JOURNAL OF THE EXPERIMENTAL ANALYSIS OF BEHAVIOR 1974, 22, 471-481 NUMBER 3 (NOVEMBER)

BEHAVIORAL INTERACTIONS IN MULTIPLE VARIABLE-INTERVAL SCHEDULES[1]

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In Experiment I, two groups of four pigeons each were exposed to multiple schedules in which one component was always a variable-interval schedule with a mean interreinforcement interval of 30 or 180 seconds. The other component was either an equal variable-interval schedule or extinction. Response rates in the unchanged component always increased when reinforcement was no longer scheduled in the changed component, and decreased in seven of eight cases when the variable-interval schedule was re-introduced. The per cent rate change in the unchanged component was inversely related to the frequency of reinforcement and to the ongoing response rate in the unchanged component. Rate changes in the unchanged component were not consistently correlated with changes in any single feature of the relative-frequency interresponse-time distributions. In Experiment II, the same pigeons were exposed to variable-interval schedules and multiple variable-interval variable-interval schedules with equal mean interreinforcement intervals. Response rates were similar under both conditions.

When the frequency of reinforcement associated with one component of a multiple schedule is reduced, the response rate in that component usually decreases, and the rate in the unchanged component increases. Reynolds (1961) labelled this effect behavioral contrast. Contrast also occurs in certain situations where the schedule, but not the frequency, of reinforcement in one component is changed. Terrace (1968) reported the development of contrast when a brief electric shock followed each response in one component of a multiple variable-interval variable-interval (*mult* VI VI) schedule. The shock intensity was adjusted so that reinforcement frequency was not altered appreciably. In the same study, contrast sometimes developed when a VI schedule was alternated with a differential-reinforcement-of-low-rate (DRL) schedule having approximately equal reinforcement frequencies. Weisman (1970) reported similar results using a differential-reinforcement-of-other-behavior (DRO) schedule. In addition, Hemmes and Eckerman (1972) found an increase in response rate in the unchanged component when a differential-reinforcement-of-high-rate (DRH) schedule was introduced in the other component.

Some researchers have concentrated on the analysis of variables that affect the magnitude of behavioral contrast. Several studies (Bloomfield, 1967; Nevin, 1968; Reynolds, 1963) have demonstrated that the magnitude of contrast may be a function of the amount of reduction of reinforcement frequency associated with the changed component. Reynolds (1963) also showed that when the frequency of reinforcement in the unchanged component was relatively low (20 per hour), contrast developed when the frequency of reinforcement in the other component was reduced. However, when the frequency of reinforcement in the unchanged component was relatively high (38 per hour), contrast usually failed to develop after reinforcement frequency was reduced in the other component. These results suggest that the magnitude of contrast may be higher for behavior maintained by less-frequent reinforcement when one component of an equal-valued *mult* VI VI schedule is changed to extinction (EXT).

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[1] Experiment I is based on portions of a thesis submitted by Roger D. Spealman to the Department of Psychology, University of Maryland, in partial fulfillment of the requirements for the M.A. degree. The research was supported in part by USPHS Grant MH-01604 from the National Institute of Mental Health. Reprints may be obtained from Roger D. Spealman, Department of Psychology, University of Maryland, College Park, Maryland 20742.

Herrnstein (1970) suggested that the equation

$$P_1 = \frac{kR_1}{R_1 + mR_2 + R_0} \qquad (1)$$

may accurately predict the response rate (P_1) in the first component of a multiple schedule. In this equation, R_1 and R_2 are the reinforcement frequencies in the first and second components, respectively. The parameter k represents the asymptotic rate of response when no alternative reinforcement is available, while R_0 represents the frequency of alternative reinforcement endemic to the experimental situation. The dimensionless parameter m may vary between 0 and 1.0 and represents the degree to which reinforcement in one component affects responding in the other component.

If the reinforcement frequencies in the two components are equal, as in an equal-valued *mult* VI VI schedule, then $R_1 = R_2$ and equation (1) may be rewritten as

$$P_1 = \frac{kR_1}{R_1 + mR_1 + R_0}, \qquad (2)$$

where R_1 is now the reinforcement frequency in each component.

When reinforcement is no longer scheduled in the second component, as in a *mult* VI EXT schedule, then the middle term in the denominator of equation (2) is zero and the equation becomes

$$P_1' = \frac{kR_1}{R_1 + R_0}, \qquad (3)$$

where P_1' is the response rate in the first (unchanged) component of the new schedule. Contrast is thus predicted, since $P_1' > P_1$, assuming $m > 0$.

Another equation that predicts the magnitude of contrast (the per cent rate change in the unchanged component) can be derived from equations (2) and (3) as follows:

$$\frac{P_1' - P_1}{P_1} \times 100 = \frac{\dfrac{kR_1}{R_1 + R_0} - \dfrac{kR_1}{R_1 + mR_1 + R_0}}{\dfrac{kR_1}{R_1 + mR_1 + R_0}} \times 100$$

$$= \frac{mR_1}{R_1 + R_0} \times 100. \qquad (4)$$

According to this equation, as R_1 increases, the magnitude of contrast also increases, assuming that m and R_0 are greater than zero and constant across experimental conditions. This is true because the relative contribution of R_0 to the denominator of equation (4) diminishes as R_1 increases. Thus, one prediction derived from Herrnstein's formulation is that the magnitude of contrast is lower for behavior maintained by less-frequent reinforcement when one component of an equal-valued *mult* VI VI schedule is changed to EXT, a prediction opposite to that suggested by the results of Reynolds' (1963) experiment.

