Inhibition of a simple visual reaction time by a second stimulus: A failure to replicate¹

Joseph S. Lappin and Charles W. Eriksen
UNIVERSITY OF ILLINOIS

Abstract

Helson & Steger (1962) have reported that simple reaction time to a light stimulus was increased if a second light occurred as long as 180 ms. after the primary stimulus. The present experiment was unsuccessful in producing the phenomenon. Some defects in methodology in the Helson & Steger (1962) experiment were considered.

Introduction

In a study by Helson & Steger (1962) it was found that a dim light following the onset of a visual signal to respond in a reaction time situation was capable of increasing the reaction time to the first signal. The inhibition thus obtained was an inverted U function of the interval between the two stimuli with a peak at about 90 ms. There is a striking resemblance of this result to retroactive effects in vision found in work with "meta-contrast" (Alpern, 1952; Alpern, 1953). In this latter research a substantial reduction in the apparent brightness of a small brief patch of light is produced by subsequently presenting two similar patches to flanking retinal areas; and, moreover, an inverted U function again appears with a peak at approximately a 100 ms. asynchrony of the flashes. The Helson & Steger (1962) experiment thus suggests a fruitful application of RT procedures to the investigation of visual perception.

However, a series of visual RT experiments presents strong evidence to the contrary. It was demonstrated that while RT is reduced by increases in stimulus intensity, it is unaffected by many manipulations which affect only the apparent intensity but not the actual physical intensity (Raab & Fehrer, 1962; Raab, Fehrer, & Hershenson, 1961). This was found to be the case for stimuli masked by metacontrast even under conditions where the stimulus to react was phenomenally absent (Fehrer & Biederman, 1962; Fehrer & Raab, 1962). Certainly it should be regarded as remarkable that a stimulus delayed by 180 ms. (as was the case in Helson and Steger's experiment) can inhibit a response which occurs within about 175-350 ms. from the onset of the first stimulus, and especially so since RT is unaffected by duration of even a dim light beyond about 5 ms. (Raab & Fehrer, 1962).

In addition, the existence of retroactive inhibition of voluntary motor responses to sensory signals challenges the notion of a "psychological refractory period" which has been derived from observations of discrete responses made to successive signals (Davis, 1957; Davis, 1959; Elithorn & Lawrence, 1955).

In view of these questions, as well as the fact that four out of 10 Ss in Helson and Steger's study were apparently

unaffected by the interpolated stimulus, an attempt was made to replicate the phenomenon.

Method

The stimuli were produced by 2 NE 51 neon bulbs (A.C.) mounted on a black panel 3/4 in. from center to center, in a horizontal plane at about eye level and approximately 2 ft in front of the S. All critical time intervals—the intertrial interval, ready signal duration, foreperiod, and stimulus asynchrony—were controlled by four Hunter interval timers. Measurement of the RTs was made to the nearest .001 sec. with a Hunter clock counter. The responses were made by depressing a telegraph key which was mounted on an easily movable handrest placed on the table in front of the S. The experiment was conducted in a dimly lighted room.

Thirteen male undergraduates were obtained from the introductory psychology S pool. One additional S was excluded due to unusually long and variable RTs.

Each S made 380 responses. The intertrial interval was 10 sec., and a break of about 5 min. was taken after the first 190 trials so that a session lasted about 1 1/2 hrs. Prior to each trial the E said "right" or "left" to indicate which of the two lamps the S should respond to. No information was given as to the purpose of the other light; questions were answered by saying that it could not be avoided, but that it was not important. Of the 380 trials, 360 were with double stimuli and 20 had just the single stimulus. Ten sec. after the onset of the stimulus of the last trial, a buzzer sounded for 400 ms. as a ready signal for the next trial. This was followed at .5, 1, 1.5, 2, 2.5, or 3 sec. from its onset by the stimulus to respond. The interpolated stimulus was presented at delays of 30, 60, 90, or 120 ms. from the onset of the first. Both lights remained on until S responded. The foreperiods, delays, and which of the two lamps was the signal to respond were arranged in a predetermined random sequence. The delays of the second stimulus were arranged in randomly permuted orders, with the 20 single stimulus trials randomly interspersed among the 380. (Trials on which the RT exceeded 400 ms. were repeated.) Four warmup trials were given on which both stimuli were presented.

