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Spatial, Social Cognition and Team Performance

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Abstract

The team members' interaction with the environment and with the members helps shape their spatial, social cognitions respectively. These cognitions help in formulating an understanding of mental models necessary for team performance. At the theoretical level, the relation between spatial, social cognitions and team performance is becoming an exciting field, as it allows not only the investigation of important aspects of spatial and social cognition, but also its relation to team performance. At the empirical level, this line of research covers a vast and varied range of tasks, measures, and effects, as properly demonstrated by this contribution, through experimental research design. The results show that Spatial and Social Cognitions have individually and collectively positive significant impact on team performance.

Key Words: spatial, social cognition, team mental model, team performance, understanding.

2. Introduction and Literature Review

The interaction among human beings has been a centerpiece of interest ever since, and the complexity of interaction kept on increasing, as the human beings went on exploring it more and more. This interaction has generally been restricted to social perspective, i.e. individual's relation to another individual, group, society, etc. whereas the other dimension, such as cognition to the niche (spatial cognition) have not been given its due consideration. The literature supports a great deal of working on human interaction at social level; still there exists room for understanding certain dimensions of this interaction.

The interaction with reference to spatial, social cognition as part of this human cognition, human and artificial intelligence (AI) enabled agents' cognition; AI agents' group cognition is under active area of research quite recently. There are emerging scenarios wherein human beings are interacting with (AI) enabled agents, and the level of cognition in such scenarios is of critical importance. It is here that human and machine and vice verse interaction becomes most important in today's complex world.

It seems, however, that firstly, spatial cognition i.e. cognition about the niche, physical descriptions has received relatively less attention in group cognition and is still regarded as an area to be further explored (Caruso & Woolley, 2008). Spatial cognition is more or

less discussed in literature with reference to geographical location, visualization, imagery and navigation of a particular location (Kozhevnikov et al., 2005). This study takes this spatial cognition in broader perspectives, which include not only geographical features, visualization, imagery and navigation of the area where organization is located, but also the internal structure of the building, physical description of the team members, team settings etc. The internal structure and location is viewed not only from navigational point of view but also from organization processes perspective. Particularly, when critical decisions are to be taken; a slight error may lead to disaster. This study therefore, takes the knowledge of the physical features of each group member, group-working environment as of crucial importance.

This study takes into consideration the group interaction, as centerpiece of group activity for achieving the higher degree of performance in organization. Group cognition is based on each individual's cognition. Cognition includes mental approach and experience of knowing e.g. perceiving, recognizing, conceiving, and reasoning. Group cognition is a social, largely linguistic phenomenon whereby small groups of people produce a sequence of utterances that perform a cognitive act. That is, if a similar sequence is uttered or thought by an individual, it would be considered an act of cognition or thinking. The main focus of the study is to surface members' understanding of each other from spatial, social perspective and thus develop understanding.

This paper, therefore, builds on work in cognitive psychology and social neuroscience, previously unexplored in organizational settings, developing a construct that characterizes spatial, social cognition with respect to how individuals encode and process information during working as a team. This study also explores how spatial, social cognition affects team processes and how these processes enhance or disrupt team performance. In so doing, this study builds bridges between spatial, social team cognitive process literatures, in an attempt to further the understanding of the mechanisms underlying the effect of spatial, social cognition on team performance. This research is especially relevant to organizations since organizational teams house cognitive diversity, but are mostly unaware of its existence, let alone its implications for team performance. This research seeks to address two important questions- *whether* spatial, social cognition matters in teams, and *how* it matters.

2.1 Significance of the Domain

An understanding of human behavior is detrimental to effectiveness and efficiency of organization and thus Organizational Behavior not only became the focus in management domain but also continued gaining more importance. In organization behavior, work around teams and groups became center of interest from performance perspective.

Bettenhausen (1991) emphasized on task driven processes in teams. Sundstrom, et al. (1990) presented an organizational systems perspective on teams that addressed issues development and effectiveness. Hackman (1992) viewed groups as contexts for individual behavior, an important perspective because teams in part enact their context. An examination of this body of work leads to the conclusion that there is an enormous wealth of information available on work teams in organizations. Several literature reviews published over the last decade shifted the focus from simply homogeneity or heterogeneity perspective to such characteristics as values, preferences and sensitivities (Huber and Lewis, 2010). Nevertheless, answers to many fundamental questions remain

elusive. Managing groups and teams for high performance is, at the same time becoming a challenge. A solution to this challenge in teams and groups is seen in mental models.

