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Neelam Gill

IMAGERY AS A PRIVATE EXPERIENCE AND ARCHITECTURAL TEAMWORK

By: Hrishikesh Deshmukh 98613004 (PD)

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✓ Neelam Gill 98625804 (V)

VCM SR

Guide: Prof Uday Athvankar

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The Special Project entitled

IMAGERY AS A PRIVATE EXPERIENCE AND ARCHITECTURAL TEAMWORK

By Hrishikesh Deshmukh
Neelam Gill

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Guide:

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MENTAL IMAGERY IN ARCHITECTURAL TEAMWORK: A PREMISE

Imagery as a private experience and architectural teamwork

Images prompted by words/ phrases in the conversation were often accompanied by associated imagery. This leads us to several interesting questions.

Do these words influence the mental imagery, teamwork and the design process in any way?

If yes can the influence can be analyzed to draw some productive inferences?

Is the mental imagery formed in the mind of the designer as his private experience as richly communicated to the partner?

Sketching is a very important mode in communicating this private experience to the other person.. It leads to ponder upon the effectiveness of making the private experience of mental imagery public and its effect on the team design process. Research is taking place in these areas to establish facts further.

Some already established facts about imagery form strong views about creativity and imagery. It is often wondered, whether creativity depends on imagery? Can discoveries be made in imagery? Einstein and many others (see *Shepards 1978*) have claimed that their creations began first as images and only later were transformed into words. If imagery has precedence in creative discoveries, why do people sometimes have difficulty in 'seeing' information in their visual images that they readily see in perception

Do our expectations effect what can be discovered in or learned from images?

How does creativity, discovery and imagery intersect?

These intriguing questions have long tantalized psychologists and others interested in creativity.

Despite the extensive history of creativity discovery and imagery as phenomena in need of explanation, relatively little progress has been made in answering these questions until fairly recently.

ROLE OF IMAGERY IN TEAM DESIGN

The nature of image formation is relevant to any study of thinking, emotion and perception. A short example can illustrate the important cognitive issues. A man chased by a lion will retain an image of the lion rather than looking over his shoulder to remind himself why he is running. The image has information derived from perception, which in turn motivates continued action for escape.

Any thought representation that has a sensory quality we call it an image. Images can involve the senses of seeing, hearing, smell, taste, touch, and movement.. But since the focus is on visual

images, the use of the word "image" for mental contents that have a visual sensory quality (unless otherwise indicated) refers to different types of image experience collectively. A person can describe an image in many ways, including information about contents, vividness, clarity, colour, shading, shapes, movement, foreground and background characteristics and other spatial relationship. Furthermore a person can often tell how the image entered his awareness, its duration, its associated emotions, the change or dispel it, and the sequential or simultaneous arrangement of series of images. now however relevant research to access theories and to chart some courses for the future. Analyzing the obtained description of these team designing reveals different patterns of behavior, arouse an interest in more detail and depth analysis of team design behavior (c) 1998 *etsever science ltd*. Keywords; design activity, team work, reflection in action, protocol analysis research method.

For team designing to be effective we rely on team members to support each other in answering questions that arise and in picking up lines of thought from each other to be built on. This should give an added value compound to individual designing, where the architect creates his/her own private understanding of the design problem at hand and its solution. We need to describe and analyze team working on design projects, to see where and why problems occur. Schions theory is based on constructionist view of human perception and thought process.

An architect is actively constructing a view of the world based on his/ her experience. Their descriptions provide us a clear view of team design strategies that they are using and if they could be used in design education. But to improve design theory and education systematically, we need to make a transition from pure description to prescription. We need to further analyze and discuss the general patterns that occur in the described teams. Looking in depth at the data the above statements might be refined into hypothesis, that should then be treated in further experiments.

SCOPE OF THE EXPERIMENT

ANALYZING TEAM DESIGN EFFORTS

The role of mental imagery and visualization in early creative phase of solving design problems is already acknowledged. But mental imagery is a personal experience. This project investigates the potential issues created by lack of access to the imagery of the partner, in team design efforts. Aim of the our project is to analyze the proceedings of imagery process in the team design in the chosen parameters and then offer some insight in developing tools and guidelines to improve it.

