

Inter-effector influences in operant autonomic conditioning¹

H. D. KIMMEL AND ELLEN KIMMEL
OHIO UNIVERSITY

Ss received visual reinforcement for emitted GSRs or vasoconstrictions (VMR). Control groups were matched to each of these in reinforcements/min, given at times of nonresponding. The effect of reinforcement depended upon which response determined its occurrence. All experimental groups responded more than their controls except when GSR determined reinforcement and VMR was measured. In this case, the controls responded more. When VMR determined reinforcement, GSR did not show this reversal. Respiration was not a significant factor. The reversal resulted primarily from the initially higher base rate of GSR over VMR. Because of this, GSR received fortuitous partial reinforcement when VMR was reinforced. VMR failed to benefit similarly when GSR was reinforced and suffered from frequent reinforcement for nonresponding.

This study sought to determine whether an autonomic response other than that which served as a basis for reinforcement would be influenced by such reinforcement. To achieve this, one group was given reinforcement in relation to emitted galvanic skin responses (GSRs) and one in relation to emitted vasomotor responses (VMRs). Both GSR and VMR were measured in both groups.

Method

Eighty male undergraduate Ss were told this was a study of the effect of external stimuli on physiological reactions and that they were to remain alert and avoid movement; 12 were rejected for unusual movement, reported drowsiness, equipment failure, or E error. The remaining 68 were assigned randomly to the GSR or VMR reinforcement conditions, within which yoked pairs were run such that both members received the same number of reinforcements per min during acquisition, the contingent S receiving the reinforcement following each appropriate criterion response and the noncontingent S receiving it at times of appropriate nonresponding.

The GSR was picked up from the palm and back of the left hand by zinc-zinc sulphate electrodes and the VMR was picked up photoelectrically from the left index finger. In addition, respiration was picked up by a chest bellows. The reinforcement was a dim 1 in. circular white light 30 in. in front of S. Its duration was 0.1 sec and it was followed by 3 sec of time out. Data were collected in an IAC audiometric chamber. Instructions were read via intercom after the equipment was attached and the lights turned out. Then a 10 min operant period was run, followed by 20 min of acquisition and 10 min of extinction. The GSR reinforcement criterion was a drop in resistance equal to or greater than 1% of the basal

R, with a maximum of 1,000 ohms. The VMR criterion was a drop in blood volume for two successive heart beats that equalled or exceeded one-half the average pulse-deflections of the previous 20 sec.

Results

The number of GSRs or VMRs per min was transformed to $\sqrt{X+1}$ and expressed as a percentage of the mean rate of the last 5 min of the operant period. Figure 1 presents the means of these percentages, in 2-min blocks, during acquisition and extinction.

Figure 1 shows that the contingent reinforcement groups responded at a higher level during acquisition than the yoked noncontingent groups, except in the two groups in the upper right-hand panel. It appeared that reinforcement of the GSR influenced the VMR in a direction opposite from what would be expected via conditioning. This reversed outcome did not occur symmetrically, since VMR reinforcement influenced the GSR in the expected direction. The upper left and lower right panels show small but expected reinforcement effects on each autonomic response when it is the basis of reinforcement. Analysis of variance of the data summarized in Fig. 1 revealed a highly significant interaction between reinforcement-contingency and which response was measured ($F=15.75$, $df=1/64$, $p<.001$) and a highly significant three-way interaction between reinforcement-contingency, response reinforced, and response measured ($F=15.15$, $df=1/64$, $p<.001$). The acquisition contingency effects vanished in extinction. Thus, no useful analysis of the extinction data was feasible. Both response measures remained above 100% throughout extinction.

Respiration rate remained essentially unchanged throughout the session for all groups (about 15-16 b/min). The groups neither differed from one another nor changed during the session.

