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Reinforcement Contingent On Two Exhaustive And Exclusive Classes Of An Organism's Spatial Arrangements

by

Ernest C. Rosenberg

A dissertation submitted to the Graduate Faculty in Psychology in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York.

1972

This manuscript has been read and accepted for the Graduate Faculty in Psychology in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

December 12, 1972
date

Wm. Schoenfeld
Chairman of Examining Committee

12/12/72
date

Florence L. Denmark
Executive Officer

Dr. Brett K. Cole
Dr. Thom Verhave
Supervisory Committee

The City University of New York

Abstract

Reinforcement Contingent On Two Exhaustive And Exclusive Classes Of An Organism's Spatial Arrangements

by

Ernest C. Rosenberg

Advisor: Professor William N. Schoenfeld

Two classes of a pigeon's spatial arrangements were designated by the use of light beams. A pigeon was in *A* whenever its spatial arrangement interrupted one or more of three light beams. The bird was in not-*A* (*$\not A$*) whenever its arrangement did not interrupt the light beams.

Repeating time cycles for *A* (T_A) and *$\not A$* ($T_{\not A}$) were chosen to be equal and coterminous. Further discussion was in terms of a single time cycle T, where $T = T_A = T_{\not A}$. Two probabilities of food reinforcement (S^R) were chosen for study: the probability of reinforcement if the pigeon was in *A* at the end of T, $P(S^R|A)$, and the probability of reinforcement if the pigeon was in *$\not A$* at the end of T, $P(S^R|\not A)$.

In Exp. I, $P(S^R|A)$ and $P(S^R|\not A)$ were equal and consequently, resulted in the presentation of the same reinforcement frequency whether *A* or *$\not A$* occurred at the end of T. Within this framework a parametric investigation of Skinner's (1948) "superstition" phenomenon was pursued. The effects of the following probabilities $[P(S^R|A) = P(S^R|\not A)]$ on the occurrence of *A* and *$\not A$* for five pigeons were investigated at T = 15 sec: 0 (i.e., operant level), 1, .5, .25, .125, .084; then a return to 1 (i.e., recovery). Some prominent effects were:

1) at some $P(S^R) > 0$, all subjects showed an increase, over operant level, in the rate of transition from *$\not A$* to *A* (R_A).

2) average time per entry into *A* remained constant as $P(S^R)$ decreased.

3) the number of entries into *A* per reinforcement increased as $P(S^R)$ decreased.

4) the T-cycle was subdivided into five consecutive 3-sec intervals; R_A rate was computed for each of these intervals. At $P(S^R) = 1$ there was a high R_A rate shortly after reinforcement followed by a decrease to a nearly zero rate as the time for the next reinforcement approached. As $P(S^R)$ decreased the rate differences between subdivisions decreased thereby flattening the T-cycle function.

Exp. II investigated the effects of repeated extinction and reconditioning of a "superstition" on two pigeons from Exp. I. At $T = 15$ sec, alternations of eleven extinction sessions $[P(S^R) = 0]$ with five reconditioning sessions $[P(S^R) = 1]$ were repeated five times. The following effects were found:

1) R_A rate decreased back toward operant level whenever extinction was in effect.

2) R_A rate was maintained in reconditioning.

3) the R_A rate function in the five 3-sec intervals of a T-cycle maintained a similar shape during every reconditioning session.

4) few consistent changes in any dependent variable were noted in comparisons among periods of reconditioning.

In Exp. III the effects at $T = 15$ sec of passing from $P(S^R)$ of 1 for both *A* and $\not{A}$ to $P(S^R|A) > P(S^R|\not{A})$ on three pigeons from Exp. I were investigated by fixing $P(S^R|A)$ at 1 and decreasing $P(S^R|\not{A})$ from 1 to 0 through $P(S^R|\not{A})$ values of .5, .25, and .125. After $P(S^R|\not{A}) = 0$, a return was made to $P(S^R|\not{A}) = 1$ (i.e., recovery). Some effects were:

1) the percentage of times that a subject was in *A* at the end of T increased over the first four experimental points for all subjects. At the fifth point [i.e., $P(S^R|\not{A}) = 0$], the effects ranged from a large increase to a large decrease in percent *A* at the end of T.

2) average time per entry into *A* increased as $P(S^R|\not{A})$ decreased.

3) the number of entries into *A* per reinforcement went through a maximum as $P(S^R|\not{A})$ decreased.

I wish to thank Gail Evra who's generosity permitted me a day of relaxation each week, and Dan Sussman who inked in figures which initially contained many errors. My special thanks go to Drs. W. N. Schoenfeld and B. K. Cole who have been my teachers in the finest senses of that word.

Contents

General Introduction

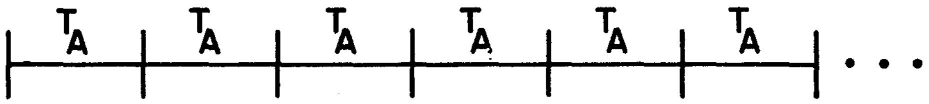
Each of the following experiments was developed within the same general procedural framework. The rationales for the individual experiments can be most clearly understood by beginning with the presentation of this framework.

Two classes of an organism's spatial arrangements were arrived at by sectioning the experimental environment into two spaces. In the three studies to follow, this sectioning was accomplished by light beams. The area of the environment which was intercepted by the light beams defined one space, and the area which was not intercepted by the light beams defined the other space. Whenever the organism's spatial arrangement was such that he interrupted the light beams, it was said to be in *A*. Whenever the spatial arrangement was such that the light beams were not interrupted, the organism was said to be in not-*A* ($\not{A}$). *A* and $\not{A}$ have been defined so that, at every instant, the organism was in one or the other (i.e., they were exhaustive of all spatial arrangements in the experimental space), and he was never in both (i.e., they were mutually exclusive).

A response class was derived from *A* and $\not{A}$ by conceiving of a response (R) as a transition from one class of spatial arrangements to another (Schoenfeld and Farmer, 1970; Logan and Ferraro, 1970). There were two such responses: a transition from *A* to $\not{A}$ and a transition from $\not{A}$ to *A*.

Reinforcer presentation was made contingent on the occurrence of *A* and $\not{A}$ by constructing two repeating time cycles, one for *A* (T_A), and the other for $\not{A}$ ($T_{\not{A}}$). A graphical representation of T_A and $T_{\not{A}}$ is given in Fig. 1. T_A and $T_{\not{A}}$ were chosen for these experiments to be equal and coterminous; further discussion may therefore be in terms of a single time cycle, T where $T=T_A=T_{\not{A}}$. Two probabilities were chosen for study: the probability of reinforcement (S^R) given that the organism was in *A* at the end of T, $P(S^R|A)$, and the probability of reinforcement given that the organism was in $\not{A}$ at the end of T, $P(S^R|\not{A})$ (all discussion is restricted to the area of "positive" reinforcement).

Fig. 1: A graphical representation of T_A and $T_{\not A}$.


TA
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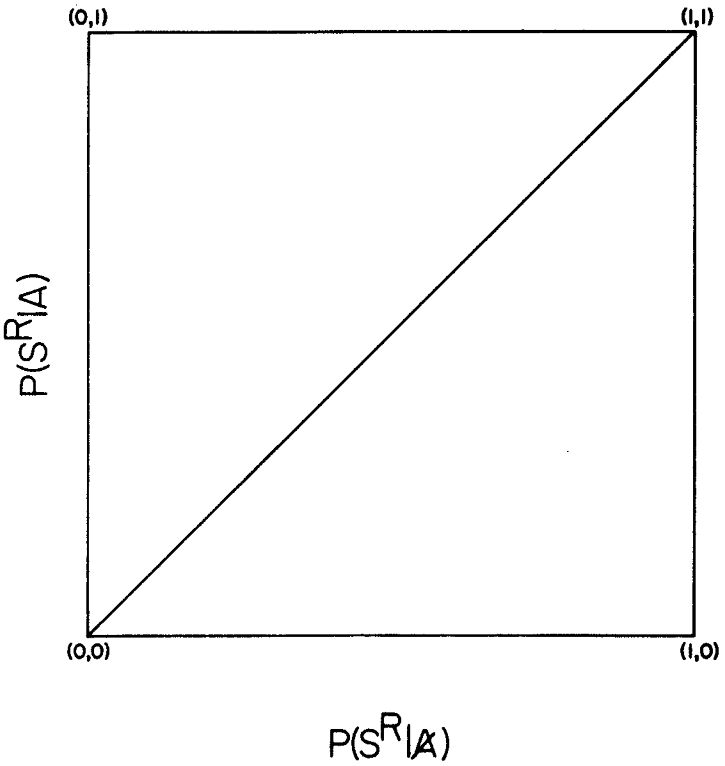
Since *A* and *A̸* were exclusive, only one probability could be in effect at the end of any T-cycle; a coordinate system of these independent probabilities is given in Fig. 2.

In Fig. 2, at the (0,1) point and T=0, every entry into *A* is immediately followed by reinforcement, and consequently, CRF is specified for the transition *A̸* to *A* when the organism is in *A̸* immediately after reinforcement. Similarly, CRF for the transition *A* to *A̸* is found at the (1,0) point. Reinforcement procedures for responses and spatial arrangements are no longer identical whenever every transition into *A* (or *A̸*) is not immediately followed by reinforcement. When reinforcement is contingent on responses (i.e., transitions), an unreinforced response must be followed by at least one other response in order for reinforcement to occur. In contrast, when reinforcement is contingent on spatial arrangements, after an unreinforced transition (i.e., a response) into *A* (or *A̸*), the organism can remain in *A* (or *A̸*) and obtain reinforcement without completing any additional transitions.

Related to Fig. 2 is a study by Baum and Rachlin (1969). They described an organism's spatial arrangements by three classes: left side, right side, and center of an experimental chamber. Reinforcement was never available for an organism in the center, and reinforcement was available on VI schedules for being on the left and right sides of the chamber. Since these investigators were interested in the applicability of the matching law to time allocation, they introduced a changeover delay for all transitions between the two sides. Descriptively and procedurally, Fig. 2 presents the simpler case; there are two rather than three exhaustive and exclusive classes of spatial arrangements on which reinforcement is made contingent without an additional contingency for transitions.

Fig. 2: Coordinate system for $P(S^R|A)$ and $P(S^R|\cancel{A})$.


(0,1)
(1,1)
$P(S^R|A)$
(0,0)
(1,0)
$P(S^R|\not{A})$

Exp. I: Noncontingent Reinforcement, The "Superstition" Phenomenon

On the diagonal of Fig. 2 from (0,0) to (1,1) the probabilities of reinforcement for $\underline{A}$ and $\underline{\not A}$ are equal. Due specifically to the selections of T_A and $T_{\not A}$ as equal and coterminous, and exhaustive behavioral classes, this diagonal results in the presentation of reinforcement which is independent of the distribution of $\underline{A}$ and $\underline{\not A}$ at the end of T-cycles. Reinforcement presentation which is independent of the temporal distribution of behavioral classes has been designated noncontingent reinforcement (Schoenfeld and Farmer, 1970).

Among the earliest studies of the effects of noncontingent reinforcement was Skinner's (1948) "superstition" experiment. Skinner found, by delivering reinforcement once every 15 sec to pigeons independently of their behavior, that some response class immediately preceded reinforcer occurrence. The established response classes under this procedure were different for each organism and included circle turning, head thrusting, pecking, and hopping. Subsequently, this experiment has been replicated by Staddon and Simmelhag (1971).

Skinner explained the acquisition of these response classes by reasoning that the first noncontingent reinforcement immediately followed some response class. The rate of this response class was then increased, and if the time until the next reinforcement was not long enough for the rate to decrease back to operant level, then this response class was increasingly likely to occur again just before the next reinforcement. Upon continuing reinforcer presentations, this response class became ever more likely until its occurrence was clear to the naked eye.

A line of research on noncontingent reinforcement has been directed toward its effects on some R with a particular history of contingent reinforcement (see for example, Herrnstein, 1966; Zeiler, 1968; Edwards, 1970; Neuringer, 1970; Lachter, 1971; Lachter et al., 1971; Schoenfeld et al., 1972). After maintaining an R on a contingent reinforcement schedule, a change was made directly to a noncontingent schedule. These experiments determined whether or not noncontingent reinforcement maintained the response rates previously established by contingent reinforcement. Maintenance of response rate has been found when an organism has a history of three reinforcements on a CRF schedule (Neuringer, 1970), and when an organism has a history of variable delay of reinforcement (Schoenfeld et al., 1972). A decrease in rate has been found when an organism has a history of interval (Herrnstein, 1966; Lachter, 1971; Lachter et al., 1971) and ratio (Edwards, 1970) reinforcement.

A second line of research has been conducted in the areas of "collateral" behavior, "schedule induced" polydipsia, and "schedule induced" aggression. The interest in these areas has been in those behaviors that do not have a history of contingent reinforcement but bear a noncontingent relation to reinforcer presentation, independent of whether or not reinforcement is contingent on some other response class. In all of these areas, the importance of the reinforcement schedule has been demonstrated. Laties et al. (1965) have shown that reinforcer presentation resulted in the occurrence of "collateral" behavior and that extinction resulted in a return in the collateral behavior to its operant level. Falk (1966a) found that polydipsia did not occur under CRF but did occur under VI 1 min where food reinforcement was contingent on bar-pressing. Falk (1966b) has also shown an increase followed by a decrease in the amount of water intake with increases in FI length where food reinforcement was again contingent on bar-pressing. Similarly, Burks (1970), after maintaining bar-pressing on a FR schedule for food reinforcement, has shown an increase in water intake with increasing time between the periodic presentation of noncontingent food reinforcement. Hutchinson et al. (1968) have shown increases in the number of attack responses with increases in the FR requirement for lever-pressing under food reinforcement.

An investigation of the diagonal running from (0,0) to

(1,1) in Fig. 2 contributed to the research on noncontingent reinforcement by an examination of the effects of a schedule of noncontingent reinforcement on behaviors without a history of contingent reinforcement, and by observing the effects that this reinforcement schedule had on $\underline{A}$ and $\underline{\not{A}}$. The investigation of this diagonal was a parametric investigation of Skinner's (1948) "superstition" phenomenon. At the (1,1) point of this diagonal, reinforcement occurred periodically once every T-cycle as in FI contingent reinforcement. At the (0,0) point reinforcement never occurred; this point was either operant level or extinction, depending on whether it preceded or followed a schedule of reinforcement. At all other points, reinforcement occurred aperiodically as in VI contingent reinforcement. The probability of reinforcement at the end of any T-cycle was P, where $P=P(S^R|A)=P(S^R|\not{A})$. The interreinforcement time (IS^RT) distributions generated at points along this diagonal had a mean of T/P and a variance of $T^2(1-P)/P^2$.

Method

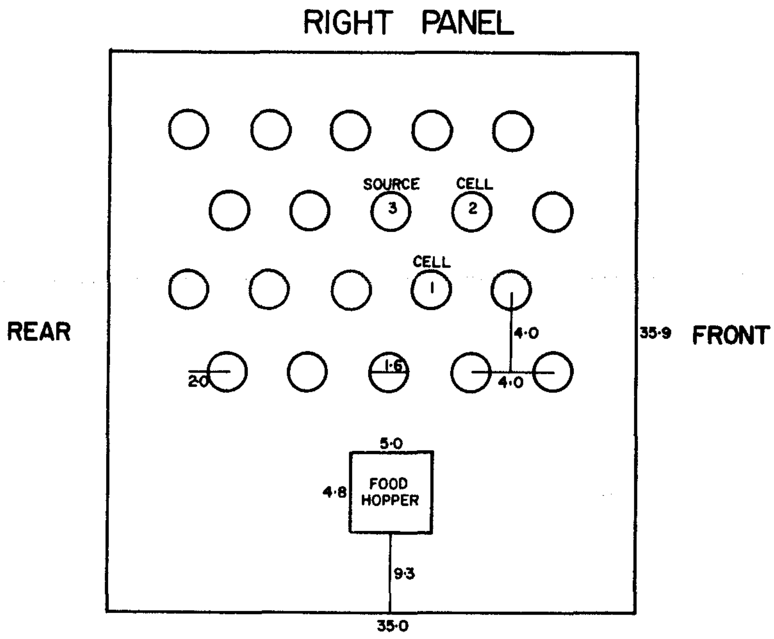
Subjects

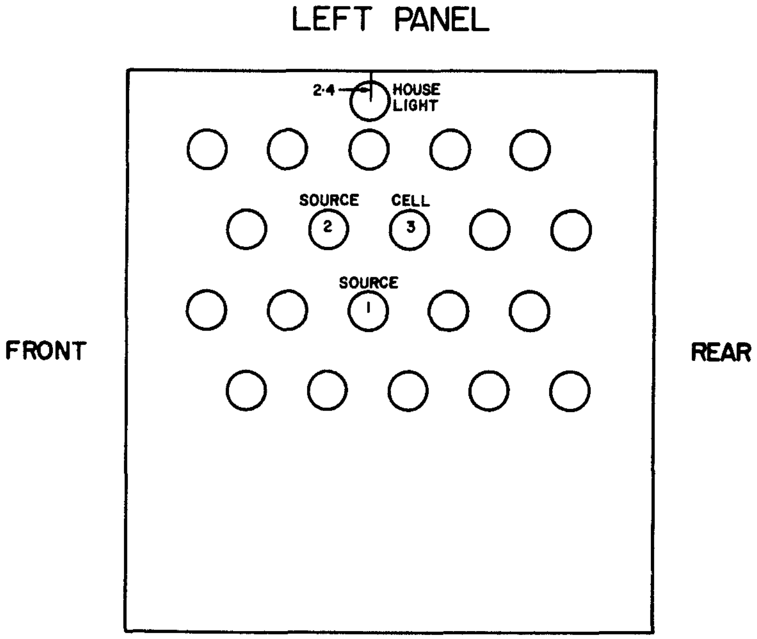
Five experimentally naive white Carneaux hens (denoted as P1, P2, P3, P4, and P5) approximately two years old were free-fed for 30 days, then reduced to 80% ± 15 gm of free-feeding body weight and maintained within this range for approximately six months prior to and throughout experimentation.

Apparatus

A Lehigh Valley Electronics Pigeon Test Chamber (Model 1519) was modified in the following way. The single intelligence panel was removed and replaced by two intelligence panels of the same size separated by 24.9 cm and designed to hold photocell and light source assemblies. Both panels, as shown in Fig. 3, consisted of four horizontal rows of five 1.6 cm diameter circular holes. The lowest row was 17.1 cm from the chamber floor, and the other three rows were placed progressively higher on a panel wall with 4.0 cm vertical separation between all rows. The centers of consecutive holes in a row were 4.0 cm apart, and consecutive rows were displaced horizontally by 2.0 cm measuring from the centers of the holes. The center of the middle hole on the lowest row was in the center of an intelligence panel. The light source and photocell assemblies were from the Lehigh Valley Electronics 221-10 photosensor unit. The sources and cells were mounted in aluminum sleeves which were then inserted into the holes in the intelligence panels so that they faced inward. The sources and cells were recessed by the sleeves approximately 1.1 cm from the face of the intelligence panels. Three pairs of sources and cells were placed in the positions shown in Fig. 3 giving a triangular configuration. This configuration was chosen on the basis of pilot work which indicated that it would record some of the behavioral changes obtained under noncontingent reinforcement; no attempt was made to explore the effects of other such configurations. All holes not containing sources or

Fig. 3: The faces of the intelligence panels (the edge of an intelligence panel located in the rear of the chamber is labeled "rear"; the edge in the front of the chamber is labeled "front"; measurements are in cm).


RIGHT PANEL
SOURCE 3
CELL 2
CELL 1
REAR
4·0
35·9
FRONT
2·0
1·6
4·0
5·0
4·8
FOOD HOPPER
9·3
35·0


LEFT PANEL
2·4
HOUSE LIGHT
SOURCE 2
CELL 3
SOURCE 1
FRONT
REAR

cells were left unfilled so as to permit ventilation. The light sources were powered from the amplifier of the LVE 221-10 unit, while the photocells were disconnected from the amplifier and interfaced into the programming circuitry by BRS (Digi-Bit) PA-203 modules. *A* was defined as the class of spatial arrangements that resulted in the interruption of one or more of the three light beams; $\not{A}$ was all other spatial arrangements. The recorded response was a transition from $\not{A}$ to *A*; this response was called R_A, the subscript indicating the class of spatial arrangements into which the organism moved to make a response. The apparatus was constructed so that when the organism ate from the food hopper, it was in $\not{A}$. The food hopper and house light, as shown in Fig. 3, were located on opposite panels and were centered on their respective panels.

Experimental conditions were programmed by BRS electronic modules, precision clocks, and probability generators. Data were recorded on Sodeco impulse counters and a Gerbrands cumulative recorder.