THE PILOT EXPERIMENT

PURPOSE

We conducted a pilot experiment in the initial stage of the project. This was done keeping in mind the following

- a) To analyze the true nature and limitations of the team work set up
- b) To write an abstract of what our final project would lead us to
- c) Finally on the basis of the pilot experiment draw guidelines for the final experiment

BACKGROUND AND PROCESS OF THE EXPERIMENT

The role of mental imagery and visualization in early creative phase of solving design problems is already acknowledged. But mental imagery is a personal experience. The two papers

IMAGERY AS A PRIVATE EXPERIENCE AND ARCHITECTURAL TEAMWORK
MENTAL IMAGERY AS A PRIVATE TO PUBLIC EXPERIENCE

investigate the potential issues created by lack of access to the imagery of the partner in team design efforts. In the pilot experiment, team of two architects were given a design problem. They worked in usual but physically separated work environments. They could only communicate and view each others sketching through video conferencing, while the protocol was recorded on a video. They were briefed and were asked to work on the design problem simultaneously as a team. The architects' mental imagery experiences were accessed by interrupting the design process at intervals. They were interviewed about their own visual images, as well as their perception of their partner's imagery.

ANALYSIS

The analysis involved, were base on the following

- a) Comparing the descriptions of the current status of the creation as separately described separately by both the architects during interval
- b) Comparing one architect's imagery experience with his partner's perceptions of his imagery and thinking, and vice versa.
- c) Studying the partner's individual images for similarity, along the time-line as the design proceeded.

FINAL EXPERIMENT

PURPOSE

On the basis of the pilot experiment we extracted the core theme and the process of the final experiment. Also we clearly defined the channel of our investigation which directed us in presenting the research paper. This would contain the possibilities and limitations of Team Work in a design process(in limited parameters)

SET UP AND PROCESS OF THE FINAL EXPERIMENT

The experiment required both the architects to video conference with each other and communicate for the purpose of designing. Thus keeping in mind the basic requirements of video conferencing a set up was created There were two separate unit set up for the two architects to work in. Identity was not to be disclosed therefore proper measure were take for the same. Each unit had a work environment with a working table with a monitor and a mike with camera focused table (to keep the identity undisclosed) This entire problem solving session will be recorded on a separate video tapes

EQUIPMENT IN EACH SET-UP

- 1) Betacam cameras on moving stand, with inbuilt microphone facility.
- 2) Microphone
- 3) Digital clocks
- 4) Monitors with speakers
- 5) Connection cables and separate recorders for both the units.
- 6) Stationary

There were a few pauses given in the entire problem solving process to question the architects about their mental imagery retrospection. After analyzing the pilot experiment the shortcomings were rectified in the final set up.

ABSTRACT

Mental imagery is a very important part of the design and each one of us experiences it. But surprisingly, the literature on design research does not offer insights on the creative use of imagery in design. An important question is how does mental imagery effect the team work, if the partners working in as a team are placed geographically apart? Does mental imagery in such a case improve the problem solving when the two partners exchange their image experiences? Or does it pose itself as a hindrance as the partners are unable to communicate their mental imagery to the other, blocking the process of problem solving.

This experiment was a part of collaborative experiments conducted on Visual Designers and Architects, in an attempt to study the significance of mental imagery in teamwork.

For understanding the project and the purpose of the project well, a pilot experiment was conducted. This was very important to know how the team work progresses, how the mental imagery helps or hinders the team work, how comfortable the team members were with sharing their images and understanding each other etc.

For the experiment, two architects were invited and a architecture problem was given to them. And in-between the experiment, there wer pauses where each was questioned about his and his partner's mental imagery.

The project was submitted in the form of a research paper.

