CONJUNCTIVE SCHEDULES OF REINFORCEMENT II: RESPONSE REQUIREMENTS AND STIMULUS EFFECTS¹

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Responding of three pigeons was maintained under conjunctive fixed-ratio, fixed-interval schedules where a key peck produced food after both schedule requirements were completed. The individual schedule requirements were then successively removed and re-instated with responding maintained under the following conditions: conjunctive fixed-ratio, fixed-time; fixed-time; and fixed-interval schedules. Patterns of responding changed in accord with the successive removal of the schedule requirements. Compared to the conjunctive fixed-ratio, fixed-interval schedule, pause duration increased and response rate decreased under conjunctive fixed-ratio, fixed-time schedules and under fixed-time schedules alone. Overall mean rates of responding were highest and pause duration lowest under fixed-interval schedules. When changes in the keylight colors were correlated with completion of the fixed-ratio, the end of the fixed-interval, or both of these conditions, the pattern of responding was modified and indicated a greater degree of control by the individual schedules. Although two birds showed large increases in interreinforcement time when they were initially exposed to the conjunctive schedule, when responding stabilized this measure was largely invariant for all birds across most schedule conditions.

Under a conjunctive fixed-ratio fixed-interval schedule (*conj* FR FI), reinforcement occurs when both the FR and FI requirements have been completed. Responding maintained under a *conj* FR FI schedule is characterized by an initial pause followed by a high rate of responding that subsequently decreases, usually abruptly, to a lower steady rate that is maintained until food is delivered (Barrett, 1974; Herrnstein and Morse, 1958). In their study of conjunctive schedules, Herrnstein and Morse examined the effects of adding FR schedules of varying sizes to an already established FI 15-min schedule. The addition of even a small FR requirement not only modified the pattern of responding occurring under the FI schedule, but also decreased the overall

rate of responding and increased the time between reinforcements.

Each requirement of the *conj* FR FI schedule appears to contribute importantly to the obtained rate and pattern of responding, in that characteristics of both FR and FI performance typically occur within a given interval. For example, the initial high rate of responding under *conj* FR FI schedules is similar to that found when FR schedules are studied in isolation (Ferster and Skinner, 1957). Also, the number of responses occurring during this period often closely coincides with the parameter value of the FR schedule of the *conj* FR FI (Barrett, 1974; Herrnstein and Morse, 1958). Such findings suggest that the pattern and rate of responding are jointly determined by the individual requirements of the conjunctive schedule.

Using *conj* FR FI maintained responding as a baseline, the present experiment first examined the effects on rates and patterns of responding of selectively omitting and re-instating the response requirements comprising a *conj* FR FI schedule. These manipulations provided a means of assessing the contribution of each schedule to the patterning obtained under the conjunctive. In addition, the effects of introducing stimuli differentially correlated

¹This research was supported initially by an NIMH Postdoctoral Fellowship at the Worcester Foundation for Experimental Biology by USPHS Training Grant MH 10625 and by research grant MH 18421. It was subsequently supported by a Faculty Research Award from the University of Maryland. The author would like to acknowledge with gratitude the support given by Dr. J. W. McKearney. Mrs. Beth Weinberg provided expert technical assistance during the experiments; Miss Evarilla Cover helped considerably in the preparation of the manuscript. Reprints may be obtained from the author, Department of Psychology, University of Maryland, College Park, Maryland 20742.

with the separate FR and FI schedules of the conjunctive were also studied. These manipulations were examined in two pigeons given extensive training under FR schedules and in a third bird with a history of responding under an FI schedule. The use of birds with prior exposure to FR schedules allowed for comparison of the development of conjunctive schedule control after FR responding with those results obtained after training under FI schedules (Herrnstein and Morse, 1958).

METHOD

Subjects

Three adult male White Carneaux pigeons (P-8348, P-10, and P-9536), obtained from the Palmetto Pigeon Plant, were maintained at approximately 80% of their free-feeding weights and had been exposed to various schedules of food presentation. P-10 and P-8348 were used in a previous experiment (Barrett, 1974). The immediately preceding history for P-9536 consisted of approximately 70 sessions under an FR 150 schedule.

