Special Project Report

EYE MOVEMENTS DURING CREATIVE CONCEPTUALISATION IN EARLY DESIGN PHASE

CAN EYE MOVEMENTS CREATE VIRTUAL OBJECTS?

Presented by
Edwin Mendes
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Project Guide
Prof. U. Athavankar

Industrial Design Center
IIT-BOMBAY
Mumbai - 400 076

APPROVAL SHEET

The special project titled

EYE MOVEMENTS DURING CREATIVE CONCEPTUALISATION IN EARLY DESIGN PHASE

by Edwin Mendes (05613803)

is approved for the partial fulfilment of the requirement for the post graduate degree in Industrial Design.

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1.ABSTRACT

This paper is an extension of the series of papers that explore the way a designer uses mental imagery in solving a design problem. The experiments reported in this project addresses the following queries:

- Do eye movements reflect the mental image during early conceptualisation?
- Can eye movements create virtual objects?

Thus the project aims to identify the potential and limitations of the eye movements as a source of shape information.

The subjects for this study were practicing architects having sufficient experience in design field. They were given a task of designing a "Sports Complex for IIT-Bombay" with simple design requirements. Eye movements were recorded using iViewX eyetracking system while test subjects tackled the design task observing a plot image shown in perspective, as they verbalised their mental image.

The results achieved shows evidence that eye movements do reflect the mental image during conceptualisation, but the limitation were in the details of this images generated

Key words:
Mental Imagery, Eye movements, Eye tracking.

2. INTRODUCTION

In many cultures the eyes are said to be a window to the mind or even to the human soul. In this project no such claims would be made, but an attempt is made to find the relationship between the mental image in a designers mind and his eye movements.

The role of visualisation and mental imagery during early creative phase in the design problem solving has already been established in previous papers (U. A. Athavankar, Singh A, Hiremath M). However in these experiments the subjects were blindfolded and asked to solve the design problem. They were restricted from sketching their ideas and hence had to rely on their mental imagery to develop ideas. The entire process appeared as if the designer was conceiving a shape in the mind's eye and kept modifying and shaping it through out . In an experiment done on an Industrial Designer (U. A. Athavankar, 1997) , where he had to design a Casserole it was observed that the subject used a large number of gestures to shape the object. This study was carried ahead to understand the role of gestures in imagery and in modelling 3D shapes using a hypothetical Intelligent system.

Until here no study was conducted to understand the relationship of eye movement with mental imagery of a designer solving a deign problem. There has been research done on eye-movements in the field of HCI and cognitive science. One study in the field of cognitive science gives strong evidence that eye movement during visual scanning of a scene reappear in the eye movements that occur during mental visualisation of the same scene. Brandt and Stark (1997) showed that spontaneous eye movement occur during visual imagery and that these eye movement closely reflect the content and spatial relationship with the original picture or scene. There is also indications that eye movements reflect verbally constructed scenes. Spivey and Gang (2001) experimented and showed that subject listening to a spatial scene description tend to make eye movements in the same directions as in the described scene.

2. INTRODUCTION

The purpose of the present study is to extend the experiments by U. A. Athavankar on mental imagery and experiments by Brandt and Stark (1997) by recording and studying the eye movements of a designer involved in solving a much more complex imagery problem of 'space design'. Most architectural designers have obsession with traditional sketching, but in this experiment the subjects are shown a perspective image of the plot on a large screen and are asked to solve the design problem without externalising their thinking process in form of sketching. Here they do not use any sketching during the session. Since they have to solve the design problem by looking at the plot image, they have to fully rely on their mental imagination. They are asked to speak their design process aloud which would be used for voice protocol study. The eye movements of these subjects are recorded along with their verbal description. An eye tracking system is used to record the eye movements. At the end of the session they have to make quick sketches of their ideas.

The hypothesis under examination is whether the eye movements do follow the mental image generated in the minds of the designer. This will be cross checked with the sketches the subject draws at the end of the session. It also tests the hypothesis whether the eye movements effect is strong to create a virtual image of the design.

3. LITERATURE REVIEW

Studies in Mental Imagery and design Problem Solving

Mental Imagery as a research topic, though new, has not gone without attention in disciplines like cognitive science as well as design. A brief review of literature in this area has been presented earlier (Athavankar, 1997). This paper is an extension of series of papers presented earlier, therefore a brief review of each paper was felt necessary.

'Mental imagery as a design tool'

-Prof. U. A. Athavankar, IDC, IIT Bombay

This paper explores the role of visualisation and mental imagery during the early creative phase in design problem solving. Here an Industrial designer was given the problem of designing a casserole when blindfolded. He was deprived of other media of expression such as sketching. Results of the experiment found that the designer created a virtual model, in his minds eye, manipulated and altered it with his hand gestures.

Imagery was found to have some typical attributes like depictive qualities, spontaneity, non linear nature and voluntary control. These attributes point to the enormous potential of imagery in contributing to the creative pursuit.
Imagery affords simulation possibilities and thus permit evaluation of ideas without the danger of real event. It encourages fanciful play which is an essential component of any creative act.

The subject used gestures in shaping the product as if it was a soft clay block. He occasionally used them as memory clues to remember position and simulate with product body. He also made interesting alternative strategies of assembling components of virtual model.

'Potential of Mental Imagery in Architectural design Process'
-Prof. U. A. Athavankar and Anshuman Singh
IDC, IIT Bombay

This paper dealt with analysis of protocol of an architect assigned with the task of designing blindfolded. The design problem was to design a Motel on a highway. The subjects used mental imagery for creating a virtual design studio in their mind. They were surprisingly accurate in the detailing of elements in their design, as well as in dimensions. They created virtual walkthroughs which were full of rich experiences of the ambience, and even switched viewports to take various decisions.

Singh observed that the architect dealt with much larger volumes and spaces. He seemed to use imagery to work both in exterior and interior spaces. He also visualised spaces in a larger scale which were even beyond human gestures.

'Learning from the way designers model shapes in their mind'
-Prof. U. A. Athavankar
IDC, IIT Bombay

The thought and observations presented in this paper are in fact a spin-off from the experiment condusted to investigate the role of mental imagery in design problem solving. Professional designers were chosen as subjects for the experiment and were asked to wear a mask during the problem solving session. Video taped records of these sessions were given to another group of experienced designers for decoding. They were asked to act as intelligent machine and recreate the product ides and the shape, based on the verbal and gestural clues available in the taped data. The result

were surprising in that, the degree of resemblance between their sketches and the original sketches of the designer was far beyond what was expected. The result show potential direction in using the computer as intelligent partner in creative design effort.