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Z.1.0 Imagery and its role in early creative phase

Recent accounts of the role of imagery in creative processes have gone beyond the anecdotes dealing with creative literature, artistic achievements and discoveries in science. These studies have shown how creative processes can benefit from the imagery. Reasons are not difficult to seek. Typical attributes of imagery, spontaneity, its non-linear nature, depictive qualities and the possibilities of voluntary control, point to the enormous potential of imagery in the development of ideas. It encourages private fantasies and yet it allows simulation, permitting evaluation of ideas. The fact that images directly depict the layout of the represented material and preserve between-part relationships is significant to designers, who creatively manipulate these relationships. So, its no wonder that most designers, in casual observations, refer to the rich imagery that they often experience during designing. Yet there is little published work available in this area. The reasons for lack of literature could be attributed to the two unique properties of mental imagery. First, the experiencing of the mental images is so well integrated with the thinking process that most people are not even aware of it. Second, it remains a totally private experience inaccessible to outsiders. This inaccessibility raises some new questions relevant to this paper.

If a private experience like mental imagery is so significant in problem solving, can a design team ever succeed in solving design problems, particularly when the team members are geographically apart? Simulating the design process where two architects work at distant locations but are connected by a video-link, the pilot experiment explores 'issues' that such private experience would raise in team design effort. We will turn to the team issues after a brief review of work on mental imagery.

Z.1.1 Studies of mental imagery

Explorations of imagery and creativity relationship are not new to research literature in cognitive science and design. We have excluded review of literature on mind's eye due to space constraints, but readers may want to refer to earlier publication (Athavankar, 1997) (also see compilation by Roskos-Ewoldsen et. al., 1993). It is not surprising that some of the design research should take its inspiration from this work by cognitive scientists. Two specific areas from this work seem to have influenced design research. The first deals with the mental synthesis of component parts, where subjects are asked to mentally combine given parts to create useful objects (Finke, 1990). His findings suggest that people are able to use mental imagery to evolve creative and interesting object ideas. Second, refers to the sketch like depictive qualities of images and explores their

potential to inspire discoveries. This has prompted researchers to compare their effectiveness as displays that could be restructured and reinterpreted. In general, imagery seems to perform poorly as a depictive display, at least in the experimental situations when it comes to restructuring and reinterpretations of displayed material (Anderson and Helstrup, 1993 and Kaufmann and Helstrup, 1993).

It is not clear why the idea of 'mental synthesis' merited so much attention in design literature. These tasks differ from typical design problems in several ways, particularly when compared to Goel's well-documented criteria for design problems (Goel, 1995). These studies fail to conceptually separate invention and discoveries from typical design problem solving. Similarly, the kind of image reinterpretation tasks used in these experiments is only occasionally experienced in design problem solving. It is difficult to agree with this conclusion, particularly in light of the findings presented by others (Athavankar, 1996, Singh, 1998). If mental images were so poor as displays, designers should find it impossible to develop creative solutions, if they were to be blindfolded. These papers show that the designers and architects used their mind's eye as a virtual design studio. They almost lived in their mental space, and created or manipulated ideas of objects with amazing ease.

Z.1.2 Collaborative design

While this literature does reiterate the contribution that mental imagery makes in individual creative efforts, it also poses new problems to the current trends in practice of design. Modern design is increasingly seen as a team effort, often with expert team members interacting across the globe to develop new ideas of teamwork, almost no material is available on the role of imagery in team problem solving. Seen in the context of the discussion above, it is not surprising that the literature on collaborative design should also neglect the role of imagery. In fact most of the literature in collaborative efforts appears to be motivated by creation of computational representations and tools, obviously external to human mind. In any case, we plan to briefly review the representative literature before we proceed.

