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## The potential of mental imaging in the architectural design process

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# The potential of mental imaging in the architectural design process

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## Abstract

*The object of the experiment was to study the role and potential of mental imaging in the architectural design process, and to study the use of mental imaging as a source of feedback while designing, in the absence of, particularly, sketching. This experiment is a continuation of experiments conducted with industrial designers. The experiment indicated that they were able to design well, blindfolded.*

*This experiment studied an architect, to ascertain the role of mental imaging in architectural design, (which differs from industrial design in both scale and complexity). This was performed by studying an experienced architect, blindfolded during the act of design. The results achieved indicate clearly that he was able to use mental imaging and his inner resources to assist him in the design process.*

Keywords: protocol analysis, mental imaging, visual thinking, architectural design

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## 1.0 Introduction

This paper is a case account, based on protocol analysis, of an architect assigned with the task of designing when blindfolded. This is a part of ongoing projects focussing on the role of mental imaging in design behaviour. These experiments were performed with design professionals, including an architect, an industrial designer (Athvankar, 1996), and an advertising designer.

The experiment was designed to study the potential of mental imaging in the absence of other media used to externalise the thought, particularly, sketching; to study whether imaging offers benefits that serve to display, to react, and to portray the content of design. The complexity, size of spaces to working both in interior and exterior spaces (which are beyond the human gestures) and scale were the factors studied. These factors were less complex in other professions studied earlier.

Sketching is known to offer several advantages when designing (over computerised media) (Ullman, 1990). It offers a way of representing and thus recording decisions. It also serves as a display for the designer to react to (Goldschmidt, 1992). By preventing the

designer from sketching, the experiment attempts to explore whether mental imaging can serve the role of sketching. It also explores the nature of imaging experience.

The objects of the experiment were to study the role and potential of mental imaging in the design process, then, to examine whether mental imaging can enrich the design process; and to study the advantages and disadvantages of using only mental imaging as a feedback while designing.

In a previous experiment, conducted with product designers (Athvankar, 1996), it was established that mental imaging is used in performing complex modelling tasks and in taking formal design decisions. In comparison with industrial designers, architects deal with much larger volumes and spaces. These spaces cannot be worked from the exterior only. The study was designed to ascertain the role that mental imaging plays while taking decisions on interior and exterior space simultaneously.

## 2.0 Experiment and procedure

The subject chosen was in his mid-fifties (referred to as V.S. in this paper) and has been practising architecture for 30 years. V.S. was

trained in traditional ways of design, and had been relying on sketching until he started using computers extensively during the past 5-7 years. A subject with 30 years of experience was chosen because of his already developed style of designing and use of methods to tackle a problem. Years of experience help to develop an individual's image bank, which was necessary in this experiment.

He was given the task of designing a motel on a highway with 18 rooms of mixed type with ancillary facilities. The task was presented as textual material and drawing (details of its introduction are given in 2.1). An architect framed the problem.

The study uses protocol analysis technique with audio-visual recordings. The design problem and environment were recreated to match the needs of a real life design situation as much as possible. Since mental imaging is a personal experience, there are no outward signs which a camera can catch consistently. Measures were taken to access this imaging without being too intrusive in the problem solving process. The subject was made to rely on mental imaging by depriving him of sketching, (which would otherwise offer a visual and kinesthetic feedback to the subject).

## 2.1 Sequence and stages of the experiment

### *Stage 1 Reading the Design Brief*

V.S. was asked to read the design brief supplied to him. The design brief contained textual description of the site, surroundings, topography as well as functional requirements (from 00:00:00 to 00:02:28). V.S. was asked to repeat the requirements and details after memorising them, until he got the content right. The experimenter, (who was well acquainted with the problem), offered clarifications and added the missing information. This part lasted from 00:02:29 to 00:09:23. V.S. was then supplied with the scaled drawing depicting the site, topography and surroundings. V.S. had to memorise the drawing & describe the site again. The experimenter added the missing information and details. This process was repeated until V.S. was able to recall all the details of the site. (This part of stage 1 lasted from 00:09:40 to

00:13:20). Stage 1 took 13 minutes 20 seconds.