Another prediction based on Herrnstein's formulation is that the response rate maintained by a VI schedule in isolation is higher than that maintained by a *mult* VI VI schedule in which the same VI schedule is used in the two components. This can be seen by noting that P_1' in equation (3) also represents the response rate maintained by a VI schedule in isolation and that $P_1' > P_1$ in equation (2), assuming $m > 0$.

The present experiments investigated the relation between the magnitude of response rate changes and the frequency of reinforcement when *mult* VI VI schedules were changed to *mult* VI EXT or to VI schedules in isolation.

EXPERIMENT I

Experiment I was designed in part to investigate the relationship between the magnitude of behavioral contrast and the frequency of reinforcement in two groups of pigeons exposed to reinforcement frequencies that differed by a factor of six. It was also designed to allow a microanalysis of behavioral contrast in terms of interresponse times (IRTs). Farmer (1963) collected relative-frequency IRT distributions of pigeons exposed to a variety of random-interval (RI) schedules. He noted that when the rate of key pecking was high, a single mode between 0.30 and 0.45 sec dominated the distributions. When rates were reduced, the distributions became markedly multimodal, with the loci of subsequent modes lying in an approximate arithmetic relation to that of the first mode. Thus, relative-frequency IRT distributions may change in an orderly fashion following experimental manipulations that affect response rate. In the present study, the response rate in one component of a multiple schedule was changed by changing the schedule associated with a second component. Previous experiments have not described how relative-frequency IRT distributions changed in this situation.

METHOD

Subjects

Eight White Carneaux pigeons, maintained at approximately 80% of their free-feeding body weights and experimentally naive at the beginning of the study, served. Pigeons P264, P267, P269, and P270 were arbitrarily assigned to Group I and Pigeons P273, P275, P298, and P300 to Group 2.

Apparatus

Four three-key BRS-Foringer operant conditioning chambers for pigeons (model PH004) were used. In each chamber, the center key was transilluminated by either a red or green light from an IEE one-plane readout cell and could be operated by a minimum force of 15 g (0.15 N). Side keys were always dark and inoperative. Each chamber was illuminated by two 2-W lamps located above the side keys and shielded by a strip of clear Plexiglas. Reinforcement consisted of 3-sec access to mixed grain from a lighted magazine. During reinforcement periods, all other lights in the chamber were off. Ventilation and masking noise were provided by a continuously operating exhaust blower. Scheduling and recording functions were performed by an on-line PDP8/E digital computer operating under the SKED process control software system. Cumulative records were made by four Gerbrands cumulative recorders (model C-3).

Procedure

After the pigeons were trained to eat from the lighted magazine, grain presentations were made contingent on successively closer approximations to key pecking. The first 60 key pecks then produced reinforcement.

Multiple variable-interval variable-interval (Phase I). The pigeons in Group I were then exposed to a *mult* VI 30-sec VI 30-sec schedule. The pigeons in Group 2 were exposed to *mult* VI 180-sec VI 180-sec after five to nine sessions of exposure to *mult* VI 30-sec VI 30-sec. Each variable-interval schedule was made up of an arithmetic distribution of 11 intervals arranged in irregular order. Reinforcements under each multiple schedule were arranged by a single variable-interval device. Components of the multiple schedules alternated every 180 sec. The red keylight was associated with the first component, and the green keylight with the second component. Scheduled grain presentations not delivered were cancelled after a component change. Daily sessions lasted either 30 min (Group 1) or 180 min (Group 2).

Multiple variable-interval extinction (Phase II). One component of each multiple schedule was changed to extinction when the following criteria for rate stability had been met. After at least 30 hr of exposure to the *mult* VI VI schedule, response rates in each component were computed for the last nine consecutive daily sessions. Each rate was subtracted from the corresponding rate in the previous session and the sign of the difference noted. If the proportion of positive or negative values for either component differed significantly from 0.5 according to a sign test, then the schedule was not changed. In addition, no schedule change was made if the me-

Table 1

Schedules and Hours of Exposure

Subject (i)	*Phase* (ii)	*Component Schedules* *Red* (iii)	*Component Schedules* *Green* (iv)	*Hours* (v)
P 264	I	VI 30-sec	VI 30-sec	36.5
	II	VI 30-sec	EXT	37.5
	III	VI 30-sec	VI 30-sec	35.0
P 267	I	VI 30-sec	VI 30-sec	45.0
	II	EXT	VI 30-sec	34.5
	III	VI 30-sec	VI 30-sec	40.0
P 269	I	VI 30-sec	VI 30-sec	39.0
	II	VI 30-sec	EXT	30.5
	III	VI 30-sec	VI 30-sec	48.0
P 270	I	VI 30-sec	VI 30-sec	40.5
	II	EXT	VI 30-sec	36.5
	III	VI 30-sec	VI 30-sec	49.5
P 273	I	VI 180-sec	VI 180-sec	81.0
	II	VI 180-sec	EXT	102.0
	III	VI 180-sec	VI 180-sec	282.0*
P 275	I	VI 180-sec	VI 180-sec	87.0
	II	EXT	VI 180-sec	135.0
	III	VI 180-sec	VI 180-sec	156.0
P 298	I	VI 180-sec	VI 180-sec	93.0
	II	VI 180-sec	EXT	99.0
	III	VI 180-sec	VI 180-sec	183.0
P 300	I	VI 180-sec	VI 180-sec	186.0
	II	EXT	VI 180-sec	78.0
	III	VI 180-sec	VI 180-sec	123.0