Communication has been a major focus of a number of these studies. For instance, Sommerwald gives a brief overview of work in software and engineering designs and neatly categorizes the research approaches (Sommerwald, 1996). Others like Badke-Schaub investigate the factors that influence teamwork in engineering design practices (Badke-Schaub, et al., 1999) and going further, also proposes a model of collaborative work. Taking a different view point, Cross looks at team design activity as a social process and explores the individual's role and relationships within the team (Cross and Cross, 1995)

Focus on teamwork in architectural design is equally common in research literature. Peng explores properties of team sustaining framework for supporting the complexities and spontaneity observed in multi-disciplinary interaction. He also proposes a pilot collaborative modeling environment (Peng, 1999). Giving a new dimension to collaborative modeling environment, Scrivener and his colleagues have examined the potential problems that arise when team are geographically separated and have to also cope with different time zones. ROCOCO project proposed and evaluated 'Sketchpad' which shares a common drawing space between distant teams (Scrivener et al., 1993). Concerned more with the interaction and communication, the literature appears to have neglected the key role that private mental images play in thinking and creative work. This paper is an attempt to fill this gap.

Z.2.0 Experiment set-up and procedure

Exploration of mental imagery in team effort is an unfamiliar territory. So the experimental set-up and procedure were evolved through experiments and had to be accommodated in the limited equipment at disposal. Besides, the useful results that the procedure had offered, does give a direction for future studies in this area.

The subjects for the experiment were two architects, SF and YR with several years of professional experience. They did not know each other, nor was their identity revealed. SF is a successful practising senior architect in his forties. YR is a budding architect in his late twenties, mainly involved in interior projects. The subjects were asked to design an information centre for a historical monument viz. Elephanta caves, eleven kms. from Mumbai. They are sculptured on an island in Oman Sea, built in the 6th Century by Hindu Kings and contain huge images of Hindu deities. A printed design brief was given simultaneously to both the partners, containing area specifications for exhibition hall, six guest rooms, reception area, recreation space, kitchen, library etc. This remained with them throughout the experiment.

They were ushered into two different rooms and were given assumed names. Simulation of distant interaction was implemented as follows: Each room had a worktop with normal stationary required for sketching. The video-link ensured that the sketches, as well as the conversation were available to each other through monitors on their tablespots. Camera angle ensured that the person's identity was not disclosed. They were told that the study deals with team process, but the focus on the imagery was not revealed to them.

Z.2.3 Accessing mental imagery

As mentioned earlier, a private experience like mental imagery remains inaccessible to outsiders and can be only accessed through immediate retrospective reports given by the subjects. In the

earlier studies an individual designer, Singh (Singh, 1998) has used retrospective report based on showing the replay to the subject at the end of the session, as a strategy to access imagery experiences. But to avoid the subjects from relying too much on memory of entire 75 minutes of the design session, pauses (of collectively 120 minutes of reporting) were used for retrospection, mostly at the completion of important arguments. Besides the three intermediate pauses, the fourth pause was at the end of the session. To ensure structured comments, the two experimenters noted the clues such as key words and phrases from the conversation between the two subjects and used them for structured discussion. On the face of it, use of intermediate pauses may appear as unusual interruptions, but the earlier exploratory studies showed that such brief pauses were not a major hindrance in the continuity. The subjects remained separated and their narration during the pauses were also separately video recorded.

The reports during the intermediate pauses were rich with information due to the recency effects in the memory. There was another important advantage. Because, the subjects had no idea of what they would do subsequently, they had no opportunity to use 'after-the-fact-relevance' of the imagery experience as a filter in their reports during pauses. The entire data was logged on to a four-column table. The first two columns contained the transcripts of the conversation between SF and YR respectively. Column three and four contained their after-the-fact reports on the imagery experiences during the pauses. Attempt was made to classify these experiences and search for probable clues in the transcripts that could have acted as triggers. Some of the important observations are given in the following sections.

Z.3.0 Word- Image relationship

Conversation was not only central to team interaction, but as it appears now, it was also a source that prompted imagery experiences in the teammates. Are there patterns that can be found in the relationship of words and the images that they prompted? The following observations reveal some of these patterns.