### *Stage 2 Blindfolded Problem Solving*

V.S. was asked to wear an eye mask and address the problem blindfolded. He was asked to speak aloud, as he proceeded with the problem solving. As he could not sketch, V.S. had to rely on mental imaging to develop his ideas. This stage could be divided further into two sub-units:

- a) General planning - allocation of spaces, site planning of the building. (00:14:02 – 00:21:50)
- b) Fine-tuning - detailing of surface treatment, fixing dimensions, interiors etc. (00:22:00 – 01:02:36)

During the second stage he discovered some problems (detailed later in this paper) which he solved by altering the decisions taken in the first sub-unit. Questions were asked by the experimenter to remind him to describe the attributes, which he forgot to mention. Some of these details were envisaged, but were not mentioned. Some questions appeared entirely new, which encouraged him to look at these aspects.

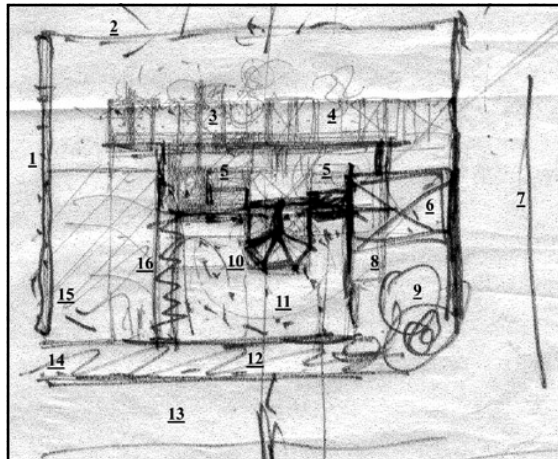
The whole stage 2 lasted from 00:14:02 – 01:02:36.

### *Stage 3 Description of the Final Design Proposal*

Finally, the subject was asked to describe the idea before the eye-mask was removed. During this process he again made minor modifications. The description was intended to be compared to the sketches done in stage three. The process lasted from 01:03:07 - 01:10:25.

### *Stage 4 Quick Sketching*

After V.S. was clear about the design, the eye mask was removed and he was asked to sketch the solution rapidly. He was instructed to reveal any new features added during the act of sketching besides those which he had visualised (he did not add any element besides what he visualised). The sketching & simultaneous discussion lasted from 01:11:35 to 01:24:26.



1. High wall on the highway side.
2. Perforated wall on farmland side
3. Pairs of rooms
4. Open space between rooms
5. Courtyards
6. Kitchen
7. Railroad
8. Service yard
9. Banyan tree
10. Dining room
11. Lawn
12. Service road
13. Land next to fresh water nala
14. Entry
15. Parking
16. Pathway

Sketch 1 The site plan sketched by V.S. (actual size 14 X 12 cm)

### *Stage 5 Commentary on the replay*

After the description he was shown the video recording of the session. He was asked to comment on wherever he had instances of mental imaging. The process lasted for two hours precisely and was again video recorded. The experimenter also intervened to ask V.S. about his mental imaging experience. (Replay time (RT) 00:00:00 – RT-2:00:00)

## **2.2 Analysis and results**

The experiment was designed to ensure that the details were not added while sketching the solution at the end. The final description of the design solution was video recorded in stage 3 and the verbal record was used to crosscheck. Results showed that all the ideas, plans, features and details that V.S. showed in his final sketches were decided during the stage he was wearing a mask. His final description, as well as his verbal protocol, referred to all the decisions suggesting that V.S. had considered everything in his images. This accords with the earlier similar results achieved with an industrial designer as a subject (Athvankar 1997).

There are certain areas in his planning where the approach remained only at a conceptual level or alteration of specific spaces, (e.g. service area and its overall appearance). He does not go into details of this area in his think aloud protocols, nor in his final sketch. He probably treated this as a 'routine' matter to

be worked out in detail later, but never reached that stage. Thus, some areas (kitchen, service yard, and general toilet) remained as space allocations only.

One would expect excessive usage of gestures as the subject was blindfolded. On the contrary, the subject, except for the initial part of the site description, refrained from usage of gestures. (This was contrary to the experiments done with industrial designers (Athvankar, 1997).) The gestures were usually limited to talking gestures and did not have spatial accuracy with them (00:02:50). In fact, the subject refrained from using gestures and sat with hands folded.

V.S., in dealing with the problem, started with the broad allocation of spaces over the site, to be detailed in the course of the session. He continuously switched back and forth to resolve issues, in a non-linear fashion. The verbal record during the design process served as a cue to recall the nature and details of imaging during the playback session. For analysis, this relationship was documented as in Table 1.

