PERCEPTION OF FORM: A PEEP ON THE EYE

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Form of the designed object and its visual response has been a point of interest for researchers especially because of its highly subjective nature of inquiry. The physical form of the object is the medium that generates a response. This response is the means of communication which is highly dependent on the past experience to the object and training of perception of the viewer. Exploration and understanding of this visual response give valuable clues for understanding user perception. Having a peep at the movement of the eye using an eye tracking device during the first few seconds of viewing an object, can give valuable clues for understanding perception of form. The clues of this research can help in understanding the role of past exposure of the user in perception of the new form of objects.

This paper presents a part of the ongoing research to investigate Form Perception and Response. The current study explores the efficacy of eye movement behavior as an objective tool to study the form perception across two different categories of respondents.

The results indicate difference of perception across considered parameters of the respondent groups. The objectivity in the eye movement analysis as a method and tool could prove helpful in investigating the same.

Keywords: Form Perception, Visual response, Attention, Eye Movement.

1. INTRODUCTION

There are various qualitative and verbal techniques that are used to investigate visual response of the user. Our present study aims to investigate with greater objectivity; the visual response as opposed to articulated verbal response through the eye movement analysis (EMR). Aspects of attention on product form are of importance to designers for form decision making. With the current technology in eye tracking, eye behavior characteristics can be studied for understanding visual response to the form.

Peep on the eye aims to investigate, how, visual attention can be studied as a factor of visual perception. The investigation is aimed at understanding the attention pattern for the form of an object as viewed by designers and non designers. Their attention pattern will be compared to see what is being most attended, according to the classification of objects into most characteristic and deviant compositional features. In other words, weather designer and non designer attention pattern corresponds to the placement of a designed object in polarity scale of typical and atypical forms. Further to this, if confirmation to attention as validation is possible by comparing the trends of the three EMR measures, Average Fixation Duration (AFD), Saccade Latency (S Lat) and Fixation Count (FC). These shall be explained as the paper progresses.

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2. THE EXPERIMENT

2.1. Forming an understanding on Perception

While developing an understanding of perception, two schools of thought have been observed; the traditional school that considers perception as a result of the senses, thus considering visual perception as superficial, and second, the radical thought — that what is sensed is also well-thought of, and governed by the mind too. Thus insisting, that all that is visually perceived, is also made to look at by the mind. Arnheim insists on the radical thought that, visually thinking mind is not simply mechanically recording images, and that "perception is intelligent" (1). Further we understand that through perception human beings create their own understanding and order of the world. It may involve both creation and discovering the personal world. It has been established that as perceivers we attend to various elements of form like formal elements, structure, and pattern. Gregory's theory of perception as hypotheses (2), stresses that a perceiver creates a hypotheses of the information received and keeps reinterpreting and filtering it until reaching the most reasonable decision.

We also observe through these perception discourses, that vision dominates perception. Though perception can be considered as a holistic operation of the senses and the mind; vision creates a prelude to that perceptual interpretation. This triggers the curiosity if we could instrumentally peep the eye and make sense on what is actually being paid more attention as a function of perception.

2.2. The Eye Movement Behavior study

For the need to study the captured vision and methods to probe visual form, EMR (Eye Movement Recording/Research) technique and methods were studied, and how they have complemented understanding form and perception. In the genre of form there has been scarce information on use and exploration of the tool along with a qualitative assessment of data generated by the Eye movement behavior.

Eye movement has been an area of probe for nearly a century and has produced useful information for many application areas, such as usability research, user interface design, and human cognition. Initially by studying the ways the human eye examines complex objects and the principles governing this process, Yarbus found that eye movements were not simple reflexes as reactions to the physical features of an image. His studies suggested that the human eye fixates mainly on certain elements of objects that may contain "useful and essential information". (3) EMR pertaining to Form has been though scarcely researched; strategies of first impression perception to perceive design in products (4) product attitude and preference (5) visual aesthetics (6) and investigating the innovation trend in Design (7) have been important contributions. Yet, evaluating the points of consideration of the Designer as seen by themselves and the un-initiated non designer respondents can have the potential to add valuable knowledge for design practice, at various stages of design where visual decisions play an important role.

3. EXPERIMENT DESIGN

The objective of the experiment is to explore attention of designers and non designer subjects on the stimulus object- Helmet. It was a product designed with metaphorical inspiration from nature images in a pedagogical course-study environment.

