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Gaze Pattern on Spontaneous Human Face Perception: An Eye Tracker Study

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Eye tracking is the process of measuring either the point of gaze or the motion of an eye relative to the head. Cognitive neurosciences has emphasized the importance of eye movements in carrying crucial information about emotional states of others. As face perception is a basic process in interpersonal communication. The facial gaze pattern of human face experiment was performed. Twenty-two subjects, all right handed, aged 25.5 ± 5.4 yrs (females =16), from visiting graduate students to NIOH and staff of NIOH were recruited. On eye tracking experiment with spontaneous gazing of neutral face photograph, majority of subjects gazed at upper half of face near bilateral eye region of the face, on focus map analysis, gaze maps, as well as on heat map analysis. Study revealed the pattern of human face perception and reiterated the results of earlier western studies among young subjects from India.

Keywords: Eye Tracker, Face Perception.

Most of the surrounding information is taken from the eyesand with a lesser extent from other sensory inputs. Thus, the external world is explored predominantly through visual perception. During visual perception, the pre-attentive and attentive stages determine the position of the target, and then the eye must be moved in such a way that the target object can be inspected with a higher acuity by foveating the object. This sudden rapid movement of the eyes to a new location is performed by executing a saccade (which is a quick, simultaneous eye movement of both the eyes in the same direction). Further, to closely follow (gaze) the objects in external world; eye movement is smoother and slower than saccades to keep the moving object foveated. This type of eye movement is called pursuit motion.

Eye tracking is the process of measuring either the point of gaze (where one is looking) or the motion of an eye relative to the head. An eye tracker is a device for measuring eye positions and eye movement. Recent reports from the social-cognitive neurosciences have emphasized the importance of eye movements in carrying crucial information about emotional states of others (Kliemann, Dziobek, Hatri, Steimke, & Heekeren, 2010). An amount of the eye gaze has been reported to be predictive of one's ability to interpret the intentions of others and the meaning of social situations. As face perception is a basic process in interpersonal communication (Haxby, Hoffman,& Gobbini, 2002). In the current study, pattern of facial gaze processing of young subjects on viewing face with neutral expression was performed to understand the patterns of spontaneous human face gazing.

Method

Sample:

Twenty-two subjects from the pool of visiting graduate students to NIOH and staff of NIOH participated in the study. Study was conducted during the year 2013. All subjects were assessed for handedness using Edinburgh's handedness inventory (Oldfield, 1971) and all subjects were right handed. An adult human face with neutral expression was presented for 2 sessions of 10seconds each.The neutral human face was selected from anonline resource (http://eilab.ca/constructivist-facial-expressions-autism/ accessed last on 1st Dec 2014). This was interspersed with the movement of a red dot in a square pattern on a SMI binocular eye tracker with 17 inch display, with maximum resolution

of 1280 X 1024 pixels with 0.5 degree accuracy at sampling rate of 50Hz. The participants wereinstructed to view the neutral human face imagevoluntarily. An interactive computerized analysis was performed to quantify thesaccade measures, the visual scan paths, heat maps, focus maps using the vendor supplied software.

Results

The study subjects were aged 25.5 ± 5.4 years (range 21 to 40 years) with majority being females (n=16). All subjects were college educated and all were right handed.The data was explored using pattern of gazes, heatmaps, and focus maps. The pattern of gazes is the path or directionality of the gaze of the face image by the subjects with radius of circle indicating the duration of gaze (foveation or visual focusing). Heatmap is a graphical representation of data where the individual face region are represented as spectrum colors, these colors indicates the duration of visual gaze, with red color for longest duration.The focus map of the data is the graphical representation of the gaze in spectrum of color ranging from complete dark to full transparency, with the level of transparency indicating the foveation. On eye tracking experiment majority of subjects gazed at the upper half of the face near bilateral eye region of the face (Figure 1a & 1b).