Since the area of focus was mental imaging in the design process, the instances of mental imaging were recorded first. To be correlated with the later playback sessions. The data accumulated as in Table 1 were later analysed for factors as discussed below.

play session time stamp	verbal record	remark	replay session time stamp	Reaction by V.S.	remark
00:27:05	As you enter there are car parks the lawn is there there is a service yard	Resolving planning issues and modelling of spaces	00:47:44	Here I had conflicting images - service yard and lawn. Will there be a wall?	Had imagery of trucks & ***tempo*** entering the yard.

Table 1

### 3.0 Creation of virtual design studio in the mind

In the absence of any externalisation medium viz. sketching V.S. had to rely on mental imaging to serve as a portrayal of his design and as a display to which to react. The entire design process appeared as if the designer was conceiving a 3D building in his mind's eye and kept modifying and shaping it throughout. It was almost like working in a virtual design studio. These factors are discussed as follows:

#### 3.1 Modelling of spaces and planning

Mental imaging was used as a potential tool to develop and change built forms with great ease and speed. V.S. used it as a part of exploratory moves and reflected upon them in imaging. Between 00:19:31 and 00:21:13 he decides on the number of storeys and the volume of the built form by analysing the space available to him. In the replay session he comments-

RT-00:31:08- "Something came to my mind ...a roof like this with mezzanine floor, triangular, with glazing on top."

The modelling ideas are much clear in the later stages of the design. In the final description he changes his design. While walking towards the building in his imaging he finds the gable of the dining hall disturbing and thus changes the front elevation.

RT-1:56:14- "I realised that there was a lawn in the front and I did not want a triangular wall coming in."

V.S. was able to allocate spaces and later change them in his mind as the design developed. When he was reminded of the fact that the service road is in the site he quickly remodelled it.

00:26:10- "Everything has to go inside the plot! My first image of Banyan tree as a part of the lawn has to change. The lawn has to shift more on left-hand side. The service entry will be on the extreme side."

RT-00:45:10- "I visualised a road from the broader side of the site. It was outside the plot, but when he said inside, a gate came to my mind. Huge large gate of metal."

#### 3.2 3rd dimension and detailing of elements

These modifications were not only limited to space allocations, but also to the elements of the built form viz. walls, windows, and roofs and their details. The rapidness, flexibility and volatile nature of mental imaging help to handle these issues with more ease than sketching does. Treatments and details can be imagined, modelled and changed at a very fast pace. For example, immediately after allocation of spaces, V.S. proceeds to develop an image of the whole building. The image emerging in his mind stays the same until the end.

00:22:12 - "Stone wall, Mangalore tile roofs, and lot of wood. I'd like to use glazing..."

RT-00:34:53- "It was like countryside as in... sloping roofs, stone walls."

After resolving the general image, which showed a fascination for use of stone and Mangalore roof tiles, he tries to resolve the interiors. The first image of stone and tiles influence his details all the time. Even in the treatment of bedrooms (00:22:41) dining hall (00:47:40) the stone treatment finds its place repeatedly.

### 3.3 Presence and walkthroughs

Perhaps one of the most rich experiences mental imaging offered, which sketching cannot, was the 'walk through' in the design process. Since V.S. was working with mental imaging, he was able to 'walk through' his building, switch viewpoints, move from inside to outside with great ease and take design decisions.

RT-00:37:10 - "I am inside the room looking outside at the lawn."

RT-01:09:11 - "From outside I saw the trees. From inside I visualised clean parking without the trees."

RT-01:37:40 - "I was walking in the corridor and toilet was blocking the view."

RT-01:46:30 - "the level differences I saw from top."

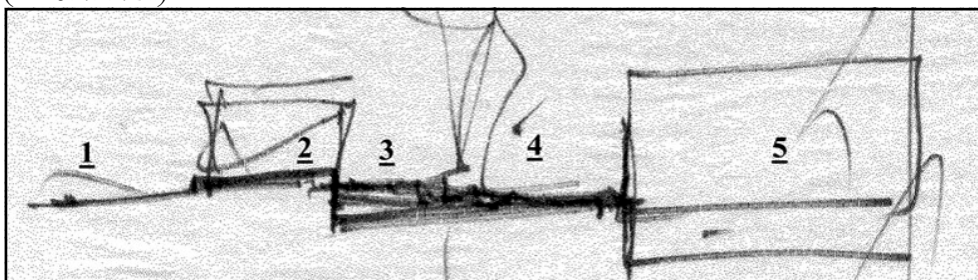
He also assumed north to be closer to him (contrary to standard practice in drawing where north is away from the viewer). This was based on his knowledge of the geography of the site (Goa being south of Bombay). He corrects this after viewing the drawing.