3.1. Equipment

For the Eye Movement Recording, an SMI Iview X system (8) was used, which is a dark pupil tracking system that uses infra-red illumination and computer based image processing. The presentation of the stimulus was executed in the SMI experiment centre software. SMI BeGaze 2 was used for gaze data output and analysis.

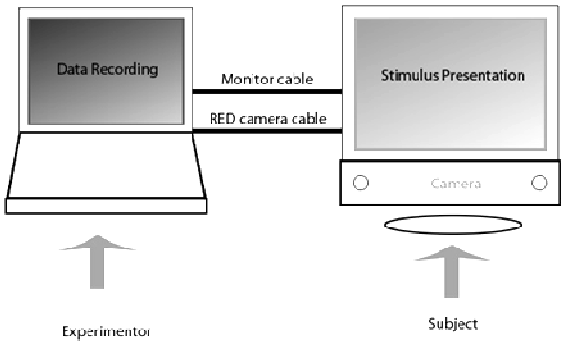

Figure 1. Equipment and technology.

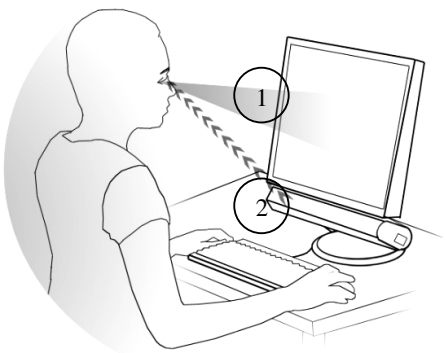

Figure 2. 1 Subject Stimulus Communication. 2 Infra-red camera recording Eye Movement.

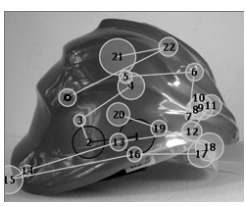

Figure 3. Eye movement data plotted as scan path, which is the blueprint of the movement of the observer's eye, comprising of fixations and saccades.

Before each experiment calibration of the eye was performed for each respondent. A double monitor system was used, where in the run-time the eye movement can be observed by the experimenter, while displaying the stimuli images on the other.

With an Infra-red light, the camera records the eye movement, as the user looks at the on-screen stimulus. The entire eye movement as scan path can be seen concurrently at the experimenter's screen, categorized in fixation and saccades.

Circles in the image- (Figure 3) denote fixations (centered at the point of gaze). A Fixation is the moment when the eye is relatively still and focused on a target. Radius corresponds to duration of a fixation. Connecting lines represent saccades. The saccades are rapid movements of the eye in between the fixations that help locating the target of attention.

Figure 4. Stimulus Images.

3.2. Scenario

In the pedagogical course study to generate new form for the safety helmet, the designers were asked to choose a metaphor from nature as inspiration in order to generate novel form. This designed product was chosen as it comprised of a vast range of experimental forms of an existing product-helmet. The research study was conducted at the end of this project. Though, while preparing stimulus, other product images were also included and shown in random order. This strategy provided a range to break visual monotony and bias.

3.3. Stimulus

When the final products were ready, these were photographed within a span of 30 minutes, in similar daylight condition. It was ensured that products were placed on a non-reflective surface. Fixed distance and a zoom of 3.3 were applied to all images to maintain uniformity.

3.4. Subjects

14 participants volunteered to be subjects, 7 Designers and 7 non-designers (mean age 24 and 30 respectively). The non designer group of respondents were chosen carefully, as completely un-initiated, to get an understanding of how the form ideas are received.

Though the eye movement data recording was done, video recording, and notes making was used to generate secondary data. At each experimental session the respondents' permission to video record was sought.

3.5. Analysis rationale

The measures considered were: Average Fixation Duration (AFD): For each stimulus, the total fixation duration was divided by the number of individual fixations to reveal the average duration (in milliseconds) of fixations on a stimulus. A fixation average length can be between 200 to 300 ms indicative of higher attention, higher information processing and visual comprehension. Also suggests that the viewer used more time relating (internalizing) with the stimulus.

Saccade Latency (S lat): The saccades are fast ballistic movements under voluntary control which cause a change in the fixation point (9). These are executed with high speed but have latency of 150–250 ms; once triggered, they are not reported to be influenced by visual information. Earlier researches stated that vision is impaired during saccades (termed as saccadic suppression), but further experiments showed that a certain amount of visual processing occur during the course of a saccade (10).