Apparatus

Experiments were conducted in a single-key pigeon chamber placed in a ventilated, sound-attenuating enclosure. The key (R. Gerbrands Co.) was mounted in the center of the front panel 9 in. (23 cm) from the floor and was transilluminated by two 7-W green lamps. A peck of at least 15 g (0.15 N) interrupted the electrical contact operating recording circuits and also produced the click of a relay mounted behind the front wall of the chamber. Mixed grain was delivered through an opening 2 in. (5 cm) above the floor in the center of the front panel. Grain presentation lasted 4 sec and was accompanied by illumination of the grain magazine and darkening of the keylights. White noise was continuously present in the experimental chamber.

Initially, responding by P-8348 and P-9536 was maintained under FR schedules where every 50 (P-8348) or 100 (P-9536) responses produced food. P-10 first responded under an FI 5-min schedule with food delivery following the first response after 5 min had elapsed. Each pigeon was then studied under a *conj* FR FI schedule where, after both schedule requirements were completed, a peck produced food. Under the *conj* FR FI schedule, a single

response after the interval had elapsed delivered food if the number of responses comprising the ratio had occurred previously; when the interval elapsed before the ratio was completed, the terminal response of the ratio resulted in food presentation. All pigeons were then exposed to variations in the schedules comprising the basic *conj* FR FI schedule. These manipulations and schedule values are summarized for each bird in Table 1.

Table 1

Sequence of experimental conditions and number of sessions at each condition.

Schedule	Sessions		
	P-10	P-8348	P-9536
FI <i>t</i>	1-23	—	—
FR <i>n</i>	—	1-51	1-80
<i>Conj</i> FR <i>n</i> FI <i>t</i>	24-170	52-95	81-139
<i>Conj</i> FR <i>n</i> FT <i>t</i>	171-214	96-138	—
FT <i>t</i>	215-239	139-168	140-178
FI <i>t</i>	240-284	169-203	179-197
<i>Conj</i> FR <i>n</i> FI <i>t</i>	285-314	204-247	198-246
<i>Conj</i> FR <i>n</i> (S) FI <i>t</i>	315-370	248-286	247-285
FI <i>t</i>	—	287-335	286-316
<i>Conj</i> FR <i>n</i> FT <i>t</i>	—	—	317-337
<i>Conj</i> FR <i>n</i> FI <i>t</i> (S)	371-386	336-363	338-373
<i>Conj</i> FR <i>n</i> FI <i>t</i>	—	364-413	—
<i>Conj</i> FR <i>n</i> (S) FI <i>t</i> (S)	387-416	414-448	374-423
<i>Conj</i> FR <i>n</i> (S) FI <i>t</i>	417-473	449-504	424-451

The value of *n* was 100 for P-9536, and 50 for P-10 and P-8348. The value of *t* was 5 min for P-10 and 3 min for P-8348 and P-9536. *Conj*=conjunctive; FI= fixed interval; FR= fixed ratio; FT= fixed time.

Under the *conj* FR FT schedule, food was delivered independently of responding when the interval elapsed (fixed-time schedule), given that the specified ratio value was completed; if the FR was not fulfilled at the end of the interval, the terminal response of the ratio schedule produced food. Under the FT schedule alone, food was delivered independently of responding when the interval elapsed. Responding was subsequently maintained under FI schedules. All pigeons were returned to the *conj* FR FI at least once. Although the sequence of schedule conditions was similar for each pigeon, P-9536 was not exposed to the *conj* FR FT schedule until later in the experiment.

After the schedule manipulations were completed, the effects of introducing stimuli distinctively correlated, with each schedule of the *conj* FR FI were examined under a procedure

where completion of the ratio before the interval elapsed changed the keylight from green to red; the red keylight remained on until a peck produced food, after which the keylight was again green. If the interval elapsed before the ratio was completed, the keylight color did not change and food was delivered when the ratio was completed. This schedule is designated *conj* FR(S) FI. The keylight change when the ratio was completed was then removed and a change in key color was subsequently scheduled to occur when the interval elapsed. Under this condition, the keylight changed from green to yellow, independently of responding, at the end of the interval [*conj* FR FI(S)]. Finally, all pigeons were exposed to a third stimulus condition where completion of the ratio before the end of the interval changed the keylight from green to red and, when the interval elapsed, the keylight alternately changed from red to yellow every 0.3 sec until a peck produced food. If the ratio was not completed when the interval ended, the keylight changed from green to yellow and food was presented upon completion of the

ratio without a further stimulus change [*conj* FR(S) FI(S)].

Sessions were conducted Monday through Friday and terminated after 30 food presentations or after 120 min (180 min for P-10), whichever occurred first. Schedule conditions were changed when both overall response rate and pause duration (time to the first response in each interval) were stable.

