Two failures to demonstrate superiority of a generalized secondary reinforcer¹

WILLIAM A. MYERS AND MILTON A. TRAPOLD
UNIVERSITY OF MINNESOTA

In two separate experiments the reinforcing effect of a generalized secondary reinforcer (paired with both food and water) proved not to be superior to that of a simple secondary reinforcer (paired only with food) in maintaining bar pressing behavior in rats. These results are discussed in relation to the commonly held generalized secondary reinforcer hypothesis and in relation to Skinner's original formulation of the hypothesis.

Although it is frequently asserted that secondary reinforcers (S^R s) established through pairings with more than one primary reinforcer (generalized secondary reinforcers, gS^R s) are stronger, more persistent, or in some other sense better than those established through pairings with only one primary reinforcer (simple secondary reinforcers, ss^R s), there is very little data on the issue. Wike & McNamara (1957) found no difference in speed of running to a goalbox which for one group of rats had been paired with both food and water and for another group had been paired with food only. Using a choice test, however, Wike & Barrientos (1958) were able in three separate experiments with rats to show a slight preference for a food-and-water-paired goalbox over a goalbox paired only with food (or water). This preference, however, was found only under some conditions of test motivation, and those varied with no apparent systematicity over the three experiments. Similarly equivocal results were obtained by Clark (1957) who compared the reinforcing effect upon bar pressing of a stimulus which for one group had previously been paired with both food and water and for another group had been paired only with food.

The experiments reported here further explore the question of whether a stimulus paired with more than one primary reinforcer (S^R) is a more effective S^R than one paired with only a single S^R . They differ from previous experiments mainly in the type of test used to assess S^R strength, and in the motivational conditions in effect during establishment of the S^R s. Previous experiments have allowed the gS^R and ss^R conditions to differ not only in the number of S^R s paired with the S^R , but also in the number of motivational conditions in effect during the S^R - S^R pairings. Clearly this confounds the basic question of whether S^R strength is a function of the number of different S^R s with which it is paired. This confounding is eliminated here.

EXPERIMENT I

Method

Ss were 17 naive male Sprague-Dawley rats, 180 days old. Two identical operant conditioning chambers each

equipped with response lever, food and water delivery devices, house light, speaker, sound-deadening enclosure, and control and recording equipment located in an adjacent room, were used.

Ss were first reduced to 80% of ad lib weight by controlled-amount feedings once a day. Water was available for 1.5 hr. while Ss consumed their daily allotment of food. This procedure insured a degree of both food and water deprivation while maintaining Ss at 80% weight. After adaptation to its assigned chamber, each S received seven sessions of magazine training. In each session 32 food (.045 gm) and 32 water (.006 ml) S^R s were delivered randomly interspersed on a variable interval 22.5 sec. schedule (VI 22.5). Water S^R s were preceded by a .7 sec. blackout of the houselight; food S^R s were preceded by the normal operating noise of the feeder. Next, Ss acquired bar pressing for food. Reinforcement was initially continuous, and then was gradually decreased to VI 60 over two sessions. Ss then received eight sessions of VI 60 training at 25 S^R s per session. Ss then received 30 min. extinction sessions daily until achieving a criterion of no response in a 5 min. period.

Next, Ss were randomly divided into two groups. With the bar removed from the chamber, group gS^R ($N=9$) received pairings of a clicking sound with both food and water. The onset of each 2 sec. presentation (scheduled on VI 22.5) of the clicker was followed after 1 sec. by either food or water, randomly interspersed. Group ss^R ($N=8$) was treated identically except that the clicker was always followed by food; water deliveries were randomly interspersed between clicker-food trials. Group gS^R received a total of 124 clicker-food and 124 clicker-water pairings evenly divided across four sessions. Group ss^R received 248 clicker-food pairings and 124 randomly interpolated water deliveries during the same period.

Finally, the bar was reinserted and all Ss received three daily 30 min. sessions in which responding was reinforced on VI 60 by 2 sec. presentations of the clicker.

