Inactivated Peripheral Fusiform Face Area

Ahmad Yousef¹

¹School of Computational Science and Engineering, McMaster University, Hamilton, Ontario, Canada

*Correspondence: mohamas2@mcmaster.ca

Abstract- We tried to entirely inactivate the peripheral fusiform face area, see description of the aforementioned brain area in reference 1. We were able to achieve great inactivation to the aforementioned area by using red background for the rabbit-duck rivalrous stimulus. We think that this inactivation had occurred for two reasons; first, because red color is very silent, and therefore greater request of oxygenated hemoglobin by V4 area. Second, the low contrast of the stimulus (black drawing on red background) constricts the pupil size, therefore, lesser light rays will reach to retinal peripheries, and its corresponding neurons in the FFA.

Introduction

We previously discussed how the decrease of the brightness (pupil dilation) increases the dominance duration of the rabbit face in the duck-rabbit illusion (see reference 1). In contrary, higher brightness (pupil constriction) allows the duck face to have greater visual awareness dominance duration. We accordingly hypothesized activation of the retinal peripheries activates its corresponding FFA neurons, namely, the peripheral FFA. Importantly, the brain activities in the FFA are greater for faces closer to human face, such as the faces of cats and rabbits when compared with the faces of ducks and horses. Reportedly, human head produces MR signal much greater than the MR signal by horse head, (Kanwisher, *etal.* 1999), however, the faces of cats and humans shows equal brain activities; namely, 1.6% MR BOLD signal, (Tong, *etal.* 2000). We have previously found that pupil dilation brought higher graded face recognition, and therefore, we theorize that its higher MR BOLD signal is because of the activation larger area of the FFA, that includes the central and the peripheral Fusiform Face Areas. For further confirmation to this theory, we tried to inactivate the peripheral FFA though manipulations in

the stimulus characteristics, and to see whether the human subjects will be unable to see the rabbit face. The manipulations aim to achieve significant pupil constriction, and to eliminate amounts of oxygenated hemoglobin from reaching to the peripheral FFA.

Materials & Methods

Twelve human subjects were recruited to participate in this study. We used a renowned face rivalry stimulus that alternates the human visual awareness between duck face and rabbit face; see reference 4. All of the subjects had dilated pupil to confirm whether the theory is correct, moreover, they have been chosen manually. Human subjects with pinpoint pupils should not be tested, the reasons will be offered in a later

discussion. Advisably, to dilate the pupils of human subjects, it could be done by caffeine intake (see reference 5), dark environment, and low brightness. We used the rabbit-duck rivalrous stimulus in two different ways, namely, we compared stationary stimuli versus motion ones. The motion stimuli moves from left to right for 80 seconds 'with a constant speed of 18 degrees/s'; and then moves from right to left for another 80 seconds. Each of stationary stimuli lasts for 80 seconds,

Human subjects has to report the perceptual switches by click '1' for duck face and '2' for rabbit face whether for stationary or motion stimulus. The distance between the screen and human subjects is 50 centimeters; and the stimulus height subtends 2.3 DVA, and its width subtends 3.77DVA. The experiment has two different background, namely, white versus red. We have chosen the red color for two reasons: 1- The color processing unit V4 resides in the ventral pathway in the brain; this is same pathway where the fusiform face area is located, namely, if V4 utilized greater amount of oxygenated hemoglobin, this might prevent the FFA from receiving enough oxygenated hemoglobin to achieve high-graded face recognition.

2- The rabbit-duck stimulus is drawn with black color, namely, the final produced image will have low contrast since the red color is known to be a dark color. The aforementioned fact should constrict the pupil size, see reference 6. Before we start the experiment, we make sure that all of the human subjects are able to notice face rivalry (duck- rabbit)

for both white and red background in the stationary mode. Afterwards, we played the videos, see the supplement materials in the reference 4.

Data Recording

For each stimulus, the data are collected by a specialized timer, and then analyzed as follows; mean dominance duration for whether the duck face or the rabbit face are collected from each human subject. These values are then compared with another human subjects to get two major statistical values, the mean and the standard error of the mean of the twelve human subjects. As shown in the central infographic, the contribution of the red background with stationary stimulus in inhabiting the rabbit face is very noticeable, but not strikingly massive. Astonishingly, however, the red background contributes in significant elimination of the rabbit face from the visual awareness when the stimulus is in motion (for each 27.6 seconds of the duck face visual awareness only 1 second for the rabbit). Namely, it deactivates the peripheral FFA assumedly because the possible reduction in the level of the oxygenated hemoglobin in the FFA. The constriction of pupil size, due to the low contrast, also played a significant role in vanishing the rabbit face from the awareness.

Discussion & Future Challenges

Before we started the experiment, we excluded three human subjects who had pinpoint pupils because they were unable to see the rabbit face in the two motion conditions. This doesn't mean humans with pinpoint pupils are unable to have high-graded face recognition, however, this means they will require additional time to achieve the recognition. In fact, the spontaneous saccadic eye movements should allow the light rays to temporarily access the retinal peripheries even with constricted pupils to do the recognition. Importantly, we designed our motion stimuli to emphasize the

pursuit eye movements to cause significant reduction in the spontaneous saccades and microsaccades.

Pupil constriction is common among elderly people (see reference 7), and this might be the main reason of the degradation in their face recognition (see reference 8). The current study also offers a way to inactivate certain neural circuitry without any destruction

against neurons in certain neurological pathways. The aforementioned fact will greatly facilitate our understanding of the human visual consciousness, for further details, see reference 9. Namely, greater activations in the early-stage visual processing area, V4, had disabled many of the 'conscious' information to be delivered to the fusiform face area, thus, degraded face consciousness.

Essential Notification

Readers should have direct access to the stimuli, see reference 4. They also should view the stimuli centrally to prohibit the light rays from accessing the retinal peripheries. Readers should connect the author directly in case of they cannot access the stimuli. Scholars with high density EEG facilitations are welcome to collaborate in the aforementioned challenging investigations. Enquiries about how to rearrange the EEG sensors in the fusiform face area for the accurate localization of the two distinct fusiform face areas should be requested from the author.

Transactional References

- [1] Yousef, A. 2019. "Two Distinct Fusiform Face Areas." PsyArXiv. doi:10.31234/osf.io/a8gzv.
- [2] Kanwisher, *etal.* 1999. "The fusiform face area is selective for faces not animals". Neuroreport.
- [3] Tong, *etal.* 2000. "Response properties of the human fusiform face area". Cognitive Neuropsychology.
- [4] The stimuli may be found here: <https://drive.google.com/drive/folders/1tKbTR7z0k8nBxM472ndG0tRPoAVtCrgv?usp=sharing>
- [5] Abokyi, *etal.*, (2017). Caffeine intake is associated with pupil dilation and enhanced accommodation. Eye (Lond) Journal.
- [6] Wang CA, Munoz DP. (2014) Modulation of stimulus contrast on the human pupil orienting response, in Euro journal of Neuroscience.
- [7] Sloane, *etal.* (1988). Aging and luminance-adaptation effects on spatial contrast sensitivity. J Opt Soc Am A.
- [8] S. Creighton, P. Bennett, A. Sekuler (2019). Classification images characterize age-related deficits in face discrimination. Vision research.
- [9] Yousef, Ahmad. 2019. "Consciousness Might Be Localized in Extra Physical Dimensions." PsyArXiv. 2019. doi:10.31234/osf.io/angc8.