RESULTS

Figure 1 shows representative segments of cumulative response records for each pigeon under those conditions where the conjunctive schedule requirements were manipulated. Under the *conj* FR FI schedule (Panel A), responding was characterized by an initial pause followed by a high rate of pecking that decreased at a point closely approximating completion of the ratio requirement. This change in response rate was often pronounced and sharply delineated. When the FI schedule was changed to FT, but the ratio schedule was still in effect (*conj* FR FT), overall response

Fig. 1. Cumulative response records for all three birds under the various schedule conditions. Panel A: *conj* FR FI; Panel B: *conj* FR FT; Panel C: FT; Panel D: FI. Ordinate: cumulative responses; abscissa: time. Records are segments taken from complete sessions. For P-10 the FI was 5 min, the FR 50 responses; P-8348 and P-9536 both responded under an FI 3-min with a 50 or 100 response FR respectively. The completion of the FR is indicated by a simultaneous slash on the cumulative record and by an offset of the event pen; when the interval elapsed only the response pen was displaced. The response pen reset after each food presentation. See text for explanation of schedules.

rates decreased and the pattern of responding changed noticeably (Panel B). Under the *conj* FR FT schedule, the greatest decrease in response rate occurred after the fixed-ratio had been completed; substantial rates of responding, characteristic of those under FR schedules in isolation, were still evident during the first half of the interval. Occasionally, P-10 paused for the entire interval and responded at an exceptionally high rate after the interval had elapsed (e.g., at *a* in Panel B). Decreases in responding after the approximate completion of the ratio were generally more pronounced for those birds with a fixed-ratio of 50 responses (P-10 and P-8348) than for P-9536 with a 100-response FR schedule.

Under the FT schedule alone (Panel C), rates of responding declined substantially. After approximately 25 sessions, responding still occurred during most intervals and typically consisted of an initial high rate with an abrupt transition to a very low rate that continued until food was delivered. Occasionally, P-9536 did not respond at all within an interval.

Response rates were consistently high for all birds under the FI schedule (Panel D). During certain intervals (e.g., at *b* for P-10 and P-8348) the rate of responding declined slightly throughout the interval, indicating some lasting effect of the *conj* FR FI history. However, decreases in response rate during the interval were not as pronounced as were those

obtained under the *conj* FR FI schedule. Generally, following an initial pause under the FI schedule, responding occurred at a relatively steady rate throughout the greater part of the interval.

Patterns of responding maintained under the *conj* FR FI schedules changed when different keylight stimuli were correlated with either or both of the schedule requirements. Panel A of Figure 2 shows that changing the key color from green to red when the ratio was completed [*conj* FR(S) FI] accentuated control by the ratio and interval requirements. After an initial pause, responding occurred at a high constant rate until the ratio was completed and the key changed color; responding then decreased abruptly and often showed a gradual acceleration throughout the remaining portion of the interval (as at *a* and during most cycles for P-8348). Thus, within a single cycle, responding was characteristic of that maintained by both FR and FI schedules in isolation (cf. Ferster and Skinner, 1957).

When the keylight changed at the end of the interval [*conj* FR FI(S)], P-10 and P-8348 typically paused until the stimulus changed and then completed the ratio (Figure 2, Panel B). Responding by the third pigeon (P-9536) was not similarly controlled by this schedule of stimulus change. Instead, P-9536 continued to complete the ratio requirement approximately halfway through the interval, a pattern

Fig. 2. Cumulative response records for each pigeon under the conjunctive schedule with added schedule-correlated stimulus changes. Panel A: *conj* FR(S) FI; Panel B: *conj* FR FI (S); Panel C: *conj* FR(S) FI(S). Recording as in Figure 1. See text for schedule explanation.

similar to that observed under the conjunctive without stimuli (Figure 1, Panel A).

Panel C of Figure 2 shows that when the key color was differentially correlated with completion of the ratio and termination of the interval [*conj* FR(S) FI(S)], P-10 often completed the ratio before the interval elapsed and then paused until the key color alternated from red to yellow at the end of the interval. At other times, P-10 paused the entire interval and began responding only when the keylight changed at the end of the interval. This pattern of pausing until the interval elapsed was also characteristic of P-8348 under some cycles of the *conj* FR(S) FI(S) schedule; during other cycles, however, responding occurred at a low rate throughout. When the stimulus change occurred with both schedules, responding by P-9536 was usually gradually accelerated; pauses occurred occasionally after the ratio schedule was completed. P-9536 typically completed the ratio before the interval elapsed.