Procedure

The subjects were exposed at T = 15 sec to the following order of points from the diagonal referred to in Fig. 2: (0,0) (i.e., operant level); (1,1); (.5,.5); (.25,.25); (.125,.125); (.084,.084); and then a return to the (1,1) point (i.e., recovery). Skinner's (1948) reinforcement procedure was duplicated at the (1,1) point where reinforcement occurred once every 15 sec. After exposure to the (0,0) point, the first session of exposure at the (1,1) point was designated as the session after the subjects had first been visually observed to eat from the food hopper. Reinforcement was three sec of access to Purina pigeon grain. Data were not recorded during reinforcer presentation, and the succession of T-cycles was interrupted during reinforcer presentation. At reinforcer presentation, the house light went out and the hopper light came on; at reinforcer termination, the hopper light went out and the house light came back on. Table 1 shows the number of sessions of exposure at each point, the number

Table 1*
Procedure For Exp. I

Experimental Point	Sessions	T-cycles Per Session	Criterion Sessions	Mean Of IS^RT Distribution (sec)	Variance Of IS^RT Distribution (sec^2)
(0,0)	6	60	3	-	-
(1,1) And Recovery At The (1,1) Point	20	60	5	15	0
(.5,.5)	20	120	5	30	450
(.25,.25)	20	240	5	60	2,700
(.125,.125)	32	300	8	120	12,600
(.084,.084)	36	400	9	179	29,209

*One exception to the procedure described in Table 1 occurred due to an unavoidable laboratory shutdown for 11 days. The shutdown occurred for P2 and P3 after a change had been made from the (1,1) point to the (.5,.5) point. For P1, P4, and P5, the shutdown occurred while they were being exposed to the (1,1) point. In order to minimize the effects of the 11 day layoff on criterion sessions for P1, P4, and P5 at the (1,1) point, these subjects were exposed to the (1,1) point for a total of 35 sessions (2100 reinforcements). Conditions for P1, P4, and P5 were, otherwise, as presented in Table 1.

of T-cycles per session, the number of criterion sessions (the sessions at the end of an experimental point from which calculations were made), and the expected mean and variance of the $IS^{R}T$ distributions. Excluding operant level, subjects were exposed to each experimental point for a predicted number of 1200 reinforcements. The predicted number of reinforcements at each point across criterion sessions was 300.

Results And Discussion

The dependent variables (all figures show means computed from data pooled over criterion sessions) are:

1) R_A rate (to nearest .01 responses per sec): the number of transitions from $\underline{\not{A}}$ to $\underline{A}$ divided by session length; session length did not include reinforcement times.

2) R_A rate as a function of time within a T-cycle: the 15 sec T-cycle was subdivided into five consecutive 3-sec intervals; R_A rate was computed for each of the five intervals. Rate within a T-cycle was identical to rate within an IS^RT only at the (1,1) point where reinforcement occurred once every T-cycle.

3) percent $\underline{A}$ (to nearest 1): percentage of times that a subject was in $\underline{A}$ at the end of each of the five 3-sec intervals of a T-cycle. The end of the fifth interval (i.e., the end of a T-cycle) was the only instant where reinforcement could occur.

4) PS^RP (to nearest .1 sec): post-reinforcement-pause, the time between the end of reinforcement and the first response. A subject was in $\underline{\not{A}}$ at the end of reinforcement because of the position of the food hopper relative to the placement of the light beams. Consequently, the first response after reinforcement had to be a transition from $\underline{\not{A}}$ to $\underline{A}$ (i.e., R_A) rather than a transition from $\underline{A}$ to $\underline{\not{A}}$. PS^RP was, therefore, the time from the end of reinforcement to the first R_A. Since an R_A did not have to occur in every IS^RT, it was decided that a PS^RP would be terminated by either an R_A or the next reinforcement. The maximum obtainable PS^RP at any experimental point was therefore equal to the mean IS^RT, and the derived measure PS^RP/Mean IS^RT was actually plotted. PS^RP/Mean IS^RT gives the proportion of the mean IS^RT that a subject spent in $\underline{\not{A}}$ before the first R_A after reinforcement. The upper limit of this measure was 1 which would indicate that a subject never responded after any reinforcement; the lower limit was 0. PS^RP was the only measure taken directly on $\underline{\not{A}}$.

5) R_A/S^R (to nearest 1): R_As per reinforcement.

6) Time/A (to nearest .1 sec): time per entry into $\underline{A}$,

total amount of time spent in *A* divided by the total number of entries into *A*. This measure is response duration for R_A.

7) Time/A as a function of the five 3-sec intervals of a T-cycle: time was accumulated for the intervals of a T-cycle for all entries into *A* initiated in an interval, independent of the duration of the entry. Time/A for an interval could, therefore, be longer than the duration of the 3-sec interval. At the (1,1) point, an entry in the first interval of a T-cycle had a maximum of 15 sec, while an entry in the fifth interval of a T-cycle had a maximum of three sec.

8) relative time in *A* (to nearest .01): total amount of time spent in *A* divided by session length. This measure is the product of Time/A and R_A rate.

Relations between measures that were taken on *A* and measures referring to *Ⱥ*:

1) the number of transitions from *Ⱥ* to *A* (i.e., R_A) is equal to, one less, or one greater than the number of transitions from *A* to *Ⱥ* ($R_{\not{A}}$) depending on with which class of arrangements the organism started and ended a session.

2) total amount of time spent in *Ⱥ* divided by the number of entries into *Ⱥ* (Time/Ⱥ) can be determined from Time/A and R_A rate from the relations:

$$\text{relative time in } \underline{A} + \text{relative time in } \underline{\not{A}} = 1 \tag{a}$$

$$\text{relative time in } \underline{A} = (\text{Time}/A)\ (R_A \text{ rate}) \tag{b}$$

$$\text{relative time in } \underline{\not{A}} = (\text{Time}/\not{A})\ (R_{\not{A}} \text{ rate}) \tag{c}$$

substituting the right side of equations (b) and (c) in equation (a):

$$(\text{Time}/A)(R_A \text{ rate}) + (\text{Time}/\not{A})\ (R_{\not{A}} \text{ rate}) = 1 \tag{d}$$

also:

$$R_{\not{A}} \text{ rate} = R_A \text{ rate} \tag{e}$$

substituting the right side of equation (e) in equation (d) and transposing R_A rate to the right side of equation (d):

$$(\text{Time}/A) + (\text{Time}/\not{A}) = (1/R_A \text{ rate}) \tag{f}$$

equation (f) can be rewritten as:

$$(\text{Time}/\not{A}) = (1/R_A \text{ rate}) - (\text{Time}/A) \tag{g}$$

or:

$$(\text{Time}/A) + (\text{Time}/\not{A}) = IR_AT \text{ (interresponse time for } R_A\text{)}. \tag{h}$$

A verbal description of each subject's behavior at the (1,1) point is found in Table 2. There was no attempt made in Table 2 to provide an exhaustive account of the subjects' behavior; the designation of behaviors as occurring "just after" and "just before" reinforcer presentation was made solely by visual inspection with the experimenter acting as the observer. The observations in Table 2 were from the criterion sessions at the (1,1) point. Table 2 shows that, in the present experiment, the variety of behaviors established under noncontingent reinforcement with the pigeon was comparable to other experiments using the same procedure and organism (i.e., Skinner, 1948; Staddon and Simmelhag, 1971). At this reinforcement density, each subject showed a unique pattern of movement and, as Staddon and Simmelhag (1971) have pointed out, a different response preceded reinforcement than followed reinforcement. Additionally, Table 2 gives some indication of those verbal categories which corresponded to interruption of the light beams. At operant level, all subjects seldom moved from a crouched position. Compared to operant level activity, the effect of presenting reinforcement at the (1,1) point was to increase, over operant level, the overall activity of each subject. Some of this activity change was recorded by $\underline{A}$ and $\underline{\not{A}}$.

The sensitivity of measures taken on $\underline{A}$ and $\underline{\not{A}}$ to the behavioral changes occurring under noncontingent reinforcement can be seen in Figs. 4 and 5. Both sets of figures show rate as a function of T/P (T/P was chosen in place of probability so that changes along the abcissa would correspond to the actual order in which subjects were exposed to the experimental points; see Table 1 for a translation between probability and T/P). The operant level for all subjects was nearly zero. Reinforcement was first

Table 2*
Verbal Description of The Subjects' Behavior At The (1,1) Point

Subject	Behavior Just After Reinforcer Presentation	Behavior Just Before Reinforcer Presentation
P1	counterclockwise circling (interrupts light beams)	standing near or facing the front wall
P2	walking along right intelligence panel (interrupts light beams)	head bobbing in right front corner
P3	no behavior discernably different from the one occurring just before reinforcer presentation	head bobbing in right front corner
P4	back and forth head movements in front of right intelligence panel (interrupts light beams)	head lowered to food hopper
P5	circling and walking along right intelligence panel (interrupts light beams)	facing rear wall

*The division of behaviors into those occurring just after and just before reinforcer presentation follows Staddon and Simmelhag (1971).

Fig. 4: Rate as a function of T/P for P1, P2, and P3 [operant level is abbreviated "OL"; unconnected data points are the rates for the recovery at the (1,1) point].

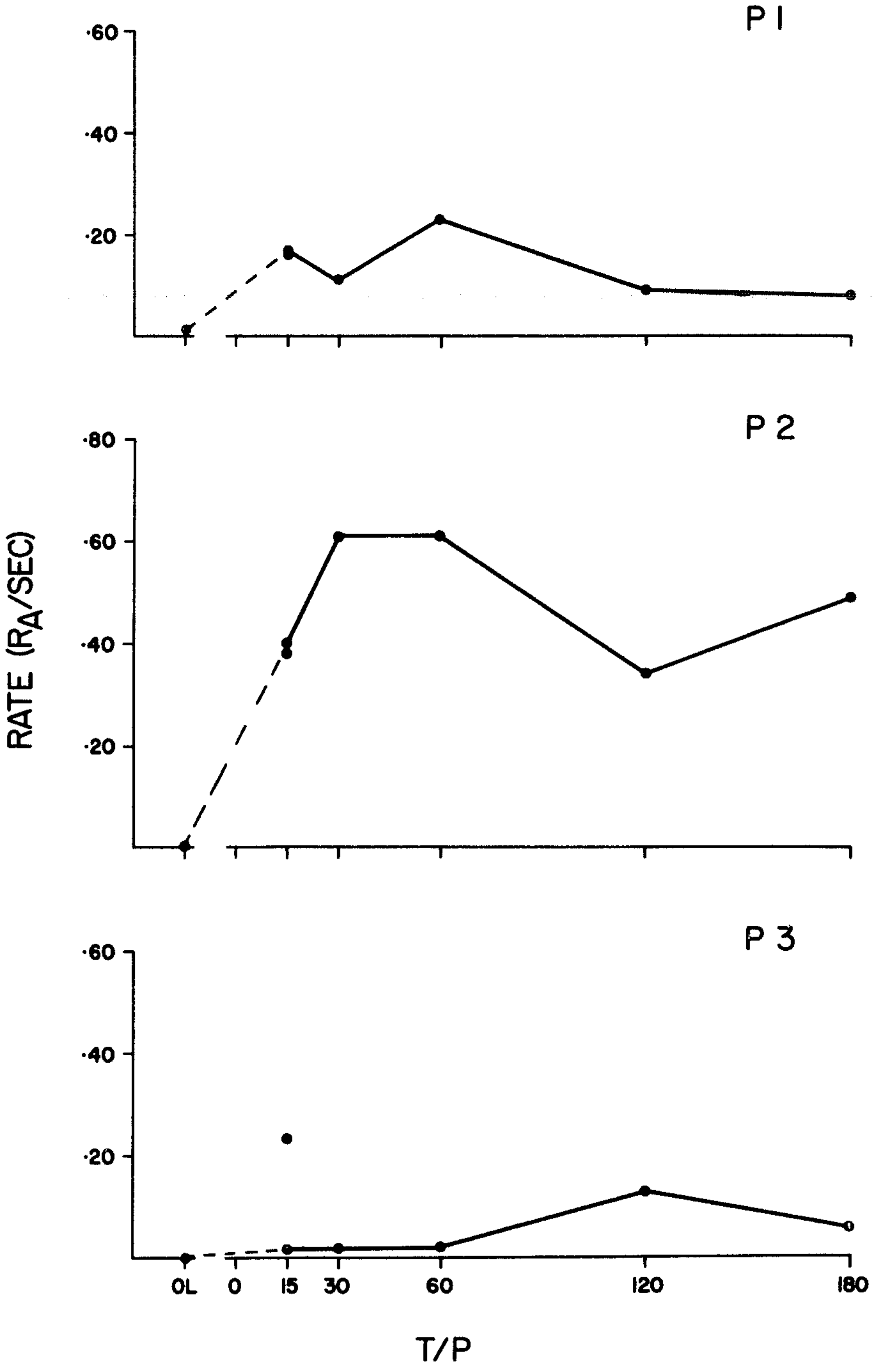
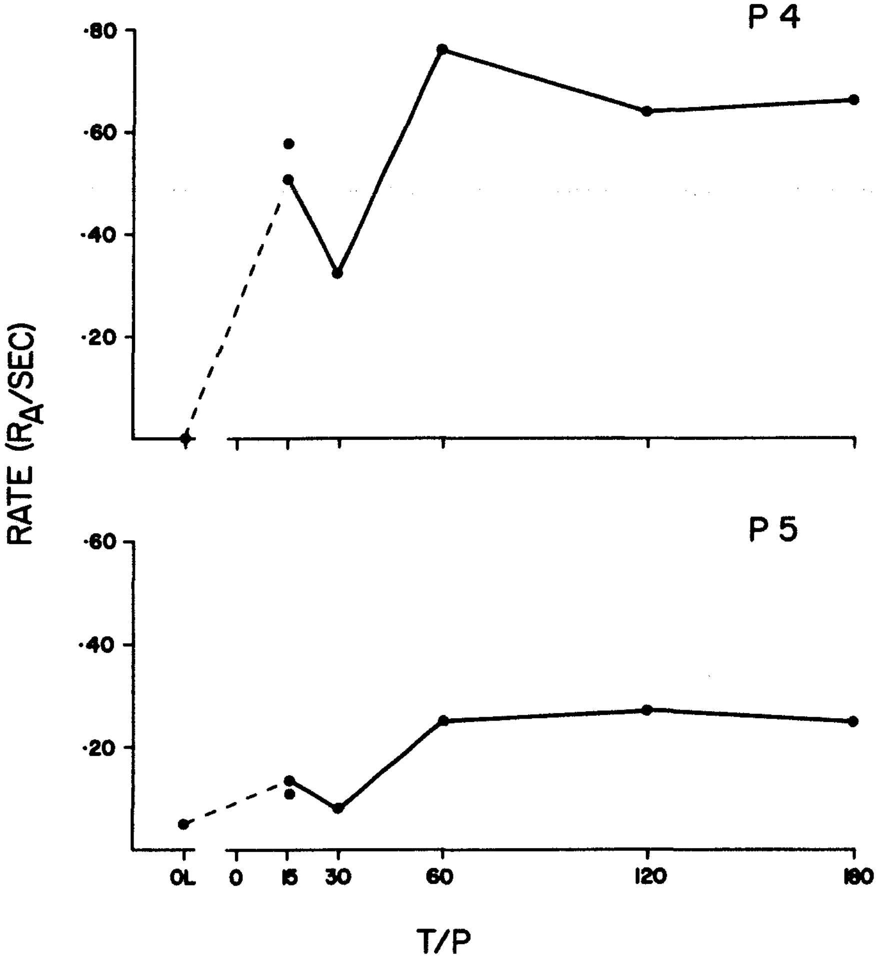

P 1
·60
·40
·20
P 2
·80
·60
·40
·20
P 3
·60
·40
·20
RATE (R_A/SEC)
0L
0
15
30
60
120
180
T/P

Fig. 5: Rate as a function of T/P for P4 and P5 [operant level is abbreviated "OL"; unconnected data points are the rates for the recovery at the (1,1) point].


P 4
·80
·60
·40
·20
P 5
·60
·40
·20
RATE (R_A/SEC)
0L
0
15
30
60
120
180
T/P

presented at T/P = 15 sec, and there was a subsequent rise in rate over operant level for all subjects. These rate increases were evident on the first experimental session. The rate changes from operant level at T/P = 15 sec were substantial for four of the five subjects with P3 showing a small increase (.02 R_A/sec) which eventually became unequivocal at T/P = 120 sec. All subjects showed a maximum rate at some point between the point of highest (i.e., T/P = 15 sec) and lowest (i.e., T/P = 179 sec) frequency of reinforcement.

Relative time in *A* as a function of T/P is shown in Figs. 6 and 7. As with the rate functions, a clear change over operant level was eventually demonstrated for all subjects, and these functions also went through a maximum. The similarity in shape between the rate (Figs. 4 and 5) and relative time (Figs. 6 and 7) functions suggests that changes in relative time [= (rate) (Time/A)] could have been primarily determined by changes in rate with only small changes occurring in Time/A. However, if Time/A showed only small changes, then changes in rate must have been primarily determined by changes in Time/A̸. This was indeed the case as can be seen when, in Figs. 8 and 9, Time/A is plotted as a function of T/P. For comparison, Time/A̸ was also included in Figs. 8 and 9, and was calculated from rate and Time/A [(Time/A) + (Time/A̸) = (1/R_A rate)]. Figs. 8 and 9 show that Time/A changed only slightly, except for P1 at T/P = 120 sec, when T/P increased as compared to the changes effected in Time/A̸. An effect of decreasing the probability of noncontingent reinforcement was reflected in the time spent in one of the two classes of spatial arrangements. This finding has been observed for contingent reinforcement where response duration (i.e., Time/A) was shown to be relatively insensitive to changes in either ratio (Schaefer and Steinhorst, 1959) or interval reinforcement schedules (Millenson et al., 1961); only when a change was made to extinction from a ratio or interval schedule, or a change was made from CRF to a ratio or interval schedule was a corresponding change reported for response duration.

Fig. 6: Relative time in A as a function of T/P for P1, P2, and P3 [operant level is abbreviated "OL"; unconnected data points are the relative times for the recovery at the (1,1) point].

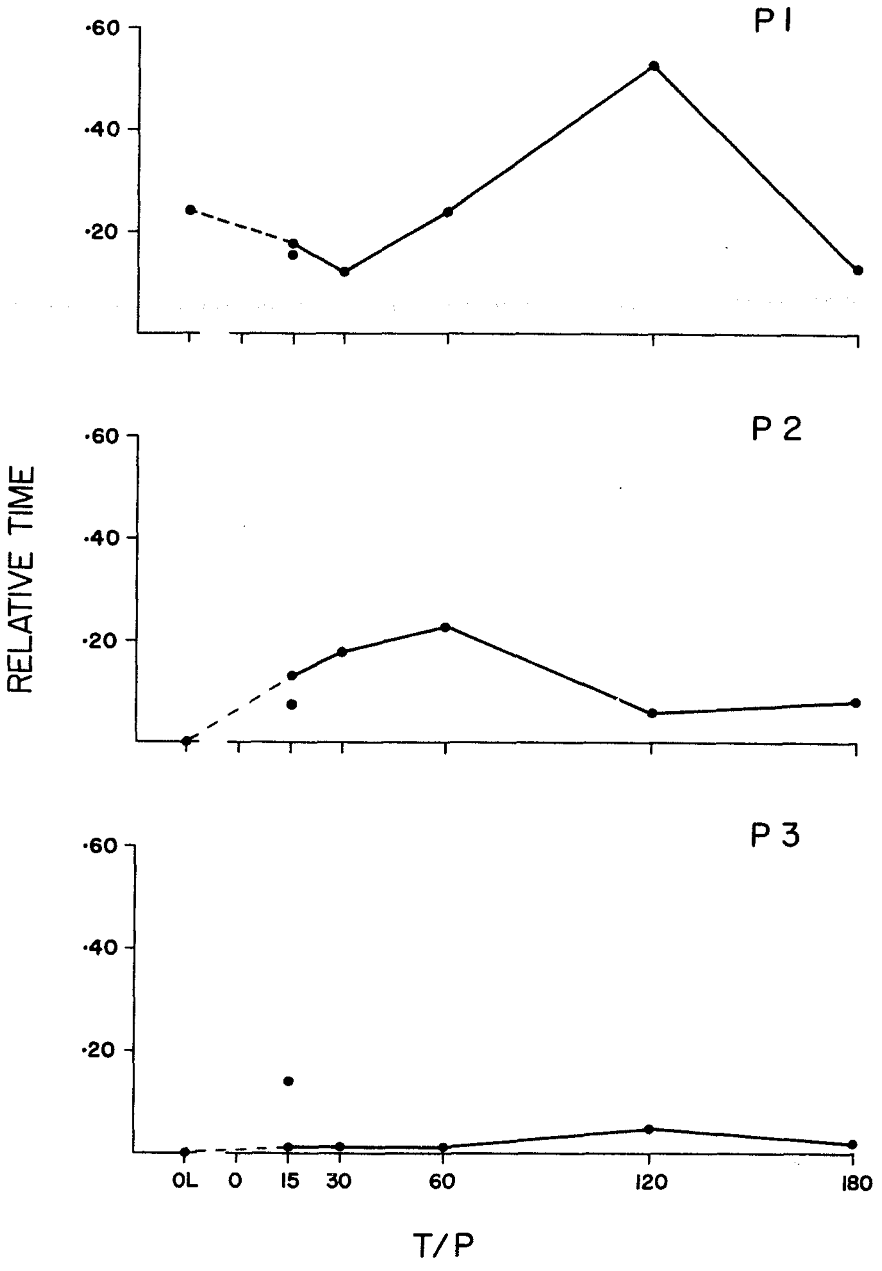

P I
P 2
P 3
RELATIVE TIME
·60
·40
·20
OL
0
15
30
60
120
180
T/P

Fig. 7: Relative time in A as a function of T/P for P4 and P5 [operant level is abbreviated "OL"; unconnected data points are the relative times for the recovery at the (1,1) point].

