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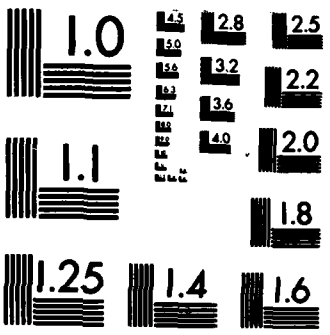

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POTENCY OF PHOTOFLASH-PRODUCED RETROGRADE AMNESIA IN RATS

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A photoflash has been shown to be an effective amnesiac under certain conditions. The objective of this study was to evaluate the effectiveness of a photoflash in relation to the potency of the preceding event, a foot shock of varying intensities.

The task was a single avoidance-trial paradigm. The subject was placed in a small aversive chamber with a door that allowed the subject to enter a large, preferred chamber. Once inside the preferred chamber, the subject received a 1-s foot shock followed by a photoflash. On the avoidance trial, the subject was again placed in the aversive chamber and the time required to enter the preferred chamber was measured. If the photoflash had produced retrograde amnesia (RA), the time required to enter would be small. Retrograde amnesia was demonstrated for the 80-, 85-, and 100-V foot-shock test trials. At 40 V the voltage may not have been great enough to be felt by the subject. For groups examined at shock levels above 100 V, the foot shock was so potent that a photoflash was ineffective in

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POTENCY OF PHOTOFLASH-PRODUCED RETROGRADE AMNESIA IN RATS

INTRODUCTION

Recently the photoflash has been shown to produce retrograde amnesia: to interfere with recall of a previously administered foot shock as measured by a single-trial avoidance task (6). The intent of this study was to determine the effectiveness of the photoflash in relation to the intensity of an aversive foot shock, and the disposition these two stimuli hold in terms of the "recency theory" and retrograde amnesia (RA) production.

The recency theory states that if a series of novel stimuli are presented, the subject will most vividly recall the stimulus presented last; most recently (1). In Wheeler's study, an aversive shock was presented 1 s before a photoflash (8), and the animal's ability to recall the shock was a function of photoflash intensity. When the photoflash was presented after termination of the foot shock, the photoflash greatly reduced the animal's adverse reaction to the foot shock. Wheeler's study also demonstrated that the photoflash alone was not an aversive stimulus, whereas a foot shock alone was aversive.

The principal goal of this study was to evaluate the function of foot-shock intensity on the effectiveness of a photoflash to mask a rat's recall of the foot shock.

METHODS

Procedure

The task was a single avoidance-trial paradigm. Animals were placed in a small chamber (A) with a background light of 50 $\mu W/cm^2$. After a 10-s adaptation period, a door opened to provide access to a larger, dark "preferred" chamber (B) (8). The time required for the animal to leave the illuminated chamber and enter the preferred chamber was the measure of interest (denoted as T). Measurement of time began when the door opened and ceased once the animal's hindquarters crossed the threshold. Once inside chamber B, a foot shock of 40, 80, 85, 100, 125, or 135 V (60 Hz, peak-to-peak) was delivered for 1 s (BRS-SGS-001 shocker). An oscilloscope was used to monitor the shock level, and a flash bulb mount (Grass-Photo Stimulator PS22C) was positioned against the outside of the clear wall of chamber B. The photoflash unit was approximately 5 cm from the animal. One second after cessation of the foot shock, the photoflash (19×10^6 lm peak, 10 ms duration) was delivered. Control groups received the foot shock but no photoflash.

A second trial on the task was conducted 1 h after the first trial. Time to enter chamber B on the second trial was recorded as T'. If the animal recalled the shock treatment from trial one, it would hesitate or refuse to leave chamber A (2); the value of T' would be large. If the photoflash had interrupted recall of the foot shock, the T' value would be considerably less. If an animal did not enter chamber B in 100 s, it was returned to its cage and given a score of 100 s.

TABLE 2. SUMMARY OF AVOIDANCE TIME (T'-T) BY FOOT-SHOCK GROUPS

Measure	Photoflash presented	Shock Intensity (V) 0*	40	80	85	100	125	135
Mean	Yes	-1.62	8.19	23.02	-0.93	17.27	37.99	66.33
	No	-2.71	7.38	53.66	35.19	55.39	50.24	67.04
SD	Yes	3.30	25.09	14.35	7.12	33.55	37.81	32.33
	No	5.50	22.57	40.28	34.93	43.35	36.59	38.85
SEM	Yes	1.10	6.48	4.54	1.84	8.67	9.79	10.23
	No	1.70	5.83	12.74	9.02	11.19	9.45	12.29
Med	Yes	0.70	0.20	16.75	-5.10	1.40	32.70	75.30
	No	-0.70	-0.50	56.80	42.80	87.00	37.90	84.35
Range	Yes	-11.20 to 0.60	-4.50 to 97.70	6.40 to 49.60	-9.4 to 18.20	-19.20 to 80.40	-16.30 to 95.70	11.80 to 97.10
	No	-15.40 to 4.80	-4.60 to 86.60	2.20 to 97.20	-14.30 to 95.40	0.60 to 97.10	6.20 to 94.90	4.10 to 97.30

*Data from Wheeler, 1982 (8).