Figure 3 summarizes the results from all phases of the experiment for each of the three

birds. This figure shows means for the time to the first response in each interval (pause duration), overall response rate, and interreinforcement time taken from the last three sessions under each schedule. Under those conditions, where the birds were returned to a given schedule for a second or third time, the last three sessions at each condition were averaged together.

Compared to the results obtained under the *conj* FR FI schedule, changing to the *conj* FR FT and FT schedule produced increases in pause duration and decreases in response rate. These effects were generally greatest for P-10 under the FI 5-min schedule. For all birds, rates of responding were highest and pause duration briefest under the FI schedule alone.

The effects of adding schedule-correlated stimuli on response rate and pause duration were different for P-9536, the bird studied previously under FR 100, than for the two birds studied under FR 50. For P-10 and P-8348, compared to the *conj* FR FI without stimuli, rates of responding were consistently

Fig. 3. Mean pause duration (lower panel), responses per second (middle), and interreinforcement time (upper panel) under all schedule conditions. Vertical bars denote ranges of observed measures.

lower when the stimulus change was correlated with the end of the interval.

The top portion of Figure 3 shows the average interreinforcement time under each schedule condition. For the most part, only slight changes in this measure occurred across all schedule and stimulus manipulations. Under the *conj* FR FI schedules, mean interreinforcement time was almost identical to that under the FI schedule alone, indicating that the FR was usually completed before the interval elapsed. Overall increases in interreinforcement time generally occurred for P-10 and P-8348 under the conjunctive schedules with the added stimuli and, with P-10, increases in interreinforcement time also occurred under the *conj* FR FT schedule.

Despite the fact that differences between interreinforcement time under the *conj* FR FI schedule and the FI schedule alone were small under stable conditions, this was not always the case. Table 2 presents mean interreinforcement time data and the range of these session values taken from the first and last 10 sessions under the conjunctive schedule. These data indicate that, when initially exposed to the conjunctive schedule, the average time between reinforcements was often substantially longer than the FI value, especially for P-10

Table 2

Interreinforcement time (seconds) under first and last 10 sessions of *Conj* FR FI schedule.

Pigeon	First 10 Sessions		Last 10 Sessions	
	Mean	Range	Mean	Range
P-10	341.31	305.38-411.01	304.90	302.14-312.67
P-8348	211.98	182.1-281.63	181.66	181.13-184.28
P-9536	196.48	183.50-235.35	183.38	181.82-183.72

The FI value was 300 sec for P-10 and 180 sec for P-8348 and P-9536.

and P-8348. These interreinforcement times decreased, however, when responding had stabilized.

Pronounced pausing developed shortly after the transition from either the initial FR schedule (P-8348 and P-9536) or the FI schedule (P-10). These effects can be seen in the cumulative response records shown in Figure 4, which depict the last session's performance under either the FR (P-8348 and P-9536) or FI (P-10) schedules and the third and twentieth session under the conjunctive schedules. The initial disruption in responding, lowered response rates, and prolonged pausing were most evident for P-10 and P-8348. Responding by P-9536, with an extensive history under higher-valued FR schedules, was least disrupted when

Fig. 4. Cumulative response records for all pigeons under the last schedule condition before the *conj* FR FI schedule was introduced (Panel A). In Panel A, the schedule for P-10 was FI 5-min., for P-8348 it was FR 50, and for P-9536, FR 100. Panels B and C are taken from Session 3 and Session 20 respectively under the conjunctive schedule. Ordinate: cumulative responses; abscissa: time. The pen reset to baseline after food presentation. In the records for P-8348 and P-9536, the event pen was displaced when the ratio was completed and for P-10 (Panels B and C) the response pen also produced a diagonal mark. Displacement of the response pen without the simultaneous offset of the event pen denotes that the interval elapsed. Portions of the event line in Panel A for P-9536 were removed to accommodate records obtained from Session 3. The event pen was displaced during alternate cycles of the FI schedule for P-10 in Panel A.

changed to the conjunctive schedule. Responding by this pigeon typically continued to occur at a high sustained rate, with the FR usually completed before the interval elapsed. After 20 sessions under the *conj* FR FI schedule, patterns and rates of responding changed little for P-9536. For P-10 and P-8348, however, response rates during Session 20 were increased above those of Session 3 and patterns of responding similar to stable performance (Figure 1, Panel A) were evident.