There were several instances, when SF's words prompted YR to quickly conjure up images, thus broadening his imagery canvas and enabling him to experience new images. Surprisingly, the very same words did not generate any images in SF's mind, who had actually spoken the words. Take for example, words like staircase, display and activities [00:09:25] which were used in the discussion in the first session. When SF talked about staircase, YR had a clear stereotypical image of a staircase with a dead wall on one side. The wall had a stone mural. The staircase had balustrade and was semi-circular in plan. He saw himself walking up the stairs along with other people when he visualised the staircase. Similarly, the word 'activities' evoked in YR images of people in the lounge, waiting, reading, sitting, and looking outside. He described them as tourists, wearing casual clothes. Much of this seems to be on the border of fantasy.

Imagery prompted by someone else's words can spring up interesting surprises. For example, midway during the design, SF says [00:59:40]: "... Also I am looking for one 'Aha' factor." The word 'Aha' referred to the eureka feeling in the process. Though the word was used as a motivational tool and was not intended to prompt any images, YR visualised himself standing at the road at night, seeing the building lit by floodlights. Considering that it was very early in the session and no spatial issues were even discussed, it appears even more surprising.

Z.3.1 It works.... Sometimes although!

There were occasions when both the partners experienced images. In such cases two kinds of situations were encountered. First deals with expected results where their conversation resulted in both visualising predictably similar images of sloping roof. Mental imagery seems to have supported their dialogue, strengthening their co-ordination.

Second type refers to a situation, where the words prompted vivid images for the speaker as well as the listener. But, what SF visualised was very different from what YR saw in his Mind's eye. As expected, this affected the teamwork, as the teammates appeared to be going in different directions. For example, the exhibition spaces visualised by YR and SF were very different in nature. It was later that they converged onto a common understanding.

It was equally surprising to note that on some occasions, even though the words used in the conversation seemed to have potential for prompting images, the team members did not report any imagery experience. For example: Words like 'Jehangir Art Gallery' [00:15:20] (a well-known local art gallery) and 'sculpture' [00:11:23] failed to invoke any imagery in either of the team members. The words and images share an interesting relationship. They trigger and expand the image canvas of the partner, giving him an opportunity to explore new areas, but the operation of the trigger remained unpredictable. There are several instances which show that the partners visualised more than what they conveyed through words. For example, when YR talked about the staircase, lounge and tourists [00:07:45], he did not convey the rich experience of imagery to his partner. These details, had they been conveyed, would have enormously enhanced the entire experience of shared imagery. We will return to this topic when concluding the paper.

Z.3.2 Imagery experiences and the development of design thinking

It was interesting to note the metamorphosis of the final image of the building project as it emerged through the 75 minutes session. In the initial part, the images that the teammates experienced were seen as individual fragments, but slowly they acquired coherence and connectedness. It seems that, as the process reached the final stages, these visual image fragments seemed to fall in place like a jigsaw puzzle.

For example, when both the subjects started with the discussion about staircase, lounge and exhibition spaces, images that they initially reported were more as independent fragments. But as the design progressed, the image fragments were integrated into a coherent building space. It was also interesting to note the differences between the initial and later imagery experiences. The images in the initial part of the design process contained people performing activities, while the architectural spaces remained as background settings. As the session proceeded further, the people vanished from the imagery and it was dominated more by architectonic spaces. Though the process was dominated by the words used in the conversation, the online access to each other's sketches seems to have played a unique role not only in team interaction but also in prompting (or sometimes suppressing) imagery. Do the sketches influence the mental imagery, teamwork, and the design process in any way? If yes, can it be better understood?

Z.3.3 Online access to sketches

Attempt by the team members to understand each other's ideas and their questions were often based on access to each other's sketches and diagrams. From a very early stage, both the partners understood each other's ideas about relationship of spaces from their simple bubble diagrams [00:10:00]. Interestingly, the strategies and idiosyncrasies of the sketching did not hinder the sharing of information. Online access to sketches seems to play an important role in understanding each other's ideas. For example, when asked to sketch the architectural ideas as perceived during the third pause, their independently drawn sketches of the building showed many common features.