'What Do Eye Movements Reveal About Mental Imagery? Evidence From Visual And Verbal Elicitations'

By Roger Johansson, Jana Holsanova and Kenneth Holmqvist
Department of cognitive science, Lund University

This paper shows evidence that eye movements reflect the positions of objects during the description of a previously seen picture; while listening to a spoken description, and during the retelling of a previously heard spoken description. This effect is equally strong in retelling from memory irrespective of whether the original elicitation was spoken or visual. In two experiments, eye movements were recorded while test subjects recalled objects that were either previously observed in a complex picture or presented in a verbal description. In both cases, the subjects spontaneously looked at regions on a blank board that reflected the spatial locations of the objects they recalled.

4. COMPONENTS OF EYE TRACKING

This section is dedicated to the definition and discussion of terms and phenomena used in eye movement study.

Saccades, fixations and visual acuity

The eye is never still for very long. The eye moves around with small jerks, called **saccades**. We are generally not conscious of these small movements. If an image is projected on the retina so that it moves synchronously with the movement of the eye, the projected image starts to fade after a few seconds (Pritchard 1961). Small saccades, called **micro saccades**, keep the eye constantly moving to reduce this effect. When we are looking at the same spot for a longer period of time this can be considered a **fixation**. A fixation allows us to gather information about an object aor an area, Jacob (1993) mentions that a typical fixation is 200 to 600 ms. According to Henderson and Hollingworth (1999) fixation time ranges fron 50 to 1000 ms with a mean average at about 230 ms. The fixation time is dependent on the amount and quality of visual information in the scene. Under certain circumstances the eye can perceive information during fixation that last less then 100 ms. For relatively simple tasks, such as object recognition, the onset time could be as short as 45-70 ms.

It is at the centre of the retina, the fovea, that **visual acuity** is at its best so in order to percieve the sharpest possible image, the eyes rotate to move the area of interest to this part of the retina. Our ability to perceive information in a picture drastically decreases as we move away from this part of the retina. Outside the fovea, acuity is only about 20 percent, and is generally not sufficient, eg. To read. The fovea is not a point on the retina; rather it is a small area covering approximately 1-1.5 deg of the visual field. Attention can be concentrated to any part of the fovea or even, in some cases, outside the foveal area. This is referred to as **covert attention** and can be observed eg. If the target of attention is too large to be inside the foveal area.

Shifts of attention are also faster than a saccade, so attention moves ahead and guides the eye to the oncoming target of the saccade, so called **preattentive processing**. Attention is moved to the new destination and the eye rotates so that this destination is projected on the fovea.

The study of animated scenes has introduced the notion of **smooth pursuits**, continuous eye movements where the typical pattern of saccades and fixation cannot be observed. Smooth pursuit is only observed when the eye is tracking a moving target and is thus not applicable in this study, where the scene is static picture. It is worth noting that the speed of the eye during smooth pursuit is relatively low compared to the speed of the saccades, as this is useful when trying to distinguish between the two types of movement.

Visual Attention

There are different forms of attention. What we look at may not be what we attend to. It is possible to look in one direction but actually notice changes in another direction. Overt attention is tha act of directing our eyes or ears towards a stimulus. Convert attention is the act of mentally focussing on particular stimulus.

Further, there can be sufficient separation in time between when information enters the eyes, and when that information actually reaches conscious attention. It is commonly considered to take about 200 ms before any action can be taken in regard of the information that is coming from the eyes.

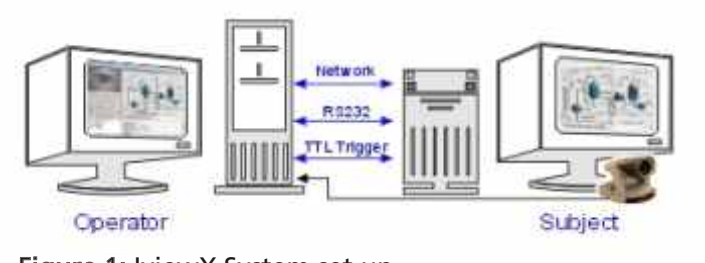


Figure 1: IviewX System set up

Figure 2: The large white circle is actually the dark pupil and the small circle at the lower left of the pupil is the bright corneal reflexion.

Area of Interest

When many fixation appear clustered close together this might suggest that there are some king of stimuli in the proximity to these fixations that attracts attention. These clusters are called areas of interest.

Eye tracking hardware

Early hardware for eye tracking typically forced the subject to restrained head movements, or even fixation of the head with straps. This, as well as the constant need to recaliberate the machine, made the test situation highly intrusive on the subject. Recent eye tracking hardware are accurate, as the device used in this study, is much less intrusive. Subjects are allowed full head freedom, and the tracking device is stationed on the desk in front of them. The system is setup and calibrated in a few seconds.

The hardware used in this is a Corneal Reflection System iView X (see Figure 1) iView X RED computes gaze path and fixations without any physical contact with the subject. The system consists of an infrared lamp and a video camera connected to a PC. The light and the camera are positioned in front of the subject. The movement of the eye is calculated by the change of position of pupil. The pupil is characterised by being a very dark, circular area. The pupil has been coloured white in figure 2. Since the subjects head is not restrained, the system keeps track of the position of the head by tracking the reflection of the infrared light source on the cornea. The corneal reflection moves along with the head, but since the ocular lobe is spherical, the angle between the reflection and the video camera remains constant (i.e. Any shift in position of the reflection is considered a head movement). When the eye is rotated to shift point of gaze, the pupil moves and the angle of the video camera changes.

5. EXPERIMENT AND PROCEDURE

Pilot Study

For the pilot study, subjects chosen for pilot study were design students having architectural background and professional design experience of more the 2 years. They were given a problem of designing cottages for a businessmen. The design required to have three cottages located separately in the same plot with a common kitchen detached from these cottages. An image of the plot perspective was projected on large screen and the subject were asked to solve the problem without using traditional method of sketching. They had to speak aloud during this process. At the end of the session they were requested to quickly sketch the design.

