

A test of Premack's "indifference principle"

ROBERT W. SCHAEFFER
Auburn University, Auburn, Ala. 36830

JOSE J. BAUERMEISTER
University of Puerto Rico, Rio Piedras, Puerto Rico 00931

and

JUDITH HUDSON DAVID
Napa State Hospital, Napa, Calif. 94558

For two female college Ss, different procedures were used to produce comparable probabilities of lever responding for points and music. Both of these equally probable responses then were made contingent upon responding on a third lever on CRF, FR-5, and FR-10 reinforcement schedules. For all three schedules, the two equally probable responses produced comparable reinforced response increments. In a second experiment, a sequence of procedures was used which produced equal probabilities of responding for music and points, then a higher probability of responding for music relative to responding for points, then the converse probabilities. Responding on a CRF schedule varied directly with the probability of the reinforcing response. The results of both experiments were interpreted as support for Premack's indifference principle.

Premack (1965) suggested that if several responses are concurrently and freely available to S, any more probable response in the set will, when subsequently made contingent upon any less probable response, reinforce that less probable response. This contention has been supported by a variety of studies in which different organisms have served as experimental Ss (Premack, 1965).

Several studies have given credence to Premack's (1965) suggestion that the specific reinforcement value of a reinforcing response is (1) dependent upon the baseline probability of the contingent response (Bauermeister, 1970; Premack, 1963b; Wasik, 1967) and (2) independent of, and indifferent to, the procedures used to produce the probability of the reinforcing response or to the topographical characteristics of the response that manifests the probability (Premack, 1963a).

The first study presented below tested this so-called "indifference principle," in two Ss, by using different procedures to obtain equal baseline response probabilities on levers which produced music and points, then making the opportunity to respond to the music and points levers contingent upon responding on a third lever which had a probability value of essentially zero.

In the second study, for two other Ss, procedures were used to produce differing, then equal, probabilities of responding on the music and points levers. The opportunity to respond on these levers was then made contingent upon responding on a third lever. On the basis of the indifference principle, it was predicted, for the first study, that each of the two equally probable

responses would bring about equal reinforced increments in instrumental responding and, for the second study, that responses of different probability values would bring differential increments in instrumental responding. For both studies, it was predicted that these outcomes would be independent of the procedures used to produce response probability.

METHOD

The Ss were one male and three female volunteer college students enrolled in a general introductory psychology course.

The basic apparatus consisted of three Microswitch IAT2 levers, three Dialco 931-207 red cue lamp assemblies, and one Sodeco TCeF5E electrical reset five-digit counter mounted in the front of a standard BUD C-1893 cabinet. Each red cue lamp assembly and lever formed a vertical panel array. An intercom speaker was visibly located at the left side of the test console. Each of the three levers was programmed to produce different events. Depression of the third lever (to the S's right) produced points in the counter above it at the approximate rate of 17/sec as long as the lever was held down. Depression of the second lever made popular music available, through the speaker, as long as it was maintained down. Depressing the first lever produced no visual or auditory events for the S. The red cue light above each of the three levers was illuminated only when that particular lever involved was operational throughout the duration of each 2-min trial. Intertrial intervals ranged from 15 to 30 sec. No cue lights were illuminated, and no levers were operational during these intertrial intervals. Programming and recording electromechanical equipment were located in an adjacent room, from which the Es could observe the S through a one-way mirror.

Experiment 1

On the first test day, S was conducted into the experimental room, was shown the test console, and administered a standard set of instructions. Each of the two female Ss was told (a) that the purpose of the experiment was to determine S's ability to perform a series of discrimination and motor tasks, (b) that their task was to produce 940 points on the counter as quickly as possible, (c) that previous work in our laboratory had indicated that Ss could earn 940 points in about 1 min, (d) that S was not restricted to the points lever and was free to respond to any of the other levers at any particular time, (e) that each lever was operational only when its cue light was on, (f) that S could depress only one lever at a time, (g) that the accumulated points would be removed from the counter at the end of each trial, and (h) that a certain number of points would be entered on the counter prior to the initiation of some of the trials later in the experiment, but that this would be done totally independently of S's performance on any preceding trials.

