Stimulus properties of varied food concentrations [1]

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Eleven mixtures of Noyes sucrose and standard food pellets were used as discriminative stimuli to control responding under a multiple fixed-ratio 30 fixed-interval 2 min. schedule of reinforcement. In rats, response rates following each pellet concentration were controlled by the presence of the larger proportion of sucrose or standard food. Loss of discriminative control occurred when pellets composed of .50 sucrose and .50 standard food preceded the schedule components. Discrimination reversals developed when the pellet concentration of the original training food was less than .50.

The presentation of food pellets has been considered to have both reinforcing and discriminative functions in operant conditioning (Skinner, 1938, p. 242). Discriminative stimulus control by the type of pellet was demonstrated by Cruse, Vitulli & Dertke (1966). They used a two-ply multiple fixed-ratio 30 fixed-interval 3 min schedule in which the delivery of a standard laboratory food pellet as a reinforcer set the occasion for reinforcement on every 30th response and the delivery of a sucrose food pellet as a reinforcer set the occasion for reinforcement after a 3 min interval. There was no constant association between a schedule requirement and the type of pellet which followed, i.e., reinforced, the response requirement. A fixed-ratio 30 component was followed, randomly, by as many standard pellets as sucrose pellets in a session, and a fixed-interval 3 min component was followed, randomly, by as many standard pellets as sucrose pellets in a session. The type of pellet came to control the animal's rate of responding so that when a standard pellet was presented a short postreinforcement pause and high rate followed, and when a sucrose pellet was presented a long postreinforcement pause with a positively accelerated rate followed. When the association between the type of pellet and the schedule component was reversed, the operant discrimination also reversed.

Terrace (1963 a) has conducted a series of discrimination experiments in which little or no errors occured in the presence of a discriminative stimulus (S+). The effect, "errorless discrimination learning," was produced by first reinforcing a response in the presence of S+ and then introducing S–, the stimulus in the presence of which no responses are reinforced. The difference between S+ and S– was initially made large and then progressively reduced to a minimal value. Terrace (1963 b) used brightness and wavelength variations of visual stimuli. If organisms are able to discriminate small differences in visual stimuli with minimal errors as a function of successive reductions in the S+ and S– differential then it seemed interesting to apply similar procedures with food pellets as the S+ and S–. The present experiment attempted to establish small differential values of food pellet concentrations as discriminative stimuli.

Method

Two male albino rats (S1 and S2) with no previous training were used. The animals weighed between 360 and 400 g under conditions of free food and water. They were reduced to 80% of their free-feeding weights and were maintained at 70% to 80% of free-feeding weight throughout the experiment.

A Grason-Stadler one-bar rat chamber was used. The chamber received pellets from two Davis pellet dispensers. Each dispenser presented different concentrations of Noyes stock and specially prepared 45 mg food pellets. The dispensers were mounted on top of the experimental enclosure in the initial phases of the study. Later, and for the duration of the study, the dispensers were mounted on a wall directly above and outside of the experimental enclosure. A Y-shaped surgical tubing arrangement extended from the dispensers to the food hopper in the chamber. A 1 sec buzz occurred whenever either dispenser operated to mask the sound of their operation. Conventional programming and recording equipment were used.

After the animals were reduced to 80% of their free-feeding weight, S1 was magazine trained with standard pellets and S2 was magazine trained with sucrose pellets. Both animals were then placed on a continuous reinforcement schedule under the same type of pellet with which they were magazine trained. The response ratio was gradually increased for both rats to a fixed-ratio 30 (FR 30) schedule over a 10 day period. After 10 days on FR 30 with standard pellets for S1 and sucrose pellets for S2, S1 was placed on a multiple schedule in which a standard pellet always preceded an FR 30 component and a sucrose pellet always preceded a fixed-interval 2 min (FI 2 min) component. The multiple schedule will hence be referred to as mult FR 30 FI 2 min. There was random association between a schedule component and the type of pellet which followed the response requirement (Cruse et al, 1966, p. 294). S2 was placed on the same mult FR 30 FI 2 min schedule except that a sucrose pellet always preceded an FR 30 component and a standard pellet always preceded an FI 2 min component.