Observations from the pilot experiments:

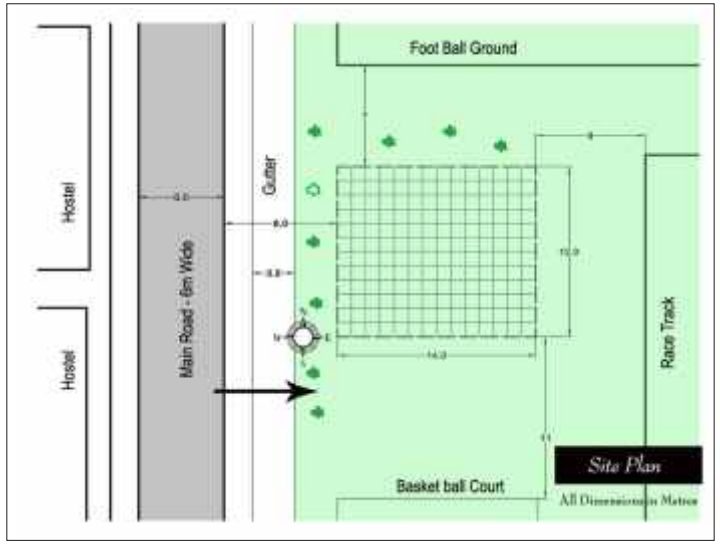
1. The design problem was too complex to be completed in the stipulated time period.
2. The eye movement recorder generated huge data and analysing it would consume a large of time and involved tedious manual computation.
3. The plot view needed to be zoomed into the design area thus eliminating unnecessary details that would distracts the subjects eye from the main plot area.
4. A scaled grid was needed on the plot with colour coded areas so that the subject would use them for proportional needs and also for clear communication.
5. It was observed that some time was needed by the subject for getting adjusted to this process of design.

Based on these observations in pilot experiment, the problem and experimental procedure was reformulated. Since the subject need some time for adjusting to the system, it was decides to have two sets of problems. The first design problem was for practice and hence not

6. SEQUENCE AND STAGES OF EXPERIMENT

Design Problem Brief
Student Sports Centre

Client profile:
1. Students of IIT-Bombay need to have a Sports centre on the main ground
·2. This will have storage for different sports equipments.
·3. Indoor games such as Table Tennis will be located in this centre.
·4. This centre should be distinguished and it would be built by sponsor fund from the student's alumni.
·5. This should include Sports Cafeteria where the students can refresh themselves after their game and would act as a hangout for sports enthusiast.



Slide 1: Site plan

Based on the observaton made in the pilot study the final experiment procedure was designed. The final experiment was divided into sessions. First was the practice session in which the design brief was to design a 'PCO booth with coffee stall'. The requirements for this problem was kept simple. Immediately following this session was the main session. The brief for this session was to design ' **A Sports complex for IIT-Bombay**'. Since the eye tracking camera needed to be calibrated, both the design briefs were given to the subject at the beginning of the experiment presentation. They had to memorise the design brief and recapitulate it. After the practice session slides the subjects were refreshed with the main design brief by the experimenter.

The typical sequence followed in both the sessions is as follows:

Stage 1:

Reading the Brief
- Asked to memorise the design briefs.
- Prompted missing details by the experimenter.
- Site plan print out shown to the subjects.

Stage 2:

Calibration of the eye tracking system.
Start of the presentation
The presentation shown on the screen was subdivided into slides.

Slide 1: Site plan

The first slide carried the site plan with all the architectural details. Here the subjects refreshed their information regarding the plan and all the doubts regarding the plan were cleared by the experimenter.

6. SEQUENCE AND STAGES OF EXPERIMENT

Slide 2: Over all site view

Slide 3, 4, 5: Plot view 1, 2 , 3 with grid

Slide 2: Over all site view

Second slide carried the photograph of the plot and the surrounding areas. The subjects were asked to relate this to the site plan shown earlier and get doubts cleared.

Slide 3: Plot view 1 with grid

This slide carried the zoomed image of the actual plot with the grids marked on it. The image carried major area of the plot view eliminating unnecessary details. At this stage the subjects were asked to start with the conceptualisation of the design.

Slide 4: Plot view 2 with grid

This slide was the same copy of the previous slide. This was done to separate the huge eye movement data generated.

Slide 5: Plot view 3 with grid

This slide was again a copy of the previous slide. Final design articulation was done on this slide.

From slide 3 - 4, the subject was asked to speak his mind aloud as he developed the design ideas. This was recorded so that it could be synchronised with the eye movement data for protocol study. Beep sounds were created with the change in each slide so that the voice protocol could be matched accurately.

Stage 3:

Concentration on final mental image of the design.

Quick Sketching of the solution with each areas labeled and minor details included. These sketches would be used for final data analysis.

7. ANALYSIS AND RESULT

Since the main focus of this project was to test if the eye movements followed the mental imagery, it was necessary to synchronize the voice protocol with the eye tracking data and also weigh against the final quick sketches that the subject made at the end of the experiment. As it was observed in the pilot study, the amount of data generated by th eye movement software was large and hence three slides were prepared for the subject to explore the possibilities in the design and make iterations. This limited large amount of scan path eye movements data that occur when the subject is initially exploring and making decisions. In the final slide the subject had to summarise the final design with details.

After an overall study of the eye movement data video with the voice protocol for all the four subjects, it was decided to study in detail only the summarisation video of two subjects.

The two subjects selected to analyse were:

1. MV - Male with 3 years of professional experience.
2. SM - Female with 2 years of professional experience.

Using the Begaze Data analysis software different scanpath patterns were generated to assist in further stuby. Interesting observations were made in the initial playback of these video. To draw conclusion from this data the analysis was done in three stages.

1. Comparison of eye movements and design style between the subjects.

2. Voice Protocol study.

3. Percentage of fixation in the intended areas.

Note: Only the summarisation video of the two subjects was taken for detail analysis. The videos of design process has been studied just as observations.

Figure 3: Scan path of MV when describing the equipment store

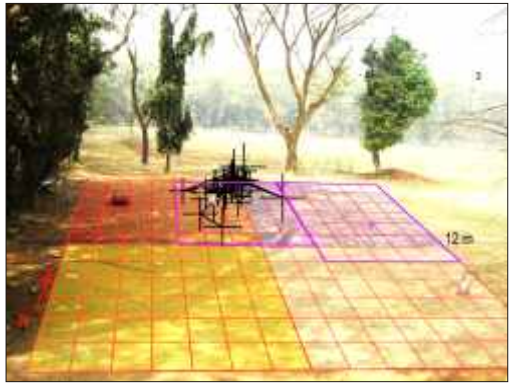


Figure 4: Scan path of SD when describing the Cafeteria.

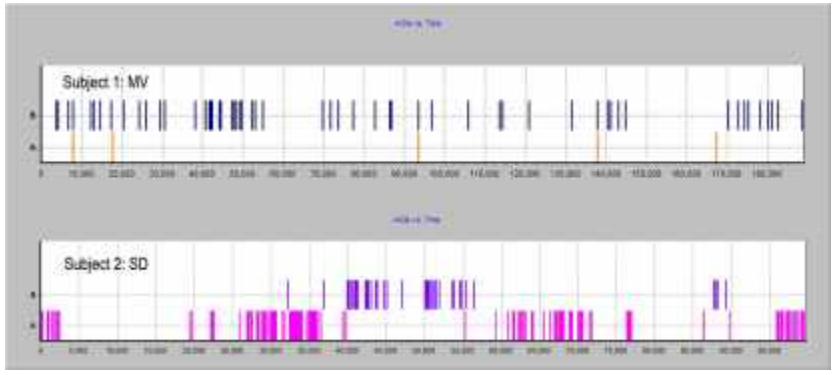


Chart 1: AOI v/s Time sequence chart

1.Comparison of eye movements and design style between the subjects.