EXPERIMENT II

Method

This experiment differed from the first in two major respects. First, several measures were adopted to increase the effectiveness of the water S^R . Second, bar press training and S^R - S^R pairings were carried out concurrently here.

Ss were 17 naive male Sprague-Dawley rats, 270 days old. The apparatus was the same as that described in Experiment I.

Ss were reduced to 80% weight by controlled-amount feedings once a day. Water was again available only during the feeding period, but in this case Ss were given a fixed amount of water based upon observations made during a 16 day pre-experimental period in which it was found that for each S there obtained a fairly constant ratio between the amount of food allotted (on the basis of the formula we use to maintain 80% body weights) and the amount of water consumed in the process of eating that food. That ratio was determined for each S and was then used to compute the amount of water to be given each day of the experiment proper.

Ss were first adapted and then magazine trained as in Experiment I except that magazine training was continued beyond seven sessions until all Ss were consistently responding quickly and vigorously to the presentation of both S^R s. Then Ss were trained to bar press for food and water randomly interspersed. Reinforcement was initially continuous, but was then gradually decreased to VI 60.

Next, Ss were randomly divided into two groups. Both groups received seven more sessions of bar press training on VI 60. For group gS^R ($N=9$), each session contained 20 food and 20 water S^R s; the clicker came on for 2 sec. after each reinforced response, with S^R delivery occurring 1 sec. after clicker onset. For group sS^R ($N=8$) each session contained 40 food and 20 water S^R s; the clicker was presented only with food. Thus, group gS^R received a total of 140 clicker-food and 140 clicker-water pairings, while group sS^R received a total of 280 clicker-food pairings and an additional 140 water S^R s without the clicker.

All Ss were then given five 40 min. extinction sessions with nothing contingent upon bar pressing, followed by nine more sessions in which bar pressing was reinforced on VI 60 by 2 sec. presentations of the clicker.

RESULTS AND DISCUSSION

In both experiments both groups showed very large and highly significant increases in bar pressing rate (over rates at the end of regular extinction) when the clicker was introduced contingent upon bar pressing, indicating that the clicker was an effective reinforcer. This increase in response rate declined gradually over test sessions in both experiments, indicating that the S^R potential of the clicker was extinguishing. In neither experiment, however, were there any differences between the two groups at any point in testing that even approached significance. Even resorting to such devices as selecting the 5-min. period that showed the largest arithmetic difference between the groups, or performing covariance analyses taking advantage of sizable correlations between various indices of first extinction and test extinction response rates, failed to yield even a single .05 level significant difference in either experiment.

Clearly, these results provide no support for the hypothesis that the effectiveness of a S^R is a function of the number of S^R s with which it has been paired. Moreover, this is true despite the use of a testing procedure that should have been extremely sensitive to differences in both the momentary strength and the persistence of the S^R s, and despite the use of powerful covariance analyses and post hoc tests of selected data points.

Despite these negative results, however, one would not want to conclude from them alone that there is nothing to the generalized secondary reinforcer hypothesis. Differences might have been obtained with another method of assessing S^R strength; perhaps a choice measure similar to that used by Wike & Barrientos (1958). Moreover, these experiments, like earlier ones, explored only the most limited range of variation in kinds of S^R s paired with the S^R ; it may well be the case that the gS^R effect will be obtained when the stimulus is paired with a wider range of S^R s. Finally, it must be noted that while these results are contrary to the gS^R hypothesis as it is usually encountered in the literature (e.g., Ferster, 1964, p. 436; Skinner, 1957, p. 53), they are not inconsistent with the gS^R hypothesis as originally formulated by Skinner (1953). There Skinner argued that a gS^R should be more effective because "...if a conditioned reinforcer has been paired with reinforcers appropriate to many conditions, at least one appropriate state of deprivation is likely to prevail upon a later occasion" (Skinner, 1953, p. 77). This particular hypothesis about gS^R s carries no implication that the gS^R should be superior to the sS^R under the conditions of these experiments; i.e., when motivation during S^R testing is constant, identical, and equally appropriate for both the gS^R and sS^R conditions.

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Note

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