The Delay of Early Visual Reactions Doesn't Seem to be Correlated with an Individual's Alpha Frequency

Vivek Gupta*

Editorial Office, Journal of Neurology and Neurophysiology, Belgium

*Corresponding Author**

Vivek Gupta
Editorial Office, Journal of Neurology and Neurophysiology
Belgium
Email: neuroscience@neurologyjournals.org

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Abstract

Several studies have connected brain oscillations in the alpha band (8 Hz–13 Hz) to the results of visual perception. Studies have indicated that the alpha phase, which occurs before the commencement of the stimulus, can predict the detection of the stimulus, sensory responses, and the temporal characteristics of perception. These results support the hypothesis that rhythmic sampling of visual information is reflected in alpha-band oscillations, but the underlying processes remain unknown. Two opposing theories have recently been put forth. The rhythmic perception account claims that alpha oscillations limit perceptual processing by physically increasing the intensity or amplitude of visual responses, which increases the chance of stimulus detection.

Keywords: Neuronal and perceptual processes

Introduction

The discrete perception explanation, on the other hand, contends that alpha activity discretizes perceptual information, rearranging both the time and the intensity of neuronal and perceptual processes. In this study, we examined the relationship between Individual Alpha Frequencies (IAF) and the latency of early visual evoked Event-Related Potential (ERP) components in order to find neurological support for the discrete perception explanation. Higher alpha frequencies may be connected to earlier afferent visual ERPs if alpha cycles were the ones altering neural events in time. Large checkerboard stimuli intended to cause a significant C1 ERP response were shown to either the upper or lower visual field of the participants (thought to index feedforward primary visual cortex activation).

The lack of a consistent relationship between IAF and the C1 delay or subsequent ERP component latencies suggests that alpha frequency was not influencing the timing of these visual-evoked potentials. So, even leaving open the potential of rhythmic perception, our data do not support discrete perception at the level of early visual responses. It has been demonstrated that brain dynamics in the alpha band (8 Hz–13 Hz) may predict a number of features of visual perception, including the likelihood of target recognition and temporal parameters of perception. Although there is a lot of evidence to support the significance of alpha phase and a growing body of data to support the relevance of alpha strength in the suppression of neuronal activity and perceptual reports, it is less obvious how alpha frequency may influence the processing of visual information. The rhythmic perception hypothesis and the discrete perception account have both been put out as possible explanations for how alpha-band frequency dynamics and changes in visual perception may be related. According to the rhythmic perception theory, alpha oscillations represent phasic variations in neuronal excitability that primarily regulates the perception's intensity.

The discrete perception account, on the other hand, contends that alpha oscillations have a role in the timing and discretization of sensory events. These findings suggest that an individual's alpha frequency would be connected to either the rhythmic perception's discretization rate or the frequency and duration of excitability shifts (discrete perception). Current evidence does not definitively favor one account over the other, as recent reviews and studies have noted.

Thus, we looked for neurological support for the claim that IAF modifies sensory process time, which is compatible with the discrete perception explanation. With a focus on the extrastriate and striate visual evoked potentials, we specifically investigated whether individual variations in alpha frequency influence the time of early visual responses. High-contrast checkerboard stimuli are known to generate strong C1 Event-Related Potential (ERP) responses, thus we looked at the data from two studies that employed these stimuli. In order to determine whether the frequency of pre stimulus alpha-band activity modifies the onset and peak delay of early visual-evoked potentials, we extracted IAF from a pre stimulus window. Higher frequencies could be connected to earlier onset if alpha frequency is related to the discretization of visual perception.

The assumption that visual ERP components are produced by a phase-rest of ongoing oscillations is similarly affected by our findings. The absence of connection contradicts the notion that the commencement of a stimulus resets existing alpha oscillations, which is thought to be the cause of (or a contributing factor in) the formation of ERPs, even if our results are limited to the alpha-band. We would anticipate a substantial association between the frequency of the oscillations being reset and the timing of the ERP components, which was not observed, if the C1 or N150 were produced by a phase reset. It is more plausible that these early visual components amount to ongoing or background brain oscillations and represent additive neural activity.

As the P1 and N1 ERPs were obscured in our datasets due to the high-amplitude C1 response, future study should examine whether IAF is connected to the delay of other early sensory responses. There could be situations when discrete perception takes place and many ways that discrete perception might show up. Our results, however, are not compatible with the idea that alpha frequency modulates the timing of afferent visual responses since alpha frequency was not linked to the latency of the first visual ERP (C1).

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