Each S was then carried through the following conditions: baseline, CRF, baseline, FR 5, baseline, FR 10, baseline. During the baseline conditions, all three levers were simultaneously and concurrently available to S, as was indicated by illuminating all cue lights. During the contingency conditions, only responses on the first (instrumental) lever were effective initially, as was indicated to S by illuminating the cue light above the first level. Completion of the contingency requirement on this lever (e.g., five leverpresses during FR 5) made both the points and music levers simultaneously operational for a 15-sec period of contingent time (CT). The availability of these levers was indicated to S by illuminating the cue lights above the music and points lever during the CT interval. Prior to the initiation of each contingency trial, all of the accumulated points S had earned on the counter were removed and points (approximately 40 points

for CRF, 80 points for FR 5, and 110 points for FR 10) were placed on the counter by the E. This made it possible for Ss to accumulate 940 points in the contingency in approximately the same amount of time required to produce 940 points during the baseline conditions. This adjustment in points was required because S lost time manipulating the instrumental lever in the contingency periods but not in the baseline periods. The Ss had, thus, essentially equal opportunities to earn access to the music lever during both the baseline and the contingent trials.

Experiment 2

One male and one female S were carried through the following conditions: baseline, CRF, baseline, CRF, baseline, CRF. The instructions given these Ss were basically the same as those described above, except that Ss were requested to obtain 940 points in the first baseline and contingency condition, 470 points in the second baseline and contingency condition, and 1,410 points in the third baseline and contingency condition. Ss were informed that previous work in our laboratory had shown that Ss needed approximately 30, 60, and 90 sec to earn 470, 940, and 1,410 points, respectively. During each CRF condition, a single depression of the instrumental lever made both the music and points lever operational and freely available for a 15-sec period of CT. Prior to the initiation of each new contingency trial, the points Ss had accumulated on the counter on the previous trial were removed and a number of points were supplemented. Approximately 20, 40, and 60 points were added in the CRF contingency conditions when Ss were to earn 470, 940, and 1,410 points, respectively. By means of this procedure, it was possible for the Ss to accumulate in the contingency period the instructed number of points in approximately the same time as required during the preceding baseline condition and still have an opportunity to work for music during the contingency trials; this CT opportunity was essentially equal to the time available for the music lever in the baseline condition.

Both experiments were conducted in three approximately 1-h daily sessions. A minimum of four trials per experimental condition was given to each S. Each new condition was initiated only after a stable level of responding on all three levers during four consecutive trials of each condition, baseline or contingency, was obtained. The results presented below represent the Ss' stable performance obtained during the last four trials of each condition.

RESULTS AND DISCUSSION

In the first experiment, mean time spent responding per trial on the points lever for Ss 1 and 2 during the baseline conditions preceding the CRF, FR-5, and FR-10 contingencies was 58.1 and 58.9 sec, respectively. Mean within-trial response duration on the music lever during the baseline conditions preceding the CRF, FR-5, and FR-10 contingency conditions for Ss 1 and 2 was 58.2 and 58.5 sec, respectively. Both Ss showed a within-trial zero probability of responding on the first lever (which was to serve as the instrumental response) during the last four trials of the baseline conditions. Thus, not only was responding on the points and music levers during the precontingent baseline trials equally probable, but both were significantly more probable than responding to the first lever.

Initiation of the CRF, FR-5, and FR-10 contingency conditions produced increments in leverpressing on the instrumental lever, with the number of leverpresses reinforced by points and music approximately equal. Mean number of instrumental responses per trial that were followed by responding on the points lever during

the CRF, FR-5, and FR-10 contingency conditions were 3.66, 16.81, and 32.83, respectively. Mean number of instrumental responses per trial that were followed by responding on the music lever during the CRF, FR-5, FR-10 contingency conditions were 3.79, 18.16, and 33.1, respectively. Furthermore, the data indicate that the mean total CT used per trial for points and music in all of the contingency conditions was approximately equal. The mean CT earned and used per trial for points during the CRF, FR-5, and FR-10 conditions was 56.7, 54.8, and 49.6 sec, respectively. The mean total CT earned and used per trial for music during the CRF, FR-5, and FR-10 conditions was 56.9, 54.1, and 49.5 sec, respectively. Thus, not only did Ss emit equal instrumental response frequencies for these equally probable reinforcing responses, they earned and used equal amounts of CT in the contingency conditions. Clearly, the effects of the reinforcing responses on instrumental responding were independent of the conditions used to produce the reinforcing response probabilities.