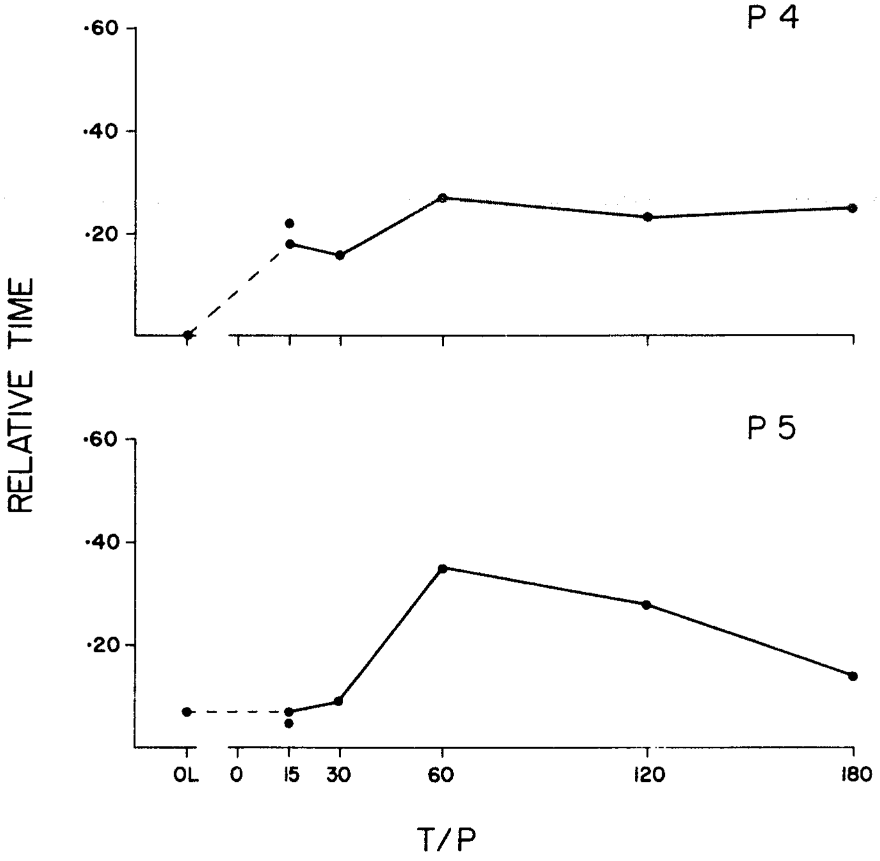

P 4
·60
·40
·20
P 5
·60
·40
·20
RELATIVE TIME
0L
0
15
30
60
120
180
T/P

Fig. 8: Time per entry as a function of T/P for P1, P2, and P3.

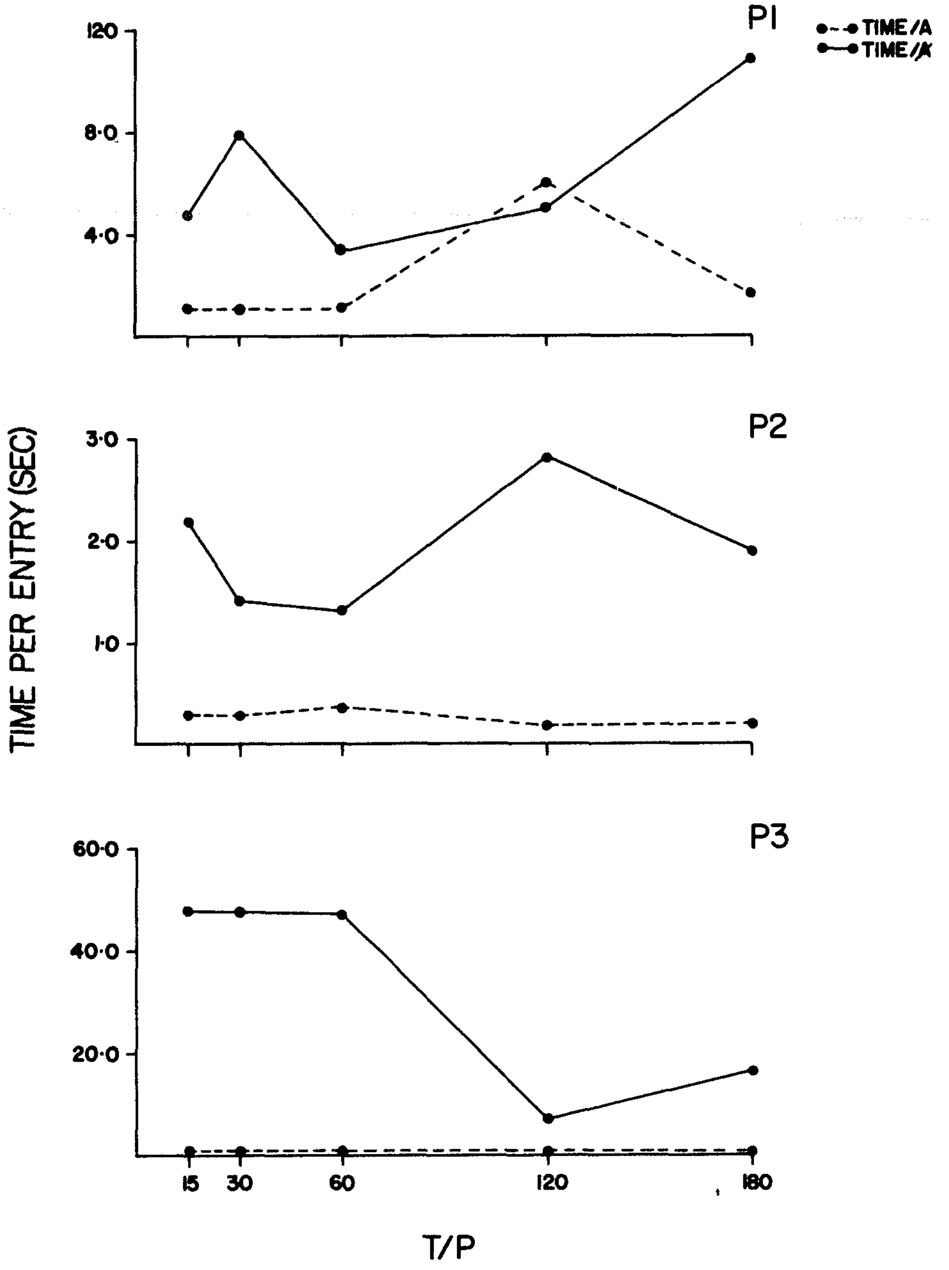
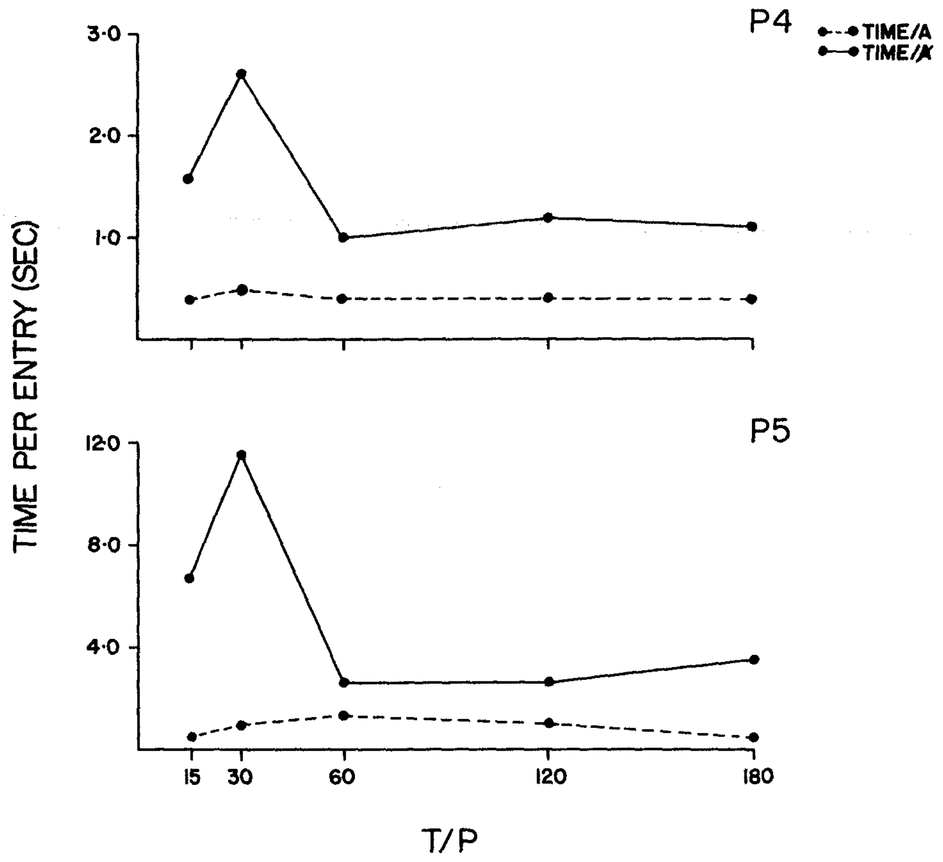

P1
●- -● TIME/A
●—● TIME/A̸
120
8·0
4·0
P2
3·0
2·0
1·0
P3
60·0
40·0
20·0
TIME PER ENTRY (SEC)
15
30
60
120
180
T/P

Fig. 9: Time per entry as a function of T/P for P4 and P5.


P4
TIME/A
TIME/A̸
3·0
2·0
1·0
P5
12·0
8·0
4·0
TIME PER ENTRY (SEC)
15
30
60
120
180
T/P

The contingent reinforcement schedules that generate $IS^{R}T$ distributions which most closely approximate the $IS^{R}T$ distributions of this present study are Farmer's (1962) random interval schedules. These schedules were such that the first R after the end of a repeating time cycle of length T was followed by reinforcement with probability P. Given that the organism makes at least one R per T-cycle, random interval schedules result in a mean and variance of the $IS^{R}T$ distribution, as in this study, of T/P and $T^{2}(1-P)/P^{2}$, respectively. Farmer used five groups of pigeons each having a different value of T and manipulated P within each group. In the present study, as Farmer found for a key peck response, it can be seen in Figs. 10 and 11, respectively, that R_{A}/S^{R} generally increased with increasing T/P, and $PS^{R}P$/Mean $IS^{R}T$ generally decreased with increasing T/P. Farmer (1962) did not actually plot $PS^{R}P$/Mean $IS^{R}T$ as a function of T/P; this measure is computable from his presented raw data, and all 12 subjects showed decreasing functions.

Figs. 12-16 show rate, at each experimental point, plotted as a function of the five 3-sec intervals of a T-cycle for each subject. Operant level was included in these functions to demonstrate again the sensitivity of $\underline{A}$ and $\underline{\not{A}}$ to the behavioral changes occurring under noncontingent reinforcement. Except for P3, the presentation of noncontingent reinforcement at the (1,1) point resulted in a change over operant level for nearly all intervals of a T-cycle, those temporally distant as well as those temporally close to reinforcer presentation. The largest changes in R_{A} rate were obtained in the time intervals of a T-cycle which immediately followed reinforcement. In general, the functions at the (1,1) point were curved with a maximum at either the first or second interval of a T-cycle after which rate decreased as the time for reinforcement approached. Staddon and Simmelhag (1971) presented noncontingent food reinforcement to pigeons once every 12 sec. The reinforcement procedure most similar to Staddon's and Simmelhag's in the present study, is found at the (1,1) point where reinforcement occurred every 15 sec. The low R_{A} rates obtained in the later

Fig. 10: R_A/S^R as a function of T/P for all subjects.

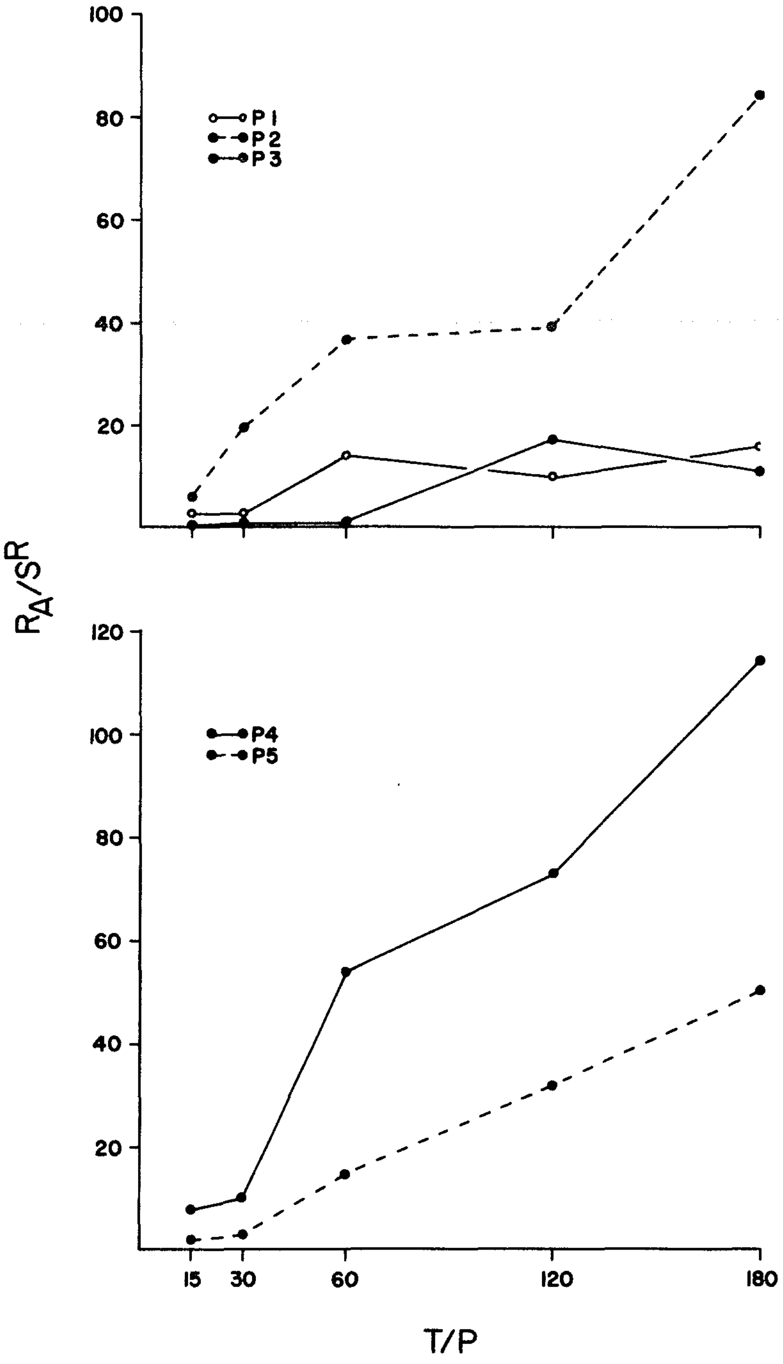

100
80
60
40
20
P1
P2
P3
R_A/S^R
120
100
80
60
40
20
P4
P5
15
30
60
120
180
T/P

Fig. 11: $PS^{R}P$/Mean $IS^{R}T$ as a function of T/P for all subjects [unconnected data points are the $PS^{R}Ps$/Mean $IS^{R}T$ for the recovery at the (1,1) point].

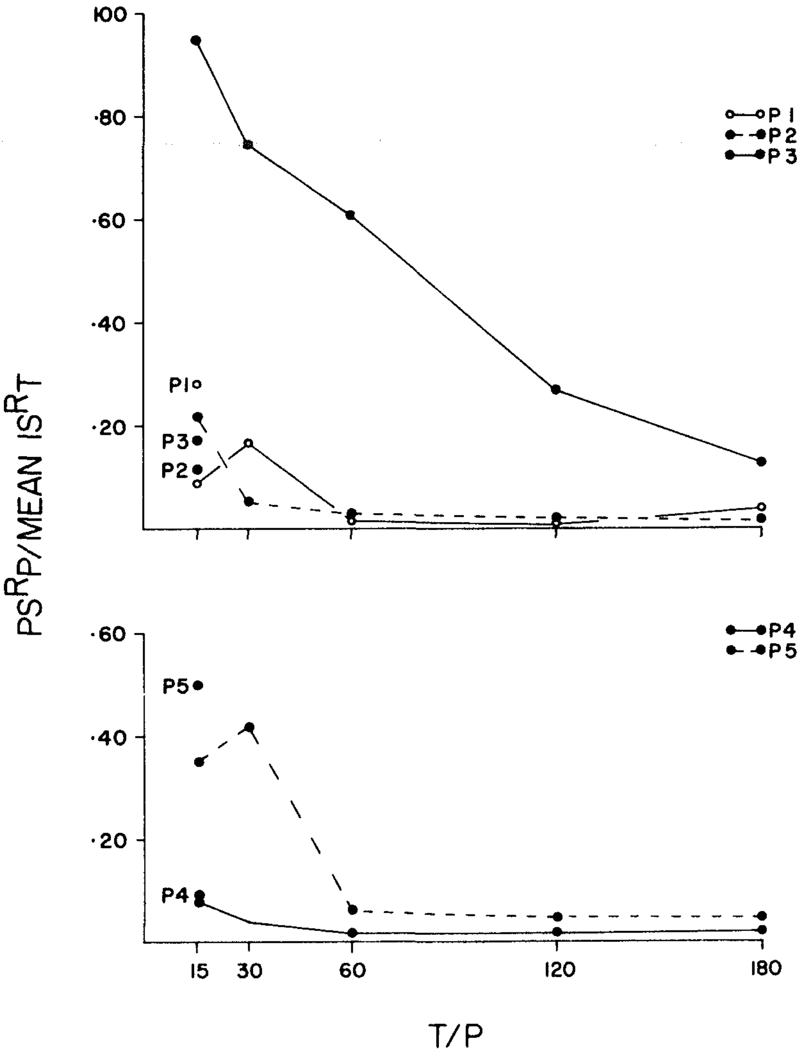

100
·80
·60
·40
·20
P1
P2
P3
P1
P3
P2
·60
·40
·20
P4
P5
P5
P4
15
30
60
120
180
T/P
PSRP/MEAN ISRT

Fig. 12: Rate, at each experimental point, as a function of the five 3-sec intervals of a T-cycle for P1 [operant level is abbreviated "OL"; recovery is a return to the (1,1) point after the (.084,.084) point].

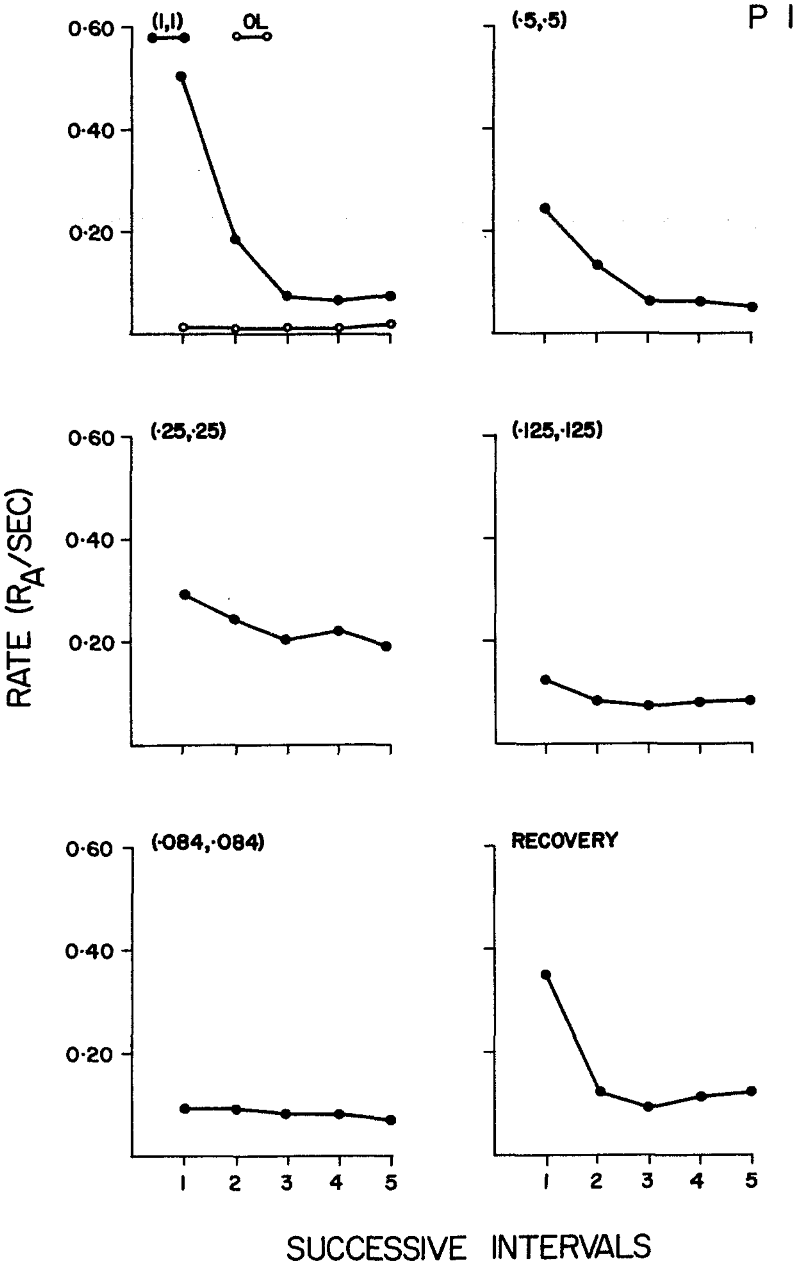

P I
(1,1)
OL
(·5,·5)
(·25,·25)
(·125,·125)
(·084,·084)
RECOVERY
0·60
0·40
0·20
RATE (R_A/SEC)
1
2
3
4
5
SUCCESSIVE INTERVALS

Fig. 13: Rate, at each experimental point, as a function of the five 3-sec intervals of a T-cycle for P2 [operant level is abbreviated "OL"; recovery is a return to the (1,1) point after the (.084,.084) point].