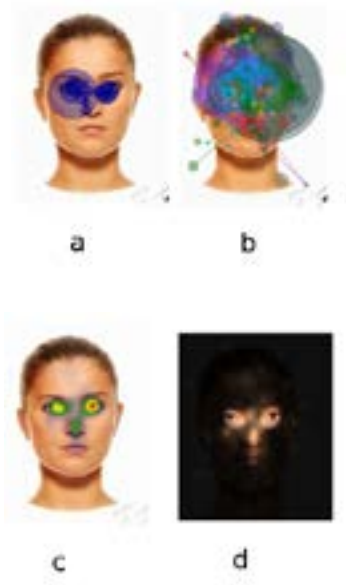

Figure 1a. Shows the pattern of human facial gaze of single subject with the directionality of gaze with radius of circle indicating the duration of gaze (foveation or visual focusing). b: Shows the pattern of human facial gaze of all subjects with each of the color indicating the facial processing pattern of individual subject. c: Shows heat map of all the subjects' spontaneous facial gaze. Spectrum of colors indicates the duration of visual gaze with red color for long duration. d: Shows the focus map of all subjects indicating the regions of face where all the subjects focused their gaze.

The heat map, which indicates the areas of face where subjects have focused their visual field, showed mainly in the bilateral eye region and nose region of the face (Figure 1c). Similarly the focus map revealed the eye regions, nose and part of the upper lip regions of the face, which were focused by the subjects during their spontaneous gaze at the photograph (Figure 1d).

On grid map based analysis, all subjects showed that the study subjects are mainly focusing on the eye region specifically in the right eye region (3193.6) of the photo then followed by left eye region (2870..2) of the photo and then the naso-labial region on right side (677.1) as shown in Figure 2.

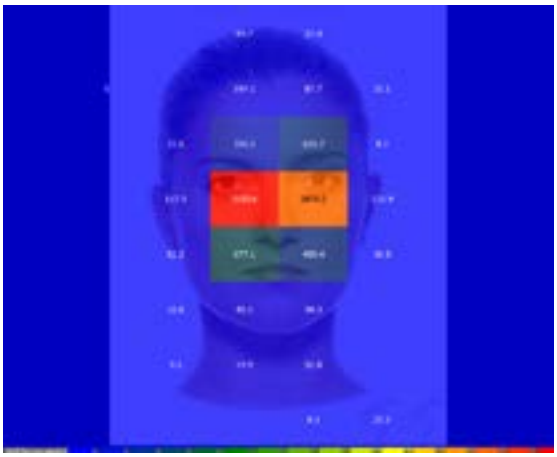

Figure 2. Shows the gridded map of all subjects of area of interest of face gazing indicating the regions of face where all the subjects focused their gaze.

Discussion

Nevertheless,certain reading patterns are easily recognized (e.g., left-to-right, top-to-bottom for English readers, or right-to-left for Hebrew), no apparent strategies for scene viewing have been easily discerned. Contrary to reading, there appears to be no canonical scanpath for particular objects (Kennedy, 1992). Study of patterns of scanpaths/patterns is important in social-cognitive neurosciences. The study of patterns of human face gazing provides insights into neurobehavioral understandings of the social behaviors. The pattern of face perception refers to an individual's understanding and interpretation of the face, particularly the human face, especially in relation to the associated information processing in the brain. Face perception is mediated by a distributed neural system in humans that consists of multiple, bilateral regions.As the saying goes, "The face is the index of mind", the understanding of visual gazing pattern of human face perception isimportant in understanding the social cognition.

The neural activity in brain regions at the extra-striate visual cortex as well as multiple other regions in non-visual cortices can get activated during the perception of the faces. The complexity of this distributed neural system for face perception reflects the complexity of face perception itself. Face perception is perhaps the most developed visual perceptual skill in humans and plays a critical role in social interactions (Haxby et al., 2002). The current study examined the patterns of face perception of static neutral face photograph among adult subjects using eye tracking technique.