In the second experiment, the mean within-trial response duration on the points lever for Ss 1 and 2 during the first, second, and third baseline periods was 58.3, 29.35, and 87.5 sec, respectively. Mean within-trial response duration on the music lever during these same baseline conditions was 58.5, 88.6, and 31.1 sec, respectively. Thus, the mean within-trial probabilities of responding on the points and music levers for both Ss were approximately .50 for both levers during the first baseline; approximately .25 for points and .75 for music on the second baseline; and approximately .75 for points and .25 for music on the third baseline. The probability of responding on the instrumental lever during the above conditions was zero. Initiation of the first CRF contingency condition resulted in each of the two equally probable points and music responses bringing equal within-trial mean increments in instrumental responding (3.74 and 3.75 leverpresses leading to points and music, respectively). Initiation of the second CRF condition resulted in the more probable music response generating a larger mean within-trial increment in instrumental responding for music (5.67 responses) than for points (1.90 responses). The third and final CRF condition resulted in the more probable points response's producing a larger mean within-trial increment in instrumental responding for points (5.65 responses) than for music (1.92 responses). Within-trial mean total CTs earned and used for points during the first, second, and third CRF conditions were 55.5, 28.6, and 85.0 sec, respectively. Within-trial mean total CTs earned and used for music during the same conditions were 55.2, 85.7, and 30.3 sec, respectively.

The results of the present experiment clearly support Premack's (1965) contention that the reinforcement value of a reinforcing response is determined, among other factors, "by response probability independent of parameters used to produce the probability or kind of

response that manifests the probability [p. 132].” The fact that two equally probable responses, one being produced by instructing S to accumulate a predetermined number of points, the other by giving S the opportunity to listen to popular music, proved to have comparable reinforcement effects supports the indifference principle. Further supportive evidence for the indifference principle is the fact that changing the probability values of the two dissimilar reinforcing responses produced reinforced instrumental increments directly proportional to the probability value of the reinforcing response.

Premack (1963a) first advanced evidence for the indifference principle in a study where different probabilities of drinking and running, respectively, were produced by presenting Ss with different concentrations of sucrose to drink, and by manipulating the torque requirements of the activity wheel in which the Ss ran. When each of these differentially probable responses was made contingent upon an instrumental barpress response, barpressing rates paralleled the corresponding reinforcing response probability values. Instrumental response rate was thus associated with the ordered set of run and drink probabilities, but was independent of the nature of the response and the procedures used to alter the probability of response occurrence.

The demonstration of the indifference principle in two widely disparate species (rats and men), under

widely disparate experimental conditions (drinking and running vs earning points and listening to music), suggests that the validity of the principle may be all-encompassing. If the capacity of the reinforcing response to reinforce instrumental responding is reducible to the common dimension of temporal duration, and precontingent temporal duration of the instrumental response is also shown to be a straightforward predictor of the outcome of the reinforcement relation (Bauermeister, 1970; Schaeffer, 1965), then the procedure of reinforcement may be shown to be remarkably less complex than many psychologists have imagined.

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Operant responding in the common crow (*Corvus brachyrhynchos*)

ROBERT W. POWELL

University of South Florida, Tampa Fla. 36620

Common crows can be shaped to keypeck for food reinforcement, using conventional operant conditioning apparatus. They will respond for a variety of foods, but live mealworms and Prime dog food are the most effective of those studied here. The crow would appear to be an interesting avian species for study, because it possesses a number of more complex behavioral characteristics than the pigeon.

Despite periodic criticisms (Beach, 1950; Bitterman, 1960; Lockard, 1968), experimental psychologists continue to focus their research upon a very small number of species, principally the domesticated rat, the domesticated pigeon, and the rhesus monkey. One of the “neglected” species has been the crow, which some ornithologists believe to represent the most advanced stage of avian evolution (Thomson, 1964). The crow would appear to be a potentially interesting subject for study because of its complex social behavior

(Bannerman, 1963), its elaborate communication system (Chamberlain & Cornwell, 1971), and ethological reports suggesting high intelligence (Lorenz, 1952).

The purpose of this report is to recount our experience in training common crows to keypeck for food, using conventional operant conditioning apparatus and procedures. As part of this research, we have investigated the relative effectiveness of a variety of food reinforcers for the crow.

METHOD

Training has been undertaken with 16 common crows (*Corvus brachyrhynchos*) so far. The crows were obtained from the Fur and Feather Game Farm, Neshkoro, Wisconsin. The birds had been taken from their nests as fledglings. They were maintained in the laboratory on a diet of dried dog food (Gaines Ken-L-Biskit), with water and grit (crushed granite) freely available. The crows were housed individually in a Bussey Products Fowl Battery. They were maintained under the same conditions as are appropriate for pigeons, except that each crow was provided with a perch, which it used frequently. Free-feeding weights, determined when each crow was approximately 6 months old, ranged from 330 to 552 g. Johnston (1961) reports that the weight of adult crows in the wild ranges from 315 to 575 g, depending upon sex and locality.