Objective of mental models is to gain insight into individual mental model from team perspective for achieving high performance in today's complex world. Cognition of each team members culminating into group cognition is viewed a solution to this problem. This solution made mental models a center of interest for research. These mental models have so far shown limited progress and are mostly limited to share mental models, situation mental models, transactive memory system, task mental models, etc.

It is observed that simply limiting mental models from social cognition perspective may not ensure higher performance, unless they are seen from surfacing the knowledge that exists in the minds of team members through more interaction. The high performance is possible if mental models are seen from layers perspective. Therefore, there exists need to explore mental model at spatial, social layers and create a better approach to problem solving.

In this way, the current study would create awareness among researchers and managers alike that mental model based on spatial, social level cognition leads to significant improvement of teams operating for achieving high performance.

The study centers on much value in taking a more syntegrative view of the team cognition, and linking the themes and disparate topics closer together. The value of this study is quite evident when necessary areas of theory development and research are identified.

3. Research Question

The main research question of the study is to check whether spatial, social cognition measures can be used to improve teams' performance through utilizing spatial, social cognition model to meet the new challenges of globalization, which is becoming more a threat and less an opportunity to the world?

4. Objectives of the Study

The purpose of the study is to develop first ever seemingly interested but so far ignored model explaining the layers of cognition i.e. spatial and social cognition with performance of teams in the organization through an experimental research design conducted on MBA and BBA volunteer students, in order to establish causal relationship. It considers widely used mental models with their limitations, and culminates into development of spatial, social model necessary in the today's dynamic world. More specifically, the study attempt to:

- Determine linkages between spatial, social cognition and Team Performance;
- Investigate the level of spatial, social cognition in teams; and

4.1 Spatial Cognition and Team Performance

Spatial cognition is concerned with the acquisition, organization, utilization, and revision of knowledge about spatial environments. These capabilities enable humans to manage basic and high-level cognitive tasks in everyday life. Numerous disciplines work together to understand spatial cognition in humans and in technical systems. Human cognition depends on a number of distinct mental components, with spatial, verbal, visual and analytical capacities, including language and behavior, being the most important.

Spatial cognition is an essential foundation for the development of cognitive capacities (e.g., de Hevia et al., 2006; Hahn et al., 2006; Landau and Lakusta, 2009; Nieder et al., 2006). Spatial cognition enables the necessary mental representations that code the positions and relationships among objects. There is need for continuous updated knowledge of position to track and manipulate objects, including the parts of the body of the individual contemplating action. Spatial abilities are essential to represent, organize, understand, and navigate the environment, to attend to specific objects, to manipulate objects, and to communicate information about objects and the environment to others, among many other functions and tasks.

The knowledge of environment for people is mandatory for their existence (Moore and Golledge, 1976). Mental models are cognitive structures that form the basis of reasoning and decision making. Mental models are however characterized as incomplete representations of reality. They are rather subjective representations of the world they view. In essence, mental models have to be highly dynamical models to adapt to continually changing circumstances and to evolve over time through learning. Conceptualizing cognitive representations acknowledges the limitations in peoples' ability to conceive the systems, which are getting more and more complex. Cognitive maps help in removing these limitations.

To give meaning to mental models in the context of this study, immediately below examples of information are provided that might be contained in the mental models of members of groups to which this work applies. At the spatial level, the mental model features relevant to a group's task and task situation is mental model content relating to the factual knowledge a member possesses about the properties or states of the system's variables—for example, facts about the geographical location of building, the internal plan of the building or understanding of the facts of overall environment.

Organization and particularly teams on specific task require specific spatial skills. These skills may be varying from task to task, nature of organizations, nature of functions of teams, but they are there and they are required, if the teams have to be transformed into performance teams. Quick reflexes and split-second decision-making are required to succeed in an action or completion of a task. Managers who notice threats too late or react too slowly do not succeed or even survive in the respective field. The cognitive demands in specific situation are considerable and they require rapid action or reaction for teams to perform in today's dynamic world.

In order to improve fluency in the workflow, the team members may be exposed to physical conditions prevailing in the environment. They need to understand the visibility in behavior. The members' experience increases their factual knowledge and their basic skills are developed into specialized, implicit sources of knowledge. Mental model features include specialized ontology, key images, useful scripts, physical description of team members, team working environments etc.

In this review, the focus of interest is to see the role of spatial cognition on team performance, department performance and finally organization performance. The literature supports that managers devote less attention to "large-scale" spatial tasks (Hegarty et al., 2006) such as way finding. This study has therefore, concentrated to find out and establish the relationship between spatial skills and team performance.