*Extended due to broken beak.

dian response rates for either component in the first, middle, and last three sessions of the nine-session sample described a monotonic function. For two pigeons in each group, the first component was changed to EXT, for the remaining two pigeons in each group, the second component was changed to EXT. The VI device was inoperative while the EXT component was in effect.

Multiple variable-interval variable-interval (*Phase III*). When the criteria for rate stability were again met, the schedule was changed back to the original *mult* VI VI schedule and remained in effect until rates again stabilized.

The component schedules and number of hours of exposure to each multiple schedule are shown in Table 1.

Recording. In addition to the number of responses and grain presentations in each component of the multiple schedules, interresponse times were recorded during every other session in the following manner. Each response that terminated an IRT incremented one class-interval counter. Each class interval was 0.04 sec wide and IRTs larger than 3 sec were pooled in the last class-interval counter. Each IRT distribution was therefore made up of 76 class intervals. Separate IRT distributions were recorded for each component of the multiple schedules. The first response following each reinforcement or component change did not increment a class interval because these responses properly terminate latencies rather than IRTs. In addition, no IRTs were counted

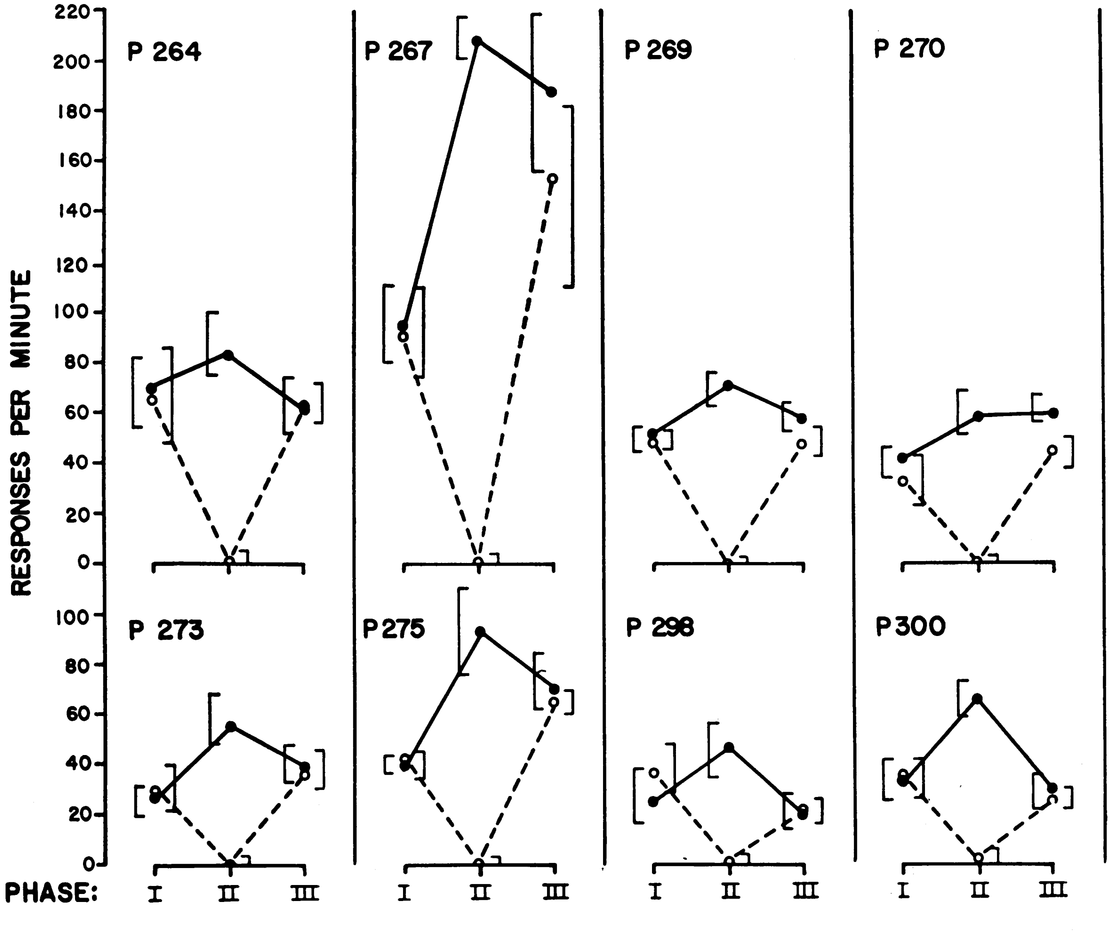

Fig. 1. Mean response rates and ranges during the last 10 sessions of each phase of Experiment I. Filled circles and brackets opening to the right correspond to rates and ranges in the unchanged component. Open circles and brackets opening to the left correspond to rates and ranges in the changed component. The top curves are from data generated from the pigeons in Group 1 and the bottom curves from data generated by the pigeons in Group 2.

during the first 6 min of each session in order to eliminate possible "warm-up" effects from the distribution.