There is a latency period associated with making a saccade; because they are motor movements that require time to plan and execute (11). It is further reported that increase in the saccade latency generally leads to increased accuracy in locating a target (12). As the measuring unit of latency is also

is in ms; that made it favorable to compare along with Average Fixation duration. Also intuitively it seemed plausible to use a sensory measure, that might support- reaffirm or disapprove attention as an iterative validation.

Fixation Count: the total number of fixations counted on a stimulus. This may suggest that the object offered as many points that evoked a respondents' attention.

4. RESULTS AND ANALYSIS

As AFD captures the essence of how much time a respondent spent in an average on various points while observing the designed form, the significance is, — the form that overall has a larger share of attention time spent across its various elements, may have a greater ability to evoke interest. In other words the many elements in a single united form, even as individual entities may hold larger share of attention on the whole as compared to other designed objects. Thus higher AFD score indicates more information processing, more attention.

The EMR analysis considering the Fixation time and duration signified the preference with respect to attention (13), (14). A form that evokes maximum attention may have more interest areas (15). Accordingly, Higher AFD along with higher S Lat can be indicative of a confirmatory attention on a stimulus.

Significant difference in the means of AFD and S Lat is observed between the two respondent groups, indicating non designer's larger attention share on each observation point of theirs in a stimulus. This signifies their more information processing and visual comprehension of the designed object on the whole. The designer's attention as per both AFD and S Lat is lower than non designers. This indicates perhaps their non exhaustive due to familiarity of the designed products.

Extreme Familiarity to the stimuli for designers can be considered a drawback creating visual bias. It was realized, that a mixed team of designer would have proved effective, including independent designers who did not take up the course assignment.

While looking at the Fixation count we observe that difference is less, than the other two measures. A less differential fixation count indicates that both respondent groups scanned almost same number of observation points in a stimulus object.

This also signifies the difference of perception between the two respondent groups, as, though the count of observation points in a product may be similar, the visual comprehension and information processing varied.

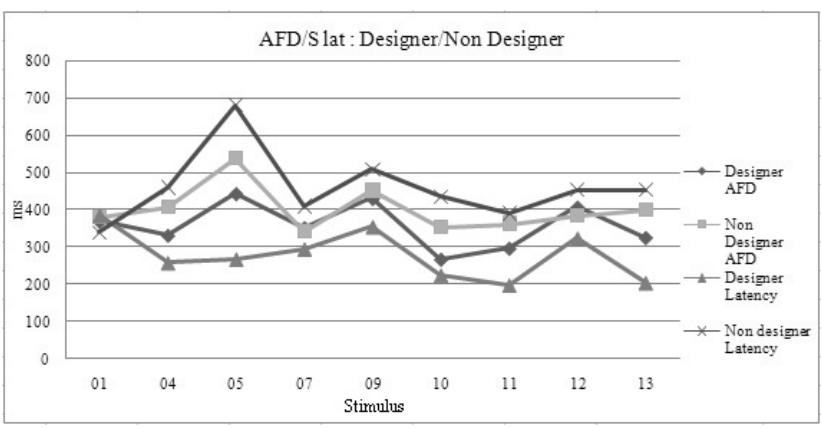

Figure 5. Average Fixation Duration (AFD) and Saccade Latency (S lat) results for both respondents groups- Designers and Non designers. Overall high difference can be observed in AFD and S lat. Higher S lat for higher AFD can also be observed.

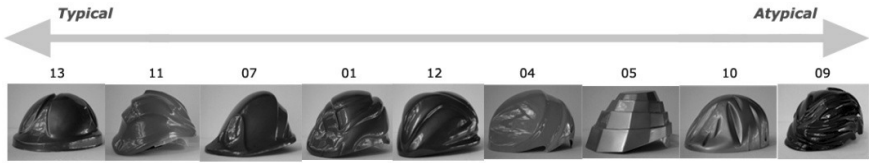

Figure 6. Images sorted from Typical to Atypical scale by experts.