DISCUSSION

Dews (1970) suggested an approach to the study of reinforcement schedules that appropriately characterizes his extensive experiments on FI schedules and the present experiment as well: "The general procedure has been to start with a characteristic steady-state performance of a subject under a schedule and then to modify particular features of the schedule or to examine particular features of the performance to assess their contributions to the characteristic steady-state performance" (1970, p. 60). In the present experiments, responding was maintained under a *conj* FR FI schedule until patterns and rates of responding were stable. The individual schedule requirements were then selectively deleted and re-instated and the effects on responding observed.

Although pigeons in the present study had varied experimental histories and different schedule values, under the *conj* FR FI schedules patterns of responding were generally comparable to those reported previously by Herrnstein and Morse (1958). After an initial pause, responding occurred at a high rate, which then decreased to a lower steady rate for the remainder of the cycle. When the FI schedule of the conjunctive was changed to FT, or when only an FT schedule was in effect, rates of responding decreased and pause duration increased. The rate-decreasing effect of changing from response-dependent to response-independent schedules has been reported previously (Shull, 1970, 1971; Zeiler, 1968) and appears to hold under a wide range of schedule conditions even when, as in the present experiment, a rather substantial ratio requirement remained under the *conj* FR FT schedule. The change from the *conj* FR FI to *conj* FR FT generally had the greatest effect on re-

sponding occurring after the fixed-ratio schedule was completed. This selective decrease in response rates provides a remarkable demonstration of the sensitivity of responding to the control of both conjunctive schedule requirements.

The effects of superimposing stimulus changes correlated with completion of the ratio, the end of the interval, or both of these conditions, significantly modified the pattern of responding under the conjunctive schedule. Generally, the schedule-correlated stimulus changes accentuated the degree of control over responding by the individual requirements of the conjunctive schedule and provide additional documentation of the sensitivity of responding to the schedules comprising the conjunctive. The patterns of responding that occurred when keylights changed upon completion of the FR schedule (Figure 2, Panel A) provide another instance of the development of positively accelerated responding under conditions where interreinforcement time is not constant (*cf.* Kelleher and Morse, 1969). Kelleher and Morse (1969) found response rate to be positively accelerated under an interlocking schedule that does not specify a fixed time period between reinforcements. In the present experiment, response rates were low after the FR schedule was completed and increased throughout the remainder of the interval; there was no fixed temporal parameter under these conditions, in that the time between reinforcement and the onset of the stimulus correlated with completion of the FR depended on the preceding pause and response rate during the FR schedule. As Kelleher and Morse have indicated, positively accelerated responding can emerge from dynamic interactions between properties of the schedule and the organism's responding.

The often large changes obtained in pause duration in the present study differ somewhat from previous studies, suggesting that pause duration is relatively invariant across a wide range of conditions when interreinforcement time remains constant (Elsmore, 1971; Killeen, 1969; Neuringer and Schneider, 1968; Shull, 1970, 1971). In the present experiment, pause duration changed substantially under conditions where interreinforcement time did not depart from that obtained under the FI schedules. It would appear that pause duration can vary independently of interreinforce-

ment time when other schedule conditions prevail.

Rates of responding maintained by FI schedules were consistently higher than those under the *conj* FR FI schedules. These results are similar to those of Herrnstein and Morse (1958), who found that the addition of even a small FR to an FI schedule decreased overall response rates. Such results are striking because under the FI schedule, the average number of responses per interval was typically greater than that specified by the FR of the conjunctive schedule. In the Herrnstein and Morse (1958) experiment, the conjunctive schedule also increased interreinforcement time. This result was not obtained under the conjunctive schedule when responding stabilized in the present study and may be due to the use of smaller FI values. Rather large changes in interreinforcement time did occur, however, during the transition from either FR or FI schedules to the *conj* FR FI schedule, and these initial effects probably contributed substantially to the development of response patterning under the conjunctive schedule. Decreases in the overall rate of responding increased the likelihood that the FR requirement was incomplete when the interval elapsed. In the most extreme case, when responding did not occur until after the interval has elapsed, food was delivered when the FR schedule was completed. It is this feature of conjunctive schedules that Herrnstein and Morse suggested was a factor contributing to the development of the FR schedule as a discriminative stimulus. Their analysis applies equally well to the present results.