Results

Macroanalysis. Figure 1 shows the mean response rate of each pigeon during the last 10 sessions of each phase of the experiment. Filled circles and brackets opening to the right correspond to means and ranges of rates in the unchanged components. Open circles and brackets opening to the left correspond to means and ranges of rates in the changed components. The top set of curves is from data generated by the pigeons in Group 1 (VI 30-sec in the unchanged component); the bottom set, from data generated by the pigeons in Group 2 (VI 180-sec in the unchanged component).

During Phase 1, most pigeons responded at nearly equal rates in each component of the multiple schedules. When one VI schedule was changed to EXT in Phase II, rates in the unchanged component increased and rates in the EXT component decreased to a near-zero level in all cases. Positive behavioral contrast was, therefore, always observed. With one exception, rate increases, either in terms of absolute rate or per cent, were higher for the pigeons in Group 2. The magnitude of positive contrast was therefore usually higher for behavior maintained by less-frequent reinforcement. When the VI schedule was re-introduced in the changed component in Phase III, response rates in that component always increased. Furthermore, with the exception of P270 (Group 1), response rates in the unchanged component decreased. Negative behavioral contrast was therefore observed in seven of eight cases. The absolute rate decreases were greater for the pigeons in Group 2 in three of four comparisons. In terms of per cent, rate decreases were always greater for the pigeons in Group 2. The magnitude of negative contrast was therefore usually higher for behavior maintained by less-frequent reinforcement.

Although the magnitude of contrast appears to be inversely related to the frequency of reinforcement that maintains responding, this may be an indirect rather than a direct relation. Figure 2 shows a scatter plot of per cent rate increases (filled symbols) and decreases (open symbols) as a function of the response rates in the unchanged components during Phases I and III, respectively. Triangles represent data generated by the pigeons in Group 1 and circles, data generated by the pigeons in Group 2. Note that logarithmic coordinates are used and there is no point representing a rate decrease for P270, as no negative contrast was observed for this pigeon. Figure 2 indicates that the magnitude of contrast in terms of per cent is generally higher for behavior occurring at lower rates. The correlation coefficient calculated from the logarithms of the values of the points in Figure 2 was −0.67. The magnitude of contrast in terms of per cent rate change therefore seems to be inversely related to the ongoing rate of response to at least a moderate degree.

Microanalysis. Figures 3 and 4 show the relative-frequency IRT distributions in the unchanged component of multiple schedules during five of the last 10 sessions of each phase of the experiment for the pigeons in Groups 1 and 2, respectively. Note that in each case, these distributions are distinctly multimodal. During most phases of the experiment, the first mode occurred between 0.04 and 0.16 sec for each pigeon. The second

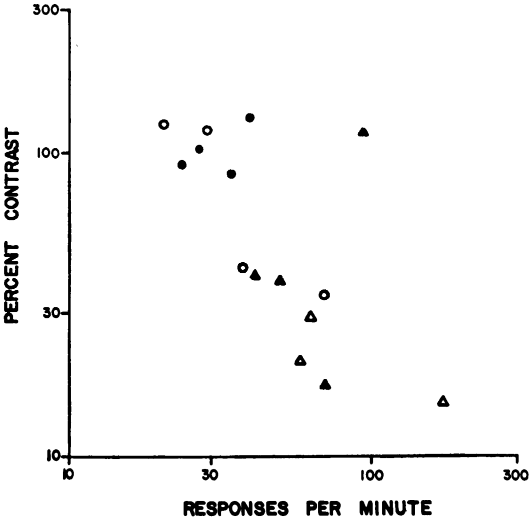

Fig. 2. Scatter plot of per cent increase (filled symbols) and per cent decrease (open symbols) in the unchanged component as a function of response rate in the unchanged component during Phases I and III respectively. The triangles represent data generated by the pigeons in Group I and the circles data generated by the pigeons in Group 2. Note the logarithmic coordinates.