During the playback of the eye movement videos with the voice protocol interesting observations surfaced. Each subjects had their unique indiviual type of eye movements scan path, and followed the same pattern over the entire design process. Hence it was felt necessary to understand this pattern and highlight them comparing against each other. The voice protocol also revealed interesting facts about the orientation of the subjects during the design process.

As for the subject MV, when describing about the equipments storage area the fixation points would move in and out of the AOI a large number of times. This is shown clearly in the figure 3. Whereas for SD the fixation points were more concentrated in that particular area as she described about the details. Within the area eye movements would happen in both the cases. Scan path created by SD when she described about the cafeteria is shown in figure 4.

To understand this better a **AOI v/s time sequence chart** was generated for the areas lying in the same region of the plot i.e. Area A and Area B. These areas marked in the Figure @ & @. This chart was prepared for individual summarisation period. Summarisation time period for MV was 3 min and for SD it was 1 min 40 sec. This chart shows the fixation distribution pattern for the two subjects. Chart of MV concludes that when he was describing a certain area in that same time period eye movements did happen in the surrounding areas. While the chart for SD shows that when she was describing a particular area fixation would be more in that area.

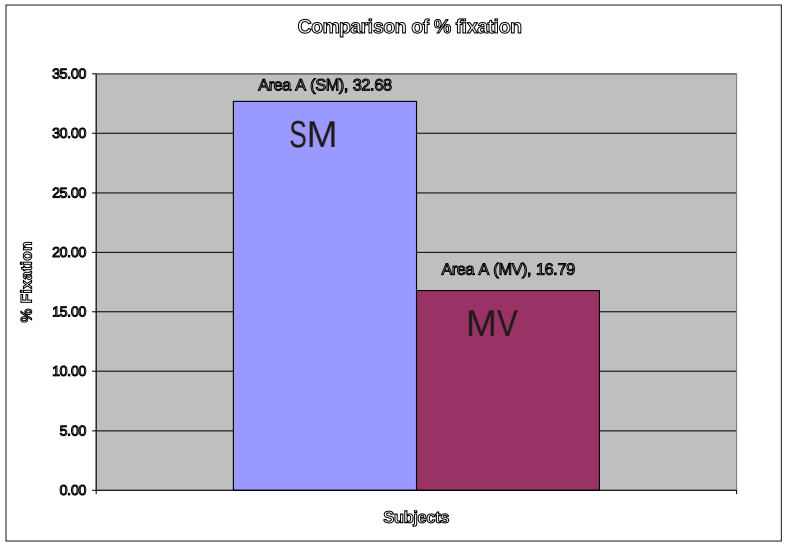


Chart 2:

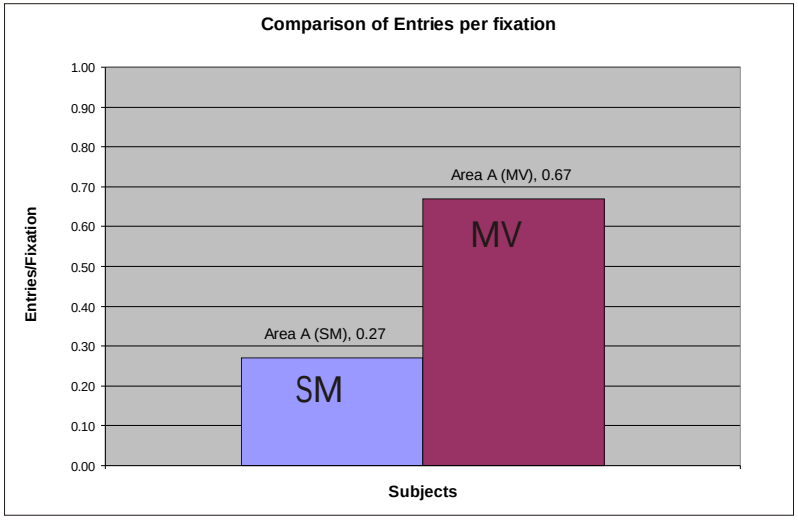


Chart 3: Entries per fixation of each subjects

Since the summarisation time periods were different it was felt necessary to compare the two data at same level and hence fixation percentage data was tabulated for both the subjects.

Chart 2 shows the fixation percentage of the subjects happening in a particular area while they were talking about that area. From this graph it is clear that MV had lower fixations percentage (16.79%) in the area that he described as compared to SM (32%)

Chart 3 gives the ratio of entry per fixation for each subject. Entry is the process of scanpath moving in and out of the AOI. As seen from this graph entries /fixation is higher for MV (0.67) as compared to SD (0.27) indicating that fixation points of MV jumped in and out of the AOI more number of times then SM.

From this analysis it is concluded that the subject when talking about a particular area or mentally imagining about a object often moved to inspect other parts of the picture, while they simultaneously continued to describe the previously perceived image. Here the perceived image was the mental image of the structure that the subject was overlaying on the scene.