To a large extent, taking cues from the speech strings and sketches available on the screen ultimately depended on the willingness of the partners. For instance, when SF switched from the idea of 'Trimurti' to sketch a cross-shaped plan [01:38:44] in the third segment of the session, YR's image of the building in his mind seems to have remained unaffected. Two different inferences can be drawn from this. On one hand, it can be taken as a positive approach, as YR remained rooted to the basic idea, while he let SF explore a new direction. On the other hand, it could be seen as a negative development, as YR lost an opportunity of exploring a new viewpoint and perhaps missed out on widening the canvas of his mental imagery.

To sum up, sketching was used as an active tool for communication and interaction right from the beginning. This took place in spite of the fact that one of the partners worked basically in 2-D while the other adopted 3-D mode of sketching. Online access proved to be very useful in the synchronisation of their work. However, in the current experimental set-up, it is difficult to directly establish the influence of sketching on the experiences of mental imagery. Z.4.0 Precedents, imagery.... the unexplained

There appears to be a perceivable logic in the way precedents were recalled and used. Words often seem to prompt teammates to access precedents. For instance, in the second segment of the design session [00:04:30], the word 'recreation' evoked the image of a bar in their minds. This seemed to have its roots in their exposure to cities, similar cultures and income groups. Though irrelevant to the location and functional context, a certain fascination for these images made the partners develop them in great details. Similarity in imagery experience can be attributed to similar cultural and professional background.

The retrospective reports suggest that the precedents often appear in the form of real world images. These images seem to show ambience of light and shade, which suggest a particular time of the day. In the earlier reported images accompanying words like lounge, staircase and activities, YR experienced images as if they were a part of early evening. YR narrated a strange experience where the precedent was seen as a drawn plan. Perhaps YR recalled the precedent the way as he had experienced it and it did not evolve into a 3-D image. These events must be seen in the context of architectural design problem, which tend to have a strong spatial dimension and a site to build on. There were instances, when the member who dwelled on a precedent had an elaborate image in his Mind's eye. But he could not evoke any image in his partner's mind, despite detailed description. For example, when SF said: "This reminds me of a museum done by Arther Errickson." [01:07:45], in spite of the speaker's excitement, no image was prompted in YR's mind. It is not easy to explain this on the basis of familiarity. Let us take another example to understand the point. SF mentioned the strong symbolic character of 'Trimurti' (central historic statue in the caves)[01:06:20]. Although SF dwelt on this extensively, this too surprisingly did not influence YR, nor did it prompt him to alter his current images. Precedents had a positive effect, only when they were shared through the description of the experiences or when one of the members motivated the other to expand his imagery and enhance the progress of the team.

Z.4.1 Unexplained experiences

During the pauses, the subjects were asked to guess what the other teammate was experiencing in his Mind's eye. Surprisingly, YR could make reasonable guesses about the imagery features of SF. For example, YR made a correct guess about the time of the day in SF's imagery world, in spite of the fact that the protocols reveal no clues of these details.

There are other similar instances, where they were asked to independently sketch the current status of the design during the third pause. To our surprise, both showed a circular cut-out in the slab over the lounge. This is difficult to explain, except by attributing it to both having been trained and practised in similar environment.

Figure Z.1 Left image shows SF's visualisation of the current idea. The right image shows YR's perception of SF's image at that point of time.

When visualising the structure, one of the architects typically experienced his own presence on the site and in the spaces that they had created. He often moved inside and outside these spaces. In fact, one of the teammates almost guessed the position and level from which his partner was visualising and experiencing the spaces in the imagery world. These experiences appear similar to a walk-through in a virtual environment. Interestingly, some of these spaces were experienced in very specific light conditions.

Z.5.0 Conclusions

Our observations on imagery are based mainly on reports during pauses and wherever possible, they are cross-referred to the protocols of the session. Though the discussion occasionally drifted to the other aspects of the teamwork, the focus was on the imagery experiences. We do not claim to have clear answers to all the questions on imagery in the team efforts that we raised at the beginning of the paper. But the results do offer some pointers.

