

presence of and in the absence of a 1-sec, 80-dB tone of the same frequency. Each data point in Fig. 1 is the geometric mean of the three Os' results. Two sensation magnitude functions were fitted to the data by the method of least squares. The finding that magnitude estimations for all amplitudes of the tactile stimulus, including zero amplitude, were higher when the tone was presented than when it was not presented supports the hypothesis that a brief auditory stimulus presented simultaneously with a tactile stimulus can enhance tactile sensations.

It should be pointed out, however, that sensory interaction as psychophysically measured is a labile phenomenon. The experimental procedure may have a variety of effects on the O. As determined by previous studies, auditory stimulation may change tactile sensitivity and it may induce O to change his decision strategy. The results of the present study suggest that auditory stimulation may also change both the signal level and the noise level in the tactile sensory system, leaving sensitivity unchanged.

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Reinforcement relation: Reversibility within daily experimental sessions

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Running and licking response probabilities in rats were obtained for the first and last 13-min periods of 30-min daily test sessions. When licking was the more probable response, it reinforced running; when running was the more probable response, it reinforced licking. These data confirm the relative and reversible properties of the reinforcement relation.

Premack (1965, 1971) has conceptualized reinforcement as a relative relation between responses. This view contrasts with the traditional concept of reinforcement in which responses are classified absolutely as either reinforcing or nonreinforcing. A

corollary of Premack's relativity hypothesis, that the reinforcement relation is reversible, was supported in an experiment with rats where differential probabilities of running and licking were produced, then subsequently reversed by manipulating the Ss' accessibility to an

Table 1
Summary of Experimental Design and Number of Sessions for Each Animal

Phase	Experimental Condition in Each Session			Number of Sessions		
	Subsession I (First 13 Min)	Intersubsession (4 Min)	Subsession II (Last 13 Min)	S1	S4	S8
I	Paired Free Operant	Paired Free Operant	Paired Free Operant	18	18	18
II	Run-to-Lick	Paired Free Operant	Paired Free Operant	20	14	14
III	Run-to-Lick	Paired Free Operant	Lick-to-Run	32	34	44
IV	Run-to-Lick	Paired Free Operant	Paired Free Operant	14	12	8
V	Paired Free Operant	Paired Free Operant	Paired Free Operant	10	10	8

activity wheel and water (Premack, 1962). In the first part of Premack's study, water was continuously available and running was made more probable than licking by restricting the Ss' access to an activity wheel to only 1 h per day. A lick-to-run contingency was then arranged in which each five licks made the wheel available for 10 sec. As expected, the more probable running response reinforced the licking response. During the second part of Premack's experiment, licking was made more probable than running by providing free access to the activity wheel and by restricting the Ss' access to water to 1 h per day, then five instrumental runs were required to make the drinking tube available for a 10-sec period. Under these conditions the more probable licking response reinforced the running response, thereby demonstrating reversibility of the reinforcement relation, between sessions, with the same Ss.

Is it possible to obtain a reversal of the reinforcement relation *within each daily session*? Preliminary data collected by Bauermeister (1970) indicated that the probabilities of licking and running, in 23-h-water-deprived rats, showed progressive within-session changes when the opportunities to run and to drink were both freely and concurrently available. Although the probability of drinking was greater than the probability of running during the first 13 min of a 30-min daily session, the probabilities of occurrence of these responses during the last 13 min of the daily session were reversed. These within-session alterations in response probabilities provided the stimulus for the present experiment, which was a test of Premack's reversibility hypothesis within each daily session.

METHOD

Three female albino rats, 180 days old at the beginning of the experiment, and under a 23-h-water-deprivation schedule, served as Ss.

Three activity chambers described in detail by Schaeffer (1966) were used. The chambers permitted the presentation and retraction of a drinking tube and the braking and freeing of the activity wheel. The drinking tube in the activity chambers contained a 4%, by weight, sucrose solution. The running and licking responses were recorded by counters and Esterline-Angus digital operations recorders.

The experiment was conducted in five phases. Table 1 summarizes the experimental design and the number of 30-min

daily sessions given each S. The total number of sessions given each S depended solely upon stabilization of the running and licking responses across sessions. Throughout the experiment, each 30-min daily session was divided into three subsessions: Subsession I (the first 13 min), Subsession II (the last 13 min), and an Intersubsession 4-min period which separated the offset of Subsession I from the onset of Subsession II.

During Phase I, a paired free operant (PFO) condition (running and licking freely and concurrently available) was employed in Subsession I, Subsession II, and the intersubsession interval to permit estimation of running and licking response probabilities for each subsession. The PFO interval that separated Subsessions I and II provided the Ss with free access to the sucrose solution and the wheel following Subsession I, and ensured a higher probability of running than licking in Subsession II. As is indicated in Table 1, the PFO condition during the 4-min intersubsession interval was maintained in each of the experimental phases throughout the entire experiment.

During Phase II, when the run-to-lick contingency was arranged in Subsession I [each completion of 12 (360 deg) wheel turns made the drinking tube available for 10 sec], the PFO condition was continued during Subsession II. The purpose of these procedures in Phase II was to determine whether the licking and running response probabilities that had been obtained during the PFO condition in Subsession II in Phase I, would be altered by the introduction of the run-to-lick contingency in Subsession I of Phase II.

