PUNISHMENT BY NOISE IN AN ALTERNATIVE RESPONSE SITUATION¹

R. L. HERMAN² AND N. H. AZRIN³

ANNA STATE HOSPITAL

Operant responses of human subjects were conditioned according to a variable-interval schedule of positive reinforcement. A brief noise was delivered as punishment for each of the responses. The noise suppressed the punished responses more when an alternative unpunished response was concurrently available than when only a single punished response was available. This finding extends the generality of a previous study that had used a period of extinction rather than the brief noise as the punishing stimulus.

Recently, Holz, Azrin, and Ayllon (1963) found that punishment could be made more effective in suppressing a punished response by making available an alternative, unpunished response. Two response manipulanda were used with human subjects. The punishing stimulus consisted of a period of time-out (TO). The period of TO was delivered for responses on one manipulandum. An equal frequency of reinforcement was programmed for responses on the other manipulandum but no TO was delivered for these responses. The results showed that responding on the punished manipulandum was greatly suppressed and the subjects shifted almost all of their responses to the unpunished manipulandum. When only a single manipulandum was available for obtaining reinforcement, the TO produced little response suppression. Holz *et al.* (1963), concluded that the effectiveness of the punishment was increased by making an alternative unpunished response available. However, TO is a special type of punisher since by definition, TO produced a reduction in the frequency of reinforcement. Consequently, responses on the punished manipu-

landum would produce a lower frequency of reinforcement. Similarly, Herrnstein (1961) and Reynolds (1961) have found that the response rate on one manipulandum in an alternative response situation can be greatly lowered by lowering the reinforcement frequency relative to that on the other manipulandum. It is possible that the findings of Holz *et al.* (1963), resulted from a differential reinforcement frequency rather than from the aversive properties of the TO punishment.

The present study repeated the essential features of the Holz *et al.* (1963) experiment in order to ascertain if the increased effectiveness of punishment was a property of aversive stimuli that did not entail a reduced reinforcement frequency. The present study used an unconditioned aversive stimulus (noise) which was not expected to produce an appreciable reduction in the frequency of reinforcement.

METHOD

The general procedure, selection of subjects and apparatus, were similar to that used by Holz *et al.* (1963). Specific procedural details may be obtained from that study.

Subjects

Three male patients (Ss) selected from a chronic ward of a mental hospital were used. The Ss had a prior history of conditioning with variable-interval cigarette reinforcement but had not been exposed to noise-punishment. They were ambulatory and had no gross organic involvement.

¹This experiment is based in part on a thesis submitted by the senior author in partial fulfillment of the M.A. degree at Southern Illinois University. The investigation was supported by grants from the Psychiatric Training and Research Fund of the Illinois Department of Mental Health, NIMH, and NSF. The assistance of Dr. R. R. Hutchinson, Dr. D. F. Hake, and Dr. R. C. Steck is greatly appreciated.

²Now at Arizona State University.

³Reprints may be obtained from N. H. Azrin, Behavior Research Laboratory, Anna State Hospital, Anna, Illinois.

Apparatus

The experimental room was 7 by 10 by 12 ft and was sound attenuating. The room contained an electrically operated vending apparatus, a chair, ash tray, cigarette lighter, and a cooling fan. A portion of the vending apparatus consisted of a response manipulandum of the type designed by Lindsley (1956). Two manipulanda were used, one of which was a brass knob that could be pulled a distance of 1 cm by a force of 1000 g thereby closing a switch and recording a response. The second manipulandum was a push button located 10 in. to the right of the knob. A response on this manipulandum was recorded when the button was pushed 5 mm with a force of 450 g. The two manipulanda were distinctly different in size, shape, color, and location to allow simple discrimination. The knob is designated as R-1 and the button as R-2. Either could be rendered inoperable by locking it in place before the session.