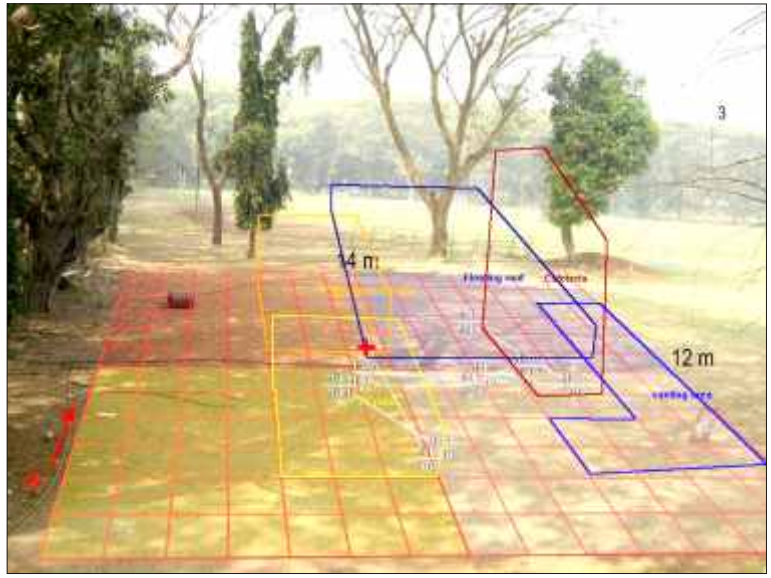


Image 1

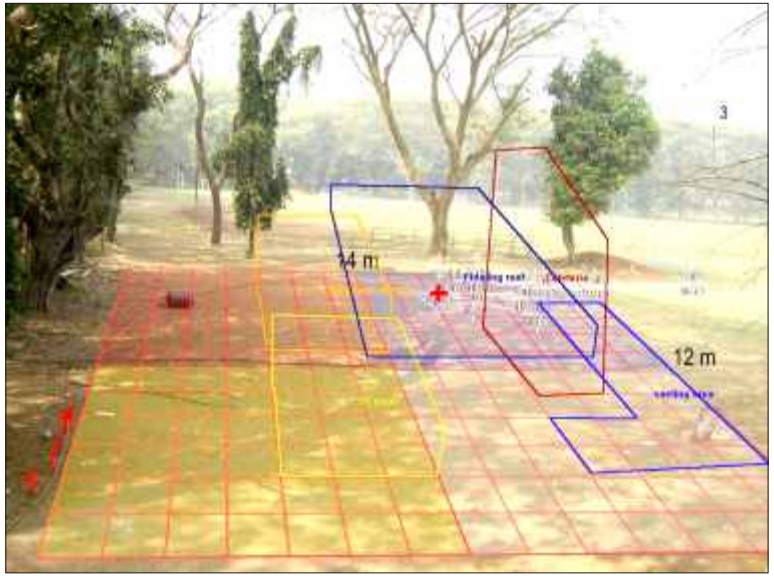


Image 2

2. Voice protocol

In this study, the eye movement scanpath video along with the voice protocol were played back and observations regarding the behaviors were recorded. The voice protocol and the final sketch served as a cross check to find the deviation of eye movement from the intended areas. Direction of eye movement, fixation point and dwell time were noted down to draw conclusion.

For analysis the relationship were documented as follows:

Image 1

Replay time: 05:37 - 05:49

Verbal Record: ... In yellow and red grid are symmetrically placed two block of .... Two solid blocks which are covered and have TT room and storage area.

Fixation points 143, 144, 145 & 147 are formed in the yellow and red marked plot areas as he mentions about those areas, but later as he speak about the TT room and storage areathe eye movements deviate from the intended areas.

Image 2

Replay Time: 05:53 - 06.00

Verbal Record: ... Covering with horizontal slab which is floated and supported by tower blocks between the white and blue grid which is free standing..

Fixation points 212, 213, 214, 216 are formed in a horizontal line when MV speaks about the horizontal slab that covers the display area. Here the fixation points directly relate to the area where he imagines the slab to appear.

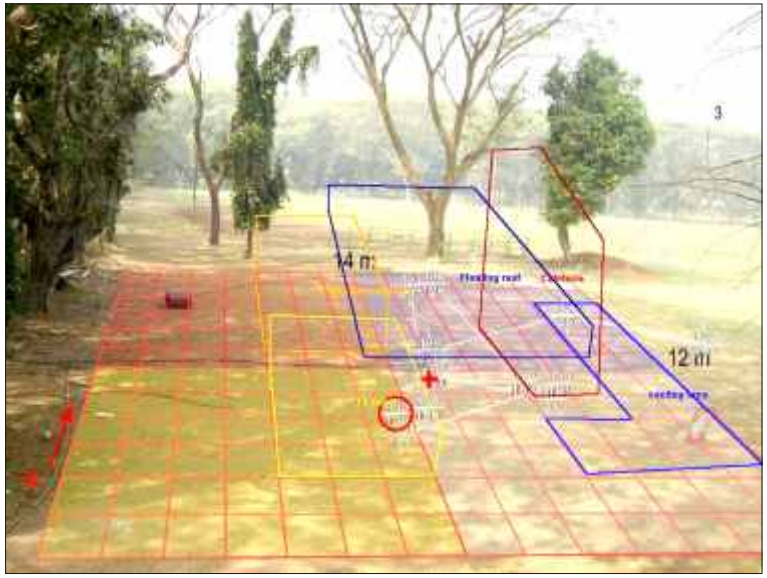


Image 3

Image 3
Replay Time: 06.50 - 06.53
Verbal Record: ... As you enter... You enter right into the display area.. You disperse to the right and turn around you see the TT table

Here when he mentions about the direction of turning right he sees himself or a third person entering the complex and turning right. From the point where he is standing turning right does not create a right turning scan path on the image. The scan path does follow the direction as the third person entering the complex would take to reach the TT room. Here we note that the subject could relocate himself into the plot and see that he turn right from that point. This relocating oneself will induce a error in creating a correct virtual image as he would be creating a visual image from a different viewpoint.

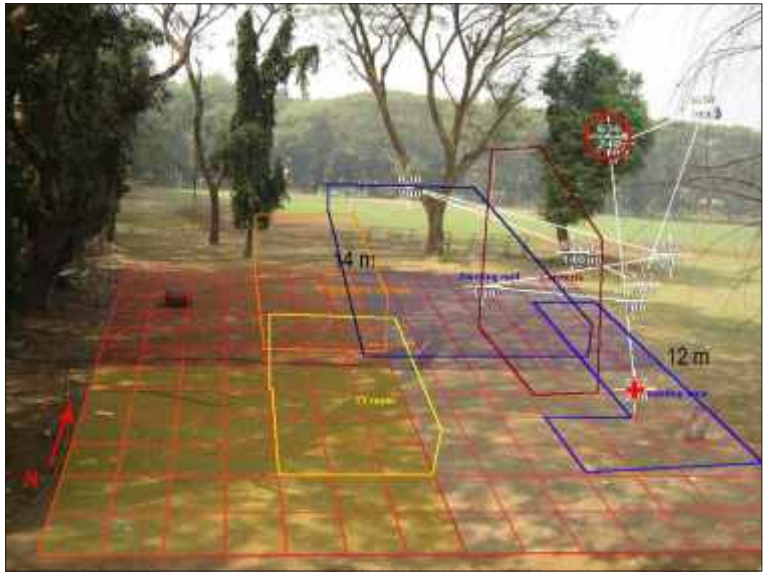


Image 4

Image 4
Replay Time: 07:38 - 07:42
Verbal Record: ... The whole concrete block which is really tall.... .And ... It steps from the highest level on the right hand side.....

When describing about the cafeteria block he mentions the words 'really tall' and immediately follows two fixation points on a vertical scanpath with a long vertical saccade. Here it seems as if MV is looking at the topmost point and then to the ground point of the concrete block in his mental image.