This study, therefore, articulates spatial layer team mental model as a part of the spatial, social cognition where group members need to have understanding of the physical bearings of the individuals in groups, their academic achievements, their experiences, their knowledge of the surroundings etc. as of crucial importance for developing cog-synergy. This study spells out how the spatial cognition explains instances where spatial cognition has a positive effect on team information processing and, hence, on performance.

- **H_1**: The better the spatial cognition in team mental model, the higher the team performance will be.

4.2 Social Cognition and Team Performance

Social cognition is the study of how people process social information, especially its encoding, storage, retrieval, and application to social situations. The social cognition refers to interaction among social groups. The information/decision-making perspective shows that high levels of diversity in group cognition have positive effects on group performance (Jehn, Northcraft, and Neale, 1999; Polzer, Milton, and Swann, 2002; Williams and O'Reilly, 1998). Whereas the social categorization perspective suggests that low levels of diversity in group cognition are beneficial (Cohen and Bailey, 1997; Mohammed and Dunville, 2001; Williams and O'Reilly, 1998), as does the literature on shared mental models (Cohen and Bailey, 1997; Mohammed and Dunville, 2001; Williams and O'Reilly, 1998). Groups need to have social cognition, in order to participate actively in achieving a target; otherwise, they may fail to do so. For example, in cross functional groups, it is important to have an understanding of the patterns of interaction among groups, their likings and disliking, their beliefs, their attitudes.

Social cognition helps in understanding groups, their dynamics and facilitates working among them. This social cognition is not limited to the knowledge of the liking and disliking of the group members rather we extend it to the understanding of the likings and disliking etc., which will subsequently help in determining the synergy of the group. This study, therefore, emphasizes its importance as part of the cognition where group members need to have understanding of the patterns of social interaction of the individuals and developing synergistic social interaction patterns by continuously interacting formally and informally in groups.

Nonaka and Takeuchi (1995) proposed SECI model wherein socialization and externalization are two most important processes. Socializations the process of knowing where tacit knowledge is situated and how to explore, and maintain it in social interactions. However, externalization is transforming tacit (partly implicit) knowledge into an external format.

The literature on group cognition, heterogeneity and homogeneity and on group information processing and cognition lacks attention to a seemingly relevant and useful concept - the extent to which a group's members possess insights into the features of other members' mental representations of the group's understanding at social level. It appears that this concept may help resolve some inconsistencies in the literature and may contribute to development of theory concerning the determinants of group outcomes.

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spatial, social cognition. This study spells out how the spatial, social cognition explains instances where social cognition has a positive effect on group information processing and, hence, on performance.

- **H_2:** The better the social cognition in team mental model, the higher the team performance will be.

5. Developing Model

The literature on group cognition, heterogeneity and homogeneity, and on group information processing and cognition lack attention to a seemingly relevant and useful concept - the extent to which group's members possess insights into the features of other members' mental representations of the group's understanding at spatial, social level. It appears that this concept may help resolve some inconsistencies in the literature and may also contribute to development of theory concerning the determinants of group outcomes.

To achieve this end, the new model is based on mental models schema and its philosophy. This refers to the extent to which the group's members possess an accurate understanding of the mental models of other members at spatial, social level. The proposed framework explains certain inconsistencies in the literature and, that it provides explanations for specific group outcomes and processes beyond the explanations currently available in the literature. It accommodates groups understanding not only separately but also synergistically at both levels; and determines that the groups with understanding at both levels can tend to perform more effectively than the groups lacking at one of the two levels. This study explores that an understanding of the group cognition at both the levels can better explain its relation to group performance. This approach to view both sides of spatial, social cognition applies to such groups as cross functional teams, task forces, product development teams, top management teams, crisis management teams and project teams.

Spatial, social cognition mental model refers to the extent to which group members have an accurate understanding of one another's mental models at spatial, social level. This understanding can evolve through members' biographical information, members' and environments factual knowledge (spatial); communications or interactive experiences (social) Fig-1. Spatial, social cognition is compositional in that it depends on the extent and accuracy of each member understands of other member's mental model.

