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RESEARCH ARTICLE

GAZE MOVEMENT PATTERN AMONG FIELD INDEPENDENT AND DEPENDENT COGNITIVE STYLE

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ABSTRACT

The aim of the present study was to estimate whether individuals with different cognitive styles show variations in their eye movement parameters. 23 volunteer with age range between 21 and 35 (M=24.7; SD=3.09), working in DIPR participated in the study. Figure Embedded Test was used to sorted out the participants as Field Dependent-Independent (FDI). Variation in Gaze Pattern parameters of the participants were traced with eye tracker device. Data were analyzed using Eye Tracking metrics and SPSS software reveals that Eye Movement (EM) parameters such Fixation, Saccade and Blink Duration of Field dependent were larger than Field Independent participants.

INTRODUCTION

Cognitive Style (CS) is the manifested psychological attribute in an individual's manner of thinking pattern, specifically in the unique way of gathering and processing information and overall constant characteristic of cognition and personality and renders a bridge between the measurement of cognition/intelligence and personality (Ausburn & Ausburn, 1978; Sternberg & Grigorenko, 1997). It is an individual's preferred way of attending and processing the stimulus and it is always represented in the bipolar dimension unlike unipolar like abilities.

Among a variety number of cognitive style theories (McKay, *et al*, 2003; Cassidy, 2004), the most widely studied bipolar dimension in the current scenario is Field Independent (FI) and Field Dependent (FD). Witkin *et al* (1950) proposed this type by individuals differing in their ability of perceiving the stimulus with respect to their surroundings (Figure-Ground).Field Dependent S' has been experiencing difficulty in tracing the information in the environment, because other relative stimuli tend to impede it, on the other hand Field Independent S' can easily retrieve the information from the environment and have high social orientation and influenced less by social constituents and has high level of intrinsic motivation than Field Dependent S' (Messick, 1986). Field Independent S' preferable mode of processing information is reported to be bottom-up (perceiving smaller elements and builds detailed results) and Field Dependent S' outstands Field Independent S' in processing information in top-down model (starts focus with the large idea and refining to finer concept) (Azar Hosseini Fatemi *et al*, 2014).

The perception of Field Dependent's are in a holistic manner quoted as 'Global-Perception' but Field Dependent have tendency to see separate parts concealed in the whole (Pask, 1976). Field Independent S' were more efficient in detecting signals than Field Dependent S' even though they were presented with additional hindering stimuli butthere is no much differences reported in regards of accuracy in detecting signals (Vesta *et al*, 1982). Field Independent S' were relatively excelled in all the types of pictorial recognition task, regardless of color made which was evidenced that the individuals' with Field Independent cognitive style has greater efficiency over Field Dependent in detecting indispensable stimuli from the inscrutable ground (Berry *et al*, 1984).

Perceiving the information from the visual field involves various Eye Movement (EM) parameters. Most frequent behavior expressed by human is considered to be Eye Movement (EM) (Bridgeman, 1992). EM is described as 'Ceaseless Twitching' (Stratton, 1906), remains the solution to process abandon visual information with limited processing.

Processing visual information and during solving spatial problem, the amplitude and Quantity (amount) of EM parameters differ accordingly with the individuals (Stoy, 1903;

Johnson *et al*, 2006). Many studies suggested that the possibility of relationship between EM and FDI cognitive style (Mack worth, *et al*, 1964; Luborsky, *et al*, 1965) and quoted out some important parameters as Amount of time in inspecting the ground, dispersion of fixations from center, scatter, mean track length and duration of fixation. EM of Field Dependent Individuals were disorganized and disoriented and Field Dependent S' tend to have large number of saccades and fixations than Field Independent and Field Neutral S'(Efi Nisiforou & Andrew Laghos, 2015). Field Dependent individual perceives information in the overall manner while Field Independent focuses on partial stimuli that to be processed, these variations are confirmed by the studies on both adults (Marendaz, 1985; Clark & Roof, 1988) and in children (Rozencwajg, 1991; Guisande, *et al*, 2007).

