A Study of the Conditioned Response in Dogs with Special Reference to the Side of the Body Conditioned[1]

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Introduction.—Studies in bilateral conditioning should have two general results. First, in the field of Psychology new facts may be uncovered to contribute to learning theory. Second, neurological theory may receive significant factual contributions.

Few studies have been made on bilateral conditioning. Gibson, Jack, and Raffell (2) have established cross-education in conditioned finger withdrawals, and subsequently Gibson and Hudson (1) succeeded in establishing bilateral transfer of the conditioned knee-jerk. The present writers have previously reported (4) a similar study in dogs in which original conditioning of the right foot and reconditioning and transfer conditioning of the left foot were compared, as were simple extinction and transfer extinction which took place in the right foot while the left foot was being conditioned.

Technique of conditioning.—The apparatus consisted of a wooden stock in which the animal was securely fastened so that each forepaw was strapped to a balanced lever, allowing recording of the flexion response to a height of about four inches. The animal wes separated from the experimenter by a one-way screen. The conditioned stimulus was an ordinary doorbell buzzer mounted on the experimenter's side of the screen, while the unconditional stimulus was a faradic shock administered to the dog's wrist through two metal electrodes and adjusted just strong enough to elicit a good flexion response.

The buzz was sounded for 2 sec. with the shock overlapping the last .2 sec. of the buzz period. If, before the shock was given, the animal raised his foot approximately 2½ inches, a mercury switch attached to the lever arm opened the circuit so that the animal escaped the shock. Reactions of both forepaws, the buzz, the shock, and the time in .2-sec. units were graphically recorded.

The stimulations were given in daily series of 20 each. The shock was omitted every tenth and twentieth trial. The criterion for conditioning was a daily series in which occurred 19 responses an inch or more in height. The dogs were first conditioned to lift the right forepaw to the buzz, were then unconditioned, and were then reconditioned. Immediately after the completion of the reconditioning, the shock was transferred to the left foot for the purpose of observing the bilateral transfer effects.

Three characteristics of the conditioned response under these conditions are to be considered in this paper, namely, the frequency, the height, and the latency. The frequency is the number of conditioned

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responses of an inch or more in height taking place in each daily series. The height of the CR is the height of the foot at the point of introduction of the shock, whether or not the animal succeeded in escaping. The latency is the time between the beginning of the buzz and the beginning of the conditioned lift.

The progress of these measures throughout the different phases of the study as shown by their relation to the number of the series and the progressive relation of one to the other will be the form of the present analysis.

Comparison between different characteristics. Reliability coefficients were obtained by correlating the first half with the second half of each daily series. All correlation coefficients are obtained by the rank difference method and are uncorrected. Arithmetical averages of the coefficients have been given to facilitate comparison despite the statistical objections which are sometimes raised against such procedure.

TABLE I.—Reliability coefficients for the frequency, height, and latency of the conditioned flexion response for 3 dogs, in original conditioning of the right foot (O), reconditioning (R), and subsequent conditioning of the left foot (T).

		FREQUENCY		
DOG Nos.	1	2	3	Av.
O	.88	.63	.92	.81
R	1.00	.80	1.00	.93
T	.90	.80	.92	.87
Av.	.93	.74	.95	.87
		HEIGHT		
DOG Nos.	1	2	3	Av.
O	.79	.59	.60	.66
R	.50	1.00	.80	.77
T	.83	.80	.90	.84
Av.	.71	.80	.77	.76
		LATENCY		
DOG Nos.	1	2	3	Av.
O	.74	.30	.80	.61
R	1.00	.50	.80	.77
T	.77	.80	.90	.82
Av.	.84	.53	.83	.73

In general, reliability coefficients are high enough to justify their use. Coefficients for frequency are slightly higher than those for height and latency, but in the latter measures, a small but definite trend is observable throughout the training series, indicating a progressive increase in uniformity and consistency with training, no matter what the nature of the training.

Intercorrelations. The intercorrelations between the number of the series, the frequency, the height, and the latency are presented in Tables

II, III, and IV. It will be noted that in Tables II and III all coefficients are positive, while most of those in Table IV involving latency are negative. These values would indicate that amplitude and frequency are positively associated with the number of trials given and that latency stands in a negative relationship to the state of advancement. Irregularities in this table necessitate some explanation. It will be noted that the relationships are negative throughout in the case of one dog and are

TABLE II.—Correlations between the frequency of the conditioned response and the number of the series for 3 dogs, in original conditioning of the right foot, reconditioning, and subsequent conditioning of the left foot.

		ORIGINAL CONDITIONING		
DOG Nos.	1	2	3	Av.
	.90	.88	1.00	.93
		RECONDITIONING		
DOG Nos.	1	2	3	Av.
	.50	1.00	.95	.82
		LEFT-FOOT CONDITIONING		
DOG Nos.	1	2	3	Av.
	.93	1.00	.97	.97

TABLE III.—Correlations between the height of the conditioned response and the number of the series and between the height and frequency of the CR, in original conditioning, reconditioning, and subsequent conditioning of the left foot for 3 dogs.