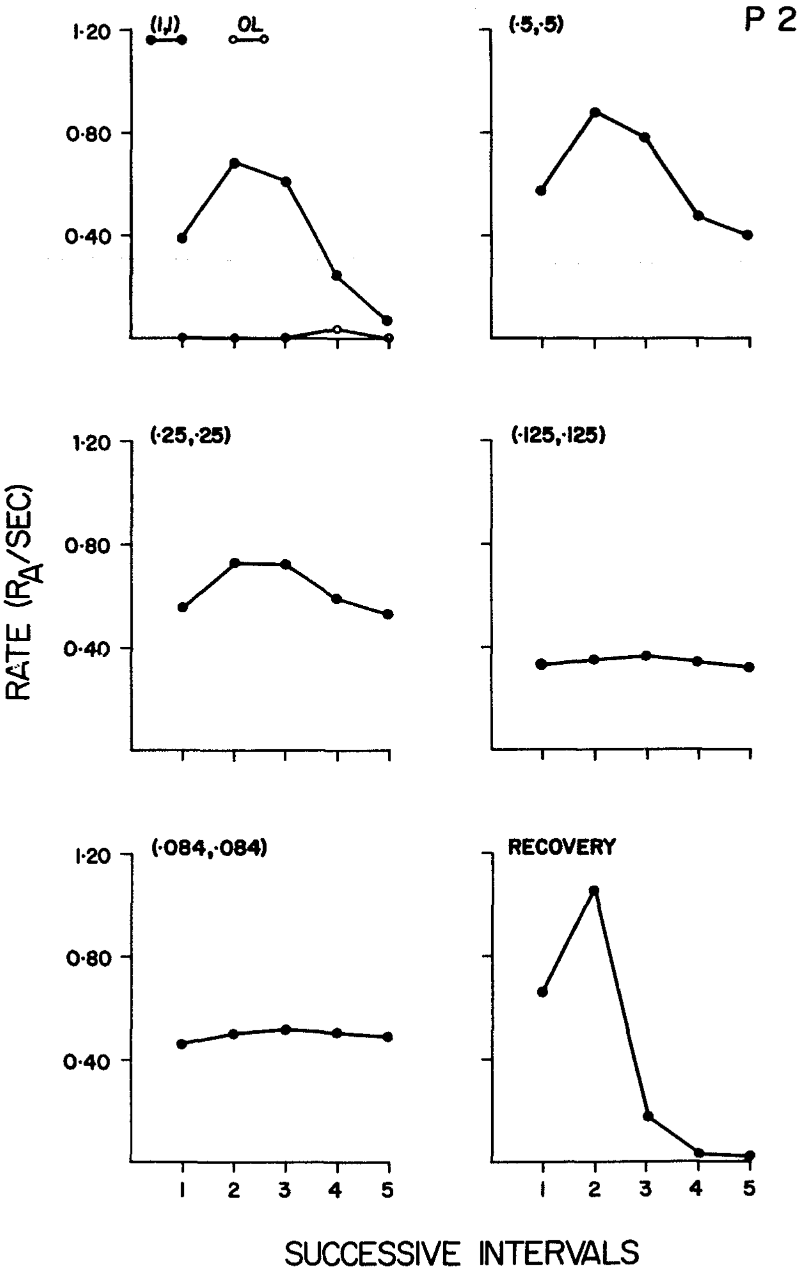

P 2
(1,1)
OL
(·5,·5)
(·25,·25)
(·125,·125)
(·084,·084)
RECOVERY
1·20
0·80
0·40
RATE (R_A/SEC)
1
2
3
4
5
SUCCESSIVE INTERVALS

Fig. 14: Rate, at each experimental point, as a function of the five 3-sec intervals of a T-cycle for P3 [operant level is abbreviated "OL"; recovery is a return to the (1,1) point after the (.084,.084) point].

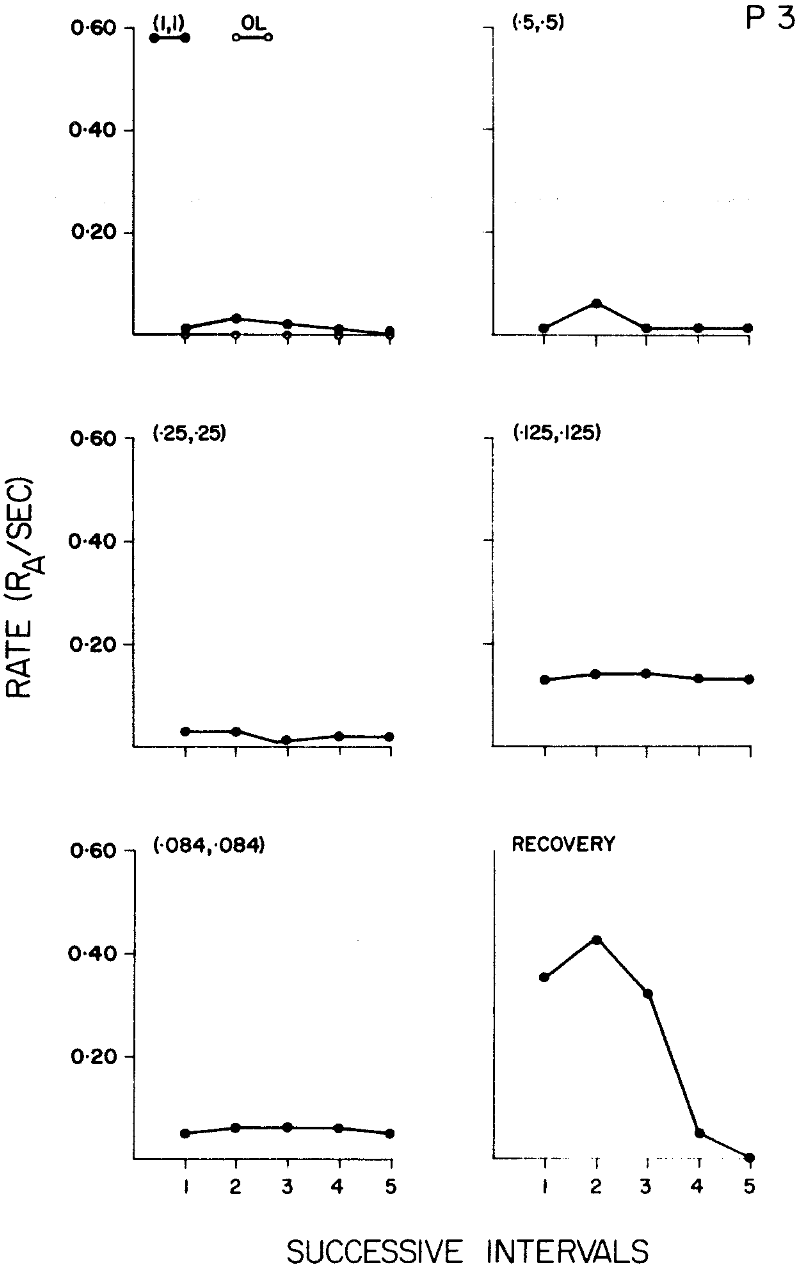

P 3
(1,1)
OL
(·5,·5)
(·25,·25)
(·125,·125)
(·084,·084)
RECOVERY
0·60
0·40
0·20
RATE (R_A/SEC)
1
2
3
4
5
SUCCESSIVE INTERVALS

Fig. 15: Rate, at each experimental point, as a function of the five 3-sec intervals of a T-cycle for P4 [operant level is abbreviated "OL"; recovery is a return to the (1,1) point after the (.084,.084) point].

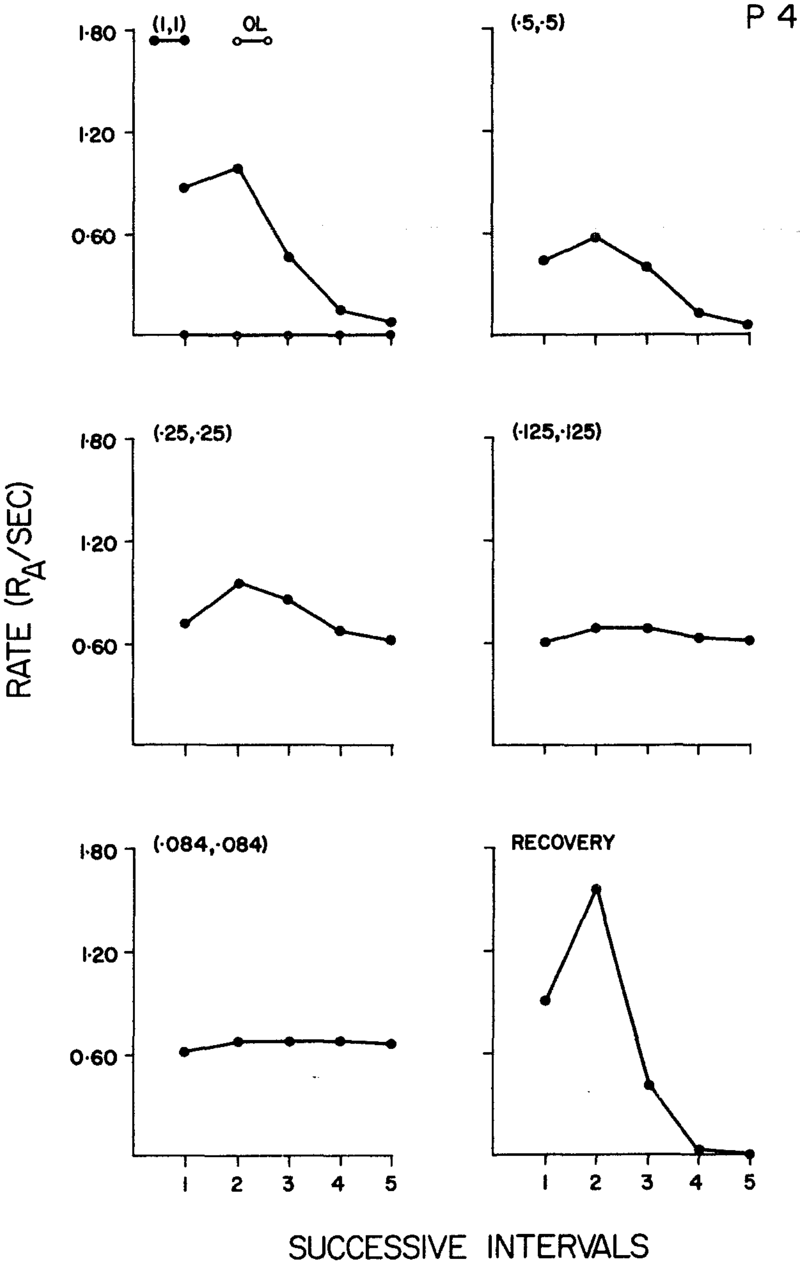
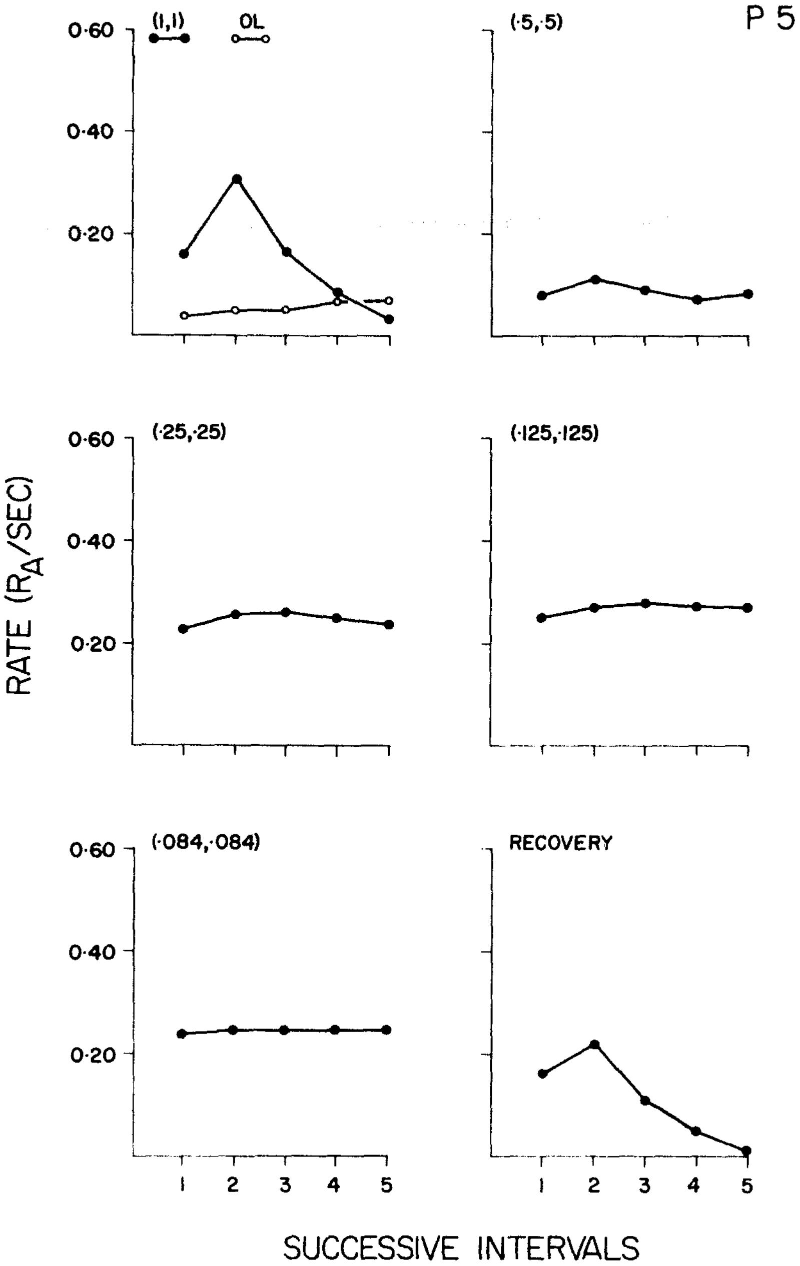

P 4
(1,1)
OL
(·5,·5)
(·25,·25)
(·125,·125)
(·084,·084)
RECOVERY
1·80
1·20
0·60
RATE (R_A/SEC)
1
2
3
4
5
SUCCESSIVE INTERVALS

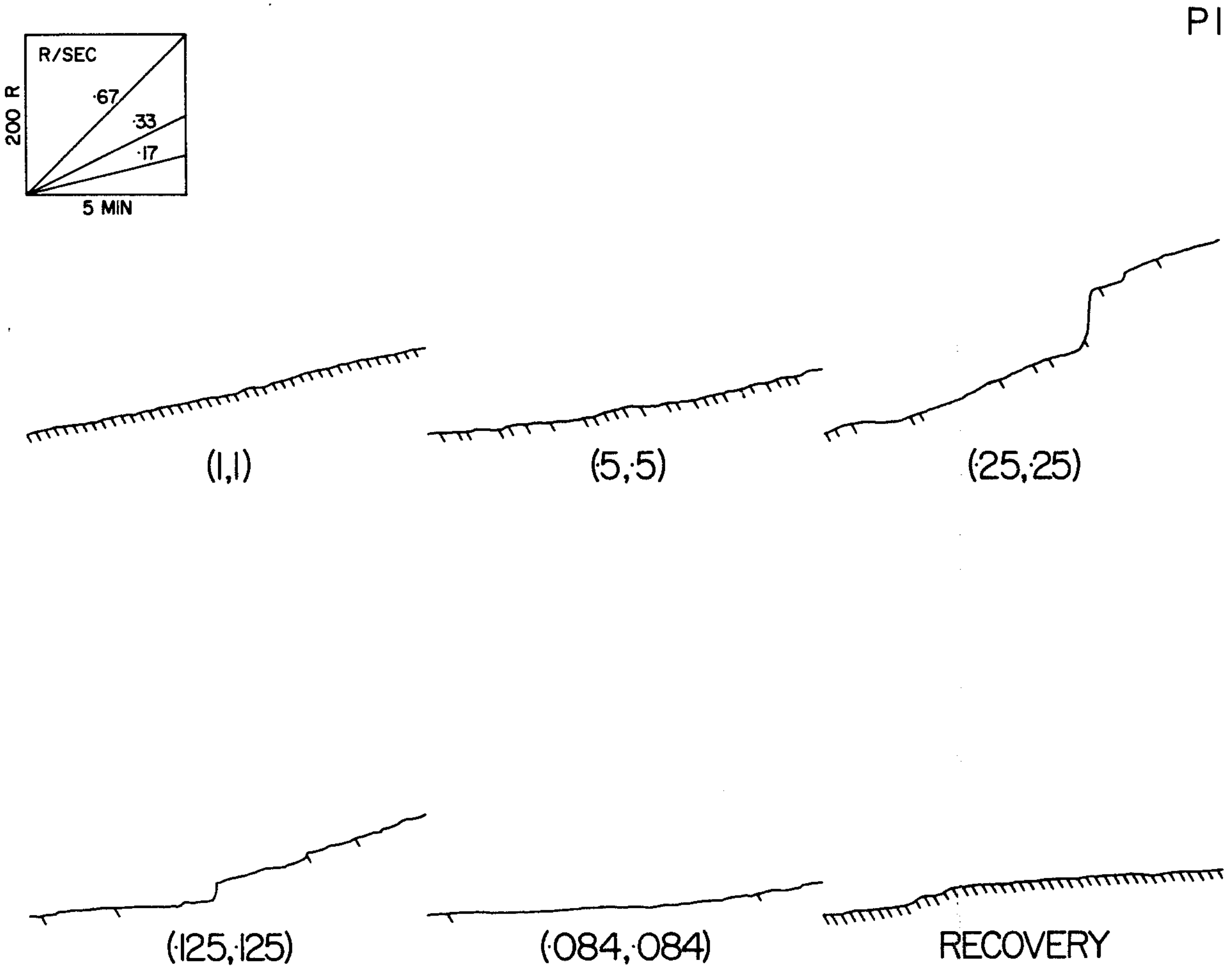
Fig. 16: Rate, at each experimental point, as a function of the five 3-sec intervals of a T-cycle for P5 [operant level is abbreviated "OL"; recovery is a return to the (1,1) point after the (.084,.084) point].


P 5
(1,1)
OL
(·5,·5)
(·25,·25)
(·125,·125)
(·084,·084)
RECOVERY
0·60
0·40
0·20
RATE (R_A/SEC)
1
2
3
4
5
SUCCESSIVE INTERVALS

intervals of a T-cycle at the (1,1) point showed, as previously observed by Staddon and Simmelhag, that a response which occurred soon after noncontingent reinforcement rarely occurred just before noncontingent reinforcement. In the present study, the effect of decreasing the probability of noncontingent reinforcement was a progressive flattening of the rate within a T-cycle functions until nearly flat functions were obtained at the lower probabilities of reinforcement. This finding can be extended from T-cycles to IS^RTs by an examination of the cumulative records presented in Figs. 17-21. These cumulative records were taken for all subjects from the beginning of the last criterion session at each experimental point. The records show that the functions in Figs. 12-16 were not the result of behavior in only a few T-cycles between reinforcements but were descriptive of behavior throughout IS^RTs. The change in the shape of the function for rate within an IS^RT from curved to flat as reinforcer presentation went from periodic [i.e., the (1,1) point] to aperiodic (i.e., all other points) has similarly been shown under contingent reinforcement when a change was made from a FI to a VI reinforcement schedule (Ferster and Skinner, 1957; Farmer, 1962; Catania and Reynolds, 1968). Compared to FI schedules, the flatter functions for rate within an IS^RT found with VI schedules were necessarily due to increases in the variance of the IS^RT distribution. This suggests that the flat rate functions obtained here were also due primarily to increases in the variance of the IS^RT distribution although, in the present study, a decrease in the probability of reinforcement, with T constant, caused an increase in both the mean and the variance of the IS^RT distribution.

As with the rate functions within a T-cycle, Figs. 22-26 show that as probability decreased the functions for percent *A* at the end of each time interval of a T-cycle became progressively flatter. For all subjects, the percent *A* for all time intervals was affected by a decrease in the probability of reinforcement. The data from Figs. 22-26 were replotted in Figs. 27-31 to show the effect on percent *A* at the end of each time interval of increasing T/P (i.e., decreasing the probability of reinforcement).

Fig. 17: Cumulative records from the beginning of the last criterion session at each experimental point for P1 (slashes represent reinforcements).



(1,1)

(·5,·5)

(·25,·25)

(·125,·125)

(·084,·084)

RECOVERY

Fig. 18: Cumulative records from the beginning of the last criterion session at each experimental point for P2 (slashes represent reinforcements).

