NOTE AND SHORT ARTICLES

STUDIES ON MODIFICATION OF SPONTANEOUS AUTONOMIC ACTIVITY: III. THE RELATION OF STRENGTH OF REINFORCER TO INSTRUMENTAL MODIFIABILITY OF AUTONOMIC RESPONSE

KEIICHI HAMANO AND SUSUMU MIYAKE

Notre Dame Seishin University

In the preceding study of this series (Hamano & Miyake, 1971), the authors have suggested that the strength of reinforcer may be a determinant of the instrumental modifiability of an autonomic response by a reinforcer. The main reason for making this statement is that reinforcers such as a dim light, a tone or money used in studies made so far (Kimmel, 1967; Miyata & Hamano, 1967; Katkin & Murray, 1968; Hamano, Okita & Miyata, 1970), are supposedly not very effective in modifying autonomic response.

As pointed out in a review by Miyata and Hamano (1967), this question can be narrowed down to the point of whether or not the reinforcer e.g., a dim light used by other investigators has great reward value for humans. As a descriptive generalization, we may say that a dim light can be quite effective; previous studies (Fowler & Kimmel, 1962; Kimmel & Kimmel, 1963; Van Twyver & Kimmel, 1966), have produced instrumental modification of an autonomic response. In the conventional instrumental situation, however, for the stimulus to acquire the rewarding effect upon the subject (S), it should be a necessary condition that he must have a "drive". And the more meaningful the stimulus has to him, the more he is motivated.

Thus, a need arises for some knowledge concerning the relation of drive level to the possibility of instrumental modification of an autonomic response. Yet, the experimental evidence considering this view has been limited to two reports (May & Johnson, 1969; Schwartz & Johnson, 1969).

The purpose of the present study was to investigate directly the possibility of instrumental modification of autonomic response as a function of drive level.

**METHOD**

**Subjects**

28 male students with an age range of 18–25 years served as Ss.

**Instructions**

Ss were instructed to sit quietly and to be as motionless as possible, but to remain awake. They were also asked to breathe normally and to pay attention to the screen. At no time were Ss told anything of the nature of the experiment.

Each S was interviewed at the end of the experiment to see whether he had remained awake and whether he had come to anticipate a further presentation of the slide which was used as reinforcer.

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The part of the study was read at the 34th Meeting of the Japanese Psychological Association in 1970 under the title of "Modification of autonomic response through training procedure of instrumental conditioning (II)."
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Recording
In the experiment, GSR with concomitant heart rate (HR) and respiration measurements were recorded. GSR was obtained by the DC resistance change from S’s left palm, HR from a standard EKG lead, and respiration from a strain gauge mounted on a rubber chest strap. The recording apparatus has been described previously (Hamano, 1969; Hamano & Miyake, 1971).

Reinforcer
The reinforcers were 130 different slides of nude females in color. These slides were projected from a Master Slide projector onto a white cardboard screen located 2 meters in front of S’s eyes. The duration of presentation was 3 sec. Projection was through the hole cut in the one-way vision glass which separated the experimental and control rooms.

Procedure
The present experiment was designed to investigate the effects of two different reinforcement schedules within the same individual after due consideration of some of the criticism pointed out by Katkin and Murray (1968). The basic design replicated that of May and Johnson (1969), after introducing some procedural changes. The main procedural way in which the two studies were different was in the reinforcement process by which spontaneous GSR evocation was suppressed as seen below.

28 Ss were divided into three groups, namely Group I and II each which consisted of 10 Ss, and Group III which consisted of 8 Ss. The procedure included a 10-min rest period, a 16-min first reinforcement period, a 16-min second reinforcement period, and an 8-min extinction period.

S was seated in a semi-sound proof, darkened experimental room and the recording electrodes were applied. The above mentioned instructions were then given. After this short briefing, the 10-min rest period was begun. During this period, all Ss were left quiet in the room without receiving any stimulation and the number of spontaneous GSRs occurring was recorded. A spontaneous GSR was defined as a change of greater than 2% of S’s basal skin resistance which was not related to movements or deep breathing on the part of S. Following this there were the first and second reinforcement periods during which Ss received stimulation. In Group I the reinforcer was given when spontaneous GSR occurred during the first 16-min period, while, during the second 16-min period, on the contrary, it was given when the GSR did not occur. Group II Ss were reinforced in an order reversed from that of Group I. In both groups, however, no reinforcer was intentionally presented for 5 sec immediately after each projection even if spontaneous GSR occurred continuously. After two different reinforcement periods, the 8-min extinction period was run.

RESULTS

The number of spontaneous GSRs shown here were transformed to the derived scores which have been used in previous studies (Kimmel & Hill, 1960; May & Johnson, 1969; Hamano & Miyake, 1971), except for those of the rest period.

