Dynamic Brain of Vertical Size Disparity Responses

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Summary
In our study we used event-related potentials (ERPs) to investigate the underlying neural mechanisms of 3D visual stimuli which is used RDS, 8 healthy adults (mean age 25, range 20–31), participated in this study. ERPs were recorded from 64 scalp electrodes while participants viewed the standard stimuli. Besides the results in which the peaks are localized within a time interval of 100-200ms, there are also results that consist of peaks within a wide 100 to 600ms time window. The most prominent peak common to most of the studies is a negative peak with latency in the 200-400ms.

Key words:
ERP Event Related Potential 3D three-dimensional RDS random-dot stereograms

1. Introduction

Binocular disparity is one of the most important cues for depth perception in humans. There are two basic types of binocular disparity: horizontal disparity and vertical disparity. Since the eyes are separated horizontally, the traditional view is only horizontal disparities have great influence on depth perception, the vertical disparities involved in depth perception has been revealed, but the vertical component of disparity is usually much smaller than the horizontal disparities [1], because of the vertical disparity is complicated by the fact that several different definitions of the vertical disparity [2]. In our study we chose the vertical disparity as the standard stimulus. As we know the best-known example of vertical disparity in depth perception is the induced effect (Ogle, 1950): The Fig.1a is two identical images, but one of them slightly magnified vertically. Fig.1b is the stereogram made of

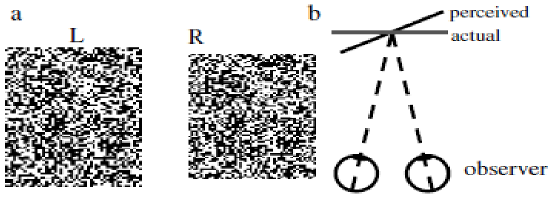

Fig. 1. (a) two identical images the induced effect.
(b) schematically here in the top view.

perceived as a slanted surface rotated about a vertical axis [3]. It has been reported that vertical disparities are spatially pooled for the perception of surface slant. More precisely, the magnitude of perceived slant from vertical disparity depends on the integrated or averaged value of the disparities over a global area, but that form horizontal disparity fundamentally depends on the magnitude of the disparity at each local area [4-8] .

Published results show differences in the latencies and the number of the peaks. Besides the results in which the peaks are localized within a time interval of 100-200ms [9-12]. The Averaged ERPs evoked of simple visual stimuli contain a prominent negative peak (N1) at 150 to 200 ms[13], and a positive peak(P3) at 210 to 370ms, and a negative peak (N350) at 300 to 420 ms, and a positive peak(p500) at 450 to 750ms(14). But in this study, Our results shown that the visual P1, N1,N350, N500 later than the published results, the delay time was between 30ms to 100ms, P300 appeared in the 800ms. This delay time may be caused by the brain processes visual information.

2. Materials and methods

Ten healthy adults (mean age 25, range 20–31), who had no history of neurological problems and have normal vision or corrected-normal vision.

Visual stimuli were generated by a computer (Macintosh Power Mac G4;Apple Computer Inc.) and presented stereoscopically using two projectors.

Recording The EEG equipment (The BioSemi active two measurement system, Finland) consisted of two 64-channel with a head cap. and 8-flat active electrodes. Raw date was recorded with BioSemi software. In addition, two active electrodes were paced under the subject's left and right eye to detect blinking artifacts. An additional reference electrode was placed on the trip of the ears.

The stereoscope was placed in a darkened so that the subjects could see only the stimuli on the display. The display area was 12*12cm and comprised 1280*1024 pixels. Subjects perceived perceive a fused stimulus 12cm straight ahead at eye level. A chin rest was used to fix the position of the head and therefore the positions of the eyes. The subjects viewed the displays from 50cm with head supported by the chin rest.

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3. Results and Discussion

Brain activity generated by subjects who can perceive an impression of a surface slanted that by vertical size disparity. Then we compared the averaged ERPs and unaveraged EEG epochs (Fig2). In this figure each colored trace represents the spectrum of the activity of one data channel. The leftmost scalp map shows the scalp distribution of power at 7.5 Hz, which in these data is concentrated on the hindbrain. The other scalp maps indicate the distribution of power at 11 Hz and 16 Hz and 22Hz The frequency dependence and the scalp topography of the mean power in the single-subject average-ERP wave forms(Fig. 2A) resembled that of the unaveraged EEG(Fig.2B). Comparing these two graphs we found concentrated in the frequency of about 10Hz, belonging to α brainwave.