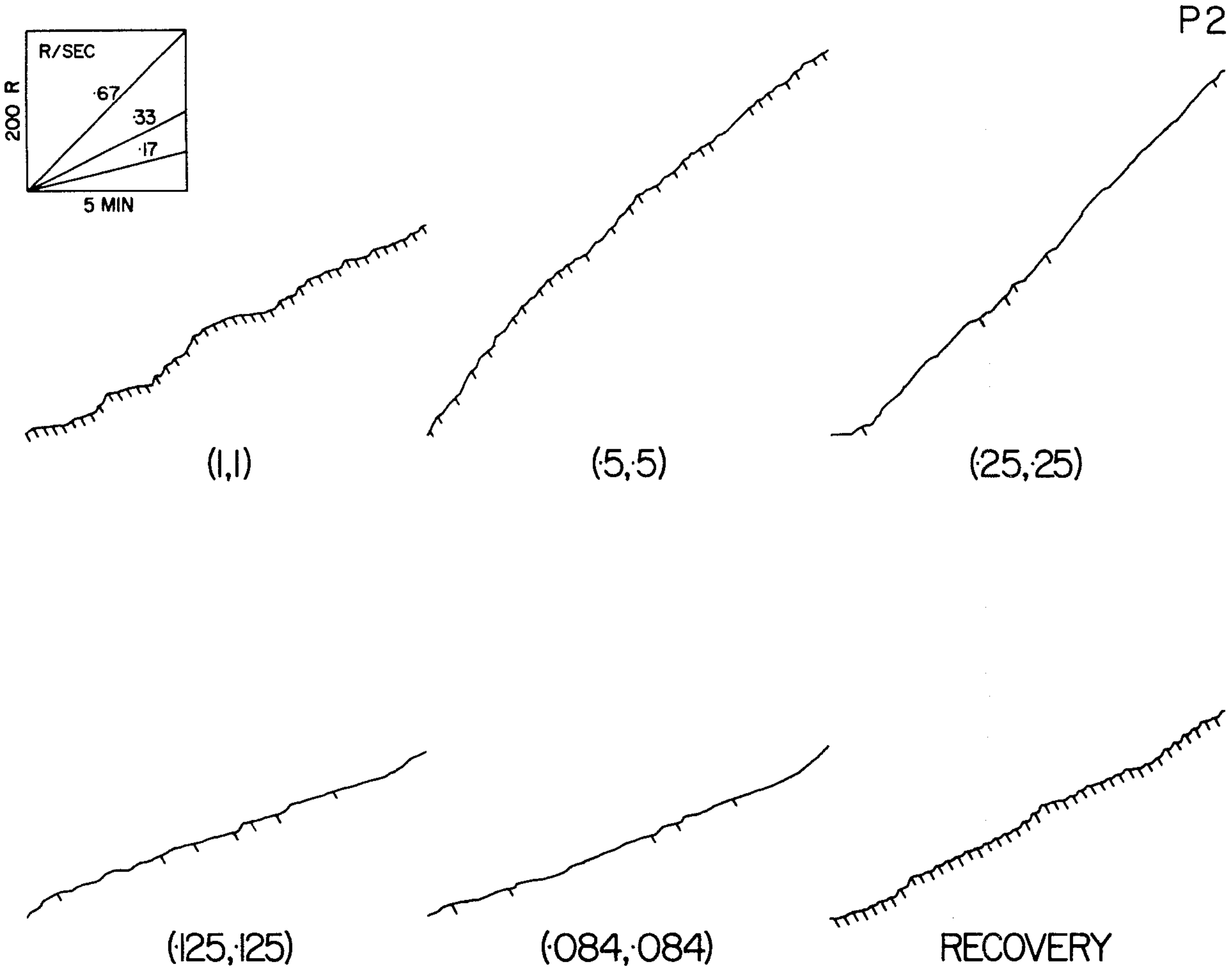

P2
R/SEC
·67
·33
·17
200 R
5 MIN
(1,1)
(·5,·5)
(·25,·25)
(·125,·125)
(·084,·084)
RECOVERY

Fig. 19: Cumulative records from the beginning of the last criterion session at each experimental point for P3 (slashes represent reinforcements).

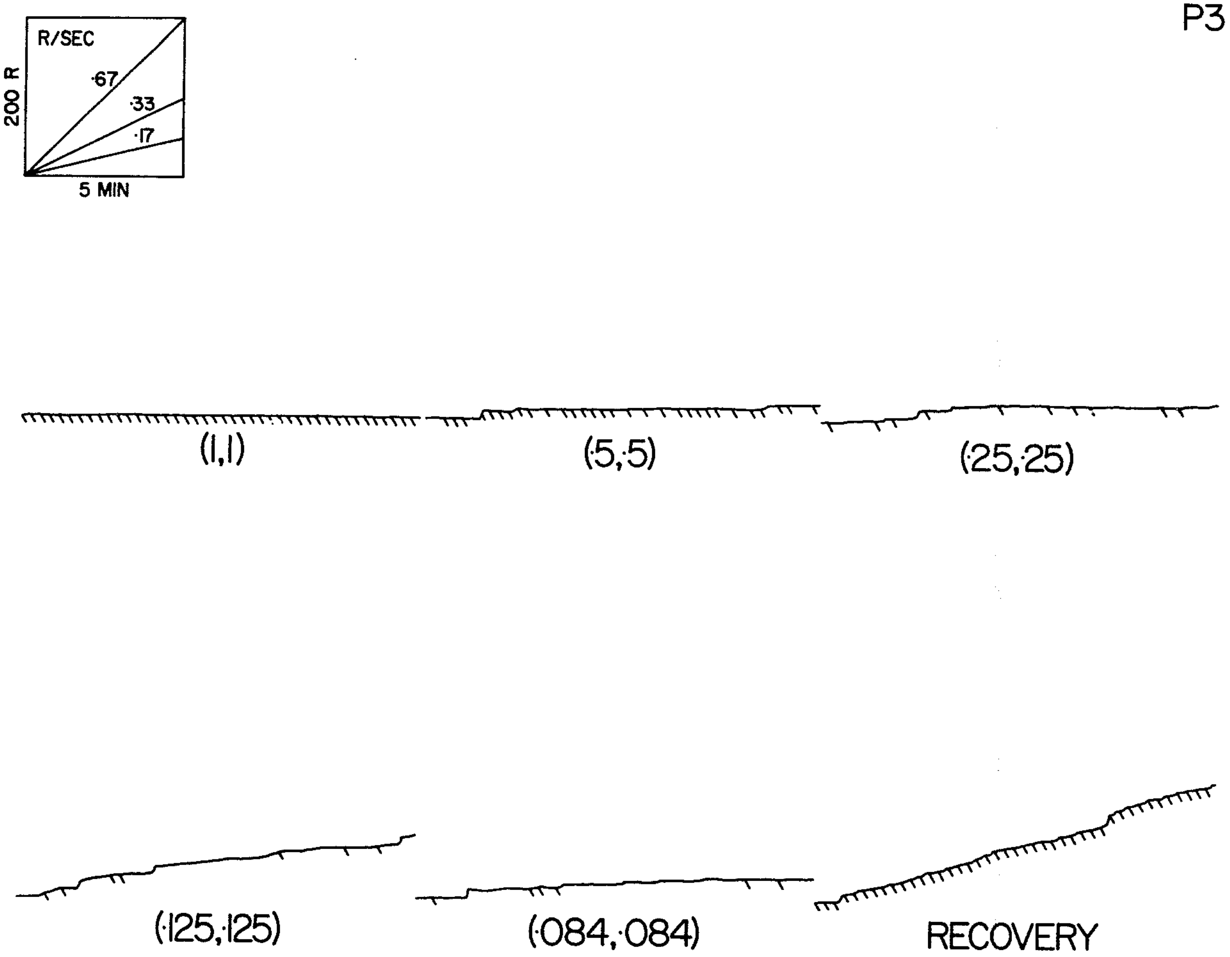

R/SEC
200 R
·67
·33
·17
5 MIN
P3
(1,1)
(·5,·5)
(·25,·25)
(·125,·125)
(·084,·084)
RECOVERY

Fig. 20: Cumulative records from the beginning of the last criterion session at each experimental point for P4 (slashes represent reinforcements).

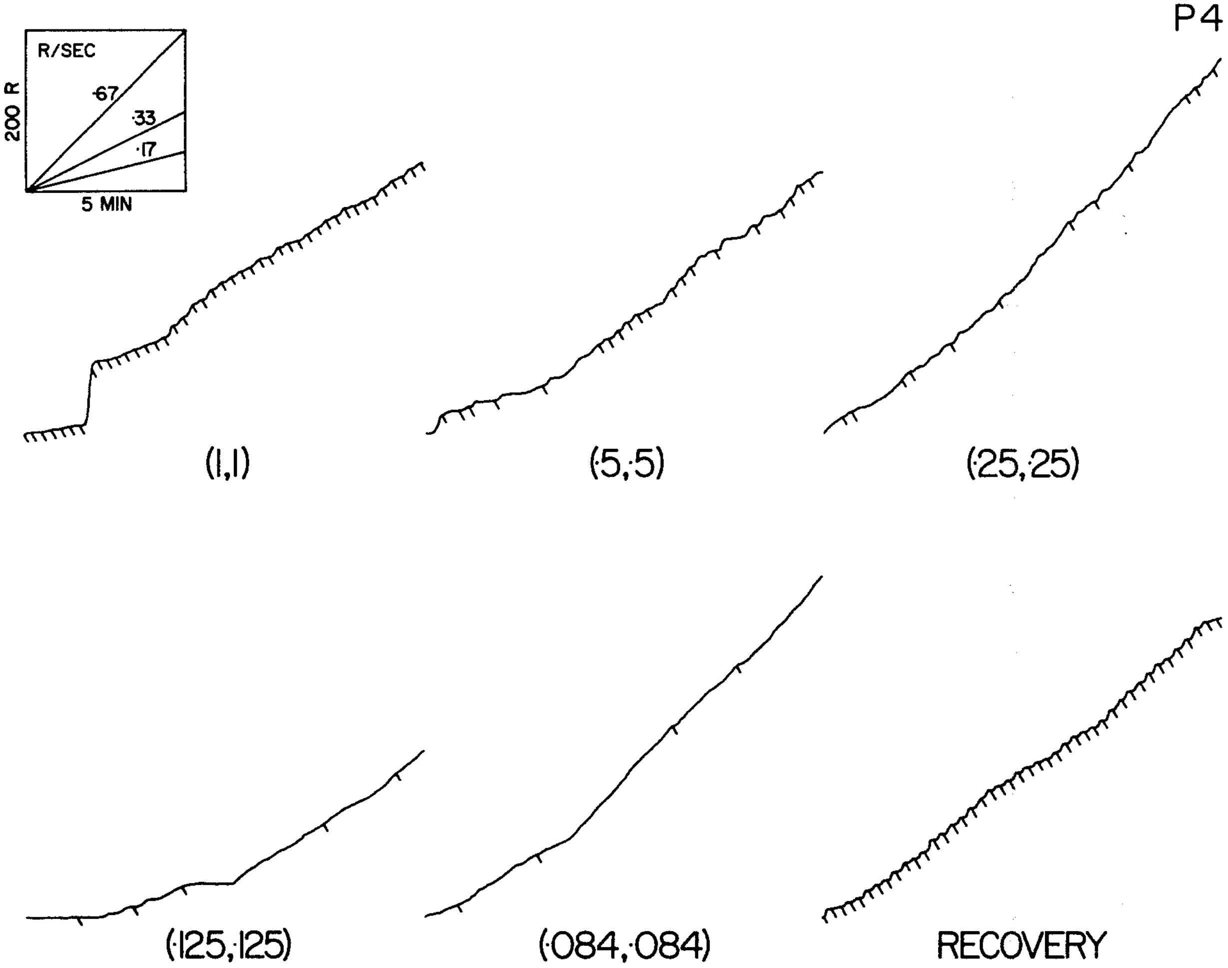

P4
R/SEC
·67
·33
·17
200 R
5 MIN
(1,1)
(·5,·5)
(·25,·25)
(·125,·125)
(·084,·084)
RECOVERY

Fig. 21: Cumulative records from the beginning of the last criterion session at each experimental point for P5 (slashes represent reinforcements).

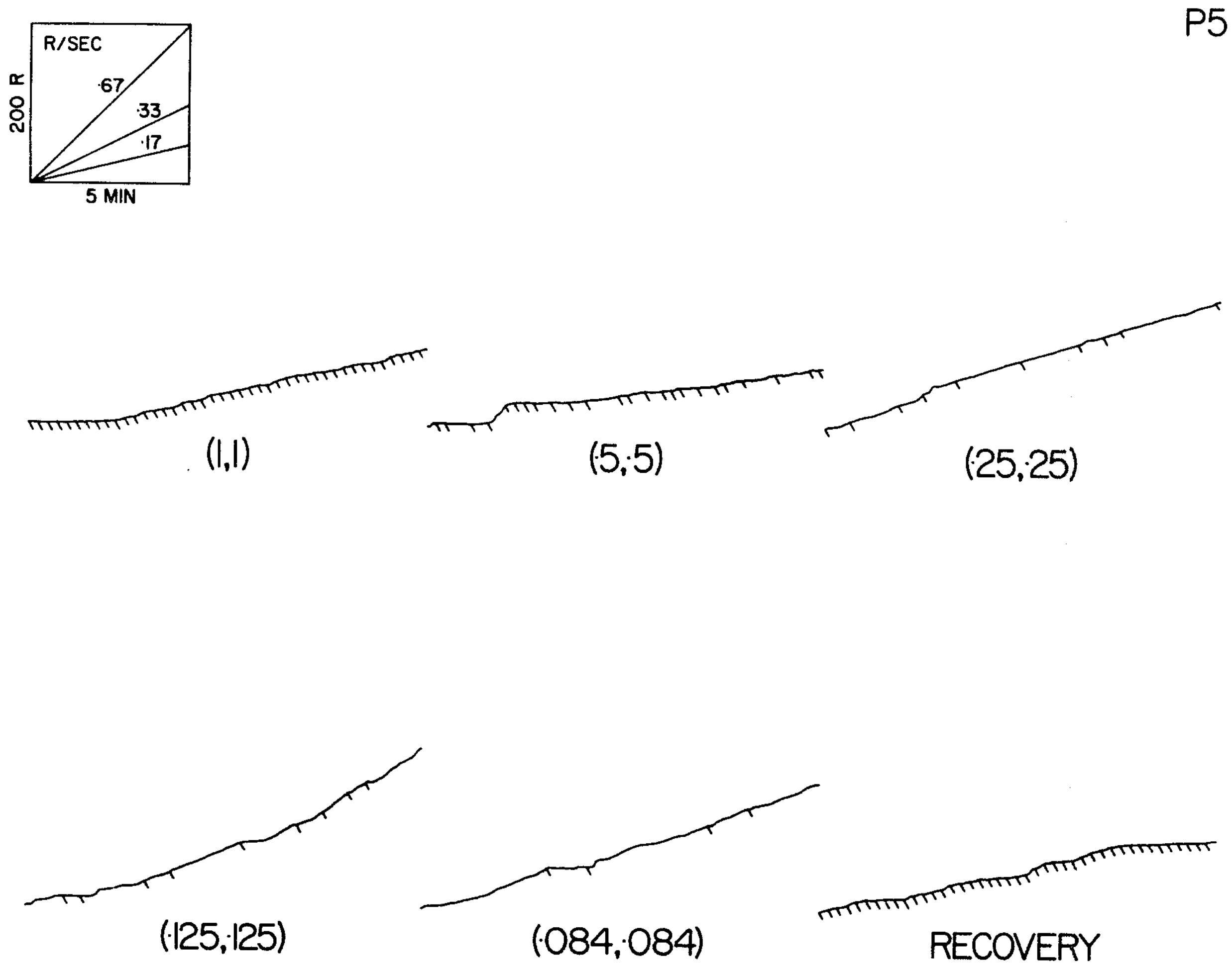

R/SEC
200 R
·67
·33
·17
5 MIN
P5
(1,1)
(·5,·5)
(·25,·25)
(·125,·125)
(·084,·084)
RECOVERY

Fig. 22: Percent A, at each experimental point, as a function of the five 3-sec intervals of a T-cycle for P1 [recovery is a return to the (1,1) point after the (.084,.084) point].

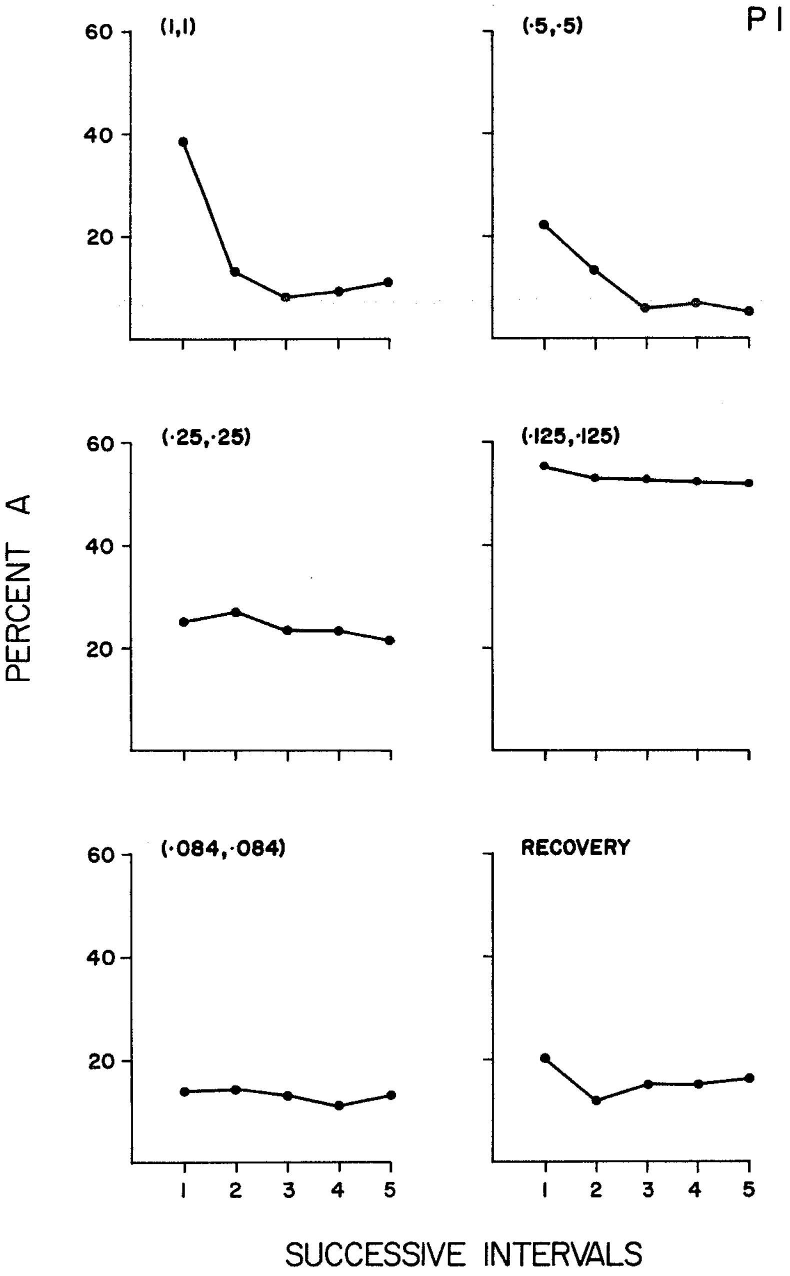

P I
(1,1)
(·5,·5)
(·25,·25)
(·125,·125)
(·084,·084)
RECOVERY
PERCENT A
60
40
20
1
2
3
4
5
SUCCESSIVE INTERVALS

Fig. 23: Percent A, at each experimental point, as a function of the five 3-sec intervals of a T-cycle for P2 [recovery is a return to the (1,1) point after the (.084,.084) point].

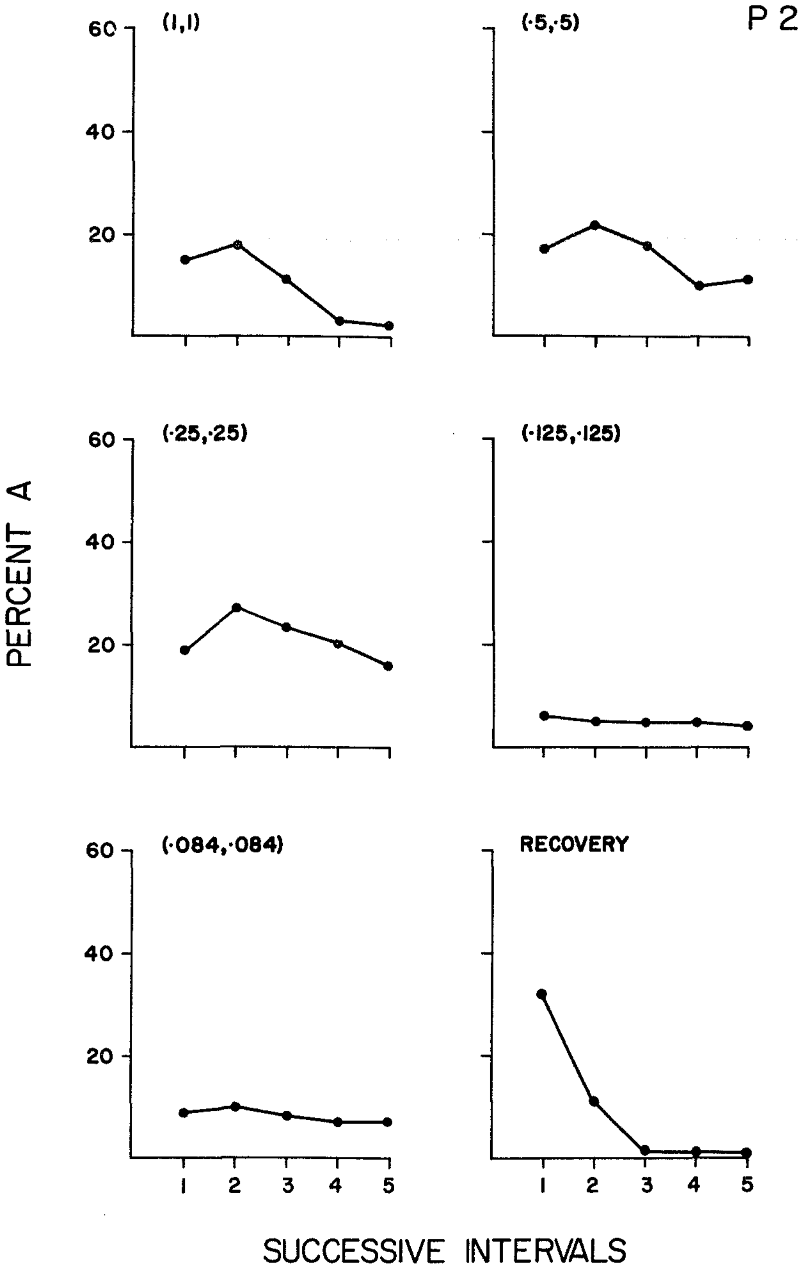

P 2
(1,1)
(·5,·5)
(·25,·25)
(·125,·125)
(·084,·084)
RECOVERY
60
40
20
PERCENT A
1
2
3
4
5
SUCCESSIVE INTERVALS

Fig. 24: Percent A, at each experimental point, as a function of the five 3-sec intervals of a T-cycle for P3 [recovery is a return to the (1,1) point after the (.084,.084) point].