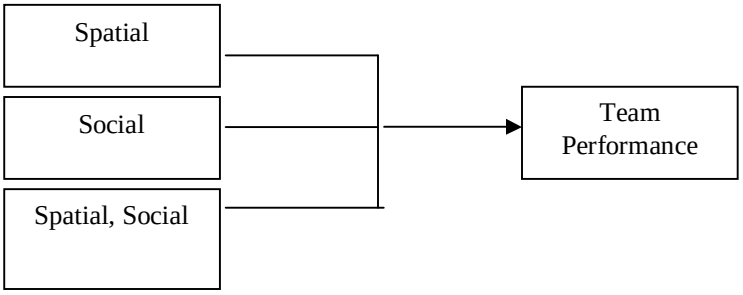

Figure 1: Spatial, Social Cognition Mental Model

6. Impact of Spatial and Social Cognition on Team Performance

Spatial cognition as first layer of cog-synergy model is important for developing team mental model, finally culminating in team performance. But spatial cognition alone may

give partially better performance. The level and the aspects of spatial cognition may also vary from teams to teams and organizations to organizations and the same is true of social cognition. This study therefore, extends the argument that spatial cognition along with social cognition is equally or more equally important for better performance. It is, therefore, mandatory to synergize not only understanding of the social interaction processes for social cognition but also by syntegrating social cognition with spatial cognition. Developing an understanding of team member's spatial and social cognition by surfacing it through interaction is mandatory for teams' high performance. Specifically, the study intends to test the following hypothesis:

- **H_3**: The better the spatial and social cognition in team mental model, the higher the team performance will be.

6.1 Experimental Design

Experimental design is useful in establishing causal relationship between the variables. An experiment deliberately imposes a treatment on a group of objects or subjects in the interest of observing the response. This differs from an observational study, which involves collecting and analyzing data without changing existing conditions. Because the validity of an experiment is directly affected by its construction and execution, attention to experimental design is extremely important. The important thing is that experimental design helps in development of causal relationship.

The experiments on the teams was conducted for testing the above mentioned three hypotheses, four groups need to be developed wherein three groups were given treatment corresponding to the characteristics associated with them and one with no treatment i.e. control group.

6.2 Empirical Validation

For empirical validation of spatial, social cognition model, the experimental research design is developed to visualize the development of spatial, social cognition among the groups of students. The volunteer participants (students of MBA/BBA) were matched on the basis of gender, pre-test, qualification, and assigned to groups.

6.3 Experimental Approach

Experimental designs determine whether some program or treatment causes some outcome or outcomes to occur, and whether the researcher is interested in having strong internal validity or not. Implementing an experimental design well determines the sophistication of research. The proposition:

If X, then Y and if not X, then not Y.

The sophisticated research design provides evidence for both of these propositions, i.e. in effect it isolates the program from all of the other potential causes of the outcome. Ideally, for a sophisticated research design, the researcher has to determine the same conditions -- the same people, context, time, and so on -- and see whether when the treatment is given, the researcher gets the outcome and when the treatment is not given he doesn't.

6.4 Team Formation

To achieve this end, the researcher creates two groups, one group is given the treatment and the other is not and homogeneity in both the groups needs to be ensured. This

homogeneity is associated to creation of two groups that are “equivalent” to each other, i.e. control group and experiment group. After the experiment, if the researcher observes differences in outcomes between these two groups, then the differences must be due to the only thing that differs between them -- that one got the treatment and the other didn't.

In order to create two groups that are "equivalent", one way is to randomly assign people to groups, so that each member has equal chance to be selected. These randomly selected groups are subjected to criticism, since the groups can be probabilistically equivalent but may be formed unequally due to random selection. Another possibility is that the people showing willingness to participate may be less in number, or a number of people drop out part way through or get resistance from the participant because control group is not given the treatment.

To answer the above observation, the other way is to match the groups by taking the confounding characteristics and deliberately spreading them across groups. This study will follow the matching groups. The bottom line here is that experimental design is intrusive and difficult to carry out in most real world contexts. And, because an experiment is often an intrusion, the researcher is to some extent setting up an artificial situation so that he can assess causal relationship with high internal validity.

The number of people in a group may vary from 3 to 11 and literature supports that smaller groups have more cohesiveness than larger groups, but still the way, this cog-synergy makes groups realize of spatial, social and strategic level needs more care to be exercised and see if there is room to improve the performance of even smaller groups; to see the synergistic interaction among the small groups.

In view of this argument, the team members are three for this research design and accordingly, the following eight teams comprising of 24 members have been formulated.

Table 1: Team Formation Procedure

No.	No. of Team Members	Spatial Level	Social Level	Strategic Level	Group Names
Team 1	3	-	-	-	Control Group (C1)
Team 2	3	1	-	-	Treatment Group (T1)
Team 3	3	-	1	-	Treatment Group (T2)
Team 4	3	-	-	1	Treatment Group (T3)

6.5 Group Assignation

Once the four groups have been formulated on the basis of confounding characteristics, the problem arises, which group will act as control group and which treatment group. One way is that researcher assigns any group at his own basis. This may lead to researcher bias. It is necessary for a sophisticated design to control the contaminating effect of researcher bias. The proper way to control such effect is to assign these groups on the basis of randomization, equivalent probability for each group to be selected either control or treatment groups. Hence, these four groups were randomly assigned to control and treatment groups (Table 2).