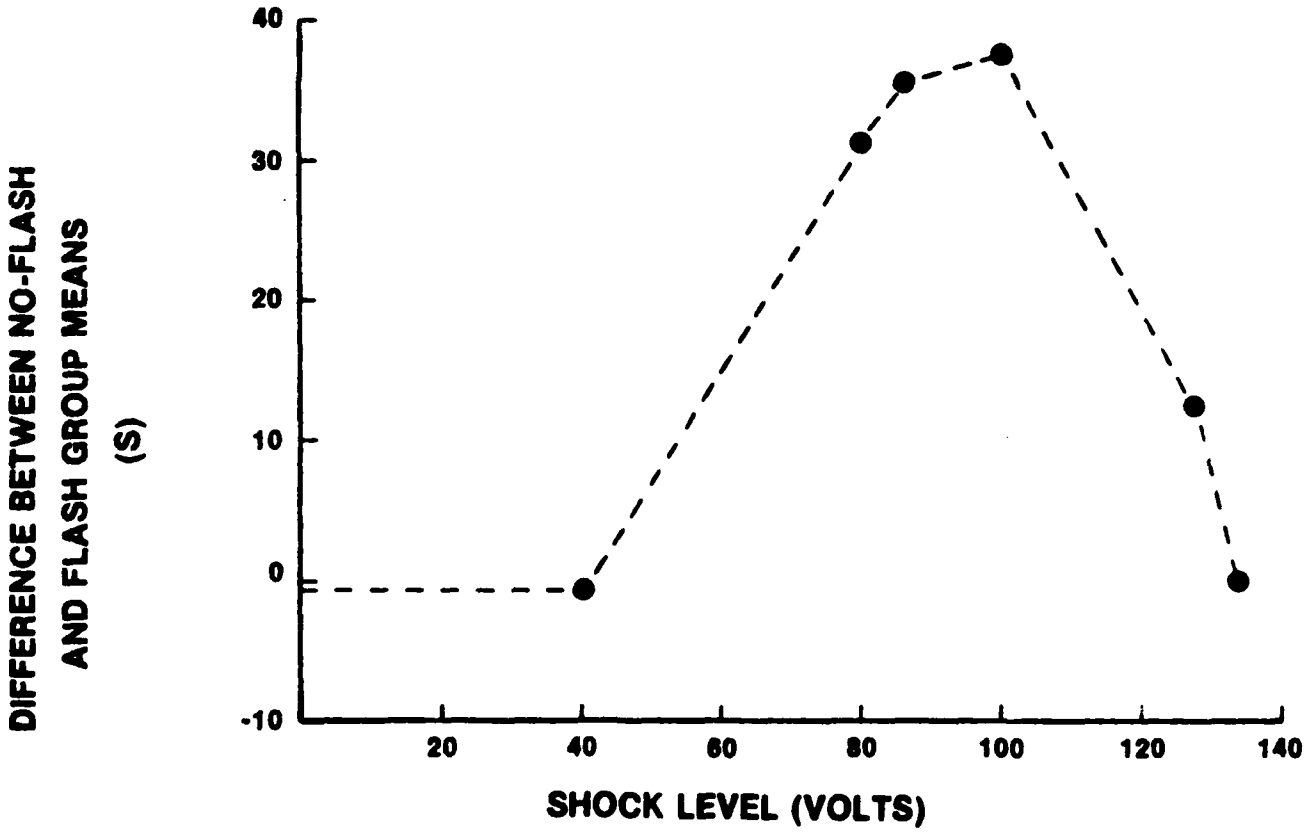

Figure 1. Relative effectiveness of photoflash in producing RA.

DISCUSSION

The inference made by the recency theory is that if any number of stimuli of any sort are presented in any sequence to a subject, the last stimulus is most likely to be the one recalled. The most recent stimulus is often termed an amnesiac, i.e., it causes retrograde amnesia (RA)--a form of memory loss characterized by inability to recall events preceding the stimulus that caused the memory deficit (5,7,9).

The impact that a stimulus has upon a subject has been referred to as stimulus potency. As long as the stimuli presented to the subject are of equal potency, the recency theory holds true. Once the potency of one stimulus is greater than the other, the more potent stimulus will be remembered; the secondary stimulus is no longer an effective amnesiac. In this study, the potency of the most recent stimulus (photoflash) was held constant while the potency of the foot shock was altered.