The noise, which was used as a punishment, was produced by a 115v ac buzzer concealed inside the console on which the response manipulanda were located. When *S* was seated, his head was approximately 2 ft from the buzzer. The intensity of the noise was 96 db. Subjectively, the noise was considered by the experimenter as mildly annoying but definitely not painful. The intensity was checked daily with a sound-level meter from a position which approximated the usual position of the *S*'s head. The duration of the noise punishment was 1 sec. If responses occurred during noise presentation, the noise continued for 1 sec after each response.

A reinforcement magazine was concealed above and to the left of R-1. A tray was located directly below the reinforcement magazine to catch the cigarette reinforcements as they dropped from the magazine. During the delivery of reinforcement, the tray was illuminated and a distinctive tone sounded for 3 sec to provide discriminative stimuli for the delivery of reinforcement. The entire vending apparatus appeared self-contained but was connected to electrical control and recording apparatus located in another room.

The reinforcements were scheduled in a manner that allowed *S* to obtain the same reinforcement frequency whether he emitted all responses on R-1, all on R-2, or some on

R-1 and the remainder on R-2. At irregular intervals that averaged 1 min, a reinforcement circuit was primed (1 min VI schedule). A cigarette reinforcement was delivered for the first response emitted following the priming of the circuit regardless of whether the response was made on R-1 or on R-2. Of course, when one manipulandum was made inoperable (single response situation), the responses could occur only on the operable manipulandum.

Procedure

The behavior of the *Ss* was studied according to the method originated by Lindsley (1956). There was no interaction between *Ss* and experimenter; *Ss* were taken to and from the experimental room by a laboratory assistant. The experimental session was 45 min in duration.

Four experimental conditions were arranged as represented in Table 1. The same schedule of reinforcement was in effect in all four Phases. In Phases 1 and 2, R-1 and R-2 were both unlocked (alternative response situation). During Phases 3 and 4, R-1 was selected as the response to be punished because when both manipulanda were available and unpunished, the response rate on R-1 was relatively greater. R-1 was thus considered the preferred manipulandum. Noise was delivered for every response on R-1 during Phases 2 and 4 but not during Phases 1 and 3. Each phase was in effect for a given *S* until the response rate showed no discernible trends from day to day. A minimum of eight sessions was provided for each of the four phases. The four phases were administered in the following order for all *Ss*: Phase 1, 2, 3, and 4.

Table 1
Experimental Conditions

	R-1	R-2
	<i>Alternative Response</i>	
Phase 1	no noise	no noise
Phase 2	noise	no noise
	<i>Single Response</i>	
Phase 3	no noise	
Phase 4	noise	

RESULTS

Table 2 presents the frequency of reinforcement obtained by each *S* during each experi-

Table 2
Reinforcement Frequency (Reinf/Min).
Each score is based on eight sessions.

Subject	No Punishment				Punishment			
	Single Resp.		Alternative Resp.		Single Resp.		Alternative Resp.	
	Avg.		Avg.		Avg.		Avg.	
	Mean	Dev.	Mean	Dev.	Mean	Dev.	Mean	Dev.
#20	.96 ± .02		.94 ± .01		.85 ± .03		.90 ± .01	
#22	.97 ± .02		.92 ± .02		.94 ± .01		.98 ± .01	
#24	.91 ± .03		.95 ± .03		.94 ± .02		.96 ± .02	

mental condition. The scores are based on the last eight sessions of each experimental condition. It can be seen that in the absence of punishment, approximately .94 reinforcements per min were received during the single response procedure as well as during the alternative response procedure. The frequency of reinforcement remained at approximately .94 reinforcements per min during the punishment condition. One subject (S-20) showed a slight (10%) decrease in the frequency of reinforcement under the single response punishment situation.

The response rates on the preferred manipulandum (R-1) during the four experimental conditions are shown in Table 3. Comparing the response rates in column 1 with the rates in column 2 shows that punishment in the single response situation greatly suppressed responding for S-20, partially for S-22, and

only slightly for S-24. The effect of punishment in the alternative response situation can be seen by comparing the response rate in column 3 with the response rate in column 4. The results show that the punished responses in the alternative response situation were reduced to a near-zero level for all Ss. S-20 and S-22 emitted less than one response per day. The effect of punishment in the alternative response situation as compared with punishment in the single response situation can be seen by comparing columns 2 and 4. The results show that the punished response rate was lower in the alternative response situation than in the single response situation for all three Ss.