Daily sessions lasted an average of 60 pellets for each S. The pellet sequence and correlated schedule com-

ponent sequence was proportionally stratified (Ferguson, 1966, p. 134) and different for each session so that both animals received an average of 50% sucrose pellets per session. This was done by aperiodic input to a scientific prototype probability generator set for .50 output.

The animals were kept on the mult FR 30 FI 2 min schedule with 1.00 proportion sucrose and 1.00 proportion standard pellets for 35 sessions. The concentration of sucrose pellets was then reduced within the multiple to a mixture of .90 sucrose to .10 standard food per pellet. The concentration of standard pellets was reduced to a mixture of .90 standard to .10 sucrose food per pellet. Thus for S1, a .90 standard to .10 sucrose pellet occasioned an FR 30 requirement and a .90 sucrose to .10 standard pellet occasioned an FI 2 min requirement. All other properties of the multiple schedule were the same as described previously. For S2, a .90 sucrose to .10 standard pellet occasioned an FR 30 requirement and a .90 standard to .10 sucrose pellet occasioned an FI 2 min requirement. The animals received .90 sucrose and .90 standard pellets in the multiple schedule for five sessions. Other pellet concentrations were then presented.

The total program for pellet concentration changes, in the multiple schedule, is presented in Table 1. The sequence of concentration ratios from block of Sessions 1 through block of Sessions 20 refers to the order in which they were presented to the animals.

Results

Figure 1 summarizes the effects of different food concentrations upon rates of responding in the two components of the multiple.

Table 1.

Concentration proportions per pellet of sucrose and standard food presented to S1 and S2 in the multiple FR 30 FI 2 min. schedule.

Blocks of Sessions	No. of Sessions	FR 30 S1: Standard S2: Sucrose	FI 2 min. Sucrose Standard
1	35	1.00	1.00
2	5	.90	.90
3	5	.80	.80
4	5	.70	.70
5	5	.60	.60
6	5	.50	.50
7	5	1.00	1.00
8	2	.90	.90
9	2	.80	.80
10	2	.70	.70
11	2	.60	.60
12	2	.50	.50
13	2	.40	.40
14	2	.30	.30
15	2	.20	.20
16	2	.10	.10
17	5	.00	.00
18	2	.20	.20
19	5	.40	.40
20	2	.50	.50

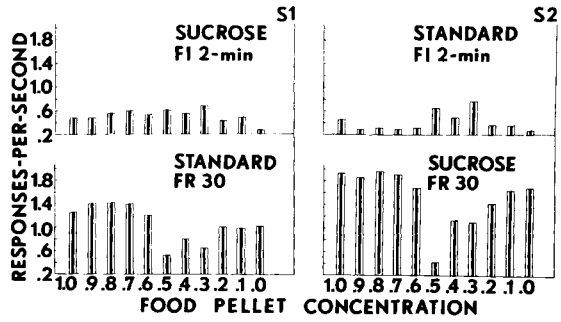

Fig. 1. Over-all responses per sec following pellet concentrations of sucrose and standard mixture in the mult FR 30 FI 2 min schedule for S1 and S2.

Discussion

The data in Fig. 1 support the notion that with respect to the food concentrations used in the present study, discriminative stimulus control exerted by food substances follows principles governing other stimuli, e.g., colors, forms, and sounds. The FR 30 rates of responding for S1 and S2 under standard and sucrose food, respectively, indicate that discriminative control by the larger concentration was relatively stable from 1.00 through .60. At .50 the FR rates dropped dramatically. The pellets lost their discriminative properties.

A "discrimination reversal" is apparent in both FR 30 graphs with regard to concentrations of .40 through .00. The opposing food substance now present in larger quantities began to exert discriminative control over response rates. The reversal rates for both animals, however, were never as high as the rates under the original discrimination.

Inspection of FI 2 min rates in relation to FR 30 rates within Ss reveals a tendency of rate inversion or "contrast effect" between components. Contrast is consistent with the interpretation that the pellet concentrations are controlling responding within the multiple schedule. High rates in FR should be associated with low, scalloped rates in FI. The inversion of rates is more pronounced for S2 than for S1.

References

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Note

1. This investigation was supported by Grants 01-6379 and 01-6391 from the Research Committee of the University of South Alabama. The valuable advice of Dr. John deLorge is gratefully acknowledged.