Fixation Induced Blindness

Ahmad Yousef

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

*Correspondence: mohamas2@mcmaster.ca

Abstract-This article discusses how visual fixation could convey a centrally presented stimulus (pink horse) into the invisibility region under certain conditions, and why breaking the aforementioned invisibility by an intentional saccade away from the fixation point allows the stimulus to exert a ghostly horse but with complementary colours. At the level of human visual awareness, we think that fixation induced blindness and Kitaoka strawberries illusions seems to comply to a hypothetical “global center-surround antagonism between the fovea and the retinal peripheries”. Namely, viewing Kitaoka strawberries with spontaneous saccadic eye movements had been unstoppable exerted ghostly clouds which have complementary colours of the peripheral visual spaces; clouds that overwhelmed the centrally placed gray strawberries. Neurophysiologically speaking, the foveal cones synapse the brain 30 milliseconds slower than the cones in the retinal peripheries; the saccadic eye movements, however, rapidly changes the stimulus’ location from the fovea to the retinal peripheries and vice versa in a successive way. We therefore hypothesize that the aforementioned temporal asynchrony seems to assist the foveal and the peripheral retinal images to be spatiotemporally fused in the visual awareness by counterbalancing the saccadic effects; to eventually emphasize the human visual stability. Detail speaking, our hypothesis might facilitate the receptive field remapping processes, namely, the aforementioned asynchrony seems to counterbalance possible issues caused by the saccades and the micro-saccades; meaning, it might be an essential assistive contributor of the receptive field remapping processes for optimal human visual stabilization. Given the fact that the stimulus under saccadic eye movements changes its retinal location continuously, and the cones across the retina are not evenly distributed; this might reveal the role of the saccadic eye movements on color constancy. To understand the present illusion, we hypothesize that microsaccades during fixation may allow the light rays to exclusively interact with the fovea for some milliseconds, and with retinal peripheries (closer to the fovea) for following milliseconds. Fixational microsaccades may eventually yield spatiotemporal overlapping in the visual awareness between the foveal retinal image and the peripheral retinal image (located closer to the fovea); and with possible global harmonies that are resulted from the fused fovea/peripheries signals the invisibility will emerge. Namely, the aforementioned sophisticated processes seem to appear locally disordered, but globally ordered; eventually therefore the visual awareness may establish the present phenomenal invisibility!

Introduction

Contrast sensitivity function describes the visible region that can trigger visual awareness produced by the human brains in gray scale, see reference 1. Colour, however, is an additional parameter that eventually generate the function of color visibility, see reference 2, and 3. When the aforementioned functions are properly integrated, the visibility region of human visual awareness can be described. In this study, we offer an optical illusion that allows visual fixation to terminate the visual awareness of the stimulus; possibly because of the microsaccades caused by the fixation. The aforementioned sensitivity functions might be therefore insufficient to explain the fixation induced blindness, FIB illusion; an illusion that may reside under the umbrella of the Troxler fading effect, despite the stimulus is neither very blurred, nor being presented peripherally, see reference 4. Further depth are therefore required to understand the neuro-machinery of the present illusion. Important to mention, fully comprehension of the present illusion by the trichromatic theory might be impossible, because we are suggesting that the present illusion is a result of the cross-talks between the different retinal area, the fovea and the peripheries ‘closer to the fovea’. The opponent process theory, however, seems to be a possible candidate. Important to remind, it is believed that trichromacy occurs at the photoreceptors’ sensing stage, see reference 5; but the opponent processes are expressed at the retinal ganglion cells’ stage and in several parts of the brain, including but not limited to, the neocortex, see reference 6. In opponent process theory, the system works based on the opposing color effect of red-green, blue-yellow, and light–dark; however, it is the visual neural processes of various types of photoreceptors that are opposed. Since Hering’s theory is a neuropsychological structure that describes a wide spectrum of behavioral dynamics, including color vision; it therefore might be able to explain our present illusion. Important to mention, there are two potential mechanisms for color constancy; the unconscious inference, see reference 6; and the sensory adaptation, see references 8 and 9. Physiologists suggested “color constancy relates to variations in retinal cells and visual cortical areas, see references, 10, 11, and 12. Interestingly, we think that our illusory stimulus is very close to Kitaoka strawberries in terms of neuro-machinery. Noticeably, Kitaoka strawberries are built in gray-scale, but they are perceived in red when the peripheral areas of the image are saturated with cyan colour; as if the retinal peripheries and its corresponding peripheral conscious brain had been desensitizing the central retina and its corresponding conscious brain from acquiring cyan colours, out of the gray colour; but it allows the red colour to pass and to be neurophysiologically processed, see reference 13. For simplicity, we would like to name the aforementioned hypothesis: “global center-surround antagonism between the fovea and the retinal peripheries”. Interestingly, Kitaoka had shared extremely beautiful images that evidence the aforementioned hypothesis; namely, when the peripheral visual spaces are cyan, the central gray strawberries become visibly red, see reference. 14. The aforementioned image provide evidence that color antagonism processes can be massively global, namely, it’s an antagonism between the fovea, and the retinal peripheries. Important to emphasize, our experiment consisted of pink horse that’s continuously visible to the visual awareness; however, prolonged fixation at a precise point convey the horse to the ‘invisible’ region, namely the horse disappears from the visual awareness, see reference 18. Because the fixation process often causes microsaccades during the optimal fixation; the stimulus might
be feeding very different but very close retinal areas one after another in a rapid way. According to the “global center-surround antagonism between the fovea and the retinal peripheries”, if the peripheral brain is consciously aware about magenta, “magenta desensitization” against the foveal brain may occur, thus, the gray will be visibly green. The microsaccades due to the fixation triggers two different retinal areas to be actively feeding their corresponding brain areas, and once the two different signals are spatiotemporally fused in the visual awareness: invisibility will be emerged. Any intentional or directional saccade after this blindness will reveal the secrets of this invisibility, namely, a green ghost horse will emerge in the direction of the performed saccade: the intentional saccade that should terminate the invisibility. The magenta horse will, afterwards, return to its normal state, but with ghostly greenish clouds around the horse. The aforementioned detachment of the two horses form the invisibility is outstanding observation, it theorizes that the two horses are there all of the time, but the ghostly green horse might be requiring further energy to be released from the unconscious brain region. As long as good fixation is applied: a perfect spatiotemporal fusion between the central and the peripheral (closer to central) retinal areas will fire their corresponding conscious brains, and this the phenomenal invisibility will emerge. Needless to mention, different colors yield different spatiotemporal properties that should eventually influence the entire human visual awareness, see reference 15; discrepancies that assist in understanding the present illusion!