Results

Simple analyses of variance for the effect of the delay of the interpolated stimulus were computed for the data of each individual S. Only one of the F ratios (df, 4/375) was significant at the 0.10 level and one more at the 0.25 level. The mean F ratio for the 13 Ss was only 0.79. Table 1 shows means for each S for each delay and also for the single stimulus. Since there were no trends ap-

Table 1. Individual Mean RTs to Single Stimuli and Five Stimulus Onset Asynchronies

	Subjects													Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	
Single	237	230	239	239	224	236	272	238	227	227	250	229	290	241
Asynchronous														
30	237	231	244	239	236	233	271	238	229	226	237	240	284	241
60	227	230	243	241	237	235	262	232	221	228	233	240	281	239
90	229	228	245	237	239	238	269	236	223	230	233	236	283	240
120	240	228	246	237	235	234	265	237	228	239	239	237	285	242
Total	234	229	244	239	236	235	267	236	225	231	236	237	283	241
SD	49	24	26	28	37	42	42	28	36	36	29	32	28	16*

*between Ss

parent for the mean RTs under each delay condition, no statistical analysis across Ss was indicated.

Discussion

Clearly no support is offered by these data for the phenomenon reported by Helson & Steger (1962). However, several differences in the procedures used in the two studies should be noted: (a) The ready signal was produced by a buzzer activated for a constant duration, whereas in the Helson and Steger experiment the signal was the E's verbal response "ready." (b) The foreperiods were arranged in a predetermined random sequence, while this apparently was not the case in the original study. (c) The intertrial interval was 10 sec., and 5 sec. in the previous study. (d) There was no fixation point between the two stimulus lamps as was the case before. The latter was omitted from the present experiment because it did not seem functional when the S was told which light to attend on each trial.

It is the author's belief that some importance may be attached to the first two of the discrepancies in procedure. Failure to employ predetermined foreperiods and the use of a verbal ready signal spoken by E is not a particularly rigorous nor objective procedure. The length and variability of the foreperiod, for example, has been shown to be a potent determiner of simple RT (e.g., Karlin, 1959; Klemmer, 1957). And the verbal ready signal, besides its inherent variability, provides too much opportunity to carry other information especially when E may be anticipating a particular experimental result (Azrin, Holz, Ulrich, & Goldiamond, 1961; Rosenthal, Persinger, & Fode, 1962).

References

- ALPERN, M. Metacontrast: Historical introduction. *Amer. J. Optom.*, 1952, 29, 631-646.
- ALPERN, M. Metacontrast. *J. Opt. Soc. Amer.*, 1953, 43, 648-657.
- AZRIN, N. H., HOLZ, W., ULRICH, R., & GOLDDIAMOND, I. The control of the content of conversation through reinforcement. *J. exp. Anal. Beh.*, 1961, 4, 25-30.
- DAVIS, R. The human operator as a single channel information system. *Quart. J. exp. Psychol.*, 1957, 9, 119-129.
- DAVIS, R. The role of "attention" in the psychological refractory period. *Quart. J. exp. Psychol.*, 1959, 11, 211-220.
- ELITHORN, A., & LAWRENCE, C. Central inhibition: some refractory observations. *Quart. J. exp. Psychol.*, 1955m 7, 116-127.
- FEHRER, E., & BIEDERMAN, I. A comparison of reaction and verbal report in the detection of masked stimuli. *J. exp. Psychol.*, 1962, 64, 126-130.
- FEHRER, E., & RAAB, D. Reaction time to stimuli masked by metacontrast. *J. exp. Psychol.*, 1962, 63, 143-147.
- HELSON, H., & STEGER, J. A. On the inhibitory effects of a second stimulus following the primary stimulus to react. *J. exp. Psychol.*, 1962, 64, 201-205.
- KARLIN, L. Reaction time as a function of foreperiod and variability. *J. exp. Psychol.*, 1959, 58, 185-191.
- KLEMMER, E. T. Simple reaction time as a function of time uncertainty. *J. exp. Psychol.*, 1957, 54, 195-200.
- RAAB, D., & FEHRER, E. Supplementary report: The effect of stimulus duration and luminance on visual reaction time. *J. exp. Psychol.*, 1962, 64, 326-327.
- RAAB, D., FEHRER, E., & HERSHENSON, M. Visual reaction time and the Broca-Sulzer phenomenon. *J. exp. Psychol.*, 1961, 61, 193-199.
- ROSENTHAL, R., PERSINGER, G. W., & FODE, K. L. Experimenter bias, anxiety, and social desirability. *Percept. mot. Skills*, 1962, 15, 73-74.

Note

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