### 3.4 Visualisation of spaces and their details

The subject was at ease while visualising spaces with decoration and specific lighting conditions. V.S. was able to visualise the presence of light and noise while visualising the motel and site surroundings.

00:32:34- "You'll get sun on the south side."

He evaluated in his mind that there would be shadow in the courts, which was conflicted with his initial images (RT-01:00:00). Also, the noise from the railway tracks prompted him to place a high wall on the railway track side (RT-01:11:24)



Sketch 2 Depicting the site section (actual size 15 X 6 cm)

### 3.5 Conceive and view spaces with people

V.S. was able to conceive spaces with people. Usually his imaging experience was in terms of built form but, at 00:23:30, while detailing the room and adjoining spaces with privacy as the key factor, he visualised people in the imaging. This presence of people was not reported anywhere else by him in the replay session.

RT-00:40:52- "visualise people.. couple & child outside with a ball. The woman was wearing a sari."

### 4.0 Imaging and image bank

"Precedents" played a vital role in dealing with issues related to imaging. An image bank is a very personalised matter, which creates distinct differences in solutions between individuals. While discussing the lobby he says:

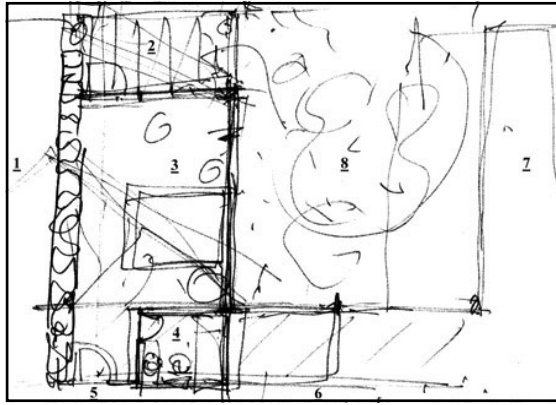
00:47:40 - "decorate it with hangings, crafts..."

V.S. later informed (RT-01:47:28) that these details about interiors were triggered by an image of the high walls of a fort and banners, crafts etc.

The origin of this image was unexplained. It was assumed that stone walls or previous visits to forts could have triggered these. Another possible reason for the use of stone walls could be his previous conservation work in hills where stone and wood are predominant building materials. These imagery driven decisions also had a bearing upon the strong notions he had about the site and the geography of the locale.

He is continuously visualising for the initial part of the experiment that the lobby was biggest and reception and dining were

1. Lawn behind the rooms
2. Rooms
3. Corridor
4. Courtyard
5. Dining



1. Adjoining room
2. Sit out (referred as porch by V.S.)
3. Room
4. Toilet
5. Entrance door
6. Corridor
7. Room across the lawn
8. Lawn in between two rooms

Sketch 3 Depicting a typical room and surroundings (actual size 28 X 25 cm)

attached spaces. This is contrary to the requirements, but goes with his image, which is derived from a five-star hotel (RT-00:11:41). At 00:19:50 he assumes a setback of the site to be of 10m, which he admits (RT-00:16:00) to have taken from the 10m x 10m grid drawn on the drawing supplied.

There were instances where imaging prompted him to take design decisions: the Banyan tree prompted him to place a lawn around (RT-00:13:47), and the railway track prompting him to place the service block along with it (RT-00:24:10). There were other interesting decisions which could not be explained:

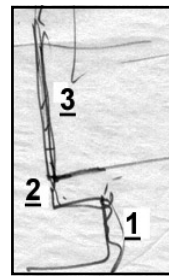
00:58:56- "the dining is floating..."

V.S. added in the replay (RT-01:48:00) that he had an image of a swimming pool in mind, which was the basis of this decision. He could not explain the basis for this imaging. Swimming pool was not a part of the design requirement.

V.S. was continuously visualising his design in a sunny environment. He continuously refers to light coming in through the windows in the room, across the court and in the dining room.