Reinforcement and extinction curves
Mean transformed spontaneous GSRs for the three groups are presented in Fig. 1 in blocks of 2 min over the 40 min of reinforcement and extinction periods. As shown, group transformation curves diverged over the process of the 16-min first reinforcement period. In the second period, it can be seen that, although on the 1st block Group II Ss continued to have the foregoing reinforcement effect, on the 2nd their score was increased to approximately that of Group I during the first period. And with subsequent blocks their score gradually surpasses that of Group I. Looking at the part to the farthest right of the vertical line in Fig. 1, group curves have the tendency to converge over the 8-min extinction period.

Two factor analyses of variance were performed separately on the first reinforcement period, the second period, and the extinction period. The analysis of variance of the first period showed that the overall differences among the groups for condition dimension (C) were highly reliable (F=31.27, df=2/424, p<.01). However, the time dimension (T) was not significant. The C X T interaction was significant (F=5.94, df=14/424, p<.01). During the second period, the C and T dimensions were significant (F=36.96, df=2/424, p<.01; F=3.62, df=7/424, p<.01). The C X T interaction was also significant (F=7.89,
The statistical analysis of the extinction period likewise yielded significance of the C dimension ($F=30.62$, $df=2/212$, $p<.01$). The $C \times T$ interaction was significant ($F=10.70$, $df=6/212$, $p<.01$), even though the $T$ dimension was not.

Concomitant HR and respiration measurements

Fig. 2 indicates the mean transformed HR of the three groups during the reinforcement and extinction periods. As evident in Fig. 2, no consistent relationship was observed between the change of HR and the frequency of occurrence of spontaneous GSR. This relationship was also statistically nonsignificant.

Similar statistical analyses were performed on the mean transformed respiration rates which are depicted in Fig. 3. But comparison of the change of respiration rate and the frequency of the GSR showed that there was no statistically constant relationship between them.

![Fig. 1. Percentage of mean transformed GSR frequencies during reinforcement and extinction periods.](image1)

![Fig. 2. Percentage of mean transformed HR (beats) during reinforcement and extinction periods.](image2)
DISCUSSION

First of all, the results offer noticeable evidence for the effects of two different reinforcement schedules within the same Ss by using a more effective reinforcer. As shown in Fig. 1, the frequency of spontaneous GSR which occurred during the first reinforcement period in Groups I and II showed a reversal in each group during the second reinforcement period. However, the reversal in Group I during that period was less prominent than in Group II. It nonetheless occurred as can be seen from the extinction curves in both groups. The increased frequency of spontaneous GSR at the first and second blocks during the first period of both groups might be attributable to emotional excitement resulting from the presentation of the reinforcer.

The results of the present study generally resembled those of May and Johnson (1969). However, both differed from each other in the following particulars. Their results showed that the frequency of spontaneous GSR during the negative reinforcement period in each of Groups I and II was considerably lower than that of the resting level. In the present study, on the other hand, the modifiability in that direction was not so marked. This may be attributable to differences in the experimental procedures. May and Johnson (1969) gave a very intense sound as a punishment for the occurrence of spontaneous GSR during the negative reinforcement period. In the present study the same reinforcer that was used during the positive reinforcement period was also employed during the period paralleling the negative reinforcement of May and Johnson (1969). However, a suppression was attempted indirectly in this study by presenting the reinforcer only when GSR did not take place. That might be one of the reasons why there appeared a better suppressive modifiability of the occurrence of spontaneous GSR during the period corresponding to the negative reinforcement in their results than in the present study.

Further, this finding made us consider the possibility that the order of experimental procedures might also exert some influence on the modifiability. No definite conclusion could be made on this point. However, as far as two different reinforcement periods were concerned, such a possibility could be conjectured because Group I showed not such a good modifiability or prominent process of reversal during the second period as Group II did during the first period.

It is generally said that GSR is controlled by the sympathetic nervous system. It may be assumed from this statement that Group I showed a more active functioning of the sym-

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**FIG. 3.** Percentage of mean transformed respiration rates during reinforcement and extinction periods.
pathetic nervous system during the first period. In the second period, however, the situation took a sudden turn, and its operation had to be suppressed. Functional properties of the nervous system in general, as well as empirical facts, will tell us that such a switching is not easy. The switching seems to have been far easier in Group II which experienced an order of reinforcement schedules reversed from that of Group I. It can also be inferred from the fact that Group II gave clearer reversal curves in the results. But the correctness of this deduction is yet to be determined by future studies.

Based upon the general argument regarding systematic effects of random error in the yoked control design by Church (1964), Katkin and Murray (1968) have attempted to criticise the legitimacy of this sort of experimental design. In the present experiment such individual differences in response seem to be minimal because of a within-Ss design. Our results may thus argue against some of their criticism.

Furthermore, our data shows that concomitant HR and respiration measurements other than GSR were not influenced at all by the two different reinforcement schedules. In addition the possibility of modification by cognitive or somatic mediation was not noticed in the interview at the end of the experiment.

We conclude from those findings that the present results support the possibility of instrumental modification of autonomic response more strongly than in our preceding study (Hamano & Miyake, 1971), thus also supporting our assumption that the instrumental modifiability of an autonomic response may be influenced to some degree by the strength of the reinforcer.

REFERENCES


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