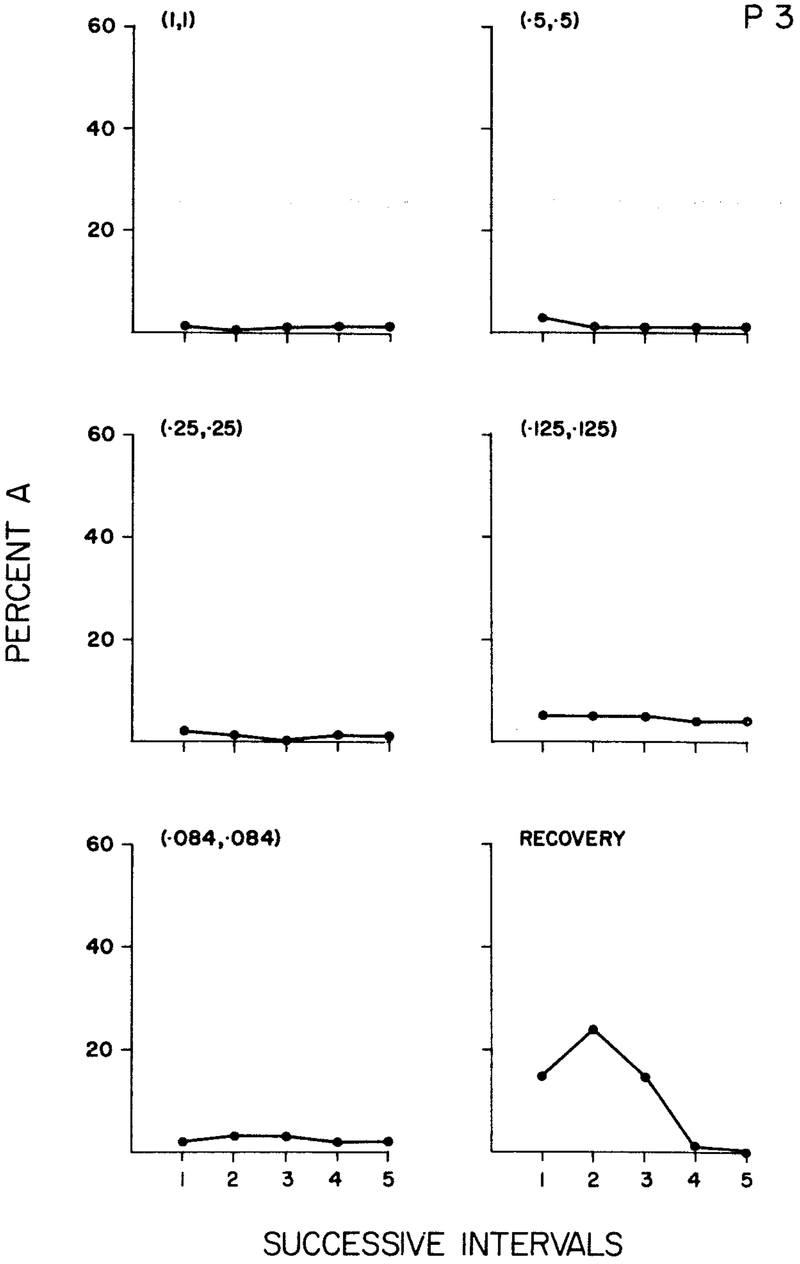

P 3
(1,1)
(·5,·5)
(·25,·25)
(·125,·125)
(·084,·084)
RECOVERY
60
40
20
PERCENT A
1
2
3
4
5
SUCCESSIVE INTERVALS

Fig. 25: Percent A, at each experimental point, as a function of the five 3-sec intervals of a T-cycle for P4 [recovery is a return to the (1,1) point after the (.084,.084) point].

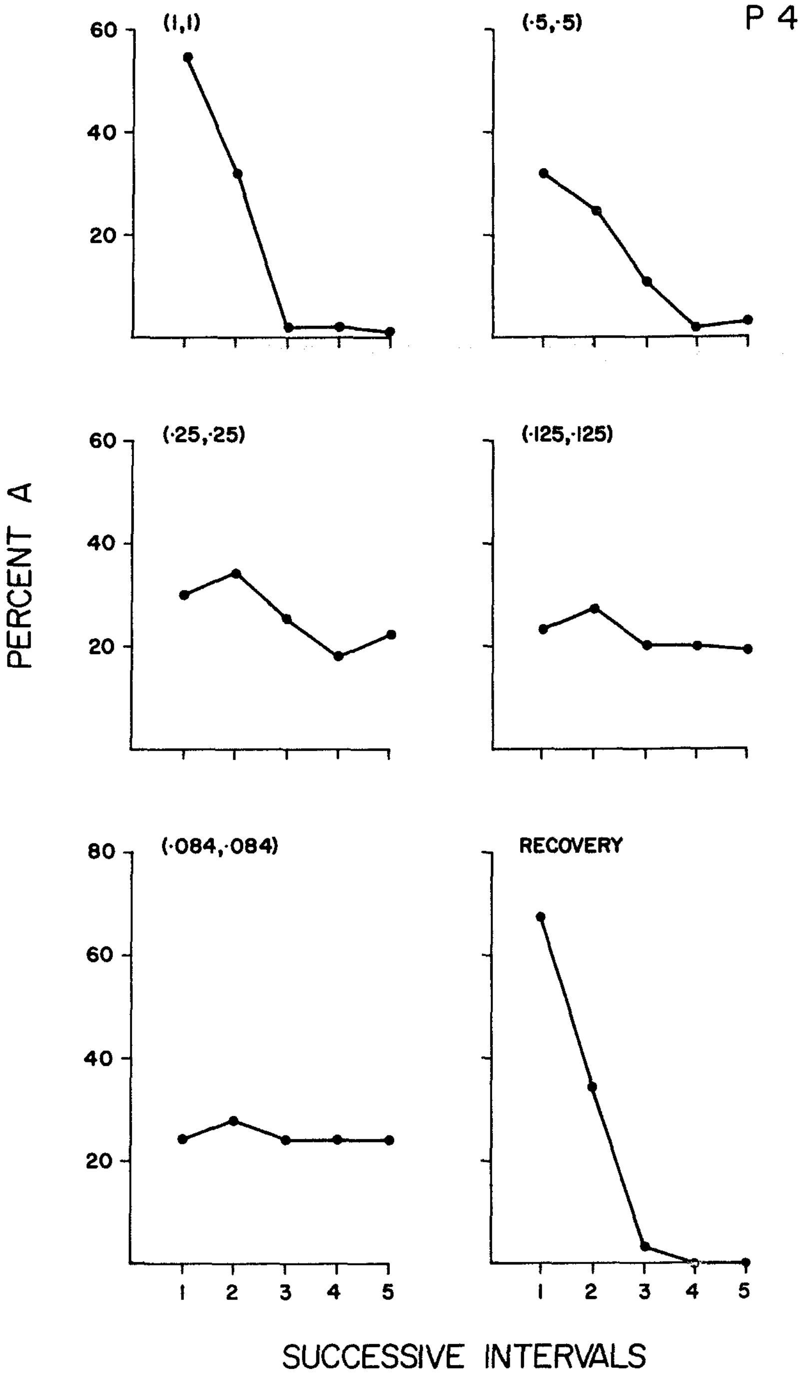

P 4
(1,1)
(·5,·5)
(·25,·25)
(·125,·125)
(·084,·084)
RECOVERY
PERCENT A
SUCCESSIVE INTERVALS
80
60
40
20
1
2
3
4
5

Fig. 26: Percent A, at each experimental point, as a function of the five 3-sec intervals of a T-cycle for P5 [recovery is a return to the (1,1) point after the (.084,.084) point].

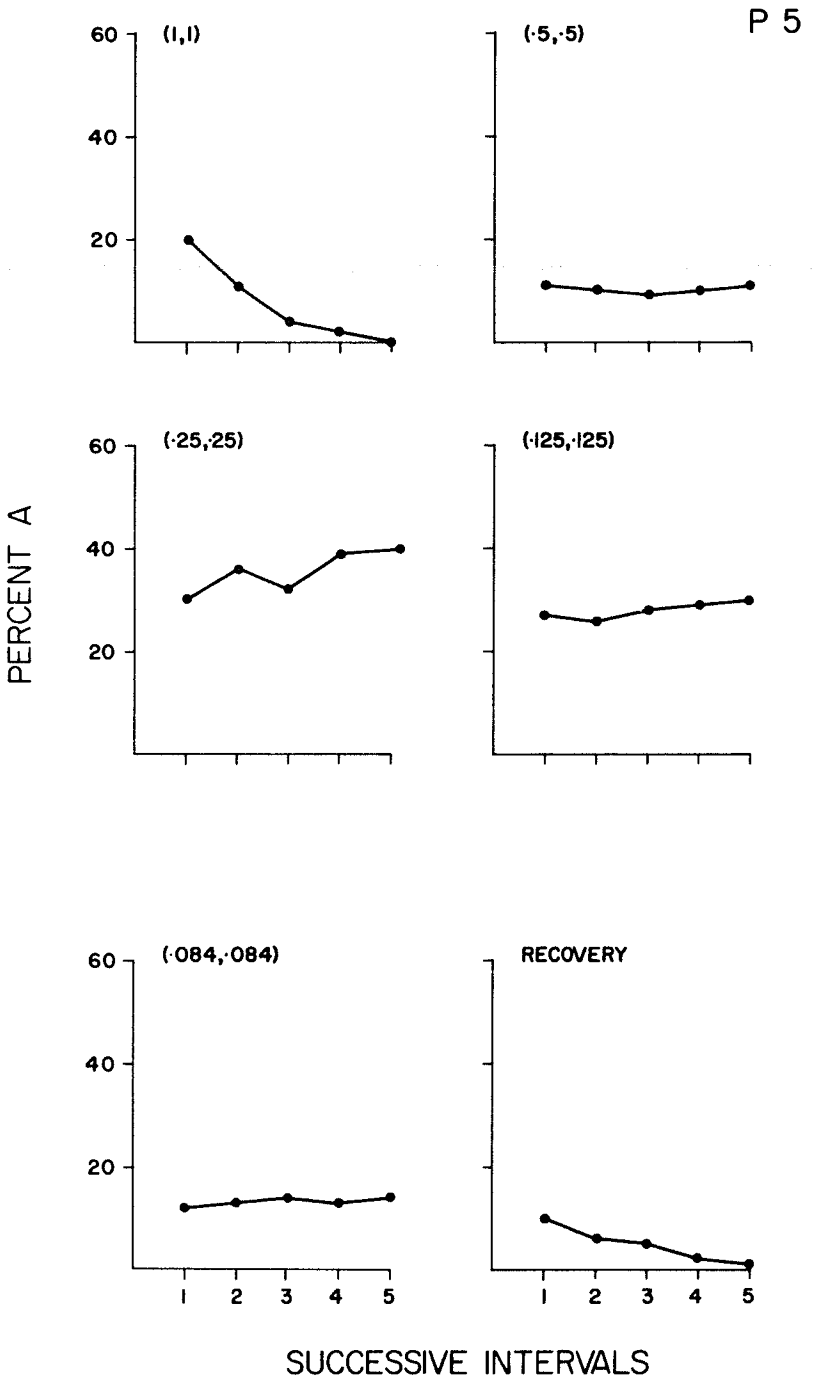

P 5
(1,1)
(·5,·5)
(·25,·25)
(·125,·125)
(·084,·084)
RECOVERY
60
40
20
PERCENT A
1
2
3
4
5
SUCCESSIVE INTERVALS

Fig. 27: Percent A, for each interval of a T-cycle, as a function of T/P for P1 (interval is abbreviated "INT").

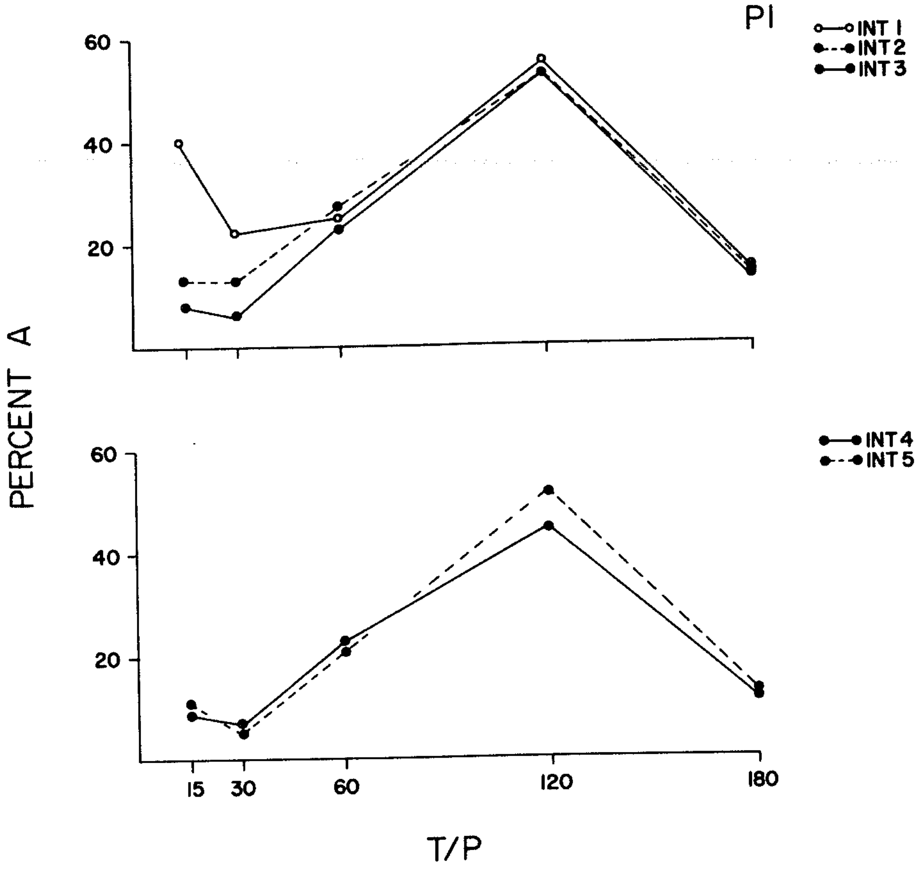

PI
INT 1
INT 2
INT 3
INT 4
INT 5
PERCENT A
60
40
20
15
30
60
120
180
T/P

Fig. 28: Percent A, for each interval of a T-cycle, as a function of T/P for P2 (interval is abbreviated "INT").

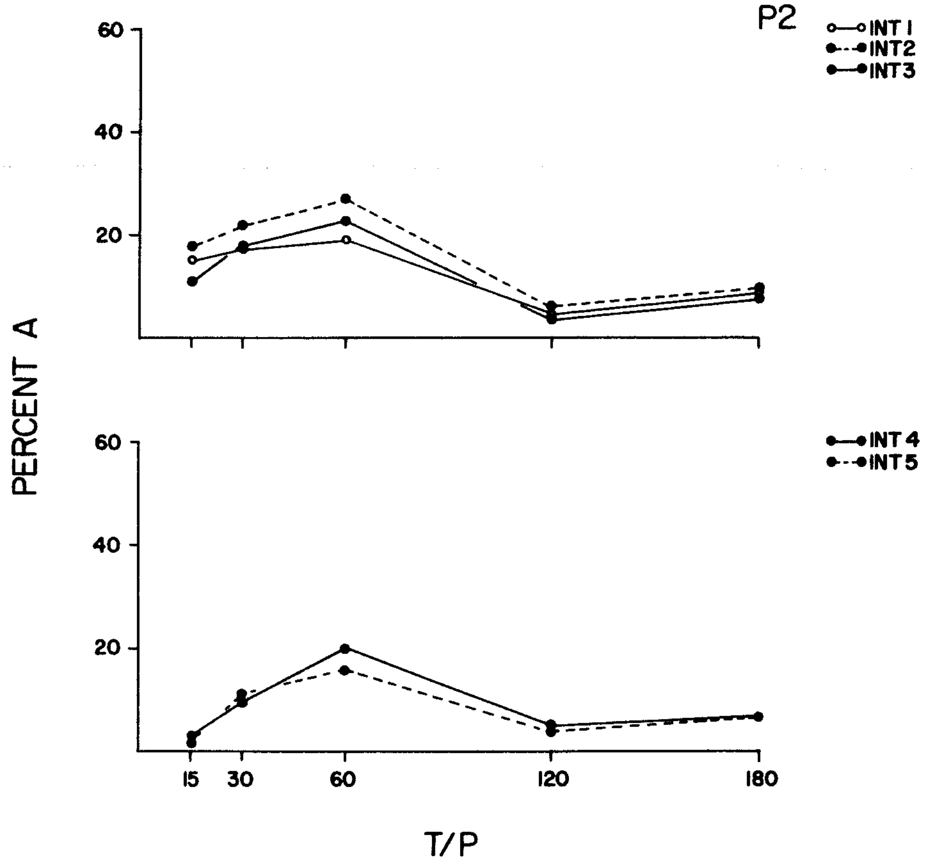

P2
INT 1
INT2
INT3
INT 4
INT 5
PERCENT A
60
40
20
60
40
20
15
30
60
120
180
T/P

Fig. 29: Percent A, for each interval of a T-cycle, as a function of T/P for P3 (interval is abbreviated "INT").

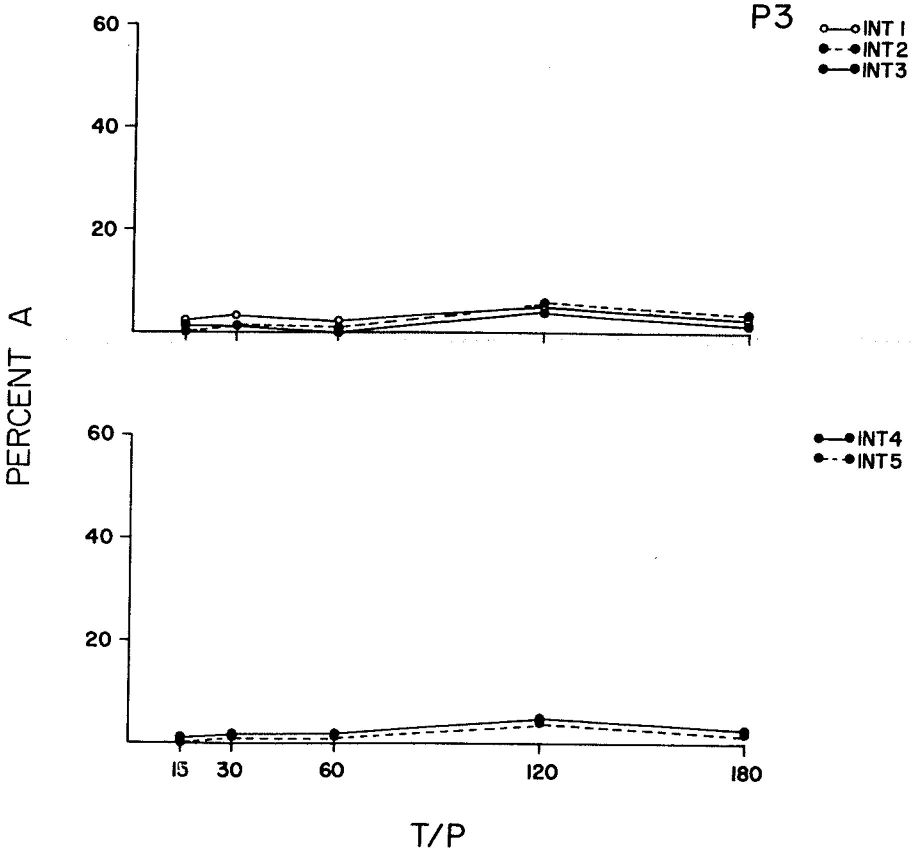

P3
INT 1
INT 2
INT 3
INT 4
INT 5
PERCENT A
60
40
20
60
40
20
15
30
60
120
180
T/P

Fig. 30: Percent A, for each interval of a T-cycle, as a function of T/P for P4 (interval is abbreviated "INT").