01:19:33 replay time- "it was a sunny day, the stone was already there, greenery..."

The subject later reported (apart from the experiment) that whenever he visualises a window, he starts by visualising a full size window with no wall. He focuses his attention on the light falling in and not on the window.



1. Dining room plinth set inside.
2. Cantilevered floor for floating effect
3. Full height windows

Sketch 4 Depicting the section of dining room wall (actual size 10cm X 6cm)

## 5.0 Significance of the findings

The experiments point up the important role that mental imaging plays in design thinking, at least when sketching is not used. The findings can be classified into three parts.

### *Pedagogic and cognitive significance*

The experiment suggests that mental imaging offers great speed and versatility while designing and has a pedagogic significance. It is a prevalent misapprehension that, in order to design better, one has to be good at sketching. The experiments suggest that mental imaging, if developed as a problem solving tool during design education can complement, if not replace, sketching. The design educators can devise and develop ways to develop this skill. Also, problem solving/decision making and representation are performed within the same system (brain). This makes the external media and their constraints redundant. The flexibility and speed available in mental imaging are far better than sketching or modelling may offer, enabling a student to experiment and choose between options at a higher rate than when sketching or modelling.

### *Significance for design research*

Some protocol analysis studies done with designers, especially architects, have been so focussed on sketching that the role of mental imaging was neither discussed in their findings nor was it studied. (Goldschmidt 1994, 19921, 1992b, 1991a, 1991b). These studies focussed more on the visible behaviour of design, and thus, left large part of the activity untouched. The results discussed here indicate the potential and versatility that mental imaging offers to designers. Any serious study done of design behaviour should not neglect the role of mental imaging. Further, the study of verbal protocols is not sufficient. There were instances of imaging like fort and banners which were reported only in the retrospective sessions (RT-01:47:28) of the experiment.

### *Significance for computing and artificial intelligence:*

In design, sketching and imaging support many decisions. But the computing tools, existing CAD software, and concept-sketching devices, do not address these issues (Michael, 1988; Athvankar, 1990). It could be because mental imaging is a highly personalised experience. However, there could be a facility developed with the current systems, which learns, grows and develops with the designer's image bank.

Also, current research in Artificial Intelligence for developing image banks, works on a system of logical thinking and deriving logical parallels between things. However, the instances where the subject draws parallels from a fort wall (RT-01:47:28), in his mental imaging, to resolve aesthetic treatment to the motel lobby, which does not follow any logical reasoning.

### **6.0 Unresolved issues**

Since only one subject was studied the findings cannot be generalised. There is a need to study more subjects in order to establish whether there may be a rule or a pattern. Thinking aloud may affect the natural flow of thought process or may not actually portray the mind. But this can be considered as the limitation of the experiment as there is no other way to access the image bank. There is

a need to find alternative ways of accessing mental imaging of the subject in a less obtrusive way.

Younger subjects, not studied here, may yield different results due to differences in their image bank, their experience and problem solving methodology.

### **References**

- Athvankar, U.A. (1990) 'Thinking style and CAD'. *Proceedings of conference on design research*, University of Compiegne, 109-116.
- Athvankar U.A. (1997) 'Mental imaging as a design tool'. In Trappe, Robert (ed) *Proceedings of 13th European meeting on cybernetics & systems*, Austrian Society of Cybernetic Studies and University of Vienna, Austria, II, 382-387.
- Goldschmidt, G. (1994) 'On visual design thinking: the vis-kids of architecture'. *Design studies*, 15,2,158-174.
- Goldschmidt, G. (1992) 'On figural conceptualisation in architectural design'. *Proceedings of 11th EMCSR*, Vienna.
- Goldschmidt, G. (1992) 'The dialectics of sketching'. *Creativity research journal*, 4, 2, 123-143.
- Goldschmidt, G. (1991) 'Serial sketching: visual problem solving in designing'. *Cybernetics & systems: an international journal*, 23, 191- 219.
- Goldschmidt, G. (1991) 'Visual clues: tacit information processing via sketching'. *Proceedings of 3rd international symposium on system research information and cybernetics*.
- Michael, E. (1988) 'The form of design process: a protocol analysis study'. *Design studies*, 9, 2, 86-94.
- Ullman D.G. *et.al* (1990) 'The importance of drawing in the mechanical design process'. *Computers & graphics*, 14, 2, 263-274.