Table 4 presents the rate of response of the unpunished manipulandum (R-2) under the alternative response situation. It can be seen that punishment of R-1 produced an increased

Table 3

Response rate (Resp/Min) on the preferred (R-1) manipulandum when only one response was available (Single Response) and when two responses were available (Alternative Response). Each score is based on eight sessions.

Subject	Single Response Available				Alternative Response Available			
	No Punishment		Punishment		No Punishment		Punishment	
	(1)		(2)		(3)		(4)	
	Avg.		Avg.		Avg.		Avg.	
	Mean	Dev.	Mean	Dev.	Mean	Dev.	Mean	Dev.
#20	63 ± 8		3 ± 1		27 ± 9		0 ± 0	
#22	158 ± 9		23 ± 7		118 ± 11		0 ± 0	
#24	102 ± 10		93 ± 6		78 ± 16		1 ± 1	

Table 4

Number of Alternative Responses (R-2) expressed as a Response Rate (Resp/Min) and as a percentage of the total responses (R-1 + R-2). Each score is based on eight sessions.

Subject	Before Punishment			During Punishment		
	Avg.		% Tot. Resp.	Avg.		% Tot. Resp.
	Mean	Dev.		Mean	Dev.	
#20	16.7 ± 2		39	22.1 ± 2		99.9
#22	.5 ± 0		1	216.8 ± 26		99.9
#24	26.3 ± 17		25	97.2 ± 4		99.0

rate of the unpunished response (R-2) for all three Ss. The increase in the rate of the unpunished response was greatest for S-22 who had made less than one response per min on R-2 when R-1 was not punished, but increased to 217 responses per min when R-1 was punished. The rate of response on R-2 is also expressed as a percentage of the total responses. It can be seen that over 99% of the responses of all Ss were made on R-2 when R-1 was being punished. Prior to the punishment of responses on R-1, less than 40% of the responses had been made on R-2. Punishment of one response in the alternative response situation appears to have shifted the responses almost entirely to the unpunished manipulandum.

DISCUSSION

The results of the present study are very similar to those of Holz *et al.* (1963). Both studies found that the punished responses in the single response situation were only partially suppressed. Similarly, both studies found almost complete suppression of the punished responses in the alternative response situation. Also, when punishment was delivered in the alternative response situation, the rate of responding on the alternative unpunished response manipulandum (R-2) greatly increased over the rate when R-1 was not punished. A principal difference between the two studies was the nature of the punishing stimulus.

Holz *et al.*, used a punisher (TO) that derived its aversive properties from the context in which it occurred (*i.e.*, a positive reinforcing schedule); whereas the present study used an unconditioned punisher (noise). This procedural difference produced a difference in results. When TO was used as a punisher, the reinforcement frequency necessarily decreased; but when noise was used as a punisher, no appreciable decrease of the reinforcement frequency occurred. The similarity of results in the two studies indicates that the increased effectiveness of punishment in an alternative response situation applies to unconditioned punishers as well as to punishment by means of a period of TO.

REFERENCES

- Ferster, C. B. and Skinner, B. F. *Schedules of reinforcement*. New York: Appleton-Century-Crofts, 1957.
- Herrnstein, R. J. Relative and absolute strength of a response as a function of frequency of reinforcement. *J. exp. Anal. Behav.*, 1961, **4**, 267-272.
- Holz, W. C., Azrin, N. H., and Ayllon, T. Elimination of behavior of mental patients by response-produced extinction. *J. exp. Anal. Behav.*, 1963, **6**, 407-412.
- Lindsley, O. R. New techniques of analysis of psychiatric behavior. Annual Technical Report No. 3 to the Group Psychology Branch, Office of Naval Research, September, 1955-November, 1956.
- Reynolds, G. S. Relativity of response rate and reinforcement frequency in a multiple schedule. *J. exp. Anal. Behav.*, 1961, **4**, 179-184.

Received August 20, 1963