Table 2: Group Assignation

No.	Group	Group No.
1.	Control Group	C1
2.	Treatment Group (Spatial Cognition)	T1
3.	Treatment Group (Social Cognition)	T2
4.	Treatment Group (Spatial & Social Cognition)	T4

This study, at the expense of raising questions about the applicability of its findings to realistic settings, would be in a much better position to clearly determine the causes of observed changes in thoughts and behaviors of the participants. It answers the systematic interventions at spatial, social level with a higher degree of confidence.

In a systematic study with a high degree of experimental control in human cognition or behavior, choices must be made that affect the degree to which the study emphasizes experimental control (the ability to hold variables other than the one under examination constant) and external validity (the extent to which the observed results also apply to realistic settings outside the context of the study). Usually, a methodological choice that increases external validity decreases experimental control, and vice versa.

This study intends to assess the cognitive effects of spatial, social intervention on group performance. Measurement and improvement of spatial, social cognition will take place during different experimental sessions.

6.6 Treatment

The three treatment teams were given treatment in the form of 'training" as is implied from group name. Common approach is to give treatment to the whole group and also evaluate the performance of the whole group. Our discussion focuses on group processes and group dynamics, which base argument on the very fact that the group members surface their knowledge and thus develop understanding. The argument is to surface the differentiated knowledge by any group member. This study instead of focusing on differentiated knowledge for performance emphasizes more on surfacing this differentiated knowledge.

To achieve this end, the proper approach is to train one group member selected on random basis at that specific level. This selection of group member on random basis helps in providing equal opportunity of selection to all the group members and is useful in taking care of researcher biases. This group member while performing the task will have intra-group interaction and through these interactions, the group will be developing understanding. Amongst three treatment teams comprising of 9 members, one member from spatial cognition team, one from social cognition team and two members from spatial, social cognition team i.e. four members randomly selected were given training in their specific area i.e. spatial, social cognition (Table 3). No member of control team, comprising of three members was not given any treatment.

Table 3: Members Receiving Training

No.	Training Area	No. of Team Members
1	Spatial	2
2	Social	2

6.7 Training Component

Training in spatial, social cognition is provided to the respective group members as shown in the Table 3. The contents of general training are shown in Table 4. These contents of training are to be imparted to all the members. However, the components of spatial training for this experimental design are given in Table 5.

Table 4: Contents of General Training (All Members)

No.	Contents of General Training to all Teams
1.	Orientation of experiment
2.	Introduction of group members
3.	Understanding of group members regarding their interaction
4.	Dress code i.e. formal
5.	Neat and clean i.e. properly shaved, washed etc.

Table 5: Contents of Spatial Training

No.	Contents of Spatial Training to Teams
1.	The designed object should be totally placed on a blue square
2.	The smooth surface of the blocks should be facing one side
3.	The seating plan of the groups
4.	The numbers indicated on the back of pieces
5.	Information regarding environment where the experiment will take place

Training in spatial, social cognition is provided to the respective group members as shown in Table 3. The contents of social training are given in Table 6.

Table 6: Contents of Social Training

No.	Contents of Social Training to Teams
1.	Minimum two pieces of same shape are to be used
2.	Minimum two pieces of same color are to be used
3.	All shapes of pieces are to be used
4.	Only two pieces or less of same shape can be used together
5.	Only two pieces or less of same color can be used together

6.8 Task

The blocks of various shapes are provided to all the groups in a box containing 60 pieces. Through joining these pieces, the various objects can be designed. The teams have to design a specified object and the spatial, social characteristics for designing the specified object were given to the members, who received training.

6.9 Material Required

The pieces, tables, chairs, proper light in the room, time watch, the board, the picture of the target objects are the material required for the experiment.

6.10 Procedure

Each group started designing the object at a specific time. A facilitator with each group noted the time taken by that particular group in completing the task. The facilitator was not a participant, rather remained simply present and observed the group behavior. The task completed was assessed on the basis of performa already developed for the purpose.

The proforma was developed on qualitative and quantitative basis. On quantitative level the no. of pieces utilized by each group and on qualitative level, how close the group achieved the target. How many aspects of spatial, social nature have been cared by the teams? Each set of four groups went through the event thrice in order to see the learning curve of the groups through interaction and through repeated process. Similarly a set of three events for four groups was formulated for ascertaining the proper number of observations necessary for analysis and generalization of results. The proforma for performance measurement was given to observer (Table 8).