The emergence of schedule-controlled responding depends to a great extent on developmental interactions between the organism's history and the imposed schedules (Morse and Kelleher, 1970). These variables probably account for some of the differences in response patterning of P-9536. This pigeon had a lengthy history of responding under FR schedules. When changed to the conjunctive schedule, responding was not as severely disrupted, nor did interreinforcement time increase as substantially as it did for the other two birds. The already high rates of sustained responding of P-9536 reduced the probability that, under the conjunctive schedule, the ratio would be completed after the interval had elapsed. Alleman and Zeiler (1974) have also

shown that a history of responding under FR schedules can affect responding under subsequent FT schedules.

The development of stable responding under the control of *conj* FR FI schedules also illustrates the importance of constant and fluctuating schedule influences on schedule-controlled behavior (Dews, 1970; Morse, 1966). Morse emphasized that stable performances are jointly determined, both by the specified constant relations between responding and reinforcement that are independent of the pattern of responding, and by other fluctuating influences that derive from the interaction of schedule contingencies with features of responding. These influences are likely to have an effect on schedule control at different times. The development of stable responding necessarily emerges from the interaction of the consequences of responding with properties of the schedule. As responding stabilizes under the prevailing schedule, influences that were formerly important determinants of responding may no longer operate, or may do so to a lesser extent. This appears to have been the case for at least two of the three birds in the present study (P-10 and P-8348), where interreinforcement time under the initial conditions of the conjunctive schedule was considerably longer than it was when responding stabilized; interreinforcement time under stable conditions of the conjunctive was comparable to that obtained under the FI schedule. Although variables may not differ under steady state conditions, this does not necessarily indicate that these same variables had no effect in the past. A thorough understanding of stable schedule-controlled responding dictates a corresponding emphasis on the analysis of developmental interactions between the properties of the schedule, the reinforcement history, and the ongoing pattern and rate of responding.

REFERENCES

- Alleman, H. D. and Zeiler, M. D. Patterning with fixed-time schedules of response-independent reinforcement. *Journal of the Experimental Analysis of Behavior*, 1974, **22**, 135-141.
- Barrett, J. E. Conjunctive schedules of reinforcement I: rate-dependent effects of pentobarbital and *d*-amphetamine. *Journal of the Experimental Analysis of Behavior*, 1974, **22**, 561-573.
- Dews, P. B. The theory of fixed-interval responding. In W. N. Schoenfeld (Ed.), *The theory of reinforcement*.

- ment schedules. New York: Appleton-Century-Crofts, 1970. Pp. 43-61.
- Elsmore, T. F. Independence of postreinforcement pause length and running rate on fixed-interval pacing reinforcement schedules. *Psychonomic Science*, 1971, **23**, 371-372.
- Ferster, C. B. and Skinner, B. F. *Schedules of reinforcement*. New York: Appleton-Century-Crofts, 1957.
- Herrnstein, R. J. and Morse, W. H. A conjunctive schedule of reinforcement. *Journal of the Experimental Analysis of Behavior*, 1958, **1**, 15-24.
- Kelleher, R. T. and Morse, W. H. Schedules using noxious stimuli IV: an interlocking shock-postponement schedule in the squirrel monkey. *Journal of the Experimental Analysis of Behavior*, 1969, **12**, 1063-1079.
- Killeen, P. Reinforcement frequency and contingency as factors in fixed-ratio behavior. *Journal of the Experimental Analysis of Behavior*, 1969, **12**, 391-395.
- Morse, W. H. Intermittent reinforcement. In W. K. Honig (Ed.), *Operant behavior: areas of research and application*. New York: Appleton-Century-Crofts, 1966. Pp. 52-101.
- Morse, W. H. and Kelleher, R. T. Schedules as fundamental determinants of behavior. In W. N. Schoenfeld (Ed.), *The theory of reinforcement schedules*. New York: Appleton-Century-Crofts, 1970. Pp. 139-185.
- Neuringer, A. J. and Schneider, B. A. Separating the effects of interreinforcement time and number of interreinforcement responses. *Journal of the Experimental Analysis of Behavior*, 1968, **11**, 661-667.
- Shull, R. L. The response-reinforcement dependency in fixed-interval schedules of reinforcement. *Journal of the Experimental Analysis of Behavior*, 1970, **14**, 55-60.
- Shull, R. L. Postreinforcement pause duration on fixed-interval and fixed-time schedules of food reinforcement. *Psychonomic Science*, 1971, **23**, 77-78.
- Zeiler, M. D. Fixed and variable schedules of response-independent reinforcement. *Journal of the Experimental Analysis of Behavior*, 1968, **11**, 405-414.

Received 6 June 1974.

(Final Acceptance 10 February 1975.)