Timing oscillation in human visual imagery

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Following the work of Weber & Castleman (1970), who found a time period of about 500 msec for the successive production in imagery of letters of the alphabet, an imaginal task less cognitive in nature was timed. Twenty-four Ss in a CFF study attempted to match the rate of flicker of a subfusional light in visual imagery. The modal ability for imagining flicker is about 250 msec in period.

How many quantitative questions be asked about mental imagery? The content of mental imagery may include the memory of past sensory events. We have begun the exploration of one particular sensory event as it may exist in visual imagery in the absence of its appropriate sensory stimulus, seeking to find features of the timing of imagery.

The sensory event we have chosen to explore in visual imagery is the CFF. Variables that control the timing of sensory fusion of flickering light include stimulus size (Roehrig, 1959), stimulus luminance (Crozier, Wolf, & Zerrahn-Wolf, 1936), retinal locus of stimulation (Brooke, 1951), relative proportion of lightness and darkness (Bartley & Nelson, 1961), and stimulus wave form (Levinson, 1960). It is not known what variables might control the rate of flicker in visual imagery when S attempts to match a flickering light which he has seen in visual imagery after that light has been removed. Clearly, methods for tapping the imaginal process with confidence have not been developed, and we limit ourselves here to the report of the discovery that Ss report that they fail to imagine a flickering light at oscillation rates well below the sensory CFF.

METHOD

Subjects

Twenty-four Duke undergraduates participated in the study in partial fulfillment of a course requirement.

Apparatus

A flickering light was presented to the right eye, using a Lafayette Model 1202D CFF apparatus. The centrally fixated disk subtended a visual angle of 2 deg 20 min.

Procedure

On the first trial, the frequency was 1.5 Hz, and the rate was increased by 0.5 Hz on each successive trial. Each trial consisted of about 7 sec of viewing the flickering light, followed by a period in which the field was dark, and Ss were asked to "try to visualize or recall in your mind's eye the exact rate of flicker previously seen. Do not try to count the number

of flickers. Just try to match, in your mind's eye, what you just saw." After each trial, S reported whether or not he was satisfied that he matched the flicker in imagery, and a run ended when S reported failure to match the preceding sensory flicker in visual imagery.

The stimulus conditions, presented in counterbalanced order, included light-dark ratios of 25-75, 50-50, and 75-25, with luminance of 7.076, 0.339, and 0.006 apparent fc.

RESULTS

Although all Ss were able to observe the stimulus as flickering when it was present, they all reported an inability to imagine this pulsating change at some rate. For most Ss, the maximal flicker imagined was on the order of 250 Hz, although one S reported an inability to form a visual image of a flickering light even at the slowest rate of one every 2 sec. Table 1 presents the maximum sensory flicker rate matched in imagery for the 24 Ss.

Analysis of variance over the stimulus conditions of luminance and light-dark ratio indicated no main effects of conditions on rate of flicker reported to be matched in imagery; almost all variance was attributable to between-Ss variability. Figure 1

Table 1

Maximum Imagery Rate (in Hz)	Number of Ss
0.0	1
0.5	0
1.0	0
1.5	0
2.0	1
2.5	1
3.0	3
3.5	3
4.0	4
4.5	6
5.0	1
5.5	0
6.0	1
6.5	0
7.0	1
7.5	0
8.0	1
8.5	0
9.0	1

displays the relation between CFF and imagery with regard to stimulus variation. While changing luminance from 7.076 to 0.006 apparent fc changed CFF significantly, for the same Ss, imagery rate was not significantly changed.

DISCUSSION

There is some similarity between the present findings and those reported by Cheatham & White (1952). They found that when the task was to judge the number of pulses in a light flickering below the CFF, Ss judged the rate to be 8 to 10 Hz at the maximum subfusional rate. The major important difference between their study and the present one is that in the present study, every S saw the light as flickering at rates too fast for him to match in imagery, indicating perhaps that the failure in imagery does not lie at a sensory level of analysis.

We find that the speed of imagining the pulsing of light is of the same order of magnitude as, but about twice the speed of, imagining in sequence the letters of the English alphabet in visual imagery, a task whose time period has been found to be about 500 msec by Weber & Bach (1969) and Weber & Castleman (1970).

The present study has found a

Fig. 1. Representation of the raw data. For the same Ss, CFF and maximum imagery rate were measured at a 50-50 light-dark ratio at high (7.076 app. fc), medium (0.339 app. fc), and low (0.0057 app. fc) luminance. The points represent the means.

temporal limit in the cycling of a particularly simple sort of visual imagery, the simple repetition of a period of lightness alternating with a period of darkness. Variables that might control the rate of flicker in imagery remain unknown, but it is now clear that a temporal limit in the rate of oscillation in visual imagery may be easily demonstrated.

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