Table 8: Performance Measurement (From Observer/Facilitator)

Time consumed in Experiment (Minutes)

No.	Contents of Evaluation	0%	20%	40%	60%	80%	100%
1.	The designed object was placed on a blue square						
2.	The smooth surface of the blocks were facing one side						
3.	The members seated according to the seating plan						
4.	The members knew the numbers indicated on the back of pieces						
5.	The members were comfortable with the environment of the experiment						
6.	The group used minimum two pieces of same shape						
7.	The group used minimum two pieces of same colors						
8.	The group used all shapes of pieces						
9.	The group used only two pieces or less of same shape together						
10.	The group used only two pieces or less of same color together						

7. Data Collection

The quantitative data are collected through independent observers. Observer s' interference normally effects the results of the experimental design. The literature supports that non-participative observer is useful in collecting unbiased data. Therefore, this study design selected independent observer, who were M.Phil., Ph.D. students and faculty members.

The two experiments were conducted on two consecutive days and the participants of one experiment did not know the participants of other experiment. This was ensured so that the participants of second experiment may not know the contents of the experiment and thus affect the performance. Coordinator facilitated the participants and observers. In each experiment three times the event was repeated during and after each event the observers recorded their observations. Each team comprised of 3 members and there were 4 teams in first experiment and the same was the sequence for the second experiment. The total numbers of observations thus collected were 192 (Table 9).

Table 9: Detail of Observation

Sr. No.	Experiment	Iteration	No. of Teams	Members of Each Team	Observer's Team Evaluation	No. of Observations
1	1	1	4	3	1x4	4
2	1	2	4	3	1x4	4
3	1	3	4	3	1x4	4
4	2	1	4	3	1x4	4
5	2	2	4	3	1x4	4
6	2	3	4	3	1x4	4
Total						24

7.1 Observations on Latent Variables

Manifest variable can be directly measured or observed. It is the opposite of a latent variable, which cannot be directly observed. Manifest variables are used in latent variable statistical models, which test the relationships between a set of manifest variables and a set of latent variables. Manifest variables are considered either continuous or categorical (a countable range).

The spatial cognition was explained through five latent variables. The designed object placed on a blue square, with the participant knew exact number of pieces, the members seated according to the seating plan, the members knew the numbers indicated on the back of pieces and the members were comfortable with the environment of the experiment. The social cognition was also explained by five latent variables which explain the social rule. The team used minimum two pieces of same shape, minimum two pieces of same color, all shapes of pieces two pieces or less of same shape together two pieces or less of same color together. The observers recorded their observations on all the latent variables. The observer gave observations on these ten variables three times and a sum of these three events was considered one observation for the purpose of analysis. Thus four observers have four observations for one latent variable for one experiment and similar for the other experiment. The total observer's observations are 80 (Table 10).

Table 10: Observer's Observations

Sr. No.	Description	Observations	Percentage
	Spatial Cognition		
1	Object Placed on Blue Space	8	6.67
2	Number of Blocks	8	6.67
3	Seated According to Seating Plan	8	6.67
4	Numbers on the Back of Pieces	8	6.67
5	Comfortable with the Environment of Experiment	8	6.67
	Social Cognition		
1	Minimum two pieces of same shape	8	6.67
2	Minimum two pieces of same color	8	6.67
3	All shapes of pieces	8	6.67
4	Two pieces or less of same shape together	8	6.67
5	Two pieces or less of same color together	8	6.67

7.2 General Linear Regression Model

General Linear Regression Model (GLRM) is the generalized linear model (GLM) is a flexible generalization of ordinary least squares regression. It allows the linear model to be related to the response variable via a link function and by allowing the magnitude of the variance of each measurement to be a function of its predicted value. It is useful for determining the linear relationship between the variables. Therefore, it was run on the data to know the effects between subjects. Intercepted model was used to calculate the value of a in Y=a+bx+cx….kx.

7.3 Univariate Analysis of Variance

Univariate Analysis of Variance is a test with only one dependent variable. There can be one or more independent variable or factors and /or variables. A one-way ANOVA is a univariate GLM with exactly one independent variable (e.g. fixed factor). A two-way ANOVA is a univariate GLM with exactly two independent variables (e.g. fixed factors). The researcher can test null hypotheses about the effects of other variables on the means of various groupings of a single dependent variable. He can investigate interactions between factors as well as the effects of individual factors. Also, the effects of covariates and covariate interactions with factors can be included.