Similarly, other areas of the videos were analysed in detail. From this analysis one can conclude that:

1. When describing about a certain image area that is in his mind MV would form fixation points in the corresponding areas on the screen, but there were large number of fixations outside the intended area. This observation was also made in the previous analysis of design style study.

2: When MV describes about a horizontal plane such as the slab or vertical heights the eye movements would suggest the direction of these planes. Thus we can conclude that eye movements to certain degree follow the direction of the image as imagined in the mind.

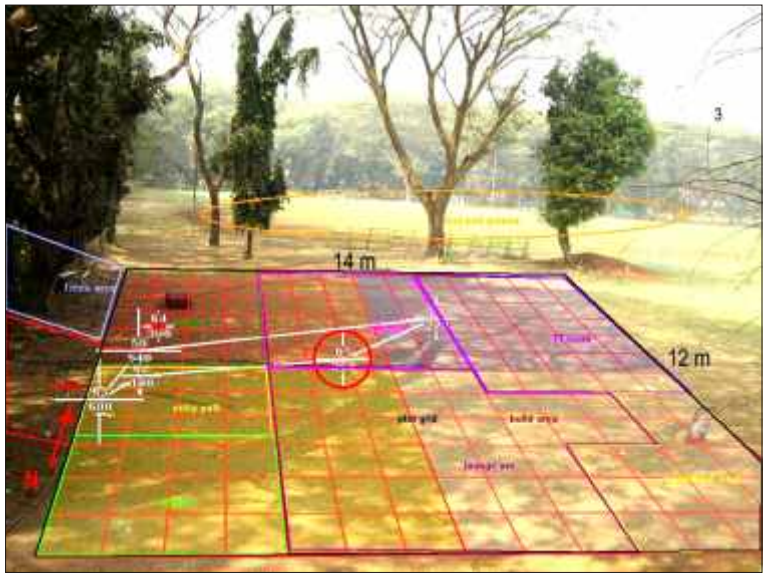


Image 5

For the second subject SD the voice protocol analysis was as follows.

Image 5
Replay Time: 09:02 - 09:06
Verbal Record: ... Entry for the sports complex would be at the center of the lawn area....

Here in this replay time it was seen that the scan path actually traces a direction when SD speaks about the entry to the sports complex. This takes place in fixations 58, 59, 60, 61, 62, 63 and when she mentions center of the lawn area large number of fixations are concentrated in this area of the plot image.

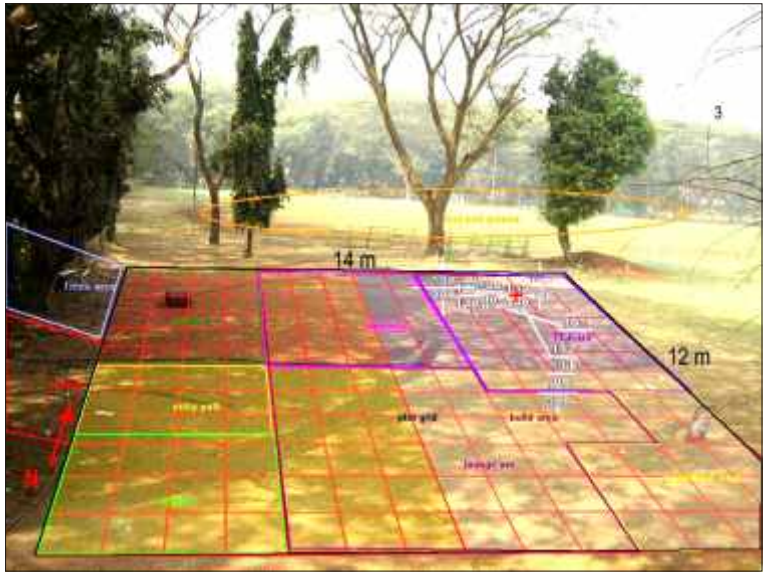


Image 6

Image 6
Replay Time: 09:25 - 09:33
Verbal Record: ... On the right corner there will be... Table tennis room.....

When SD speaks about the TT room in the right corner, a large number of fixations (120 - 159) area formed in this particular area, but these fixation form in random fashion without following a particular pattern. It was also observed that before she mentions about the TT room, a couple of fixations happen in this area before she speaks about it.

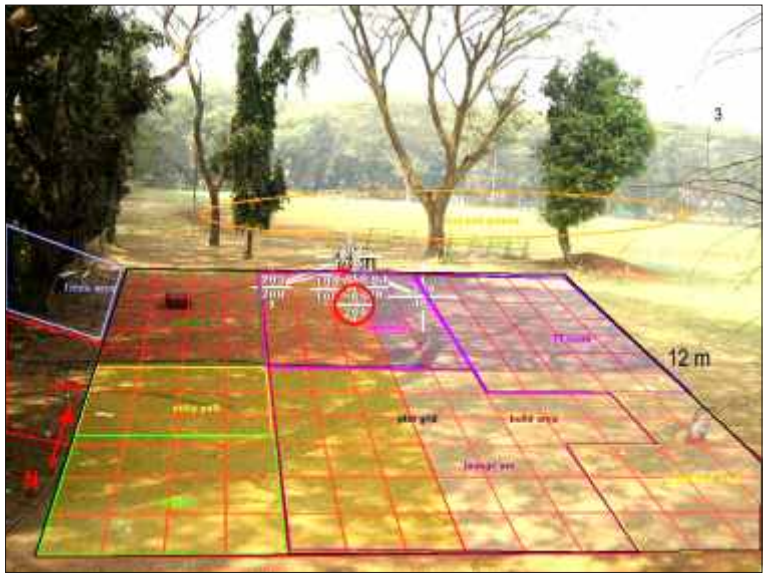


Image 7

image 7
Replay Time: 09:44 - 09:52
Verbal Record: ... And just besides the Tt room there will be one cafeteria which will be accessible from the entrance lobby only.....

Here again SD makes a large number of fixations at the center of the cafeteria area when she is speaking about it. One interesting observation is the fixations that form near the lobby wall when she mentions about the entrance to the cafeteria.