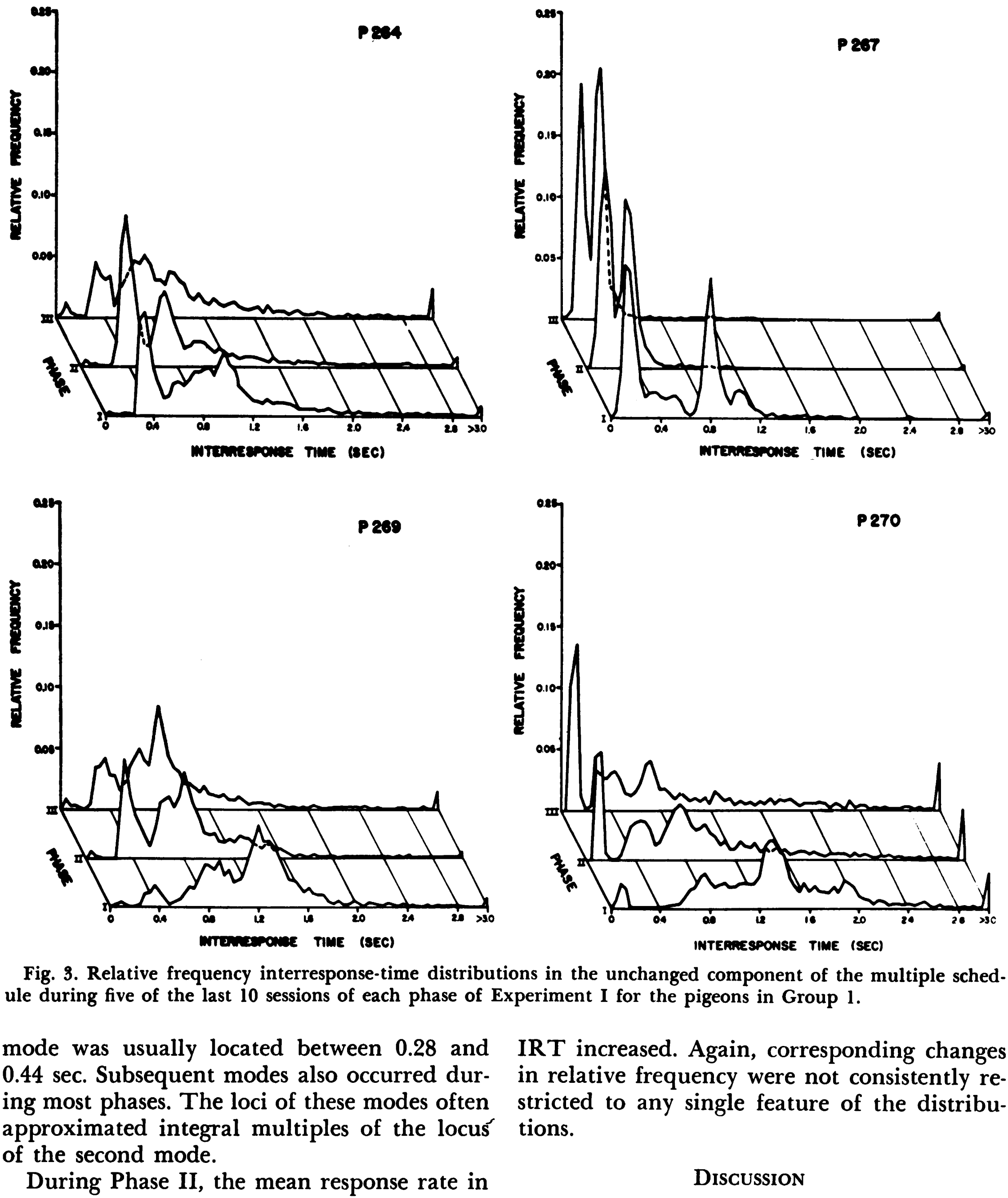

Fig. 3. Relative frequency interresponse-time distributions in the unchanged component of the multiple schedule during five of the last 10 sessions of each phase of Experiment I for the pigeons in Group 1.

mode was usually located between 0.28 and 0.44 sec. Subsequent modes also occurred during most phases. The loci of these modes often approximated integral multiples of the locus of the second mode.

During Phase II, the mean response rate in the unchanged component always increased, and hence the mean IRT decreased. Figures 3 and 4 reveal that this decrease in the mean IRT was not correlated with changes in the relative frequency of IRTs in the region of any single mode, group of modes, or in nonmodal IRTs for all pigeons. During Phase III, the mean response rate in the unchanged component usually decreased, and hence the mean IRT increased. Again, corresponding changes in relative frequency were not consistently restricted to any single feature of the distributions.

Discussion

The results of Reynolds' (1963) study suggested that the magnitude of contrast may be higher for behavior maintained by less-frequent reinforcement when one component of an equal-valued *mult* VI VI schedule is changed to EXT. In the present experiment, the magnitude of contrast in terms of absolute rate change and per cent change was usually higher for the pigeons in Group 2 (VI