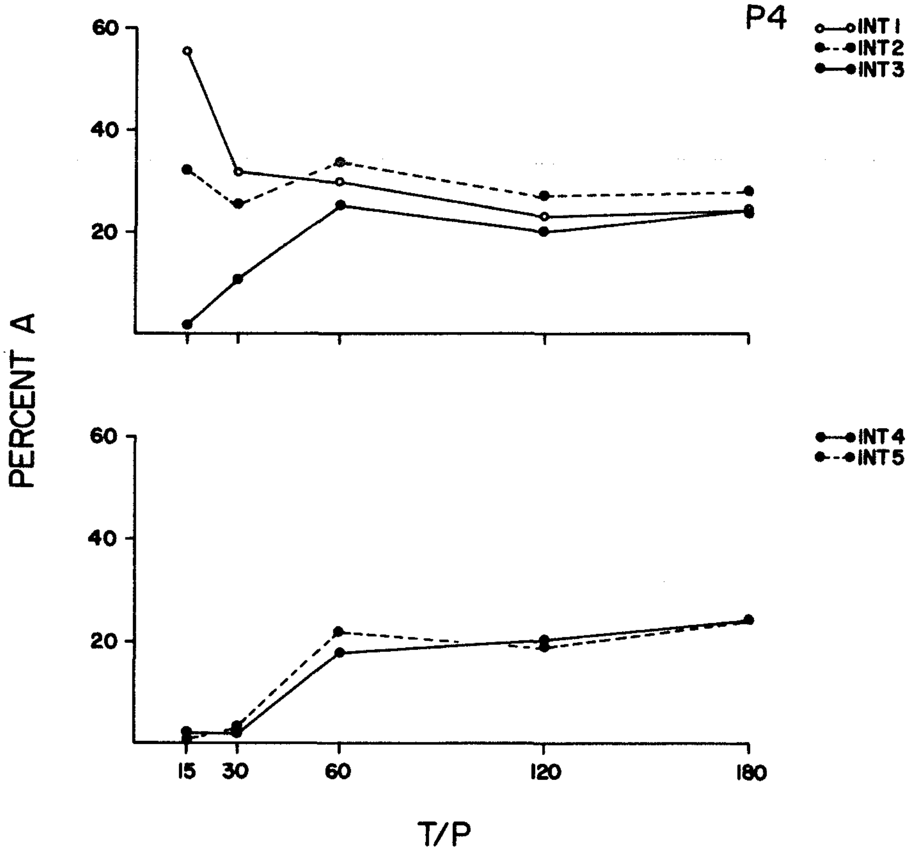
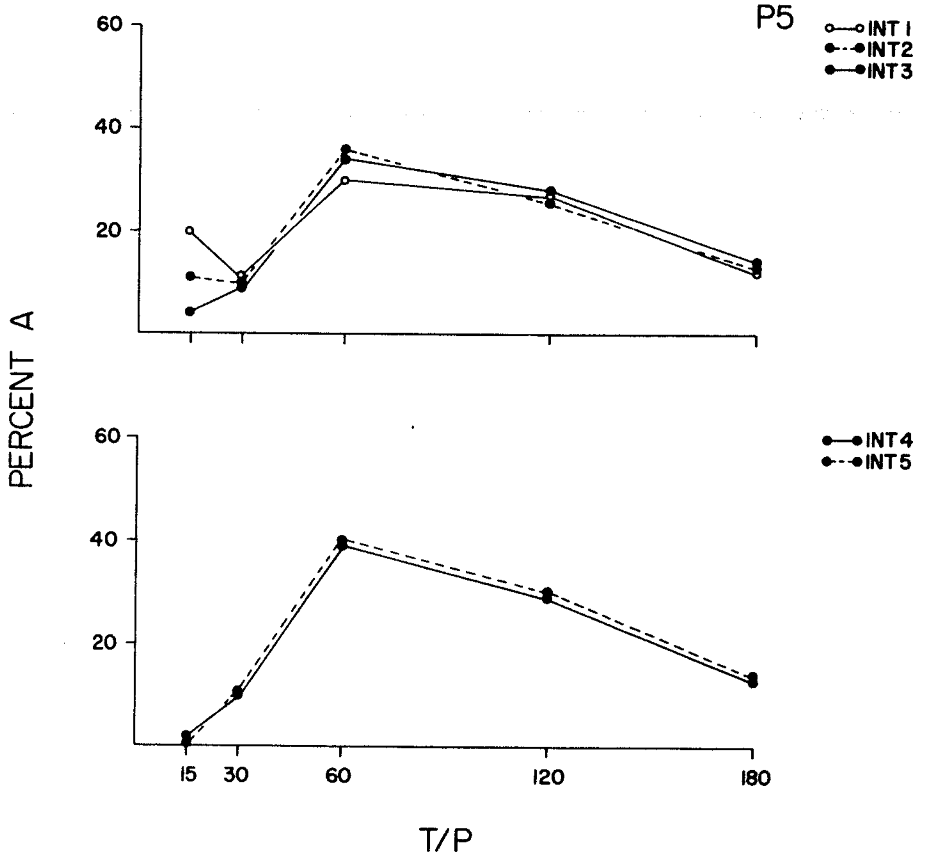

P4
INT 1
INT 2
INT 3
INT 4
INT 5
PERCENT A
60
40
20
60
40
20
15
30
60
120
180
T/P

Fig. 31: Percent A, for each interval of a T-cycle, as a function of T/P for P5 (interval is abbreviated "INT").


P5
INT 1
INT2
INT3
INT4
INT5
PERCENT A
60
40
20
60
40
20
15
30
60
120
180
T/P

The similarity of the shapes of these functions for each subject showed that the percent A obtaining at the instant of reinforcement (i.e., the end of the fifth interval) was not affected differently, in terms of direction of change, by a decrease in probability than percent A at the end of intervals more temporally distant from reinforcer presentation. For each subject, it is also of interest to note that, for each time interval of a T-cycle, all of these percent A functions were similar in shape to the relative time function (Fig. 6 or Fig. 7). This suggests that the relative time function could be used to predict the shape of the percent A and T/P function for any instant within a T-cycle. Although the relative time and rate functions were quite similar, a relative time function was the better predictor of the shape of a percent A function because of the small changes that did occur in Time/A (Figs. 8 and 9). Differences in shape between the percent A and relative time functions were most commonly due to the values for percent A obtained at T/P = 15 sec.

Time/A as a function of the five 3-sec intervals of a T-cycle is shown in Figs. 32-36. Although these functions did not show the systematic changes found with the corresponding rate and percent A functions, there seems to be a trend toward flatter functions as probability decreased. For P2, P4, and P5, the functions were flatter at T/P = 179 sec than they were at T/P = 15 sec for both the initial exposure to the (1,1) point and the recovery of the (1,1) point; the trend toward flatter functions was particularly clear for P4.

Except for P3, the rates (Figs. 4 and 5) and relative times in A (Figs. 6 and 7) obtained on the recovery of the (1,1) point were close, respectively, to the rates and relative times in A obtained on the initial exposure to the (1,1) point; and the rates and relative times in A obtained in recovery were neither uniformally higher nor lower than the rates and relative times in A found on the initial exposure to the (1,1) point. The differences in rate between the initial exposure to the (1,1) point and the recovery at the (1,1) point were (rate at initial exposure minus

Fig. 32: Time/A (total amount of time spent in A divided by the total number of entries into A), at each experimental point, as a function of the five 3-sec intervals of a T-cycle for P1 [recovery is a return to the (1,1) point after the (.084,.084) point].

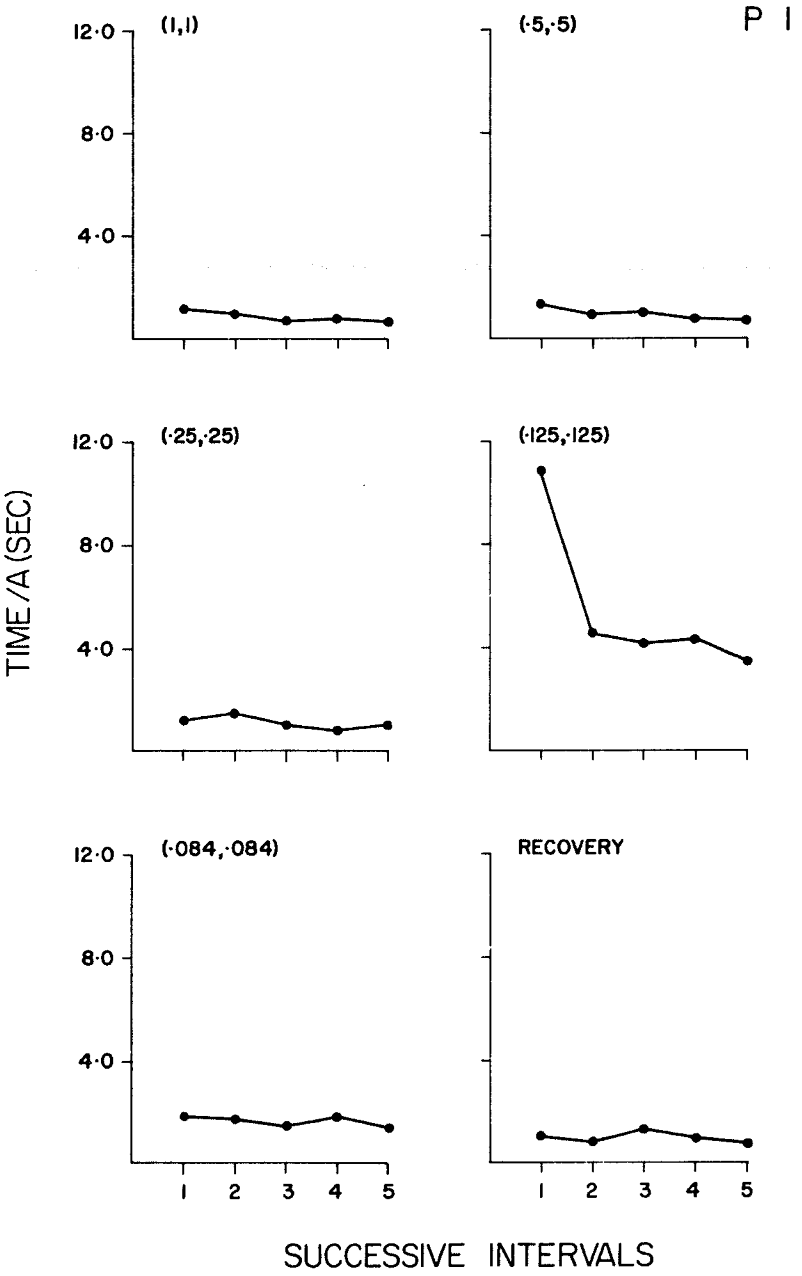

P I
(1,1)
(·5,·5)
(·25,·25)
(·125,·125)
(·084,·084)
RECOVERY
12·0
8·0
4·0
TIME /A (SEC)
1
2
3
4
5
SUCCESSIVE INTERVALS

Fig. 33: Time/A (total amount of time spent in A divided by the total number of entries into A), at each experimental point, as a function of the five 3-sec intervals of a T-cycle for P2 [recovery is a return to the (1,1) point after the (.084,.084) point].

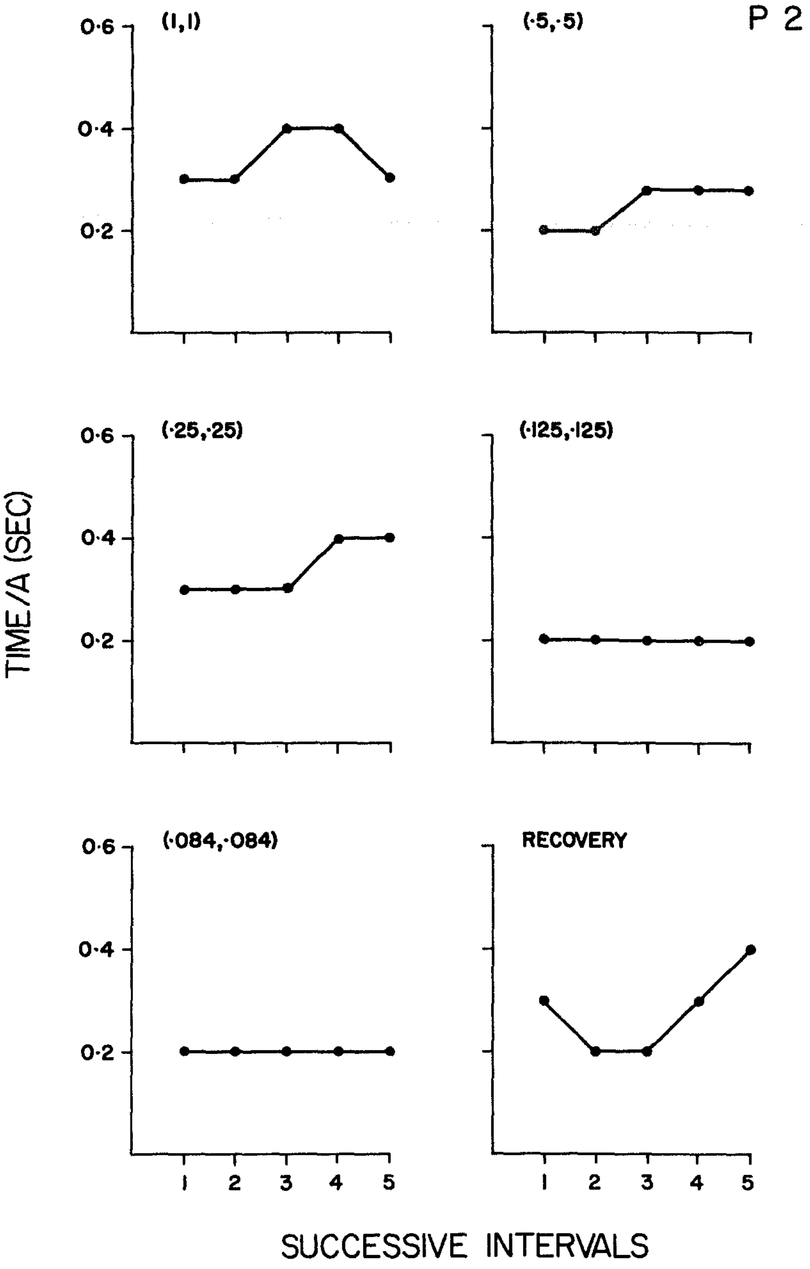

P 2
(1,1)
(·5,·5)
(·25,·25)
(·125,·125)
(·084,·084)
RECOVERY
TIME/A (SEC)
0·6
0·4
0·2
1
2
3
4
5
SUCCESSIVE INTERVALS

Fig. 34: Time/A (total amount of time spent in A divided by the total number of entries into A), at each experimental point, as a function of the five 3-sec intervals of a T-cycle for P3 [recovery is a return to the (1,1) point after the (.084,.084) point].

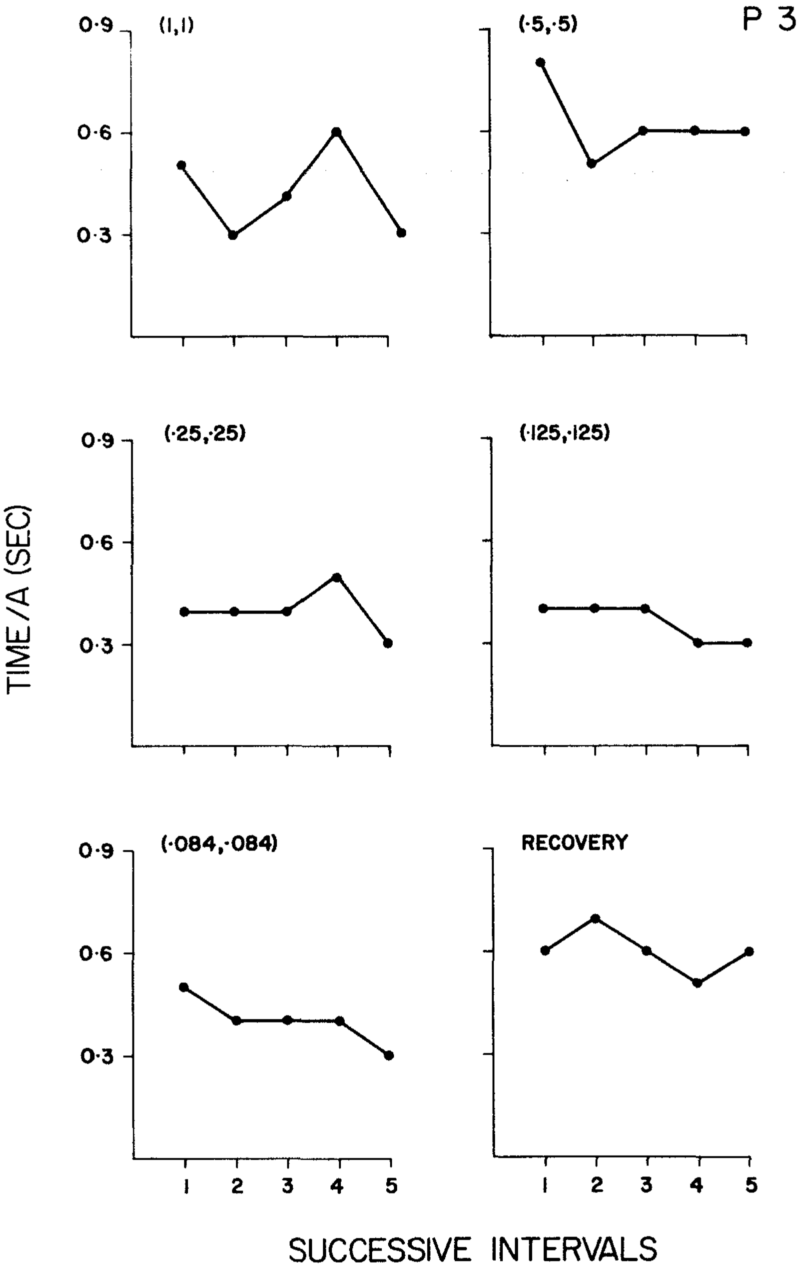

P 3
(1,1)
(·5,·5)
(·25,·25)
(·125,·125)
(·084,·084)
RECOVERY
0·9
0·6
0·3
TIME/A (SEC)
1
2
3
4
5
SUCCESSIVE INTERVALS

Fig. 35: Time/A (total amount of time spent in A divided by the total number of entries into A), at each experimental point, as a function of the five 3-sec intervals of a T-cycle for P4 [recovery is a return to the (1,1) point after the (.084,.084) point].

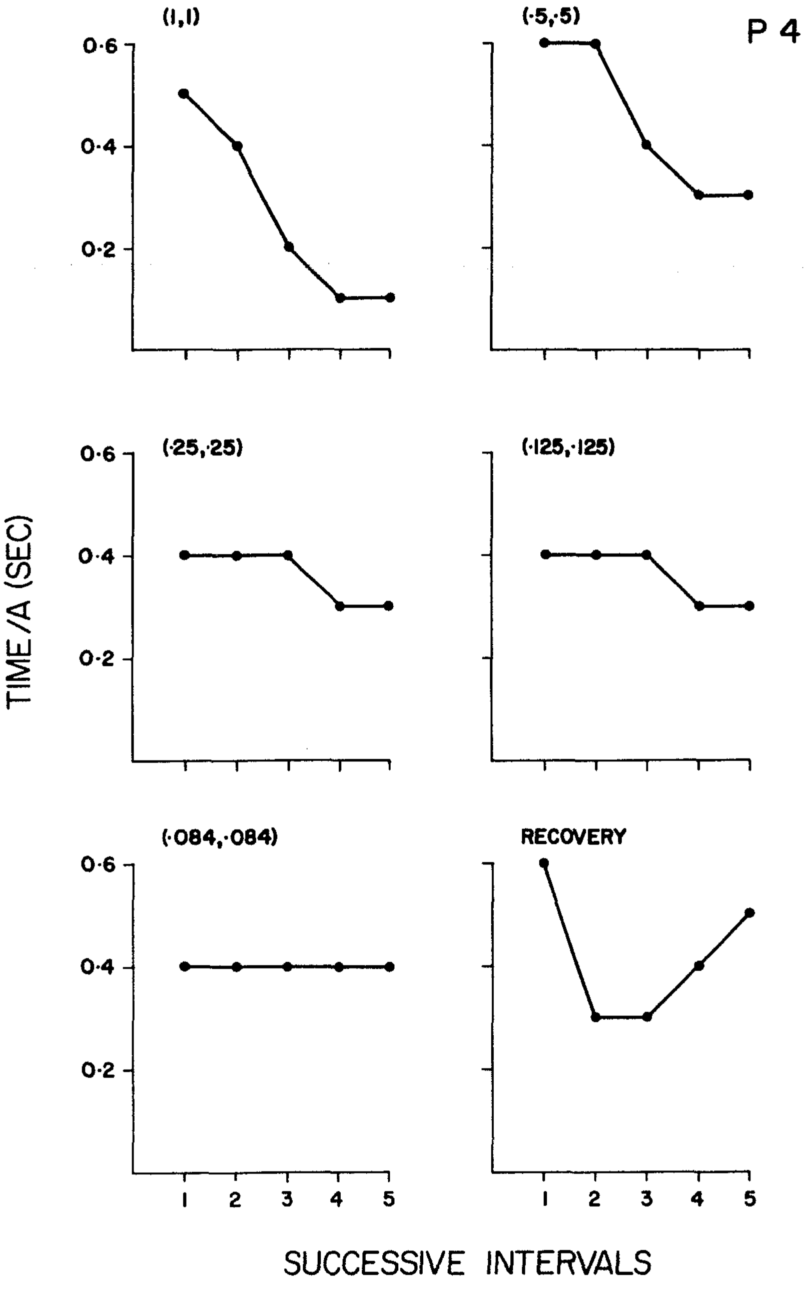
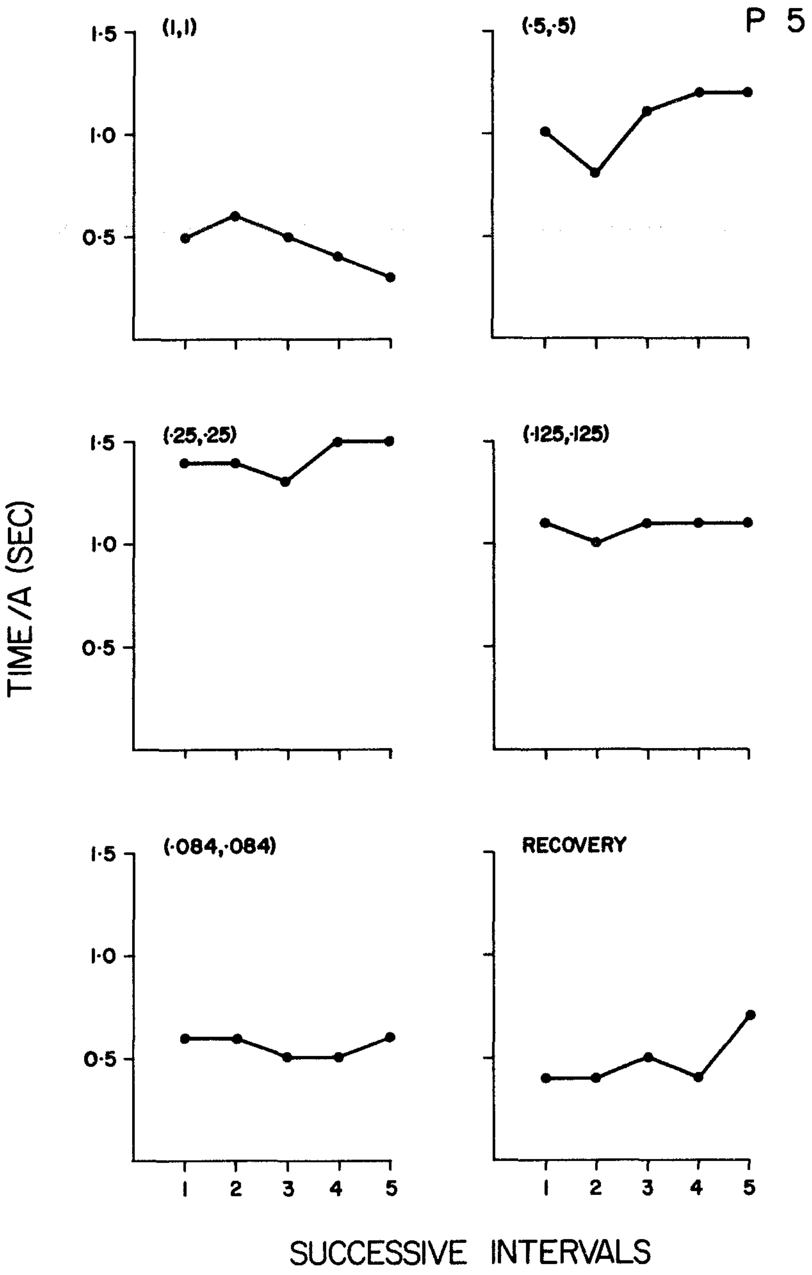

P 4
(1,1)
(·5,·5)
(·25,·25)
(·125,·125)
(·084,·084)
RECOVERY
0·6
0·4
0·2
TIME /A (SEC)
1
2
3
4
5
SUCCESSIVE INTERVALS

Fig. 36: Time/A (total amount of time spent in A divided by the total number of entries into A), at each experimental point, as a function of the five 3-sec intervals of a T-cycle for P5 [recovery is a return to the (1,1) point after the (.084,.084) point].


