The effect of movement on the perceived brightness of chromatic afterimages

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The present study explored the effects of adaptation to static and moving chromatic stimuli on the perceived brightness of afterimages projected on static and moving achromatic test stimuli. The Ss were presented with two stimuli of the same color to which they adapted for 1 min. The Ss then reported the brightness of their afterimages when viewing achromatic stimuli. A rotating stimulus, viz, 16, 45, or 78 rpm, was compared with a stationary stimulus. Results indicate that (a) the introduction of movement detracts from the brightness of an afterimage, and (b) a speed of 45 rpm affects the afterimage more than 16 or 78 rpm.

Speed of stimulus rotation has been shown to have a direct relationship to duration and strength of movement aftereffects (Granit, 1927; Thomas, 1963). Research on the problem of the effect of movement on chromatic afterimages has received little experimental attention. Wheeler & LaForce (1967) studied the effects of disc rotation speed, chromaticity and luminosity of a color pulse with a Bidwell-type apparatus. In an analysis of their data a comparison of low rotation speeds (10-60 cps) with high rotation speeds (60-110 cps) indicates that the low speeds produced brighter negative afterimages in 46.7% of the trials, while the high speeds yielded brighter afterimages in only 6.7% of the trials. The percentages indicate that speed of movement may have an inverse relationship to the perceived brightness of chromatic afterimages. The present experiment sought to continue research in this area by exploring the effect of static and slow moving stimuli on the brightness of afterimages.

Method. Three students, each with at least 3 h of previous experience with color afterimages, served as Ss.

Two 12 in. diameter, white cardboard discs, both bisected by a $\frac{1}{4}$ in. x 12 in. black line, were used as stimuli. Each stimulus was mounted on a three speed turntable which permitted clockwise rotations of 16, 45, and 78 rpm. The turntables were placed side by side below the S's line of sight. The rear of each turntable was elevated to permit the S to view each disc fully while seated at a distance of 4 ft. The stimuli were viewed through a pair of $1\frac{1}{2}$ in. x $7\frac{1}{2}$ in. tubes which prevented the two monocular fields from overlapping and ruled out extraneous light stimulation. Coloration of the discs was provided by red or green acetate filters placed over the stimuli.

To test the effect of movement on afterimages a stationary stimulus was compared with a rotating stimulus. Each disc had a filter of the same color, e.g., red or green. The procedure consisted of S adapting to the two stimuli for 1 min. The S was instructed to use the spindle of each turntable as the center of each visual field to insure that each eye received equal stimulation. In this manner the two fields did not overlap, but seemed to touch on their

inner edge. The S was instructed to fixate at this point. Following adaptation S was asked to close his eyes while E removed the filters from the white discs. The S was then told to open his eyes and report both his afterimages and any apparent differences in brightness.

Each S reported his afterimages under five stimulus conditions. The first two conditions, serving as controls, consisted of static adaptation and static test stimuli with red or green filters. Condition 3 consisted of static adaptation (red or green) and movement (16, 45, and 78 rpm) in the left or right test stimulus. Condition 4 involved movement in the left or right stimulus during both adaptation and test. Condition 5 consisted of movement in the left or right stimulus during adaptation and a static test. It should be noted that the S did not undergo two successive conditions with the same color. Colors were alternated to permit each adaptation period to wash-out the effects of the previous condition.

Results. All Ss responded with no difference between the afterimages in Conditions 1 and 2 demonstrating that both fields were equally effective in producing afterimages. Perceived differences in brightness were reported for Conditions 3, 4, and 5. However, only in Condition 3 (static adaptation and movement in one test stimulus) do Ss' reports systematically demonstrate the effect of movement on the perceived brightness of afterimages. These results are presented in Fig. 1. The curves indicate that the introduction of movement in one test stimulus detracted from or inhibited the brightness of the afterimage. The results from Conditions 4 and 5 do not demonstrate any systematic tendency for Ss to report one test stimulus as being brighter than the other.

The Ss' responses were also examined as a function of three speeds of stimulus movement. The data from combined Conditions 3, 4, and 5 for stimuli at 45 rpm are presented in Fig. 2. These data, analyzed in terms of differences between perceived brightness for static stimulus left and right, yielded curves of greatest difference, viz, maximal inhibition of the afterimage. The data for 16 and 78 rpm show the same trend, but not of comparable magnitude.

Discussion. In review, the present study indicates that (a) the introduction of movement detracts from the perceived brightness of a chromatic afterimage, and (b) a speed of 45 rpm inhibits the brightness of an afterimage more than 16 or 78 rpm. The first finding is consistent with Wheeler & LaForce's (1967) observation of an inverse relationship between speed of rotation and brightness of afterimage. The second finding, however, is in apparent disagreement. In the present study an angular rotation of 78 rpm resulted in a brighter afterimage than obtained with 45 rpm. A possible explanation for the disparity in the findings of the two studies may be found in Wheeler & LaForce's grouping of all speeds into two categories, low and high speeds, in which small variations may have been averaged out. Further research on the brightness of afterimages generated by a wide range of stimulus speeds should resolve this question.

Fig. 1. Perceived brightness of afterimages with static and moving test stimuli following static adaptation.

Fig. 2. Perceived brightness of afterimages for Conditions 3, 4, and 5 with a stimulus speed of 45 rpm.

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