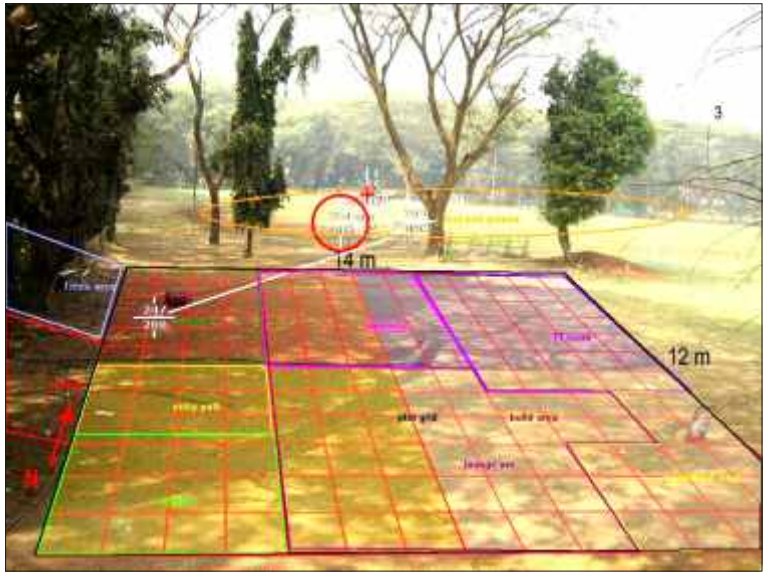


Image 8

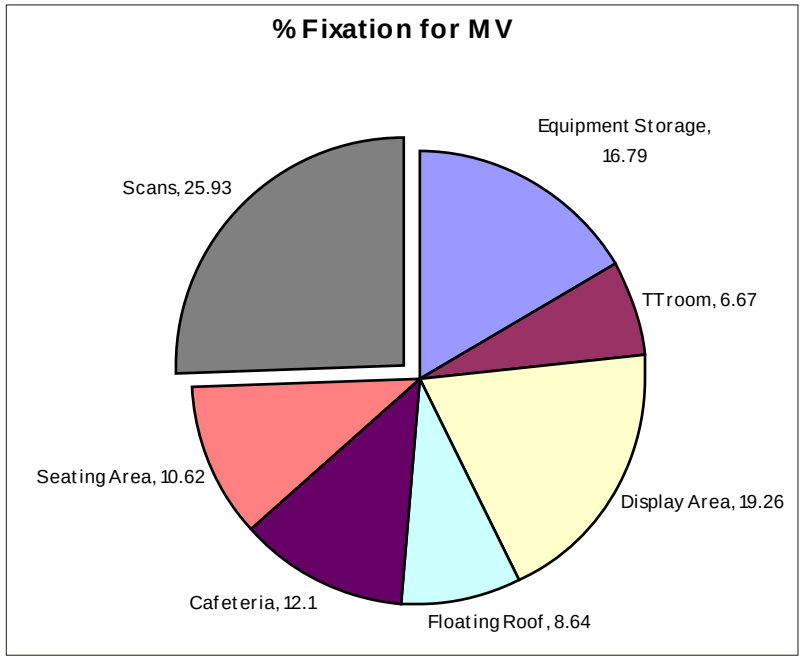
Image 8
Replay Time: 10:00 - 10:07
Verbal Record: ... Cafeteria will have a good view of the front landscape area and the backside, that is the open area..... Open play ground.....

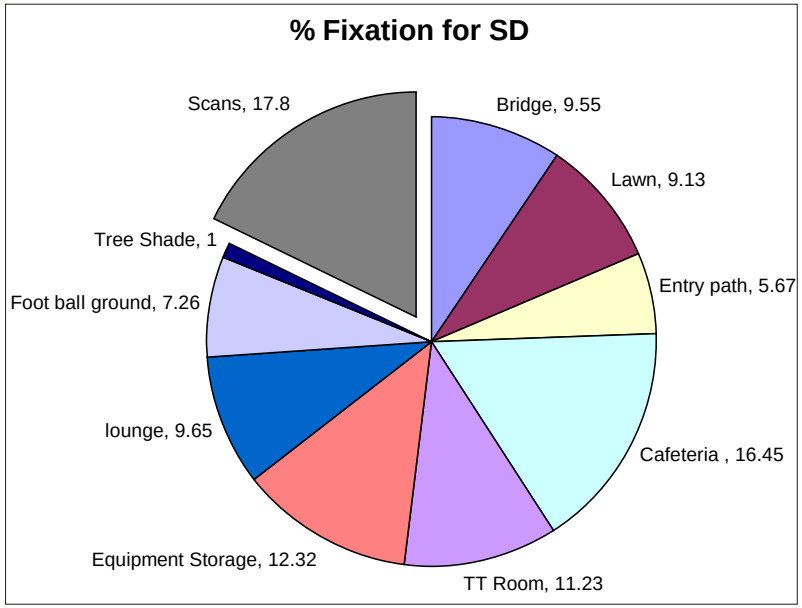
When describing about the view one would get from cafeteria the eye movements create a scan path directing to the places she describes about, such as the front lawn and the open play ground.

Following conclusions are drawn from SD's voice protocol study:

1. Large number of fixations area created within the AOI when SM mentions about it. But, again the fixations do not create a visible image of the constructed building as such.

2. When describing about a certain direction of movement in the building such as the entry into the complex, the fixations would create a scan path indicating that direction.





3. Percentage fixation in the intended areas.

This analysis was done to get a quantitative answer regarding the relationship between the fixation points and the mental imagery of the subject. I.e. To know whether fixation points reflect the visualisation process of the subject. For this the scan path video witht the fixation point number was cross checked against the voice protocol and the final sketch. The fixation points which fall within the AOI and the that fall outside it were noted down and a data shee prepared. Since the play time and total number of fixations were different for each subjects, percentage fixation was calculated. This data was then plotted on a pie chart.

From the pie chart one can conclude that major number of fixation were in the AOI. Percentage of fixations outside the AOI were low and these are labeled as scans in the pie chart. In the case of MV the scan fixations were approximately 26%, whereas for SD they were 18%.

8. CONCLUSION AND INFERENCES

Each subjects used for the experiment had their individual style of tackling the design process. This change in design style effected the eye movements generated by each subject. From the detail study of two subjects it was observed that subject MV imaged himself walking through the building and deal with the design decision, where as subject SD solved the design problem as a third person viewing the plot. For most of the design process viewpoint for SD was that from which the plot picture was taken.

When the initial slides of the plot were shown, each subject took their time in studying the plot and the surrounding areas. Some of the design decision were being made during this process. When clearing some doubts over a certain area in the plot that would influence the decision making process a large number of eye movements were generated in these areas and also in the adjacent areas.

During the initial stage of the design process the percentage of eye movements outside the intended areas where more as compared to the eye movements during the design summarisation. This was because the subject during the initial stage would scan other areas of the plot in order to get the relationship between the intended area and the surroundings. A large number of design decision were made during this phase and the design image was getting clear in the mind of the designer. During the summarisation stage the mental image was more clear and the percentage of eye movements in the intended area increased to a large extent. The eye movements in these could to an extent express the mental image of the design.