Phase III constituted the critical phase of the experiment. As indicated in Table 1, the run-to-lick contingency in Subsession I was continued, as was the PFO condition during the 4-min intersubsession period. In Subsession II in Phase III, the drinking tube was freely available, but the activity wheel was braked, and a lick-to-run contingency was programmed so that each completion of 12 licks was followed by a 10-sec period of wheel availability. Phases IV and V constituted direct replications of Phases II and I, respectively.

RESULTS AND DISCUSSION

Table 2 presents the mean number of runs (180-deg wheel turns) and licks for each S during the last 6 days of Subsessions I and II, for Phases I, II, III, IV, and V. The table shows that for each S, the sucrose-licking response was more probable than the running response during the PFO condition in Subsession I of Phase I. This numerical response relation was confirmed by analyses of response durations: mean times spent licking and running by the three Ss during the last 6 days in Subsession I of Phase I were 283.97 and 228.09 sec, respectively. Running, however, was a more probable response than licking in Subsession II of Phase I. Mean times spent running and licking by the three animals during Subsession II (last 6 days) in Phase I were 347.19 and 20.26 sec, respectively. The data in Table 2 show

Table 2
Mean Number of Runs (180-Deg Wheel Turns) and Licks During the Last 6 Days
in Subsessions I and II Under Experimental Phases I-V

Interval	Rat	Response	Phase I	Phase II	Phase III	Phase IV	Phase V
Subsession I	S1	Runs	602.16	695.33	697.66	720.16	428.82
		Licks	1771.77	1506.83	1576.50	1818.33	1940.77
	S4	Runs	511.82	760.50	882.00	898.50	681.72
		Licks	1964.50	1507.33	1783.33	1572.00	1952.41
	S8	Runs	622.49	874.55	829.00	844.83	423.49
		Licks	1801.15	1692.16	1641.00	1762.83	2394.99
Subsession II	S1	Runs	741.31	773.16	317.75	671.81	781.82
		Licks	97.83	167.51	856.66	164.91	268.00
	S4	Runs	758.50	793.30	202.66	990.00	969.58
		Licks	264.94	31.66	280.50	22.30	96.66
	S8	Runs	999.98	1053.29	160.33	954.48	1033.66
		Licks	32.31	135.33	587.00	34.32	54.28

that the run-to-lick contingency in Subsession I in Phase II resulted in increased running and decreased licking, relative to the running and licking rates obtained in Subsession I of Phase I. The contingency in Subsession I of Phase II did not significantly alter the relationship between running and licking that was established in Subsession II of Phase I. Mean times spent running and licking by the three Ss during Subsession II in Phase II were 363.85 and 17.15 sec, respectively.

During Phase III, the run-to-lick contingency in Subsession I maintained responding as effectively as it had in Subsession I of Phase II. Analysis of the Subsession I Esterline-Angus records for each S in Phase III indicated that, as in Phase II, a run-to-lick response pattern was developed in which completion of the scheduled running requirement was followed by licking during the 10 sec of drinking tube availability. During Subsession II of Phase III, the lick-to-run contingency resulted in an increment in instrumental licking and a decrement in contingent running, relative to PFO licking and running rates obtained in Subsession II in Phase II. Visual observation and analysis of Subsession II Esterline-Angus records indicated that a lick-to-run response pattern was adopted by Ss in which each completion of the FR 12 lick requirement was followed by running during each 10-sec period of wheel availability. Thus, during Phase III, the more probable licking response reinforced the less probable running response in Subsession I; in Subsession II, the more probable running response reinforced the less probable licking response. The group mean increment in running in Subsession I during Phase III was 39% greater than mean PFO Subsession I running during Phase I. The group mean increment in Subsession II licking during Phase III was 415% greater than the mean PFO subsession licking during Phase II.

Phases IV and V constituted replications of Phases II and I, respectively. It is evident from Table 2 that the mean licking and running observed in Subsessions I and II of Phases IV and V replicated the data obtained

during the corresponding subsessions of Phases II and I, respectively.

The findings of the present study corroborate Premack's (1965, 1971) contentions regarding the relativity and reversibility of the reinforcement relation. Unlike Premack's (1962) study, in which probabilities of running and licking were reversed across sessions by manipulating S's access to an activity wheel, in the present study the probabilities of the two responses were left to undergo natural preferential response alterations characteristic of unrestrained behavior patterns that occur outside laboratory restrictions. Independently of the potential appropriateness of the baseline technique of allowing response probabilities to be expressions of the individual Ss' reactivity and preferences, rather than simple products of experimental manipulations, the present results emphasize the importance of careful identification of momentary response probabilities. This is of crucial predictive importance to the reinforcement analyst who might fail to recognize that average overall sessional response probabilities may represent gross miscalculations of momentary within-session probabilities, and misidentification of appropriate and predictive contingencies of reinforcement, as has been acknowledged previously by Bauermeister (1970) and Premack (1971).

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