Considering the benefits associated with univariate analysis of variance, a two way ANOVA was run on SPSS and the intercept shows significant impact on the model. Similarly, spatial cognition, and teams have also significant impact on the model and finally, corrected model is also significant. The theoretical background also talks about the treatment given to the teams and it is the teams that have to show difference in performance, since each team has been given a separate treatment. Inspection of the source table shows that both the main effects and the interaction effect are significant.

The spatial and teams' effect can be interpreted directly since there are only two levels of the factor.

Interpretation of either the spatial main effect or the team's interaction is ambiguous, however, since there are multiple means in each effect. Hence, it is wiser to delay testing and interpretation of the interaction effect later. The concern now is how to determine which of the means for the teams are significantly different from the others (Table 11).

Table 11: Tests of Between-Subject Effects

No.	Source	Type IV Sum of Squares	Df	Mean Square	F	Sig.
1	Corrected Model	1990.821	21	94.801	6.351	.000
2	Intercept	819.007	1	819.007	54.867	.000
3	Spatial	342.075	4	85.519	5.729	.000
4	Social	24.050	4	6.013	.403	.807
5	Teams	1357.796	7	193.971	12.994	.000
6	Error	3254.142	218	14.927		
7	Total	42073.000	240			
8	Corrected Total	5244.963	239			

7.4 Post-Hoc Analysis

Post-hoc analysis refers to screening the data for patterns, if they are not already specified. It is also known as data dredging i.e. to evoke the sense that the more one looks at data, the more likely something will be found. More subtly, each time a pattern in the data is considered, a statistical test is effectively performed. In practice, post-hoc analyses are usually concerned with finding patterns and/or relationships between subgroups of sampled populations that would otherwise remain undetected and undiscovered. Post-hoc analysis is an important procedure without which multivariate hypothesis testing would greatly suffer.

Accordingly, the post-hoc analysis using Least Significant Difference (LSD) test was conducted in order to explore all possible pair-wise comparisons of means comprising a factor using the equivalent of multiple t-tests. Since the spatial, social and strategic cognition showed significant impact on team performance, post hoc analysis of team is done.

7.6 Spatial Team's Comparison with Other Teams

The team that was given spatial treatment showed significant performance than control team i.e. .000, but it is not very significant than social 0.152 and spatial, social 0.739. Thus, the significant impact is in line with the theoretical background (Table 12). This proves the hypothesis that team with spatial treatment is going to perform better than the teams without any treatment i.e. control team.

Table 12: Spatial Team's Comparison with Other Teams

No.	Other Team	Mean Difference	Standard Error	Significance
1	Social	1.4333	0.99757	.152
2	Spatial, Social	-0.3333	0.99757	.739
3	Control	4.5667	0.99757	.000

7.7 Social Team's Comparison with Other Teams

The team that is given social treatment is labeled as social team. The performance of this team is significant than spatial, social team i.e. .078, but it is less significant in comparison with team given spatial treatment i.e. 0.152. However, it shows more significant difference of performance than the control team (Table 13). This supports our second hypothesis that Team with social Treatment is bound to perform more significantly than the team without social treatment i.e. control team.

Table 13: Social Team's Comparison with Other Teams

Other Team	Mean Difference	Standard Error	Significance
Spatial	-1.4333	.99757	.152
Spatial, Social	-1.7667	.99757	.078
Control	3.1333	.99757	.002

7.8 Spatial, Social Team's Comparison with Other Teams

The two team members out of three are given treatments on spatial and social cognition respectively and they are required to share all the information with their third member and also between themselves. This team showed significant performance than social team, i.e. .078, but it showed most significant difference with control team 0.000. Since this team falls into the extreme side of the scale, i.e. control team is not given any treatment, thus the significant impact is in line with the theoretical background (Table 14). This partially proves our hypothesis that teams with spatial, social cognition will have significant difference than the control team and teams with one treatment i.e. spatial, social. Our hypothesis with better performance than the control group is proved with quite significant improved performance.

Table 14: Spatial, Social Team's Comparison with Other Teams

No.	Other Team	Mean Difference	Standard Error	Significance
1	Spatial	.3333	.99757	.739
2	Social	1.7667	.99757	.078
3	Control	4.9000	.99757	.000

7.9 Control Team's Comparison with Other Teams

The team that was given no treatment at all showed significant performance than all the rest of the teams. Since all the other teams are given either one or two treatments, there is a significant difference in the performance (Table 15). This proves our hypothesis that

team without any treatment is going to perform significantly different from the rest of the teams.