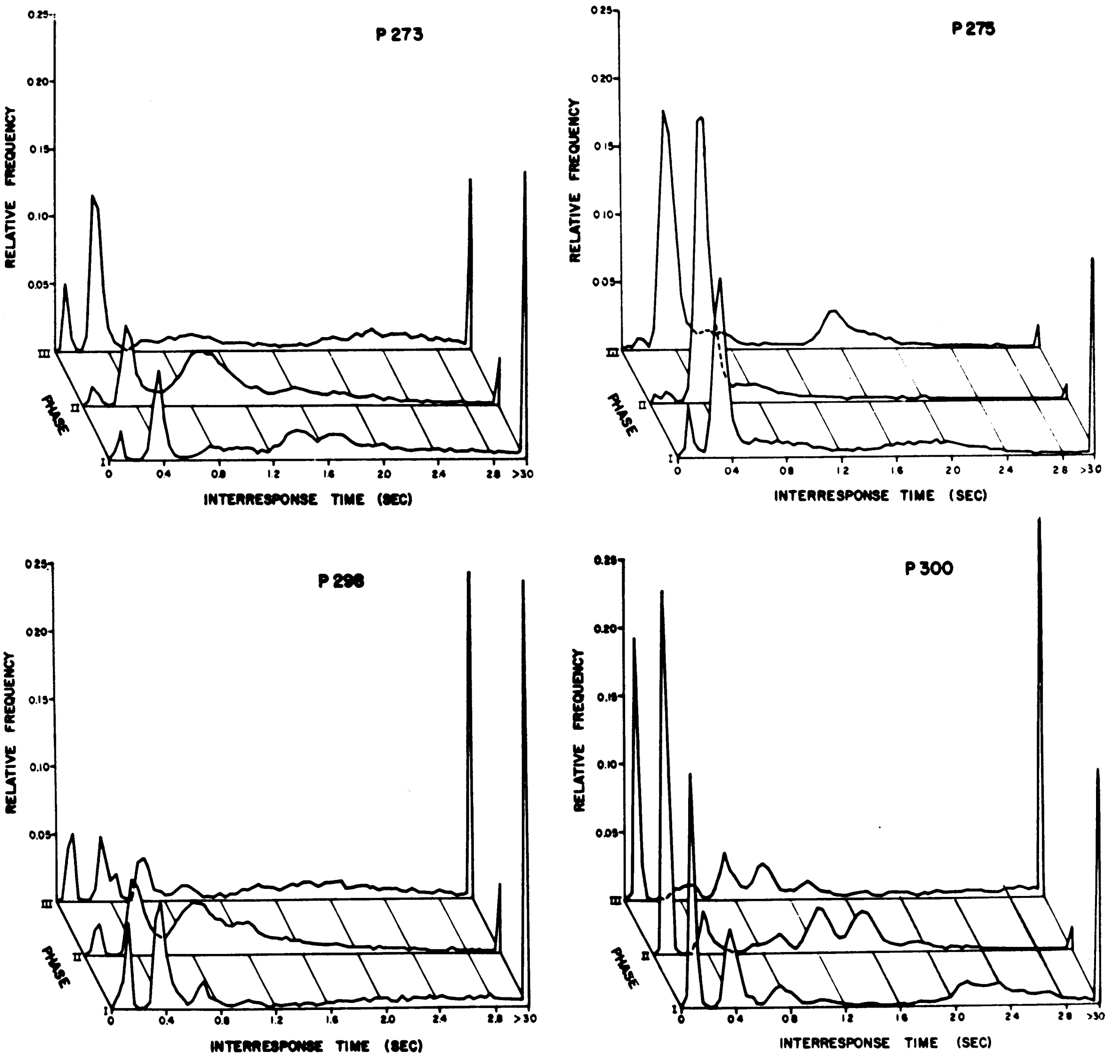

Fig. 4. Relative frequency interresponse-time distributions in the unchanged component of the multiple schedule during five of the last 10 sessions of each phase of Experiment I for the pigeons in Group 2.

180-sec in the unchanged component). Thus, the magnitude of contrast appeared to be inversely related to the frequency of reinforcement that maintained responding. These results are similar to those obtained by Reynolds (1963), but are not readily compatible with predictions derived from Herrnstein's (1970) formulation. Recall that, according to equation (4), the magnitude of contrast is directly related to the frequency of reinforcement, assuming that both m and R_0 are greater than zero and remain constant across experimental conditions. In the present experiment, it is reasonable to assume that the values of both m and R_0 were positive, since contrast was typically observed and the rates of responding were usually lower for behavior maintained by less-frequent reinforcement. Furthermore, since the features of the experimental setting remained constant throughout this study, there is little reason to believe that the values of either m or R_0 varied systematically across experimental conditions or between groups.

A scatter plot of per cent contrast as a function of the ongoing rate of response revealed that the magnitude of contrast was often greater for behavior maintained at lower rates. Several previous studies indicated similar trends. For instance, a general rate-dependent relation can be seen by the appropriate replotting of data reported by Reynolds (1963, Figure 2a) and Nevin (1968, Table 2). In these studies, as in the present one, contrast developed when a VI schedule alternated with EXT. In another experiment (Reynolds and Catania, 1961), contrast developed when a fixed-interval schedule alternated with EXT. Low rates occurring in the early portions of the fixed interval usually increased proportionally more than did high rates occurring in the latter portions of the fixed interval for individual pigeons (Figure 1b). Examinations of the data reported by Bloomfield (1966, Figure 4) showed that the magnitude of peak contrast was also frequently greater for behavior maintained at lower rates. Rate-dependent relations have been reported with other phenomena. Kelleher and Morse (1968) showed the ongoing rate of response to be a specific determinant of drug action. Similarly, Blackman (1968) suggested that the magnitude of conditioned suppression in part depends on the baseline rate of response. The magnitude of contrast may also be determined, at least in part, by the ongoing rate of response, independent of reinforcement frequency. However, since the frequency of reinforcement and rate of response usually covaried in the present study, this possibility could not be tested directly.

