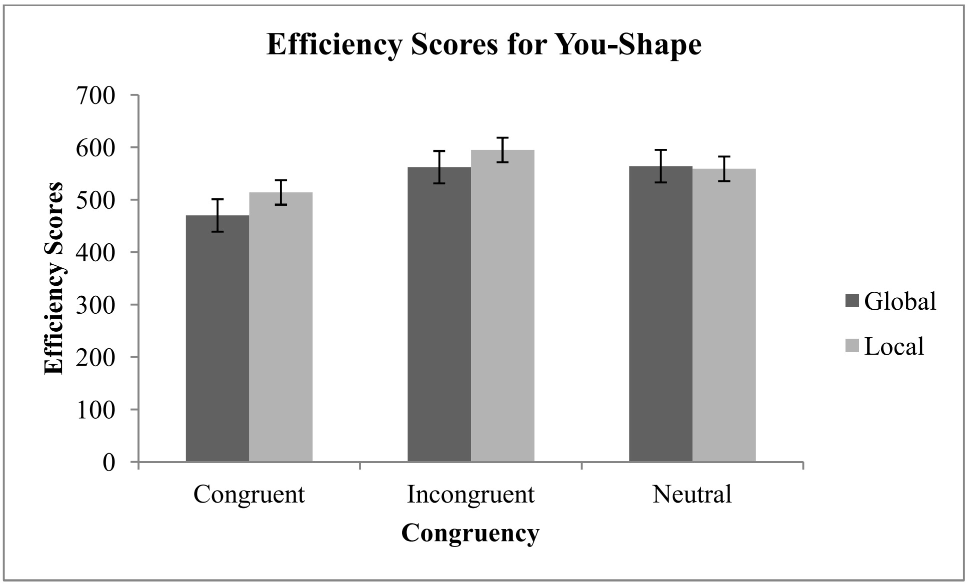


Figure 14 shows a significant difference in IES for different experimental condition of you shape on the left hemisphere. A higher response accuracy and a faster reaction time for you (self) shape are evident when responses are to be made on congruent condition relative to incongruent or neutral conditions.

Differences in the Pre and Post TMS Effects

A repeated measures ANNOVA on efficiency scores with location (right versus left hemisphere), time (pre versus post TMS), Task (local versus global), congruency (congruent, incongruent or neutral) and target saliency (you or friend) revealed main effects of congruency $F(1, 11) = 17.642$, $p < .001$ reflecting that performance on the congruent shapes was quicker relative to incongruent and neutral shapes.

We also computed repeated measures of ANNOA on left versus right hemisphere with task (local versus global), congruency (congruent, incongruent or neutral) and target saliency (you or friend). The results revealed main effects of shape, $F(1, 9) = 38.98$, $p < .001$ reflecting that performance on the you shape condition was quicker relative to friend or other shapes.