Table 15: Control Team's Comparison with Other Teams

No.	Other Team	Mean Difference	Standard Error	Significance
1	Spatial	-4.5667	.99757	.000
2	Social	-3.1333	.99757	.002
3	Spatial, Social	-4.9000	.99757	.000

8. Contribution of the Study

The study has focused on a current active area of research and contributed to the research community by making spatial, social cognition an essential component of team composition and team performance. First, the literature has mostly supported the social cognition perspective and spatial level is either dealt with separately or ignored for team performance. This study focuses on an approach: supporting the understanding of both sides of cognition i.e. spatial and social. The research reveals that the performance of teams enjoying understanding of each member's spatial, social cognition at both the layers is predicted and empirically tested and validated.

This study also suggests guidelines for measuring spatial, social cognition and proposes the use of experimental design in order to establish the causal relationship. The study provides first ever empirical evidence of association between spatial cognition, social cognition and team performance around the world thus would be a good source of reference for mental model researchers in future. The contribution of this research is important for both academic researchers and business managers. Understanding the role of cognition in developing team performance is beneficial for deciding the potential role of spatial, social cognition in achieving the team performance and ultimately the organization performance. While, business managers may benefit by understanding the importance of cognition and its role in allocating the human resources to support team performance and ultimately organization's performance. Managers are benefitted by learning that good understanding of mental model can help them convert human efficiencies into team structure, administrative structure and finally, organization structure.

This study enhances the validity of previous studies on relationship between mental models and team performance and makes several significant contributions to the literature. The study discusses mental models and gives an understanding of cognition and its synergy at all the three levels. High cog-synergy is likely to strengthen the understanding of the group members and hence lead to performance. First, it proves that good understanding of spatial, social and strategic cognition can enhance team efficiency. Secondly, it identifies several cognitive indicators which exert significant impact in team performance and ultimately organization performance. Third, by using data collected through two different approaches i.e. experimental design, it confirms that spatial, social cognition has significant impact on performance. Fourth, it also supports the impact of mental model on team performance and thus enhances the validity of previous studies (Langan-Fox et al. 2000 and 2001; Klimoski and Mohammed 1994; Cooke et al. 2000;

Khan and Lodhi 2010). Fifth, this study meets the future study directions of Kaplan (2008); Huber and Lewis, 2010, and Khan and Lodhi (2011). Sixth, the study also confirms empirically the previously undeveloped and untested relation of spatial, social cognition with team performance.

The study is based on strong theoretical foundations and research proven methodology. Data utilized in this study was collected by observing the necessary prerequisites of experimental design, thus increasing reliability.

9. Practical Implications

Keeping in view the significant role of mental models towards team performance, the study emphasizes the need to draw the guidelines for measuring spatial, social cognition and make it part of the practices for developing team performance. In a global environment, if information related to cognition is known to the managers, the managers may take effective steps to develop spatial, social cognition in team members and answer the challenges that they face today.

The study would be very beneficial for business managers to draw their attention to proactively use human resources for organization performance. This study creates awareness about team cognition in team mental models and its role to maintain the sustainable competitive advantage which leads to maximum performance.

The study provides the strong proof of importance of human cognition for team performance and ultimately, organization performance which is useful in assessing the level of the teams' cognition. Due to availability of information related to spatial cognition, social cognition and strategic cognition, potential investors would be in a better position to estimate the ability of their teams to match the task they have to perform.

10. Limitations of Research

Virtual teams have entirely different scenario and their case may be more interesting from spatial, social cognition perspective. The variance in the level of specific layer of cognition is of crucial importance. The experimental design is criticized on the basis of its application in real life settings; therefore, the study may be limited in scope from survey perspective.

11. Extensions through Further Research

The study's contribution to current theory can be further elaborated or extended in several ways. One avenue for future research would be to study the difficulty and effectiveness of different approaches to rapidly increasing spatial, social cognition. Rapid development of spatial, social cognition would be of considerable importance for groups operating in or attempting to manage crises, producing quality products, launching new projects, etc.

Research in spatial, social cognition may result interesting features i.e. the groups may be required for understanding of physical features, social interaction separately or the extent to which they can be made part of the group functioning. For example, a group working on construction project may need more knowledge at spatial level, but a group fighting terrorist might need spatial, social cognition at both the levels. The development of global and specific construct might be another area where future research can focus for

this mental model. The theoretical model can also be empirically tested through the use of Social Network Analysis, neural network analysis for its measurement and analysis.

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