This study observed that participants' eye gaze fixations were almost the same and they kept fixations on the upper half of the face. The regions focused were mainly at the level of the eyes. Our results confirm recent findings of centrally located initial fixations, positioned just below the eyes, on the top part of the nose (Cook, 1978; Luria and Strauss, 1978;Hsiao and Cottrell, 2008; Orban de Xivry, Ramon, Lefèvre, &Rossion, 2008; Bindemann, Scheepers,&Burton, 2009; Saether, Van Belle, Laeng, Brennen,& Øvervoll, 2009).

Importantly, the initial fixation, directed towards the average face, did not fall on the geometric center of the face stimulus, which would be located lower (tip of the nose), but rather on a slightly higher location. This fixation location may correspond to the center of the mass (Hsiao &Cottrell, 2008; Orban de Xivry et al., 2008) or center of gravity (Bindemann et al., 2009) of the face, i.e. a central position weighted by the amount of diagnostic information of the face. Possibly, this location is fixated because there are higher contrast areas in the top part of the face (eye-eyebrow combination), usually containing more diagnostic information than in the lower part (Gosselin & Schyns, 2001; Sekuler, Gaspar, Gold, & Bennett, 2004).

Conclusion

The study examined the face perception among young adult subjects by the eye tracking technique. Study revealedthe pattern of human face perception (gaze) of young subjects, which mainly included the upper part of face near eye and surrounding regions. Thispreliminary study reiterated the results of earlier studies among young Indian subjects.

References

Bindemann, M., Scheepers, C., & Burton, A. M. (2009). Viewpoint and center of gravity affect eye movements to human faces. *Journal of Vision, 9*, 1–16.

Cook, M. (1978). Eye movements during recognition of faces. Practical Aspects of Memory, eds M. M. Gruneberg, P. E. Morris, & R. N. Sykes. (New York: Academic Press). 286–292.

de Heering, A., Rossion, B., Turati, C., &Simion, F. (2008). Holistic face processing can be independent of gaze behavior: Evidence from the face composite effect. *Journal of Neuropsychology, 2,* 183-195

Gosselin, F., & Schyns, P. G. (2001). Bubbles: a technique to reveal the use of information in recognition tasks. *Vision Research, 41,* 2261–2271.

Haxby J.V., Hoffman, E.A., &Gobbini, M.I. (2002): Human neural systems for face recognition and social communication. *Biological Psychiatry, 51,* 59–67

Hsiao, J. H. & Cottrell, G. (2008). Two fixations suffice in face recognition. *Psychological Science. 19,* 998–1006.

Kennedy, A. (1992). The Spatial Coding Hypothesis. Eye Movements and Visual Cognition: Scene Perception and Reading. eds K. Rayner, (New York: Springer-Verlag. Springer Series in Neuropsychology) 379-396.

Kliemann, D., Dziobek, I., Hatri, A., Steimke, R., & Heekeren, H. R. (2010). Atypical reflexive gaze patterns on emotional faces in autism spectrum disorders. *The Journal of neuroscience, 30*(37), 12281–12287.

Kroll, J. F. (1992). Making a Scene: The Debate about Context Effects for Scenes and Sentences. Eye Movements and Visual Cognition: eds K. Rayner,. (Springer Series in Neuropsychology) 284-292.

Luria, S. M., & Strauss, M. S. (1978). Comparison of eye movements over faces in photographic positives and negatives. *Perception 7,* 349–358.

Oldfield, R.C. (1971). The assessment and analysis of handedness: The Edinburgh inventory. *Neuropsychologia, 9*, 97-113

Orban de Xivry, J. J., Ramon, M., Lefèvre, P., & Rossion, B. (2008). Reduced fixation on the upper area of personally familiar faces following acquired prosopagnosia. *Journal of Neuropsychology. 2*(1), 245–268.

Saether, L., Van Belle, W., Laeng, B., Brennen, T., & Øvervoll, M. (2009). Anchoring gaze when categorizing faces' sex: evidence from eye-tracking data. *Vision research, 49*(23), 2870–2880.

Sekuler, A. B., Gaspar, C. M., Gold, J. M., & Bennett, P. J. (2004). Inversion leads to quantitative, not qualitative, changes in face processing. *Current Biology. 14*(5), 391-396.

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