Figure 15

Pre and Post TMS IES Mean Differences on You and Friend on Hierarchical Levels

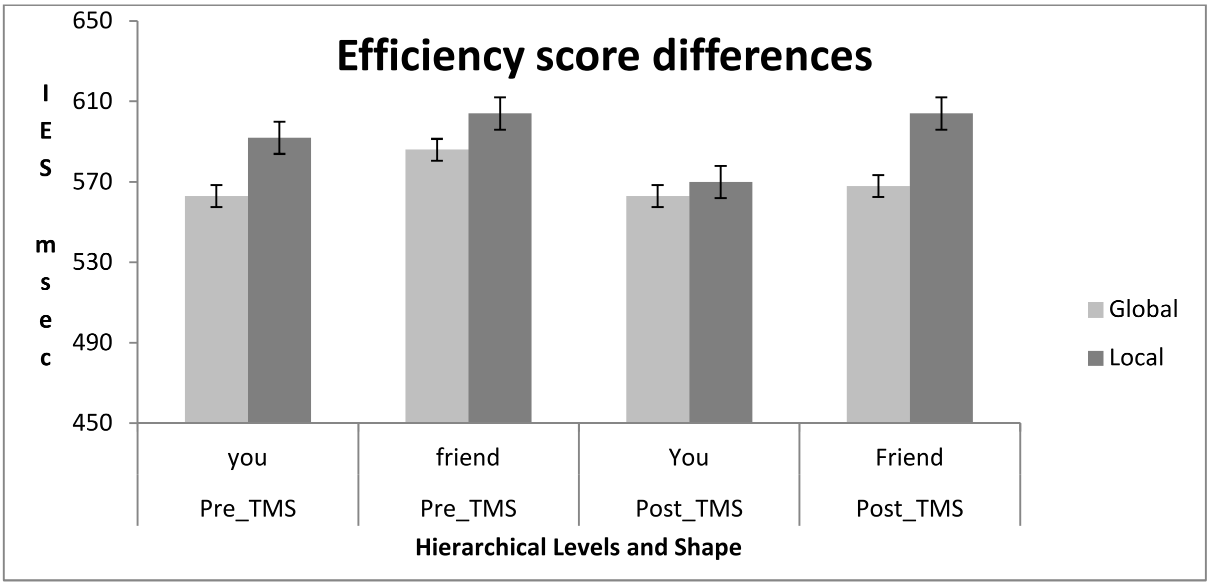


Figure 15 reveals a comparison of pre and post TMS efficiency score for you and friend shape category for the target levels i.e., local versus global conditions. We assessed the better response for the shape category of you across the hierarchical levels in both pre and post TMS sessions.

Discussion

In the constantly moving and dynamic visual world, it is very common to draw attention to the stimulus and events that have a social salience. Salience is basically the point where a particular stimulus captures attention compared to the other stimuli in the same context. Our attention guides the perceptual processing of visual information as we interact with a stimulus by deliberately directing our attention to the stimulus.

People usually attend the information in terms of their salience irrespective of the fact that the features of the information are relevant to the task or not. Keeping in mind this fact, we examined the learning associates to shape-label matching task by using the geometrical images that were not apparently relevant to the self, friend or other.

In the present study we used low level perceptual matching task to examine that how a label referred to you (self), friend (familiar) or other (unfamiliar) can transform association to an arbitrary shapes. The participants were introduced the labels for geometrical shapes in the training part of experiment. After the training session, they were presented shape with matched or mismatched pair of labels and they judged the correct label for the shape.

The analyses based on the efficiency measure showed an overall, the pattern of results was quite similar to the learning associate part of experiment in both with or without TMS. The results of the data showed an evidence of self prioritisation in accuracy and reaction time in case of self-relevant shape-label matching task relative to when the labels were referred to familiar friend or unfamiliar others. This clearly demonstrates that the social salience can account for the differences between self associates relative to familiar or unfamiliar others.

A self advantage for self-relevant shape relative to friend or other has been clearly evident across all the sessions of learning associates when we used it with no rTMS session or immediately before the administration of rTMS on right or left hemisphere. The results demonstrated a rapid learning of the saliency of self-reference that leads to self-prioritization with low level perceptual matching task (Sui & Humphreys, 2010). The geometrical shapes proved to be able to trigger the self-representation, a self advantage effect, as has been demonstrated by some previous studies of self-face perception (Keyes et al,. 2010; Sui et al., 2009).

Distinctive feature of stimuli related to self were found to be more benefited from the learning associates as compared to the familiar or unfamiliar other associates confirming our first hypothesis, that the social salience of stimuli can be more persuasive for the self-relevant information compared to stimuli related to familiar (friend) or unfamiliar (other). The results are also consistent with the perceptual matching studies (Bamber, 1969; Krueger 1978) in which the participants showed rapid responses for the judgement of same letter as compared to the different ones.

With the line of the previous research evidences, we also found substantial support for matching shapes for friend (familiar) relative to other (unfamiliar), indicating that the social salience of the stimulus can be an indicative of significant differences of the prioritization of attentional resources (Sui & Liu, 2009; Vuilleumier, 2005).