Farmer (1963) showed that the relative-frequency IRT distributions of pigeons exposed to several RI schedules were distinctly multimodal. The first mode usually occurred between 0.30 and 0.45 sec, with the loci of subsequent modes often arithmetically related to the locus of the first mode. Weiss (1970) described a similar relation among modes when pigeons were exposed to VI schedules. During most phases of the present experiment, the relative-frequency IRT distributions appeared multimodal. The second mode typically occurred between 0.28 and 0.44 sec. The locus of this mode is similar to that of the first mode reported by Farmer. Subsequent modes also occurred and often their loci appeared arithmetically related to that of the second mode. Weiss suggested that this type of multimodal relationship indicates that while pecking at a fairly constant rate, pigeons either miss the key or do not strike it with sufficient force on a number of occasions. The forms of the distributions reported here are consistent with that interpretation. Another mode occurred between 0.04 and 0.16 sec during most phases of this experiment. The locus of this first mode was not related in any obvious manner to the loci of the second or subsequent modes. Similar short IRT modes have been reported between 0.03 and 0.04 sec (Smith, 1974) and between 0.04 and 0.12 sec (Weiss and Gott, 1972). Smith interpreted these short IRTs in his distributions as indicating the occurrence of topographical variants of single key pecks. A similar interpretation may account for the appearance of the first mode in the distributions reported here.

When one component of the multiple schedules was changed to EXT in Phase II, response rates in the unchanged component increased in all cases and decreased in seven of eight cases when the VI schedule was re-introduced in Phase III. Rate changes, however, were not accompanied by changes in the relative frequency of IRTs in the region of any single mode, group of modes, or in nonmodal IRTs for all pigeons. Thus, the occurrence of behavioral contrast was not consistently correlated with changes in any single feature of the relative frequency IRT distributions.

EXPERIMENT II

Herrnstein (1970) suggested that response rates maintained by a variable-interval schedule in isolation are higher than rates maintained by a multiple schedule in which the same variable-interval schedules are used in the components. Herrnstein described an unpublished study by Terrace that supports this position. In Terrace's experiment, pigeons were first exposed to a VI 1-min schedule. After rates were judged stable, a second VI 1-min component was added (*mult* VI 1-min VI 1-min). Response rates in the presence of the stimulus common to both schedules were on the average 30% lower in the multiple schedule. Rachlin (1973) interpreted this rate difference as indicating that stimulus changes in the multiple schedule acted as response-independent reinforcers, thereby reducing key-pecking rates. Experiment II was designed to compare more fully response rates maintained by VI schedules in isolation with rates maintained by VI schedules in the context of a multiple schedule.

METHOD

Subjects and Apparatus

The subjects and apparatus were the same as in Experiment I. Pigeon P273 was dropped from the study before the last phase because of a broken beak.

Procedure

Variable-interval (*Phase IV*). After completing the last phase of Experiment I, two pigeons in each group were exposed to a variable-interval schedule in the presence of the red keylight. The other two pigeons in each group were exposed to the same schedule in the presence of the green keylight. The variable-interval schedules and session lengths were identical to those of Experiment I. In addition, scheduled grain presentations not collected were cancelled at the end of every 180 sec. This ensured that the only scheduled difference between Phase III and Phase IV was the stimulus change associated with the multiple schedule.

Multiple variable-interval variable-interval (*Phase V*). When rates were judged stable according to the criteria of Experiment I, the schedule was changed back to the *mult* VI VI schedule of Phase III. When rates again stabilized, the experiment was terminated. The required hours of exposure to this phase were reduced to 15 for the pigeons in Group 2 because no consistent changes in rates were observed over the course of the experiment.

Table 2 shows the schedules and hours of exposure to each phase of Experiment II.

Table 2

Schedules and Hours of Exposure

Subject (i)	*Phase* (ii)	*Schedules* *Red* (iii)	*Green* (iv)	*Hours* (v)
P 264	IV	VI 30-sec	—	34.0
	V	VI 30-sec	VI 30-sec	15.5
P 267	IV	VI 30-sec	—	40.0
	V	VI 30-sec	VI 30-sec	17.5
P 269	IV	—	VI 30-sec	31.5
	V	VI 30-sec	VI 30-sec	15.0
P 270	IV	—	VI 30-sec	31.0
	V	VI 30-sec	VI 30-sec	15.5
P 273	IV	VI 180-sec	—	90.0
P 275	IV	VI 180-sec	—	165.0
	V	VI 180-sec	VI 180-sec	126.0
P 298	IV	—	VI 180-sec	165.0
	V	VI 180-sec	VI 180-sec	81.0
P 300	IV	—	VI 180-sec	108.0
	V	VI 180-sec	VI 180-sec	105.0

RESULTS

Figure 5 shows response rates maintained by the VI and *mult* VI VI schedules during Experiment II. Each point represents the mean rate during the last 10 sessions of each phase. For comparison, the points from Phase III are also included. The symbols and brackets are the same as those in Figure 1. During Phase IV, response rates changed slightly for all pigeons. However, the direction of rate changes was unsystematic and increased in only three of eight cases. Note also that the direction of rate change did not appear to depend on the schedule associated with the common stimulus in Phase II. Differences in experimental history did not, therefore, seem to determine the direction of rate change. During Phase V, rates also changed slightly, but again in unsystematic directions. On the whole, rates in Phases III, IV, and V were similar. Relative-frequency interresponse-time distributions were also similar in Phases III, IV, and V, and these data will not be considered here.