The fact that it was an architectural problem that was being handled, has influenced the nature of imagery experiences. But for a few exceptions, it is quite clear that imagery, and in turn the words that prompted it, were central to the development of the initial approach at an individual level and to a limited extent at a team level. Most of the imagery that accompanied the design precedents appear to be motivated by the words in the conversation, but the actual experiences of the imagery remained unpredictable. For instance, some of the words, in spite of their potential to invoke images, failed to prompt imagery even though the subjects were familiar with the precedents. As the session progressed, the imagery experiences also changed. The initial discussions were accompanied by images in which people and activities were more prominent. As the spatial issues got resolved, the images were dominated by shared architectonic spaces and people within these spaces almost vanished. Perhaps this convergence could be attributed to the fact that they had an online access to development of each other's sketches.

It is interesting to note that experiences of concrete imagery of spaces and building forms were common even in a very early stage. Surprisingly, these experiences occurred much before the spatial issues were even touched, almost as early as the discussion on the brief started. Most of this imagery was built on 'stereotypes' of architectural and interior spaces. It is difficult to predict if the cross-cultural teams would share these stereotypes. Though the flow of conversation in the discussion prompted the experiences of stereotypes, much of their richness in the imagery remained private to the teammates.

Unfortunately, much of these private experiences remained unreported in the conversation and the opportunity to jointly develop these ideas and images was further lost, a problem that the team design has to account for. The team members often did not report all the rich imagery experiences in the conversation. This not only prevented sharing of ideas but also prevented the partner from taking clues and developing his own creative canvas. There are several reasons that could explain this. First, they may not be aware of their own imagery experiences as it often naturally accompanies the conversation. Second, perhaps they may not consider the experience important enough to share and third, even when the attempt was made; the words fell short of capturing the richness of the images. However, it would be too premature to come to the conclusion that the partners should convey their imagery experiences to each other. The images flow naturally with the thought process. It is not clear if the burden of description of imagery experiences on the speaker will slow down his natural flow of ideas and even hamper the development of the thought.

Z.6.0 Bibliography

Anderson R and Helstrup T (1993) Multiple Perspectives on Discovery and Creativity, in the Minds and on Paper in B Roskos-Ewoldesen, M J Intos-Paterson and Anderson R (eds.) Imagery, Creativity and Discovery, North Holland, 223-251

Athavankar U (1997) Mental Imagery as a Design Tool, Cybernetics and Systems. 28 (1): 25-42. (Initially published in Robert Trappl (eds) Proceedings of the Thirteenth European meeting on Cybernetics and Systems. Austrian Society of Cybernetics Studies and University of Vienna, Austria, April 19-12, 1996, Vol. II, 382-387.)

Badke-Schaub P, Frankenberger E, Kurfursten A (1999) Analysis of design projects. Design studies 20:465-480

Cross N and cross A C (1995) Observations of teamwork and social processes of design. Design studies 16: 143- 170

Finke R (1990) Creative imagery, Discoveries and inventions in visualisation, Lawrence Erlbaum, New Jersey.

Goel V (1995) Sketches of Thought, MIT press, Cambridge, Ma.

Kaufmann G And Helstrup T (1993) Mental imagery: Fixed or multiple meanings? Nature and function of imagery in creative thinking in B. Roskos-Ewoldesen, M.J. Intos-Paterson and Anderson R.(eds) Imagery, Creativity and Discovery, North Holland, 223-251

Peng C (1994) Exploring communication in collaborative design: co-operative architectural modelling. Design studies 20: 537-551

Roskos-Ewoldesen, M J Intos-Peterson and Anderson R (eds.) 1993 Imagery, Creativity and Discovery, North Holland, 123-150

Scrivener S A R, Harris D, Clark S N, Rockoff , Smyth M (1993) Designing at a distance via real time designer-to-designer interaction. Design studies 14: 261-282
Singh A (1999) The potential of mental imaging in architectural design process, Proceedings of International Conference on Design And Technology Educational Research and Curriculum Development, IDATER 99, University of Loughborough, England, 230-236

Sommerwald D H (1996) Communication role that support collaboration during the design process. Design studies 17: 277-301