Discussion

Reinforcing the GSR appeared to have an effect upon the rate of occurrence of the VMR that was opposite in direction from the effect that reinforcing the VMR had upon the rate of occurrence of the GSR. To explain this phenomenon, it was necessary to consider the possibility that reinforcing either of these responses could result in fortuitous reinforcement of the other and, in addition, that reinforcement of one could result in reinforcement of nonresponding in the other. Both of these possibilities were likely to be influenced by the independent operant

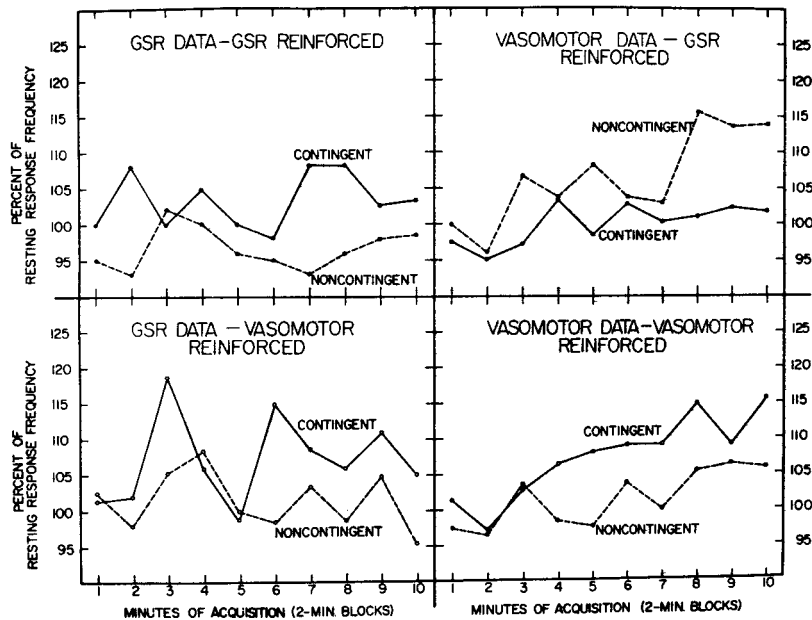


Fig. 1. Average percent of resting response frequency of acquisition GSRs and VMRs in all experimental conditions, in 2-min blocks.

rates of the GSR and VMR before conditioning and by the initial frequency of joint occurrence of the two responses.

During the last 5 min of the operant period a total of 548 criterion GSRs occurred, while there were only 293 criterion VMRs. On 89 of these occasions the two responses occurred simultaneously. This latter figure represents some 16% of the GSRs and 30% of the VMRs. Differential operant rates of the two reactions obviously led to a difference in the probability that reinforcement of one response would occur fortuitously in close temporal contiguity with the other.

A total of 453 GSR-contingent reinforcements were given, while there were 437 VMR-contingent reinforcements. In the GSR-contingent group the reinforcement was contiguous with a VMR on only 49 occasions and occurred in the absence of a VMR on 404 occasions. In the VMR-contingent group the reinforcement was contiguous with a GSR on 130 occasions and occurred in the absence of a GSR on 307 occasions. While the two groups received approximately equal reinforcements, the GSR benefitted much more from fortuitous reinforcement (in the VMR reinforced group)

than did the VMR (in the GSR reinforced group). Also, the VMR may have suffered in the GSR reinforced group from the high frequency of reinforcement contiguous with nonresponding.

Perhaps even more cogent in this analysis are the data relevant to partial reinforcement. When the GSR was reinforced and 49 VMRs occurred in close contiguity with the reinforcement, these VMRs represented only 23% of the total of 217 VMRs that occurred in that condition. On the other hand, when the VMR was reinforced and 130 GSRs occurred in close contiguity with the reinforcement, these GSRs represented 31% of the 413 GSRs that occurred in that condition. This last relationship is somewhat distorted in a conservative direction by the inclusion of the data of one S who received nine reinforcements for the VMR, of which seven occurred with GSRs, but who made a total of 75 GSRs. When this unusual S's data are excluded, the GSR was receiving better than a 50% schedule of reinforcement when the VMR was the response being reinforced.

Note

1. Done under USPHS grant MH-12262-02.