		ORIGINAL CONDITIONING		
DOG Nos.	1	2	3	Av.
With number of series	.89	.83	1.00	.91
With frequency of response	.89	.92	1.00	.94
Average	.89	.88	1.00	.92
		RECONDITIONING		
DOG Nos.	1	2	3	Av.
With number of series	.50	.80	1.00	.77
With frequency of response	1.00	.80	.95	.92
Average	.75	.80	.98	.84
		LEFT-FOOT CONDITIONING		
DOG Nos.	1	2	3	Av.
With number of series	.83	1.00	.90	.91
With frequency of response	.93	1.00	.97	.97
Average	.88	1.00	.94	.94

TABLE IV.—Correlations between the latency of the conditioned response and the number of the series, between the latency and the frequency of the CR, and between latency and height for the CR, in original conditioning, reconditioning, and subsequent conditioning of the left foot.

ORICINAL CONDITIONING				
DOG Nos.	1	2	3	Av.
With number of series	—.69	.37	.80	.16
With frequency of response	—.71	.26	.80	.12
With height of response	—.63	.13	.80	.10
Average	—.68	.25	.80	.13
RECONDITIONING				
DOG Nos.	1	2	3	Av.
With number of series	—.50	—1.00	—1.00	—.83
With frequency of response	—1.00	—1.00	—.85	—.95
With height of response	—1.00	—1.00	—1.00	—1.00
Average	—.83	—1.00	—.95	—.93
LEFT-FOOT CONDITIONING				
DOG Nos.	1	2	3	Av.
With number of series	—.07	.75	.30	.33
With frequency of response	—.24	.75	.35	.29
With height of response	—.39	.75	.40	.25
Average	—.23	.75	.35	.29

negative in the reconditioning series for all three dogs. The fact that they are not so in the first training series for both the left and the right feet in two dogs is probably due (a) to the fact that the CR was unstable and irregular during the early trials and (b) to the possibility that the animals were more emotionally disturbed by the shock in the original conditioning and transfer conditioning than they were in reconditioning. This latter interpretation is supported by empirical observation during these phases of the study.

Hilgard and Marquis (3) reported this negative relationship between progress and latency in the case of the conditioned eyelid response. The irregularities indicated in this study may not have occurred in their work because of the difference in emotional effect between a puff of air on the eye, which they used, and the electric shock employed here.

Right-foot vs. left-foot responses. To discover whether there are characteristic differences between the CR movements which could be

related to the side of the body stimulated, the values in Table V were computed.

TABLE V.—Latency of the conditioned response in seconds for the original conditioning of the right forepaw (O), reconditioning (R), and subsequent conditioning of the left forepaw (T).

DOG		N	Av.	σ	σ av.
	O	419	.912	.558	.0273
1	R	52	.692	.490	.0680
	T	87	1.082	.450	.0482
	O	171	.440	.436	.0333
2	R	56	.436	.386	.0516
	T	72	.628	.366	.0432
	O	58	.924	.460	.0604
3	R	74	.858	.458	.0533
	T	86	1.258	.392	.0423

DOG		Diff.	σdiff.	Diff. / σdiff.
	OR	.220	.0732	3.00
1	OT	.170	.0554	3.07
	RT	.390	.0833	4.68
	OR	.004	.0614	.07
2	OT	.188	.0546	3.44
	RT	.192	.0673	2.85
	OR	.066	.0806	.82
3	OT	.334	.0738	4.53
	RT	.400	.0682	5.86

The average latencies in seconds, standard deviations, and standard errors of the averages are shown for O, R, and T in the case of each dog. It must be remembered in this connection that O and R involve the right side of the body while T involves only the left. From this table it may be seen that the critical ratios obtained are somewhat smaller between O and R than they are between R and T or O and T although the difference is a minor one in the case of Dog 1. It may also be seen that all three animals were slower to respond with the left than with the right forepaws.

It is probable that these differences are an outgrowth of an artifact of experimental procedure, namely, from what the authors have called *ambiguous conditioning*, a condition of the transfer series in which the dog apparently learns to lift the right foot and then the left foot in response to the buzz. This condition results from a continuation of the right foot lift even though the shock has been shifted to the left foot. The occurrence of this somewhat more complicated response may continue for only a few trials to as many as a hundred stimulations.

Further search for consistent differences between height, duration, and configuration of the right and left foot CR's has led to negative findings.

Summary. (1) Bilateral transfer of conditioning was experimentally observed in three mongrel dogs by means of the shock-buzz technique. The animals were trained to lift the right foot in response to the buzz, were unconditioned, were reconditioned, were then retained with the shock transferred to the left foot.

(2) The relationship between frequency, amplitude, and latency of the responses were considered in this report.

(3) Reliability coefficients for all these measures ranged from .30 to 1.00 with averages falling between .63 and .93.

(4) Latency was found to be the least consistent of the three, while frequency was the most consistent.

(5) Intercorrelations were reasonably high and positive between frequency, amplitude, and the stage of training, while correlations between latency and other measures were generally negative.

(6) Comparisons between responses of the left and right feet show a difference in latency which is large enough to be statistically reliable in most instances. No significant differences between the responses of the two sides were observed in duration, amplitude, or configuration.

References

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