Materials & Methods

Twelve human subjects, with dilated pupils, were recruited to participate in this study. The experiment consisted of one horse centrally presented: and it’s tested for three times with three different textures of backgrounds to ensure not only data finetuning but the contribution of texture perception in this color illusion. The horse subtends maximally 13 degrees visual angles for both length and width. The stimulus is lightly blurred to trigger pupil dilation, and thus allowing the retinal peripheries to be fed by sufficient number of light rays. The subjects are requested to perform up-right saccade after experiencing the invisibility, and to describe what they had seen at the corresponding visual space. The behavioral data were collected manually, and then averaged among the human subjects to estimate the simplest statistical values, namely, the average and the standard error of the mean of the visibility strength compared to the reference.

Results and Conclusion

As shown in the up- central infographic, visual fixation drastically diminishes the visibility of the horse. Through their precise fixation, the twelve human subjects were able to make the horse mostly invisible from their visual awareness with almost no noticeable contribution of the texture perception on the present color illusion. The performed saccade after the invisibility enable the human subjects to see the green ‘ghostly’ horse. These observations might suggest that the human visual system is dealing with the present stimulus in two different but simultaneous ways: namely, the detachment that happens just after the invisibility due to the directed saccade, could be an evidence that the human visual awareness is a product of central versus peripheral visual conscious brains that complies to the “global center-surround antagonism between the fovea and the retinal peripheries”. When we talk about fusion of two active visual brains that eventually triggers fusion (Invisibility), we have to state that the foveal cones synapse the visual awareness 30 milliseconds slower than the retinal peripheries cones, see reference 15; and this temporal asynchrony could be a major contributor to the invisibility. But why? We understand that microsaccades during fixation allows the stimulus to jump from the fovea to the retinal peripheries ‘closer to the fovea’ and vice versa, and these microsaccades themselves consume time, thus, the temporal asynchrony between the two different retinal areas might counterbalance the delays caused by the microsaccades, namely, it might allow the central & the peripheral retinal images to be eventually overlapped spatiotemporally at the level of human visual awareness: thus the invisibility emerges! There are also other factors that may assist in the eventual overlapping, such as: the unstoppable dynamics of the pupil, and the lens, see references 16, and 17. The aforementioned factors seems to be sufficient to resolve the mystery behind the illusory invisibility for the single horse stimulus. Namely, perfect spatiotemporal dynamics based on cross-talks with the other human visual system parts might assist to feed certain retinal areas (fovea versus retinal peripheries closer to fovea) with information in a harmonic way that might eventually yield illusory invisibility.

Essential Notifications

Readers should have direct access to the stimuli, see reference 18. Advisably, download the videos for the best quality of experience. Wait for a few seconds to allow adaptation to the pupil and the lens: the illusion afterwards should work. For rapid validation process, have the test with dilated pupil, and seriously fixate at the black cross in the center of the stimulus. If you blink in the moderate environment; namely, fifty percent of the monitor’s max. brightness. Caffeine intake also dilute the pupil, in case of pinpoint pupils, see reference 19. Important to mentioned, the invisibility might be occurred even with zero blurriness, but it will require very dilated pupils; we therefore blurrized the images for convenient experience. Scholars with professional eye tracker, and brain imaging facilitations are welcome to collaborate in challenging investigations, namely, to achieve critical analyses of the spatiotemporal properties of two distinct V4 areas (fovea versus peripheries), and other neocortical and subcortical areas to comprehend the neurophysiological reasons of the FIB. Enquiries should be sent to the author.

Transcational References