During the summaristion stage subject when talking about a particular area or mentally imagining about a object often moved to inspect other parts of the picture, while they simultaneously continued to describe the previously perceived image

8. CONCLUSION AND INFERENCES

Eye movements do follow the mental image in a person mind, but the effect is not so strong as to create a virtual shape on screen. This is due to the saccadic movement of the eye.

It is also observed that when visualsing a direction, the eye movements would happen in that particular direction.

It has also been observed that when a person is perceiving an image in his mind the eye move on other areas where the mental attention directs them for the purpose of scanning

9. FUTURE SCOPE OF WORK

As an extension of this study, in future the mental imagery of a designer when he recalls the scene previously imaged could be studied in detail. In the future experiment the subject would be asked to design a space using the same experimental setup as reported in this experiment. The difference would be that during the process of designing the subjects eye movements need not be recorded, but the voice would be recorded. Later the subject will be made to listen to his own voice protocol of selected time of interest. He would then have to describe as to what he imagined or saw in the mental image as first person when he spoke those sentences. Here, when the subject recollects the mental image his eye movements and also his voice would be recorded. This data would be analaysed to see the relationship and study the eye movement patterns when he recalls the mental image.

In brief the experimental process would be:
1. The subject would be asked to design a space without sketching. This step would be same as the one adopted in this report.

2. Only the voice explanation of the subject would be recorded.

3. Specific sentences or time of interest would be selected by the experimenter and replayed to the subject.

4. The subject would be asked to describe in detail what he imagined when he spoke those sentences.

5. During the description the subjects eye movements and voice protocol will be recorded for further analysis.

6. Suitable analysis technique will have to be generated in order to analyse the data collected.

As a word of caution a chapter on 'Eye accessing Cues' has been includes for the experimenters reference. The experimenter would have to take these findings in consideration while conducting the experiment.

9. FUTURE SCOPE OF WORK

Eye Accessing Cues

By Roger Ellerton Phd, ISP, CMC, Renewal Technologies Inc. Www.renewal.ca
Http://www.renewal.ca/nlp13.htm
Last accessed on : 14/06/2007

Have you ever noticed that people's eyes move when they are thinking? This is valuable information that can provides us with clues as to whether they are thinking in pictures, sounds, feelings or talking to themselves. Or in other words, information about their lead and preferred representational systems.

According to neurological research, eye movement both laterally and vertically seems to be associated with activating different parts of the brain. In the neurological literature, these movements are called lateral eye movements (LEM) and in NLP we call them eye accessing cues because they give us insights as to how people are accessing information.

To get an idea how your eyes move, consider the following questions. For each question, as you think of the answer, notice the direction(s) your eyes move (up down or to the side) or if your eyes do not seem to move notice if you have a sense that you are looking in a certain direction (even if only for a fraction of a second).

What is the colour of your front door?
What will you look like in 15 years?
What does your favourite music sound like?
What would your voice sound like if you had marbles in your mouth?
When you talk to yourself, what type of voice do you use?
What does it feel like to be in a nice warm bath?

9. FUTURE SCOPE OF WORK

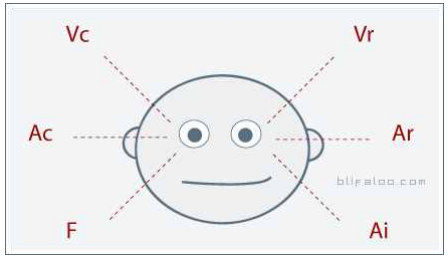
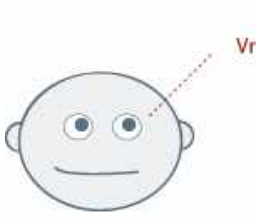


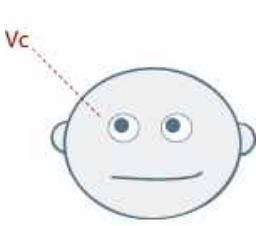
Fig i: Eye Pattern Chart

Did you notice your eyes had a tendency to look up for the first two questions, to the side for the next two questions and down for the last two questions? In general, if you are making a picture in your mind your eyes will tend to go up to the left or the right, for sounds laterally to the left or right, and down to the left or right for feelings or when you talk to yourself.

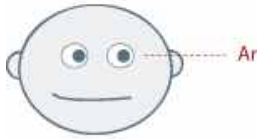
The Figure i, describes the eye patterns for a right-handed person as you look at them - please note this distinction. These patterns are fairly consistent across all races. For many left-handed people, the chart is reversed i.e. mirror image.



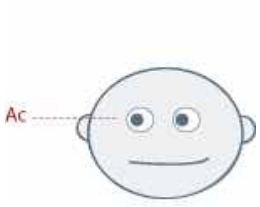
Visual Remembered (VR)
Question 1 - eyes up and to your left.
This is a question about something you have seen before and hence you remembered it.



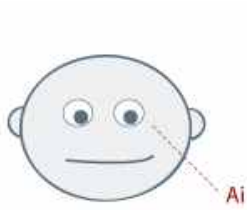
Visual Constructed (VC).
Question 2 - eyes up and to your right.
This is a question about something that you may have not seen before and hence you constructed this picture.



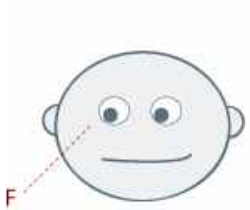
Auditory Remembered (AR).
Question 3 - eyes on the horizontal plane to your left.
This is a question about something you have heard before.



Auditory Constructed (AC).
Question 4 - eyes on the horizontal plane to your right.
This is a question about something you have not heard before.



Internal Dialogue / Auditory digital (Ai).
Question 5 - eyes down and to the left.
This is a question about your self talk.



Feeling / Kinesthetic (K).
Question 6 - eyes down and to the right. This is a question about your feelings- kinesthetic (K).

People's Eyes do not Always Move.

Sometimes people's eyes do not move and this may be due to:

Look to talk rule: Some people have a look to talk rule. That is, when you are making eye contact with them, they will also look at you and their eyes will seem not to move or move very slightly and quickly. What may be happening in this situation, is that they are defocusing their eyes so that their 'internal' eye can look in the appropriate direction.

Near term memory: If the answer is something that is well-known to the person (i.e. What is their name?) or is a recent observation, then they do not need to search for the answer and their eyes will not move.

Using Eye Patterns to Assess Truthfulness or Congruence.

If a person is describing something that they have seen or heard, then their eyes should primarily move to visual or auditory remembered. However if a person is making something up, then their eyes will tend to move to visual or auditory constructed, indicating that the person is constructing some part of the situation they are describing. This may indicate that the person is uncertain or untruthful about what they are thinking.
Care should be taken in assuming someone is untruthful.

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