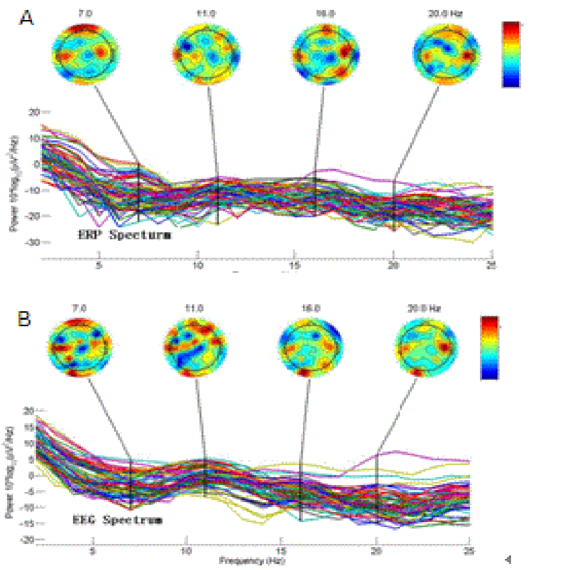

Fig.2 Power spectra of unaveraged EEG and averaged ERP

In occipital region, the VEP image averaged by EEGLAB as follows (Fig.3) P3, P4, Pz, PO3, PO4, POz . From this figure we find the peak amplitudes and latencies for ERPs were analyzed in time windows of 100–160 ms (P1), 160–350 ms (N1) , 350–520 ms (P500), 520–600 ms (N350) and 600–800 ms (P300). For these ERP images, the peak amplitudes and latencies were analyzed with repeated measures. P500 showed the strongest peaks in parietal sites. These dates were all later then the published date. Then we choice the ERP image of POz to analyzed.

Fig.4 is the ERP image of POz which isat posterior central scalp. The rectangular colored image in which every horizontal line represents activity occurring in a single experimental trial, the color-code their values in left-to-right straight lines, the changing color value indicating the

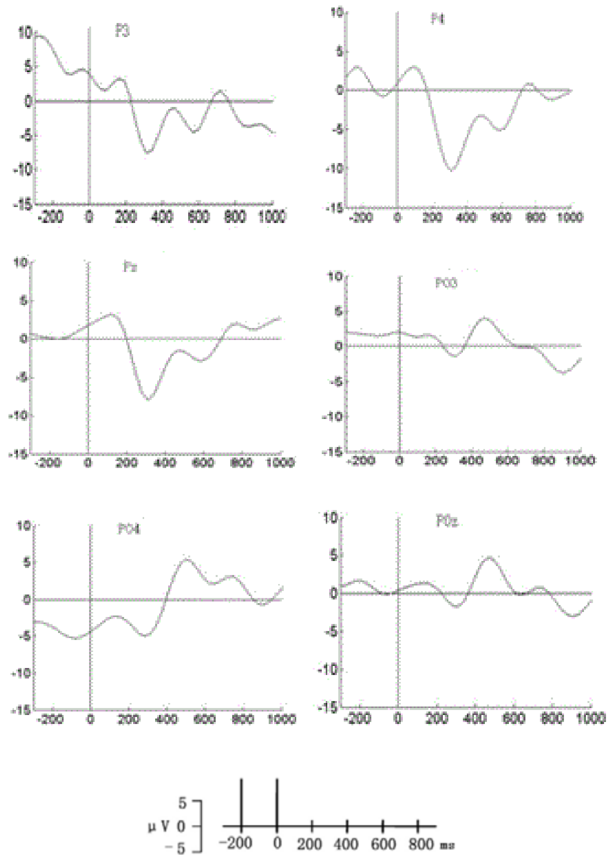

Fig.3 The VEP of P3, P4, Pz, PO3, PO4, POz#

potential value at each time point in the trial. Note the color μV scale on the right.

The panels appear below the ERP panel (μV). The middle panel, labeled ERSP for "Event Related Spectral Power", shows mean changes in power across the epochs in dB. The blue region indicates 1% confidence limits according to surrogate data drawn from random windows in the baseline. Here, power at the selected frequency (10.38 Hz) shows no significant variations across the epoch. The number "0.686 dB" in the baseline of this panel indicates the absolute baseline power level. This shows that the vertical component of disparity is very small。 The value "10.38 Hz" here indicates the analysis frequency selected. Phase synchronization becomes stronger than our specified p=0.01 significance cutoff at about 300ms. We believed that the 2D image is recognized between 0 and 200 ms, and the 3D shape is processed by the brain in the following 200ms. Therefore, the brain has the processing of distinguishing and managing the stimuli, so the third positive peak （P300） appears in the 600-800ms, the N1,

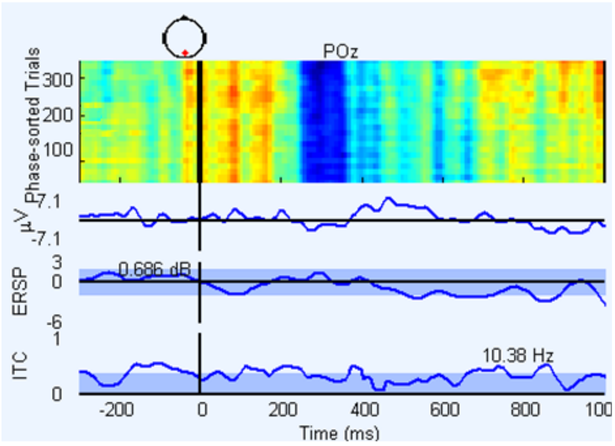

Fig.4 The ERP image of POz

P1 and other data we observed in Figure 3 were delayed than the study of used the 2D images as stimuli.

4. Conclusion

In our study， we Analyzed the brain waves generated by 3D vertical stimuli, and compared the results to the published conclusions. Our results shown that because of the brain has the processing of distinguishing and managing the stimuli, he 2D image is recognized between 0 and 200 ms, and the 3D shape is processed by the brain in the following 200ms. the visual P1, N1,N350, N500 later than the published results, the delay time was between 30ms to 100ms, P300 appeared in the 800ms.

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