While finding evidence that the geometrical shapes can be used to trigger the self association, we suggested that the shape properties can be used to investigate the perceptual process. Eventually, we hypothesized that the hierarchical levels of the stimuli can be processed perceptually while linking the salience based information. In the global local task of the experiment, we were supposed to bring the learning associates of social salience into active use of hierarchical levels. We examined saliency effects by manipulating the self biased information, in which participants were asked to discriminate the stimuli by responding to either local or global part. Manipulation of perceptual salience through the use of local global, hierarchical stimuli, could not demonstrate significant main effect on the data. We were expecting that the spatial features of the objects can guide the attention when the object is in a hierarchical structure.

Though we could not find significant influence of social salience of stimuli on the perceptual salience i.e., identification of local global features but a difference between the means of local and global conditions has been demonstrated by the descriptive analyses of the data. The difference of the mean of local versus global identification did not lead to a substantial influence on the main effect of perceptual salience.

The rationale in finding perceptual salience was that if advantage of the learning of self associates has been represented in the first behavioural part of experiment, then the presentation of hierarchical levels would lead to higher accuracy for the salience based target levels as compared to the less salient target levels. The selection of the global shape was expected to be made according to the saliency of the shape.

One explanation for not finding significant perceptual salience at local global task might be the shapes used in the experiment as Hoffman (1980) showed that the information at local and global level may reverse the speed with which the local and global targets are identified. Another possibility might be that the local elements are as salient as the global ones and they didn't interfere in the perception of competiting stimuli as Miller had also (1981) found the subjects responding with the same speed when target appeared at the both, local and global levels. Several investigators (Boer & Keuss, 1982; Miller, 1981; Navon, 1981) have agreed that global and local processing can occur in parallel fashion or at least proceed with a similar time period.

Although the behavioural data revealed social salience influence on the low level perceptual task of shape-label matching but we could not find any evidence of transferring this self associate learning at the perceptual level where participants identified global or local features of the shape. Eventually, we did not find the support for our hypothesis that hierarchical levels of the stimuli can be processed perceptually while linking the salience based selection.

We further investigated that how brain mechanisms are significantly involved in determining attentional response to saliency. To find out the role of Posterior parietal cortex (PPC) in saliency of the non-spatial task selection, we administered rTMS to the participants immediately before the local global saliency based identification task. Several researchers have demonstrated the difference in the role of left and right posterior parietal cortex to social salient of stimuli. The role of right posterior parietal cortex while drawing attention to a salient event and left posterior parietal cortex towards the stimuli that have low salience, has been demonstrated (Mevorach, Shalev and Humphreys; 2006).

We used repetitive Transcranial Magnetic Stimulation (rTMS) to disrupt the neural activity in posterior parietal cortex region of brain. Based on the rTMS experiment, in which participants responses were observed on rTMS to both, right and left posterior parietal cortex (PPC) to social salient hierarchical stimuli related to self, friend and other, we can suggest a difference in the role of right and left hemisphere in guiding attention to the hierarchical levels on the basis of significant effect of location found in TMS sessions. The results are consistent with some previous research evidences for functional hemispheric differences in hierarchical processing (Delis, Robertson, & Efron, 1986; Robertson & Delis, 1986; Robertson, Lamb, & Zaidel, 1993; Weissman & Woldorff, 2005). Characterization of left and right hemisphere as responding to the local or global target has been established (Fink, 1996; Evans et al, 2000).

However, we could not find support for the hypothesis that repetitive transcranial magnetic stimulation with right or left hemisphere will interfere the attention towards more or less saliency respectively, as evident by pre and post TMS results.

Behavioural task analysis presented evidence that attention contribute differently to a local or global feature of the stimuli when approaching the target at the hierarchical level. We found a difference in the responses when target level shifted from global to local (Miller, 1988). Data also demonstrated a higher accuracy and faster reaction time for the congruent images relative to incongruent or neutral images.

Social salience is the attribute or the immediate effect of an object which cause the observer to pay more attention to that object relative to other objects present in the environment at the same time. Individuals are likely to draw their attention toward some object because of the general object attributes.

The results of the study demonstrate that social salience can be established by using geometrical images. The results also provide evidence of the role of hemisphere in the salience based information selection. Global precedence is also evident from the analyses of the data.

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