There exist enormous studies related to EM behavior in other developed countries. This study being facilitate the investigation of gaze pattern of Indian population, brought up in the collectivistic society. So the present study is to estimate whether individuals in India with different cognitive styles show variations in their eye movement parameters.

Objective

To assess the Gaze movement pattern among field independent and dependent cognitive style

Hypothesis

There exist the variations in eye movement parameters among individuals with different cognitive style.

METHOD

Sample

Prior to the conduction of experiment, participants were explained with experiment and have got signed in informed consent. A total of 23 participants aged between 21 and 35 years (Mean =24.7; SD=3.09) working in Defense Institute of Psychological Research. All the participants had normal vision, and corrected-to-normal vision and those who had previous exposure with Embedded Figure Test were excluded from the study.

Tools

Eye Tracker: Eye movements were recorded using a high-bandwidth, binocular eye tracking device.

The SMI RED has high spatial resolution with noise limited at <0.01° and a temporal resolution of 500HZ samples per second with corneal reflection. The use of the corneal reflections in combination with pupil tracking permits stable tracking of the eyes and reduces errors caused by minor headband slippage or other environmental causes. Primary measures included saccades, fixations, blinks, pupil diameter, and gaze frequency. To calibrate the SMI RED eye-tracking system each subject was instructed to move his or her eyes and fixate on the nine target locations that appeared consecutively on the computer screen. These measurements were made twice to ensure that the subjects were making eye movements toward the instructed locations.

Embedded Figure Test

It was developed by Witkin.H. A *et al*, in 1971was administered to the participant's in order to assess the cognitive style. The standard test consists of figures (A, B, C, D, E, F, G, and H) and 24 complex figures. For each simple figure, there are several different complex figures that contain it and hence, each complex figure is denoted by a letter to indicate the simple figure to be found in it. Of the 24 complex figures 5 contain simple figure A, 2 contain B, 5 contain C, 2 contain D, 5 contain E, 1 contain F, 3 contain G and 1 contain H. Performance is scored in terms of time taken to locate the time taken to locate the simple figure in the complex figure. The test has a fairly high reliability as shown by odd even correlations of 0.87 for men and 0.74 for women in an American sample and 0.76 for men and 0.81 for women in an Indian Sample.

Procedure

Participants were provided with height adjustable seat and were instructed not to interrupt the eye tracker and not to shift their position of head as the Eye Tracking device is tracing their gaze pattern. Before starting the experiment calibration was adopted as mandatory with certain limits (X=<0.05; Y=<0.05), those who haven't successfully calibrated in their first attempt was given chance till they successfully met that parameter. After the successful calibration, subjects were presented with one sample figure which is excluded from the analysis. The system was programmed to show cards as per the instructions provided by the manual as complex figure for 15 seconds and simple figure for 10 seconds and again the complex figure for about 5 minutes where the subjects' task is to identify the simple figure concealed in the complex figure. The participants were instructed to press space bar as soon as they identified, since their response time was measured. Eye tracking device was programmed to gather data only during their process of identification (i.e. during the projection of complex figure for 5 minutes) to eliminate the unnecessary data.

Table 1 shows the mean, standard deviation and t-test for field independent and field dependents'

S.No.	EM Variables	Group	N	Mean	Std. Deviation	t	Sig. (2-tailed)
1	Blink Duration Average [ms]	FI	15	427.8	267.7	-2.5	**0.02**
		FD	8	960.7	745.6		
2	Fixation Count	FI	15	60.0	30.8	-2.2	**0.03**
		FD	8	125.1	108.7		
3	Saccade Count	FI	15	66.1	37.2	-2.1	**0.04**
		FD	8	137.1	121.3		
4	Saccade Amplitude Total [˚]	FI	15	242.2	163.0	-2.1	**0.03**
		FD	8	496.2	394.8		
5	Saccade Velocity Total [˚/s]	FI	15	5588.6	3661.9	-2.3	**0.02**
		FD	8	11877.2	9206.4		

RESULTS AND DISCUSSION

IBM SPSS.20 was used for statistical analysis. To test the hypothesis, assess the relationship of oculomotor responses (Eye movement variables) and Cognitive style through

statistical methods like mean, standard deviation and independent sample t-tests.

