Prolonging visual after images¹

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Abstract

This study indicates that supplying stimulus changes (flickering on-off light) to the visual field following initial stimulation of the retina can prolong the duration of visual after images. Although most current research on after images has focused on the biochemical and neural basis of this phenomena, it is suggested that post stimulation conditions in the visual field as well as such simple 'changes' as blinking may also be significant parameters.

Problem

Reports by Brindley (1959, 1963) and Alpern & Barr (1961) argue for a biochemical interpretation of visual after images. Photochemical bleaching is believed responsible for the prolonged sensations following stimulation of the retina. Other studies, however, suggest some neural involvement. Misiak & Lozito (1951) report that binocular rather than monocular viewing resulted in shorter latencies and longer durations of after images; they suggest a neural interaction between the two eyes. Barlow & Sparrock (1964) employ a 'noisy receptor' model, accompanied by retinal adaptation, to account for after images and their fading.

Important as these approaches may be, they neglect some fundamental characteristics of after images. The durations of these images can be manipulated and they may be 'revived' after complete fading by supplying changes in the illumination of the visual field following the initial retinal stimulation. Helmholtz (1896) cites several studies on the 'reviving of after images by alternate brightening and darkening of the field.' Evans (1928) reported that slowly flickering lights serve to prolong and intensify after images; Williamson (1945) merely turned the room lights on and off to reproduce after images. The present study investigates some of the parameters which can prolong visual after images.

Method

Two sets of conditions were employed, one which tended to maximize after images (change conditions) and one which tended to minimize them (homogeneous conditions). The monocular stimulus consisted of a circular spot of light that subtended a visual angle of 3 degrees and lasted for 50 milliseconds (G. E. Photoflash No. 5). One half of this circle was always covered by a 60% absorbing neutral density filter; the stimuli were presented alone (White light) or after passing through red, green or blue Wratten filters.

In the set of change conditions, which prolonged after images, the S was instructed to attend to the stimulus flash and then fixate on a dot on a homogeneous white screen. In this set of conditions S could abruptly change the illumination of the screen by pushing a button which operated a set of shutters. The three change conditions

were (1) from adaptation level (4.5 FC) to darker (less than .01 FC), (2) from brighter than adaptation (28.8 FC) to darker, and (3) from the adaptation level to brighter.

In the set of homogeneous conditions, which favored the rapid disappearance of after images, the S, after stimulation either (4) attended to the fixation dot on an illuminated screen, (5) closed his eyes, or (6) attended to the fixation dot on a screen that was brighter (28.8 FC) than adaptation level.

Both authors served as subjects and over 90 stimulations were conducted in the course of the experiment. The dependent variable of concern was the S's reports on the duration of the after images.

Results

Figure 1 shows the mean duration of the after images under the change and homogeneous conditions when the stimulus was the flashbulb (without any color filter but half covered by the neutral density filter).

When the data were pooled into change versus homogeneous conditions, a t of 6.63 with 22 df was obtained ($p < .01$). An analysis of variance on the data was also significant ($F, 51.20; df, 5/18; p < .01$) and indicated that condition 6 was significantly different from all other conditions whereas conditions 1 and 2 did not differ significantly nor did 3, 4, and 5.

Figure 2 displays the data for the after images when the stimulation was passed through red, green, and blue filters. These stimuli were not equated for brightness but the general results are much like those for the White light treatment. When the data for any given color was pooled into change versus homogeneous conditions, the t tests were significant, again indicating the efficacy of changing illumination to prolong the after images.

Fig. 1. Mean durations of the after images in white light treatment; no color filters.

Fig. 2. Mean durations of the after images for color filtered treatments.

Discussion

Although no quantitative measures were taken, it was usually possible to differentiate the stimuli (i. e., discriminate between the neutral density filtered and unfiltered parts of the after image) under all conditions until near the end of the fading process.

It was noted during the testing that blinking the eye had a marked effect upon the after images. Especially in condition 6, where the image tended to fade rapidly, blinking often gave a striking 'reviving' of the after image on the bright screen; holding the eye closed under this condition often gave intense color fading.

Thus changes in the visual field after the initial stimulation, even so subtle and obvious changes as blinking, influence the visual after images and may prove to be of great importance in future investigations.

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Note

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