The potency of the foot shock might be equated to the trauma it causes the animal to suffer. Lanum et al. (6) studied shock sensitivity in terms of just-detectable vs. adverse shock levels. The just-detectable shock level was found to be .15 mA, and the animal did not make any attempt to actually avoid the shock until the level reached .22 mA. If the animal received a low-level, nonaversive shock (20 and 40 V), the presence or absence of a photoflash would not affect the results.

Figure 1, Relative Effectiveness of Photoflash in Producing RA, illustrates this point. The curve suggests that until the shock experienced by the animal was approximately 60 V, it was not aversive enough to be considered a dependent variable of this study. The photoflash in this study was an effective amnesiac until the foot-shock level became potent enough to override the photoflash effectiveness. The production of RA was apparent in the shock range of 80 to 100 V. It is unclear whether RA occurred or not at 40 V; this shock level may not have been detectable. The potency of the 125- and 135-V stimulus was so great that the second stimulus, the photoflash, was not an effective amnesiac.

APPENDIX

AVOIDANCE-TIME REACTION TO FOOT SHOCK

(Time to enter chamber B: T, prior to foot shock in chamber B; T', 1 h after foot shock; T'-T, avoidance time)

With flash					No flash			
Animal No.	T	T'	(T'-T)		Animal No.	T	T	(T'-T)
				40 V				
143	2.3	100.0	97.7		170	3.4	90.0	86.6
150	3.4	13.1	9.7		163	8.2	19.5	11.3
134	4.0	13.1	9.1		183	2.5	13.7	11.2
133	3.1	8.0	4.9		161	2.6	12.6	10.0
140	8.4	13.2	4.8		173	3.0	9.6	6.6
151	2.7	6.9	4.2		174	2.5	4.5	2.0
154	2.7	4.7	2.0		184	2.4	2.8	0.4
130	1.9	2.1	0.2		180	2.4	1.9	-0.5
144	2.1	2.1	0.0		171	2.9	1.9	-1.0
153	2.1	1.9	-0.2		172	5.2	4.2	-1.0
141	4.5	4.1	-0.4		160	4.3	2.2	-2.1
132	3.2	2.3	-0.9		181	3.9	1.8	-2.1
131	3.1	2.0	-1.1		162	4.7	1.9	-2.8
142	5.5	2.8	-2.7		164	5.9	2.6	-3.3
152	6.1	1.6	-4.5		182	5.2	0.6	-4.6
				80 V				
232	7.1	56.7	49.6		140	2.8	100.0	97.2
211	1.6	42.3	40.7		243	3.3	98.6	95.3
231	8.5	40.6	32.1		224	5.4	100.0	94.6
233	4.9	35.5	30.6		241	5.4	97.2	91.8
230	4.9	22.7	17.8		244	5.6	74.9	69.3
210	4.0	19.7	15.7		242	1.8	46.1	44.3
214	1.7	14.8	13.1		222	2.6	24.8	22.2
213	3.4	16.1	12.7		221	8.4	22.3	13.9
212	5.4	16.9	11.5		223	3.9	9.7	5.8
234	3.1	9.5	6.4		220	5.0	7.2	2.2

With flash					No flash			
Animal No.	T	T'	(T'-T)		Animal No.	T	T	(T'-T)
				125 V				
51	4.3	100.0	95.7		93	5.1	100.0	94.9
130	10.9	100.0	89.1		34	5.7	100.0	94.3
102	19.0	100.0	81.0		71	6.9	100.0	93.1
103	20.6	100.0	79.4		94	12.1	100.0	87.9
101	36.4	100.0	63.6		74	20.0	100.0	80.0
20	21.3	82.4	61.1		132	21.6	100.0	78.4
21	4.0	42.0	38.0		91	23.0	100.0	77.0
53	6.5	39.2	32.7		92	4.9	42.8	37.9
23	13.7	36.3	22.6		131	4.2	39.1	34.9
104	24.8	45.8	21.0		73	7.9	32.3	24.4
54	6.9	17.5	10.6		32	17.8	34.5	16.7
100	6.6	9.8	3.2		70	3.7	16.1	12.4
140	9.7	5.0	-4.7		30	8.6	16.6	8.0
22	11.6	4.5	-7.1		90	15.2	22.7	7.5
134	61.1	44.8	-16.3		72	16.3	22.5	6.2
				135 V				
62	2.9	100.0	97.1		40	2.7	100.0	97.3
51	5.7	100.0	94.3		42	2.9	100.0	97.1
52	6.9	100.0	93.1		80	3.0	100.0	97.0
63	4.0	94.1	90.1		44	3.2	100.0	96.8
53	7.2	92.3	85.1		81	5.2	100.0	94.8
60	2.6	68.1	65.5		41	4.3	78.2	73.9
54	4.1	64.8	60.7		43	5.5	79.1	73.6
61	2.5	55.2	52.7		82	8.4	39.2	30.8
50	4.2	17.1	12.9		84	2.5	7.5	5.0
64	2.6	14.4	11.8		83	5.1	9.2	4.1

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