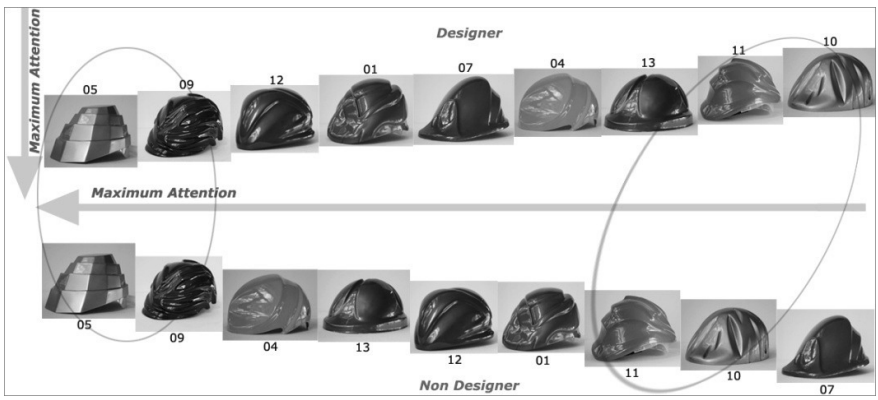

Figure 7. Maximum and minimum Attention of designers and non designers of the stimulus.

The AFD has been observed to be higher to lower on the atypical to typical polarity respectively. The extremity in atypical order generates highest attention for both groups. The more typical the product is, the least the attention.

Looking at attention to each product, it was observed that where AFD was higher, S Lat also corresponds thus affirming AFD result on attention.

For analysis, the stimulus images were arranged in a polarity from typical to atypical by three experts and the attention results of the two respondent groups were compared. The aim was to examine whether the attention is affected by the form being atypical or typical. Though the non designer may seem to visually comprehend the form more than the designers, their maximum and minimum attention to the objects is observed to be homogeneous. Also when compared with the typical and atypical scale polarity; both categories of respondents have paid maximum attention to the most atypical forms and least to the typical.

Thus higher the AFD; higher is the Atypicality of the designed object.

This indicates that irrespective of the background of the person, the eye pays attention and comprehends the form that is most atypical in its class. However familiar be the form to the designer, overall there is maximum attention to the atypical than typical.

5. DISCUSSION

Eye movement is a technique that gives us objective data on visual attention. The drawback is that it gives post-process records, and may give the location and temporal data to what is seen, not what can be the possible reason of a possible attention area. A few points worth considering with context of Form are that information is dynamically recorded as the concepts are being viewed, involuntary movements are captured, there is an advantage of it being a non-invasive tool, and equally compares with other techniques that may rely on the participant verbal responses.

As interviews with the respondents helped analyzing the Eye movement data at various points, a combination of methods of EMR and verbal responses was observed to add value to the EMR data while investigating perception of form.

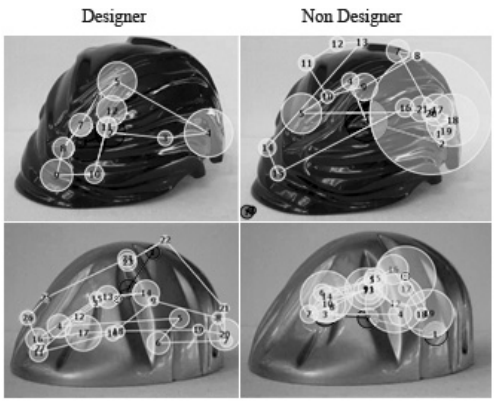

Figure 8. Example of Scan-path of Designer and Non designer. (Representation only)

EMR measures highly derive from the web-evaluation research domain, and many measures and interpretations have evolved. Needless to say for form and perception research the available technology needs to redefine the way a webpage is looked at level of search or to perform an action, in order to achieve targeted information.

S Latency seems a potential investigative point for research in form perception.

Research with the Eye movement technology has potential to provide provocative and useful information for form perception investigation. As a higher AFD may suggest attention to atypical forms and vice-versa, form polarities can be sought or categories created by the designer at an objective level to evaluate form in design practice.

While the form may be perceived with difference by designers and non designers, familiarity being the surfacing factor; yet, attention to the physical appearance of form for both seems to evoke attention in similitude.

6. CONCLUSION

This paper attempts to investigate form perception with respect to attention and perceptual response, both as factors to understand how the eye behaves with respect to attention on designed objects, for different respondent groups. In turn it also examines whether eye movement analysis can prove useful for form studies.

Though the study may be considered as a pilot and results may be considered as initial findings, the results may yield interesting insights into the domain of Form and perception.

Future experiments could involve studying preference in variations of design concepts, and visual evaluation perhaps at various stages of design, with various respondent groups to understand the form perception.

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