Two-bar sucrose preference'

GEORGE COLLIER, JOHN VOGEL AND FRANK REGA
RUTGERS UNIVERSITY

Rats given the alternative of a high and a low concentration of sucrose on a CRF schedule gave the greatest total number of responses to the low concentration bars and made the most responses in any pair to the bar that produced the highest concentration. The introduction of an FI schedule led to an increase in the rate of responding, a shift in the maximum to a higher concentration pair, and the disappearance of preference for either bar. These results were interpreted as evidence that rate of responding and preference reflect the same underlying process.

Numerous studies have shown initial BP rate to be a monotonic increasing function of sucrose concentration (e.g., Collier & Myers, 1961). These results have been interpreted as evidence that reinforcement magnitude is some function of concentration. Another way to define reinforcement magnitude is in terms of relative preference. On this basis it may be assumed that S will more frequently choose (respond to) the high concentration alternative if alternative responses lead to different concentrations of sucrose.

The present experiment examined the response frequency on two bars leading to two different concentrations under two schedules of reinforcement, in order to compare the two measures of reinforcement magnitude.

Method

The 24 Ss were male albino rats of the Sprague-Dawley strain, maintained on 12 gm per day of Purina Lab Chow and ad lib tap water. All of the Ss had previous training (continuous reinforcement by water) in the apparatus.

Four Skinner boxes delivering liquid reinforcements and employing two 25 gm bars were used. The bars were 3 in. apart and 3.9 in. above the floor of the cage, and were separated by a Plexiglas partition that extended 1 in. into the box. Two Plexiglas reinforcement cups were connected to two syringe-type liquid magazines set to deliver 0.1 ml reinforcements. A dim light (110 v ac GE No. NE51H bulb) which was located 1.4 in. to the side of each lever flashed when a reinforcement was being delivered. Four animals were assigned to each of the six permutations of 8, 16, and 32% sucrose. Where different, the position of the concentrations were rotated daily. The Ss received 10 daily sessions of CRF, then 25 days of FI-1 min., and then an additional 16 days of CRF, each session lasting 20 min. The FI schedules were programmed in such a fashion that a reinforcement on only one bar could be obtained in any given minute.

Results

The data for the last four days of each schedule were analyzed in terms of the mean number of BP per session, the percent BP made to the higher concentration or to

Table 1. Total number of BP and relative percent to alternative bars as a function of concentration pairs

CRF ₁					
	BP*	%*		BP*	%
8-16	210	73**		8-8	190 79
8-32	164	82**		16-16	164 67
16-32	157	79**		32-32	138 60
FI					
8-16	241	49		8-8	229 58
8-32	329	53		16-16	282 64
16-32	264	54		32-32	232 69
CRF ₂					
8-16	298	85**		8-8	381 54
8-32	259	88**		16-16	228 65
16-32	208	84**		32-32	245 58

* Cell means significantly inhomogenous.

** P differs significantly from 50%.

the preferred side where no choice was possible (Table 1). In the first CRF run the greatest number of responses were made by the low concentration groups, while in a given concentration pair the greatest number of responses were made to the highest concentration. The larger the difference in concentration the greater the preference. The animals receiving the same concentration on both sides showed a definite sidedness preference. The introduction of the FI schedule resulted in a substantial reduction in the preference for the higher concentration with significant differences appearing only at the very end of the series of sessions. The maximum rate of responding shifted as would be expected from prior work (Collier & Myers, 1961) toward the higher concentrations. Reintroduction of the CRF schedule resulted in an immediate reversion to the prior pattern of preference for the higher concentration and of the BP at the lowest concentration pair. The percent preference was significantly increased.

An analysis of the mean number of bursts (responses on one lever uninterrupted by a response on the other lever) and of the duration of the bursts for each concentration condition and schedule is shown in Table 2. It is apparent from these data that the introduction of the FI schedule led to a reduction of the length of the bursts to essentially the point of alternation.

Discussion

Free ingestion studies typically show a maximum intake of sucrose in the region of 8 to 16% sucrose, as do BP studies using a CRF schedule, even for initial rates (Jennings, 1966). On the other hand, brief exposure (see Young, 1966), two choice situations (Young, 1966;

Table 2. Mean numbers of bursts and length of burst in alternative bars as a function of concentration pairs

		CRF ₁					
H	L	#Bursts		P	NP	#Bursts	
8-16	13	6	18	8-8	18	4	14
8-32	14	2	12	16-16	30	3	9
16-32	19	4	13	32-32	18	5	10
FI							
8-16	2	2	122	8-8	2	2	119
8-32	2	2	164	16-16	4	2	116
16-32	3	4	96	32-32	4	2	104
CRF ₂							
8-16	31	2	22	8-8	10	2	65
8-32	17	2	31	16-16	8	3	39
16-32	33	4	27	32-32	7	3	59

Carpenter, 1958), and BP on FR and FI schedules (Collier & Myers, 1961; Jennings, 1966) show maximum intakes or maximum rates of responding for the higher concentrations. The CRF data of the present experiment are homologous with these prior results. The highest total number of presses occur for the lowest (average) concentration pairs, while preference, in terms of frequency of choice, is for the highest concentration. Thus, both rate and preference can be considered to be measures of the "same" response strength if the non-monotonic character of intake and CRF BP functions can be accounted for in terms of some other non-reinforcement phenomenon. Previous explanations have been in terms of the post-ingestive load (McCleary, 1953; Young, 1966; and Collier & Siskel, 1959). However, the present results and those of Jennings (1966) showing that even initial rates on CRF are non-monotonic sug-

gest that some additional non-reinforcement factor must be operating, responding immediately to the concentration in such a fashion as to limit intake of solute and acting independently of the post ingestive consequences.

The overall rate of responding increases and the point of maximum responding shifts toward the higher concentrations when the FI schedule is introduced. In this respect it resembles the single-bar FI data. Unexpectedly, however, the preferential responding breaks down. This failure appears to result from S alternating responses on the two bars, possibly as a function of non-reinforcement, and seemingly resulting in an inability to discriminate the response which leads to the reinforcement. In any case, it would appear that response rate and preferential responding reflect the same underlying process (s) if non-reinforcement (e.g., post-ingestive effects) variables are controlled or eliminated.

References

- Carpenter, J. A. A comparison of stimulus-presentation procedures in taste-preference experiments. *J. comp. physiol. Psychol.*, 1958, 51, 561-564.
- Collier, G., & Myers, L. The loci of reinforcement. *J. exp. Psychol.*, 1961, 61, 57-66.
- Collier, G., & Siskel, M. Jr. Performance as a joint function of amount of reinforcement and inter-reinforcement interval. *J. exp. Psychol.*, 1959, 57, 115-120.
- Jennings, W. A. Sucrose preference in a two-bar situation. Eastern Psychological Association, New York City, 1966. (Abstract)
- McCleary, R. A. Taste and post-ingestive factors in specific hunger behavior. *J. comp. physiol. Psychol.*, 1953, 46, 411-421.
- Young, P. T. Hedonic organization and the regulation of behavior. *Psychol. Rev.*, 1966, 73, 59-86.

Note

1. This investigation was supported by Research Grant HD00941 from the National Institute of Mental Health, Bethesda, Maryland.