The participants were segregated in to two groups with their median score (17) as Field Dependent (m=<17) and Field Independent (m=>17) obtained from FET. As a result, among 23 participants 8 were considered to be Field Dependent (M=23.9, SD=1.97) and 15 were Field Independent (M=25.63, SD=3.88).

The present study results revealed that gaze movement parameters such as Blink Duration, Fixation Count, Saccade Count, Saccade Amplitude and Saccade Velocity among Field Dependent and Field Independent S' were significantly different. The Blink duration of Field Dependent S' (M=960.7, SD=745.6) were higher than Field Independent S' (M=427.8, SD=267.7) and t-value is 2.5 and p=<0.02. Field Dependent S' have larger number of Fixation Count (M=125.1, SD=108.7) when compared with Field Independent S' (M=60.0, SD=30.8), t=2.2, p<0.05 and the Saccade count of Field Dependent (M=137.1, SD=121.3) was larger than that of Field Independent (M=66.1, SD=37.2), t=2.1, p<0.05. The Saccade Velocity of Field Dependent S' (M=11877.2, SD=9206.4) were larger than the saccadic Velocity of Field Independent S' (M=5588.6, SD=3661.9) and it shows the significant difference of Saccade Velocity among Field Dependent and Field Independent individuals, t=2.1, p=<0.39. There exists the significant difference in saccade Amplitude among Field Dependent (M=486.2, SD=394.8) and FI (M=242.2, SD=163.0), t=2.3, p=<0.02.

The existing difference in gaze movement parameters among different cognitive style support the finding that user cognitive abilities such as perceptual speed affect user gaze behavior and user performance (Toker *et al*., 2012, 2014) on contrary of other study finding that there is no significant relationship between Eye movements during EFT related to Field Dependency(Alan Burdick .J, 1965).The finding that the Fixation count and Saccade Count of Field Dependent are higher than the Field Independent shows that the effort to crack the complex figure in the Figure Embedded Test by the Field Dependent S' was more than the effort of Field Independent S' these finding goes in line with the statement of Goldberg and Kotval, (1999) that higher the saccade reflects more searching whereas more fixations reveal inefficient exploration. This result is consistent with the result of Efi Nisiforou, *et al*., (2015) which concludes that the Fixation and Saccade of Field Dependent were higher than that of Field Independent individuals and the Eye Movement of Field Dependent are disoriented and disorganized (Nisiforou, E.A., *et al*, 2014). Tsai, Y.-F., *et al*. (2007) found that the blink duration of individuals are higher when they are presented with higher level cognitive tasks, additionally it is found that the Blink Duration of Field Dependent are more than the Blink Duration of Field Independent individuals. The finding results that the Saccade Amplitude and Saccade Velocity of Field Dependent are higher than the field Independent individuals' it is supported by the finding of Velocity Fritz *et al* (1992) that increased difficulty in cognitive tasks results in increased saccadic movements. This variation in the gaze movement parameters is in line with the statement that during solving spatial problems the amplitude and amount of gaze movement parameters differ in accordance with the individuals (Stoy, 1903; Johansson *et al*, 2006).

CONCLUSION

The overall outcome of the study reveals that there is a variation in gaze pattern among Field Dependent and Field Independent individuals'. Systematic perceiving ability of the Field Independent S' leads to have lower saccades and fixations and whereas overall perception of Field Dependent leads to maximize the effort. Convenient and relatively small sample size used in this research is the major limitation of this study.

Further study with the optical brain imaging could facilitate the recording of Cerebral Haemodynamics that may vary accordance with the individual with the different cognitive style. The future scope of the study is wide, by understanding the EM parameters of the individuals with effective cognitive style will help the professionals in psychology and neuroscientists to formulate the interventions to train the army personnel who are indeed to perceive minute radar signals to avoid destruction.

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