Behavioral contrast resulting from a change in sucrose concentration*

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Three rats were trained to respond on a two-component multiple schedule, with identical variable-interval 1.5-min components for 32% sucrose reinforcement. Subsequent reduction in the sucrose concentration of reinforcement to 8% in one component resulted in positive behavioral contrast for two Ss. Response rate facilitation was observed in both components for the third S.

The behavioral effects of manipulations in one component of a two-component multiple schedule are not necessarily limited to the manipulated component. For example, Reynolds (1961) trained pigeons on a multiple schedule, with identical variable-interval (VI) schedules of reinforcement associated with each component. A change to extinction in one component resulted in a response rate decrease in that component. Concomitantly, response rate facilitation occurred in the constant unaltered component. Reynolds (1961) termed this type of interaction "positive behavioral contrast" and emphasized the change in relative frequency of reinforcement as a determinant. However, contrast has been reported when the manipulation did not involve a change in relative reinforcement frequency. Differential reinforcement of low rate (e.g., Weisman, 1969), differential reinforcement of other behavior (e.g., Weisman, 1970), and shock punishment (e.g., Brethower & Reynolds, 1962) when introduced in one component have resulted in facilitation in the constant component.

Bloomfield (1969) suggested that contrast results when there is a "change for the worse" in one component. Thus, decreases in reinforcement frequency, punishment, and rate contingencies are assumed to entail such a change. In a similar vein, Premack (1969) suggested that contrast results when there is a change in the "relative aversiveness" associated with the components. A change in value of reinforcement, such as sucrose concentration, would also seem to involve this type of manipulation. However, as Premack (1969) noted, there seem to be no data relevant to this variable and behavioral contrast. The present experiment was designed to investigate behavioral contrast resulting from a decrease in the sucrose concentration of reinforcement associated with one component of a two-component multiple schedule.

SUBJECTS AND APPARATUS

The Ss were three male Holtzman albino rats, approximately 150 days old at the start of the experiment. They had received previous training in a two-compartment box under water deprivation 20 days before the start of the experiment. Throughout the experiment they were maintained at 80% ($\pm 2\%$) of free-feeding body weight. The experimental space was a 20.32 x 33.66 x 31.75 cm wooden chamber equipped with a ventilation fan and white noise. The response panel contained a response bar, horizontally centered 11.43 cm above the chamber floor, and two solenoid-operated liquid dippers with 5.72-cm-diam apertures, the centers of

which were 5.40 cm above the floor and 11.11 cm to either side of the response panel midline. The dipper cups held approximately 0.30 cc. Located 12.06 cm directly above each dipper was a 28-V dc signal light. During reinforcement, neither of these lights was on and illumination was provided by a 6-W 110-V ac light behind the appropriate dipper. A 28-V dc relay located behind the response panel provided response feedback. Associated control and recording equipment was located in a separate room. The sucrose mixtures were prepared from tap water and commercial sugar and are expressed in terms of percentage of sucrose by weight (Guttman, 1953).

PROCEDURE

The signal lights served as discriminative stimuli for the schedule components. During the left component (L), the left signal light was on and responses were reinforced with presentation of the left dipper. Similarly, during the right component (R), the right light was on and the right dipper was operative. Reinforcement duration was always 5 sec. Following two sessions of training with continuous reinforcement, the mean interreinforcement interval was increased over approximately 13 sessions to 1.5 min. The baseline condition was a two-component multiple schedule, with VI 1.5-min schedules of reinforcement associated with each component. The components alternated every 3 min and were separated by a 2-sec timeout. During timeout and during reinforcement, responses were neither recorded nor produced response feedback and the component timers did not operate. These schedule parameters remained unaltered throughout the experiment. During the baseline condition, both dippers presented a 32% sucrose solution. This condition remained in effect until stable performance was observed (R1, 13 sessions; R2, 15 sessions; R3, 15 sessions). Stability was defined in terms of the difference between the mean response rate for six consecutive sessions and the mean rate for either the first or last three sessions. A difference of less than 3% of the six-session mean was regarded as stable performance. This criterion was imposed upon each component.

One component was then altered so that responses were reinforced with an 8% sucrose solution. The left component was altered for R1 and R2 and the right component for R3. This condition remained in effect for 20 sessions. Throughout the baseline and experimental conditions, each session consisted of 10 3-min exposures to

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each component.

RESULTS AND DISCUSSION

For each S, the mean number of reinforcements per session and the mean response rate in each component for the last six sessions of baseline and the 20 sessions of the experimental condition are presented in Table 1. It is apparent that there was very little change in frequency of reinforcement throughout the experiment. In terms of actual response rate, the mean rate for R1 in the unchanged component (R) was over 20 responses per minute (R/min) higher during the experimental condition than during baseline. Also, the rate in the manipulated component decreased approximately 6 R/min. For R2, the rates also diverged, but the separation was far less pronounced with the rate in the constant component (R) increasing by about 2 R/min and the rate in the manipulated component (L) decreasing by less than 1 R/min. Response rate facilitation occurred in both components for R3. In fact, the degree of facilitation was somewhat greater in the manipulated component.

Sessional data are presented in terms of deviation from baseline in Fig. 1. Positive numbers indicate facilitation above the mean rate for the last six sessions of baseline, and negative numbers indicate suppression, e.g., 0.2 indicates an increase of 20% above the baseline rate. The manipulation resulted in immediate facilitation in the constant component (R) for R1, and responding remained markedly above baseline throughout the condition. Response rate in the constant component (R) for R2 did not begin to show an upward trend until the eighth session. Although the effect was not as pronounced in this S, response rate was consistently above baseline for the last 14 sessions of the condition. The degree of suppression in the manipulated component was also less for this S than for R1. The overall effect of the manipulation for R3 was facilitation in both components. Also, there was no evidence for separation in rates. The reasons for this discrepancy are not clear. However, in a later experiment, this S did demonstrate some degree of contrast when the component was altered to 4%, but, again, in a replication of the 8% condition, no

Fig. 1. Effects of the experimental condition in terms of deviation from the baseline response rate. Changes in responding in the left component are indicated by open circles and in the right component by filled circles. B represents the baseline condition.

contrast was observed.

In the present experiment, a decrease in reinforcement value in one component of a multiple schedule resulted in positive behavioral contrast for two Ss. The results would not be expected from Reynold's (1961) relative frequency of reinforcement interpretation, since this variable remained relatively constant. Furthermore, changes in body weight due to the decrease in sucrose concentration cannot account for the data, since this variable was also controlled (cf. Dunham & Kilps, 1969).

Since response rate decreased in the component associated with 8% sucrose, the results are congruent with the suggestion by Terrace (1968) that a sufficient condition for contrast is the reduction in responding in the manipulated component. However, interpretation in terms of Bloomfield's (1969) hypothesis seems equally applicable. In the latter case, the decrease in sucrose concentration does not result in contrast due to response rate reduction per se, but rather the

manipulation entails a "change for the worse" in the schedule component. Unfortunately, it is not possible to separate these factors in the present design.

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Table 1

		Subject					
		R1		R2		R3	
		L	R	L	R	L	R
Baseline	$\bar{X}$ Rate	35.5	35.0	12.8	10.7	15.3	11.3
	$\bar{X}$ SR/Session	20.0	20.0	19.2	19.7	19.3	19.0
Experimental Condition	$\bar{X}$ Rate	29.0	56.8	11.8	12.6	17.8	14.5
	$\bar{X}$ SR/Session	19.8	20.0	20.0	20.0	19.8	19.4