DISCUSSION

In Experiment II, response rates maintained by VI schedules in isolation were similar to rates maintained by the same VI schedules in a multiple schedule context. These results are not readily compatible with predictions based on Herrnstein's (1970) formulation because the rates of response were usually not higher during Phase IV (VI schedule in isolation). Furthermore, these results differ from Terrace's unpublished results described by Herrnstein (1970) and Rachlin (1973). These differences are probably not due to differences in the VI schedules used in the two studies, since the mean interreinforcement intervals of 30 and 180 sec used here bracketed the value used by Terrace (60 sec). In the present study, scheduled food presentations not collected were cancelled every 180 sec to ensure equal reinforcement frequencies on the VI and *mult* VI VI schedules. It is possible that this procedure resulted in rates maintained by the VI schedules that were lower than normal and thus more similar to rates maintained by the *mult* VI VI schedules. This

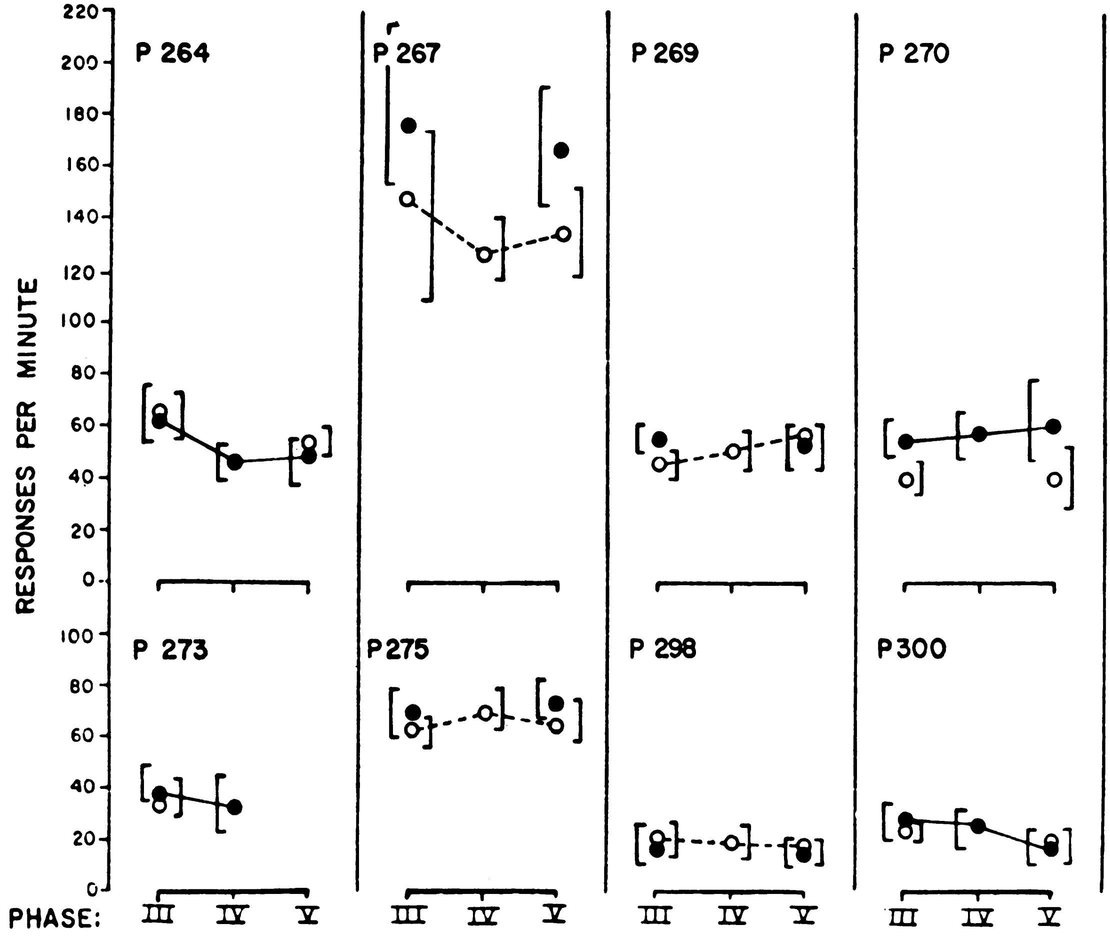

Fig. 5. Mean response rates and ranges during the last 10 sessions of each phase of Experiment II. Mean response rates and ranges during the last 10 sessions of Phase III (Experiment I) are redrawn here for comparison. Symbols and brackets are the same as in Figure 1.

argument is unconvincing for two reasons. First, the procedure of cancelling reinforcement should also affect rates maintained by the *mult* VI VI schedules in the same manner, thus decreasing rates in both phases of the experiment. Secondly, cancelling of reinforcement only rarely occurs if pigeons respond at a fairly constant rate, as they did in the present study.

In Terrace's experiment, components changed every 90 sec and in the present study, every 180 sec. One might expect, following Rachlin's reasoning, that more frequent stimulus change would act in the same manner as more frequent response-independent reinforcement. It is possible that the difference in the frequency of component changes was responsible for the difference in the present results and those obtained by Terrace. Another possibility is that in Terrace's experiment, responding maintained by the VI schedule in isolation was metastable (Staddon, 1965). That is, had Terrace re-introduced the VI schedule after exposure to the *mult* VI VI schedule, perhaps rates in these two conditions would have been more similar.

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Received 4 September 1973.
(Final Acceptance 24 June 1974.)