P 5
(1,1)
(·5,·5)
(·25,·25)
(·125,·125)
(·084,·084)
RECOVERY
1·5
1·0
0·5
TIME /A (SEC)
1
2
3
4
5
SUCCESSIVE INTERVALS

rate at revovery): .01 for P1; .02 for P2; -.21 for P3; -.07 for P4; and .03 for P5. The differences in relative time between the initial exposure to the (1,1) point and the recovery at the (1,1) point were (relative time at initial exposure minus relative time at recovery): .02 for P1; .05 for P2; -.13 for P3; -.04 for P4; and .02 for P5. $PS^{R}P$/Mean $IS^{R}T$ (Fig. 11) showed a decrease over the initial exposure to the (1,1) point on recovery at the (1,1) point for P2 and P3, and an increase for P1, P4, and P5. The differences in $PS^{R}P$/Mean $IS^{R}T$ between the two exposures to the (1,1) point were large for some subjects other than P3; P1, for example, showed over a three-fold increase in $PS^{R}P$/Mean $IS^{R}T$ on recovery at the (1,1) point. Except for P3, all of the remaining four subjects would, however, show the same decreasing functions between $PS^{R}P$/Mean $IS^{R}T$ and T/P if the values obtained on the initial exposure to the (1,1) point were replaced by the values obtained for the recovery at the (1,1) point. Except for P3, the rate functions within a T-cycle (Figs. 12-16) and the percent *A* functions within a T-cycle (Figs. 22-26) were flat at the (.084, .084) point and subsequently resumed, in recovery, the curved shape which had been previously obtained on the initial exposure to the (1,1) point. The maximum of both the rate and percent *A* functions within a T-cycle generally occurred in the same interval of a T-cycle for the initial exposure and recovery at the (1,1) point except for P3. Interestingly, data similar to the other subjects were obtained for P3 at those experimental points where a behavioral change over operant level was clearly recorded. The rate (Fig. 14) and percent *A* (Fig. 24) functions within a T-cycle at (.125,.125) and (.084,.084) were flat for P3, and these same functions upon a return to the (1,1) point were markedly curved with a maximum soon after reinforcement.

When noncontingent reinforcement is delivered to a pigeon, it has been found, under conditions similar to those of this present experiment, that different subjects engaged in different behaviors when those behaviors were described by everyday speech (Skinner, 1948; Staddon and Simmelhag, 1971). This result is also found in

Table 2. In this present study, the behavior of all subjects was described by the same behavioral classes, $\underline{A}$ and $\underline{\not{A}}$; and $\underline{A}$ and $\underline{\not{A}}$ have been shown to provide dependent variables which were sensitive to changes in the probability of noncontingent reinforcement. Throughout this section the functional similarities between contingent interval reinforcement and noncontingent reinforcement for the measures of response duration (i.e., Time/A), PS^RP/Mean IS^RT, responses per reinforcement, and rate within an IS^RT have been indicated. The basis of the comparison has been that in both schedules reinforcement is delivered only after the passage of some interval of time. A difference between the effects of contingent and noncontingent reinforcement can be found in the fact that in contingent interval reinforcement a pre-specified R is always temporally contiguous with reinforcer presentation; while in contrast, noncontingent reinforcement permits the R which is initially temporally contiguous with reinforcer presentation to be replaced by some different R upon a schedule change. The low R_A rate in the three sec preceding reinforcement at the (1,1) point (Figs. 12-16) indicated that R_A, at this point, followed and was not temporally contiguous with reinforcer presentation. At the lower probabilities of reinforcement, R_A showed an increase in rate over the rate at the (1,1) point in the three sec immediately preceding reinforcement (i.e., the fifth interval of a T-cycle). This increase in rate immediately before reinforcer presentation indicates that R_A may have replaced the response which was once temporally contiguous with reinforcement at the (1,1) point. In the cumulative records (Figs. 17-21), it can be clearly seen for P2, P4, and P5, that R_A was occurring just prior to reinforcer presentation at the lower probabilities of reinforcement.

Numerical values of means and standard deviations for each subject in Exp. I are found in Appendix A.

Exp. II: Extinction And Reconditioning Of A "Superstition"

Skinner (1948) investigated the effect of omitting noncontingent reinforcer presentation (i.e., extinction) on the hopping response of a single pigeon. After increasing the time between periodic noncontingent reinforcer presentations from 15 sec to 1 min, extinction was introduced. There was a subsequent decrease in the hopping rate until few responses occurred in a 10 or 15 min period. Skinner then alternated reconditioning (1 min periodic reinforcer presentations) with extinction. On the second reconditioning, a change in response class from hopping to walking about the cage was observed.

Exp. II investigated the effects of extinction [i.e., the (0,0) point of Fig. 2] and reconditioning on A and $\not{A}$. In addition, A and $\not{A}$ permitted quantitative measures to be obtained when, as Skinner reported, a change in response class occurs as the result of this procedural manipulation.

Method

Subjects

Two birds from Exp. I; P4 and P5, were maintained at 80% ± 15 gm of free-feeding body weight.

Apparatus

Same as Exp. I.

Procedure

After recovery at the (1,1) point in Exp. I, these subjects were exposed at T = 15 sec to five alternations of an extinction period followed by a reconditioning period. Each extinction period was eleven sessions at the (0,0) point of Fig. 2; each session was 120 T-cycles. Each reconditioning period was five sessions at the (1,1) point of Fig. 2; each session was 60 T-cycles. Procedures were, otherwise, the same as in Exp. I.

Results And Discussion

Figs. 37-38 and Figs. 39-40 show rate as a function of sessions in each extinction and reconditioning period for P4 and P5, respectively. The rate in the first extinction period showed over sessions a progressive decline back toward operant level (Fig. 5) for both subjects. This progressive rate decrease is not found in subsequent extinction periods. In all other extinction periods there was a large rate decrease in the first extinction session, and rate remained relatively unchanged for the following 10 extinction sessions. For each reconditioning period, there was a rate increase over the prior extinction sessions on the first reconditioning session which was maintained in the four succeeding reconditioning sessions.

Fig. 41 shows Time/A for successive periods of extinction and reconditioning for P4 and P5, including the recovery at the (1,1) point in Exp. I. Time/A was calculated for each extinction period over the first five extinction sessions and over all five reconditioning sessions for each reconditioning period. Time/A for extinction periods was generally higher than the preceding reconditioning period. This was always the case for P4 whose rates in extinction were substantial. P5, on the other hand, showed in the third and fourth extinction periods a decrease in Time/A over the prior reconditioning period. The rates, however, for P5 in the later extinction periods were extremely low, and the effect was clear for the first extinction period where the rate was relatively high.

R_A rate as a function of the five 3-sec intervals of a T-cycle for each reconditioning session is shown in Figs. 42-44 for P4 and Figs. 45-47 for P5. For comparison, the rates over the five intervals of a T-cycle from the preceding extinction session were also included. These functions show that the shape of the rate functions within a T-cycle remained nearly unchanged across all sessions in all reconditioning periods, and were similar to the initial exposure and recovery at the (1,1) point in Exp. I

Fig. 37: Rate as a function of sessions in extinction and reconditioning periods for P4 with recovery from Exp. I included (extinction is abbreviated "EXT"; reconditioning is abbreviated "RECOND").

P4

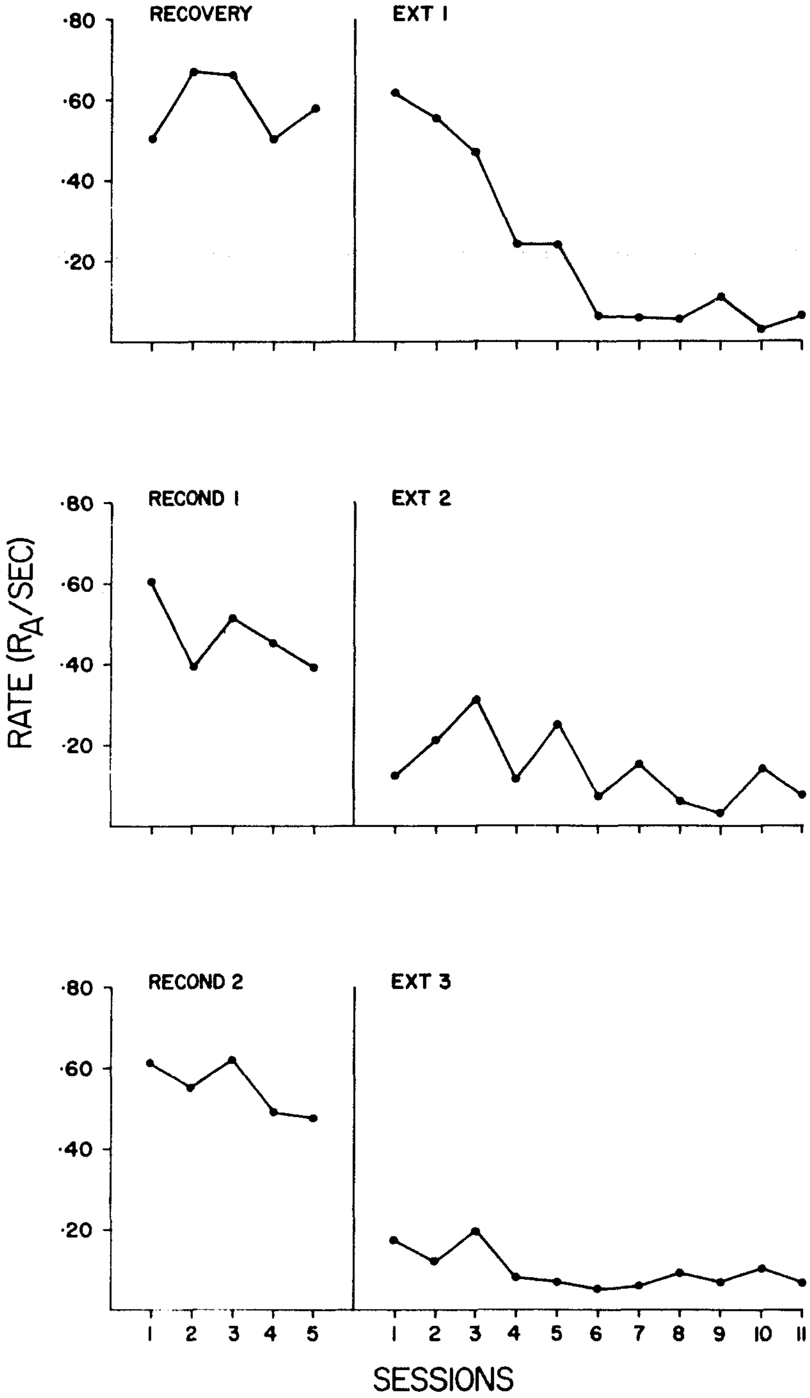

RECOVERY
EXT I
RECOND I
EXT 2
RECOND 2
EXT 3
·80
·60
·40
·20
RATE (R_A/SEC)
1
2
3
4
5
1
2
3
4
5
6
7
8
9
10
11
SESSIONS

Fig. 38: Rate as a function of sessions in extinction and reconditioning periods for P4 (extinction is abbreviated "EXT"; reconditioning is abbreviated "RECOND").

P4

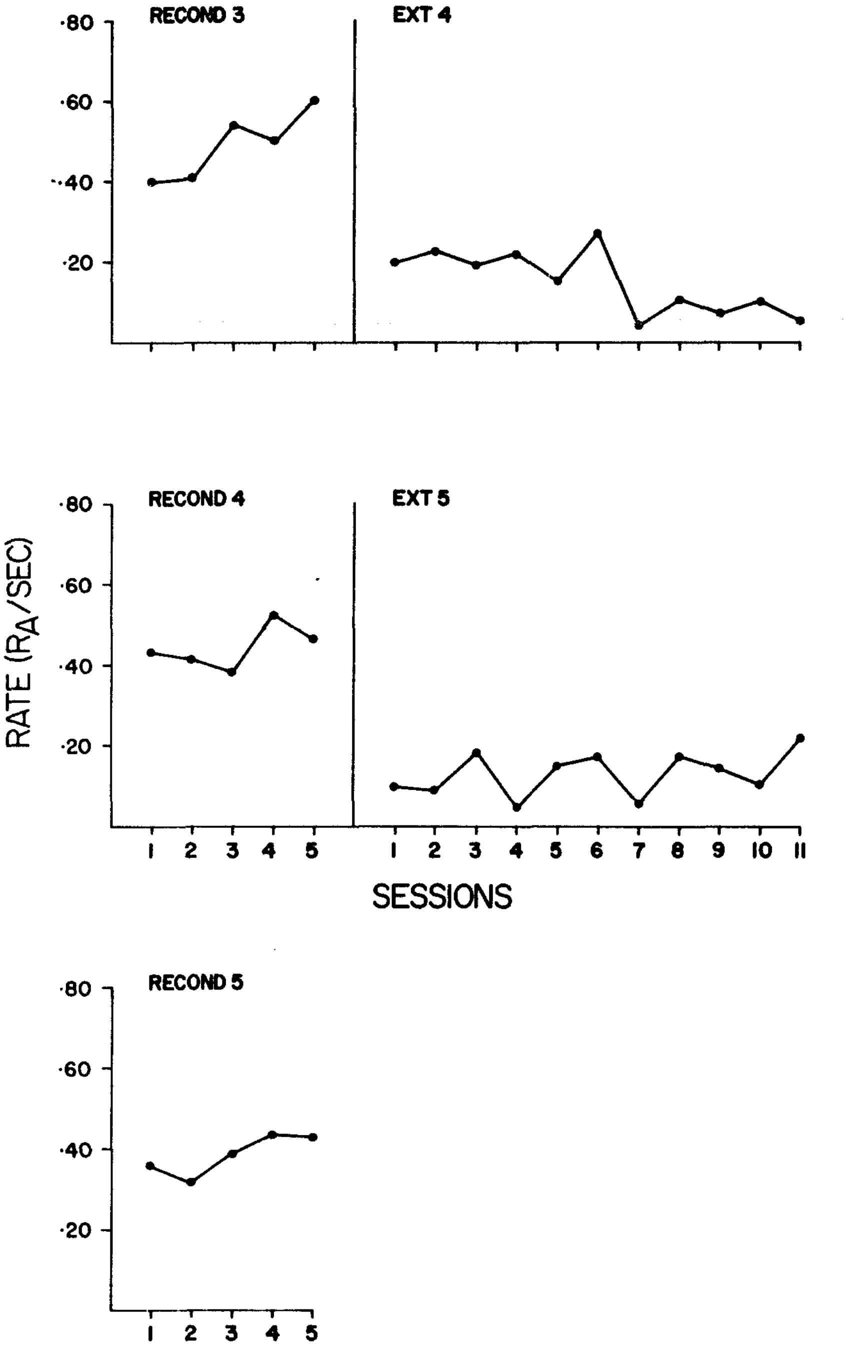

RECOND 3
EXT 4
RECOND 4
EXT 5
RECOND 5
·80
·60
·40
·20
RATE (R_A/SEC)
1
2
3
4
5
6
7
8
9
10
11
SESSIONS

Fig. 39: Rate as a function of sessions in extinction and reconditioning periods for P5 with recovery from Exp. I included (extinction is abbreviated "EXT"; reconditioning is abbreviated "RECOND").

P5

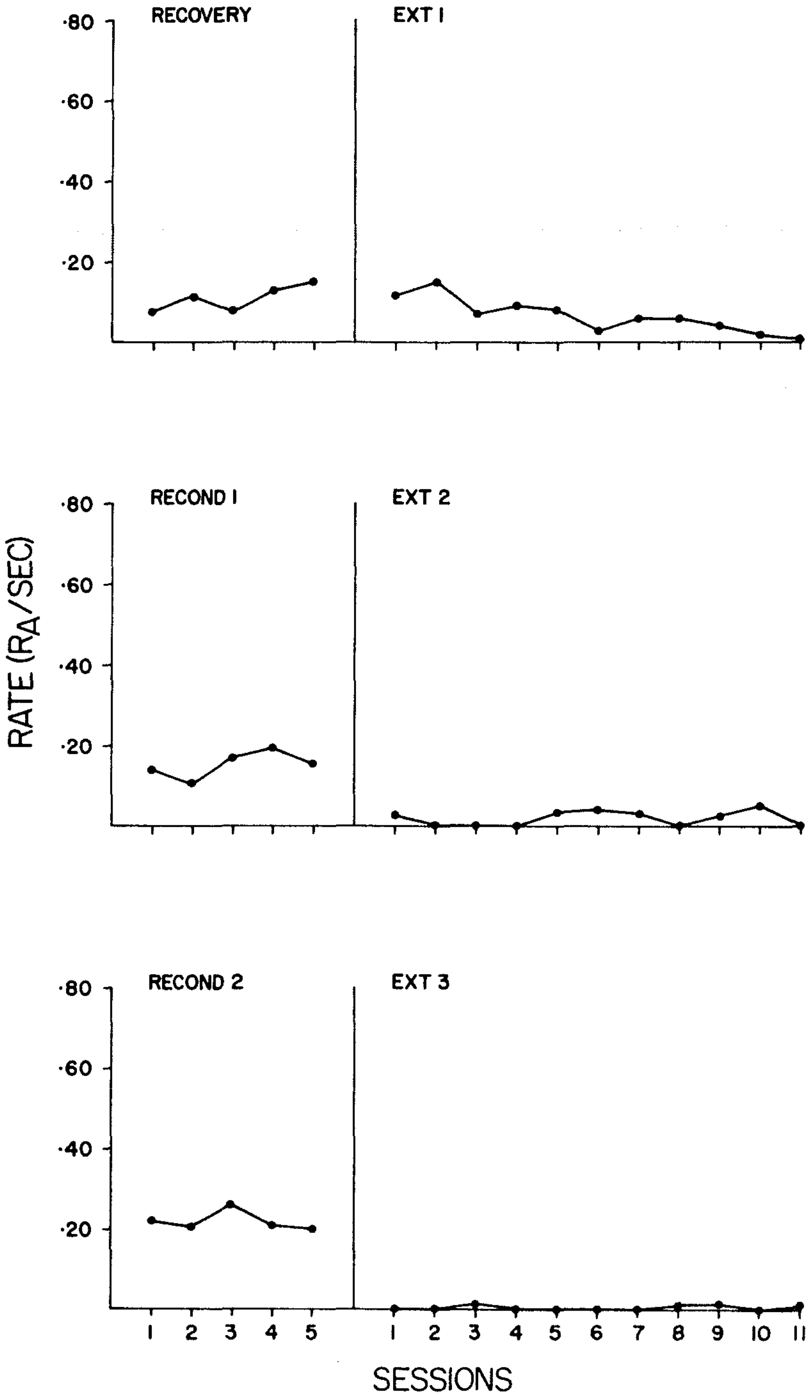

RECOVERY
EXT I
RECOND I
EXT 2
RECOND 2
EXT 3
·80
·60
·40
·20
RATE (R_A/SEC)
1
2
3
4
5
1
2
3
4
5
6
7
8
9
10
11
SESSIONS

Fig. 40: Rate as a function of sessions in extinction and reconditioning periods for P5 (extinction is abbreviated "EXT"; reconditioning is abbreviated "RECOND").

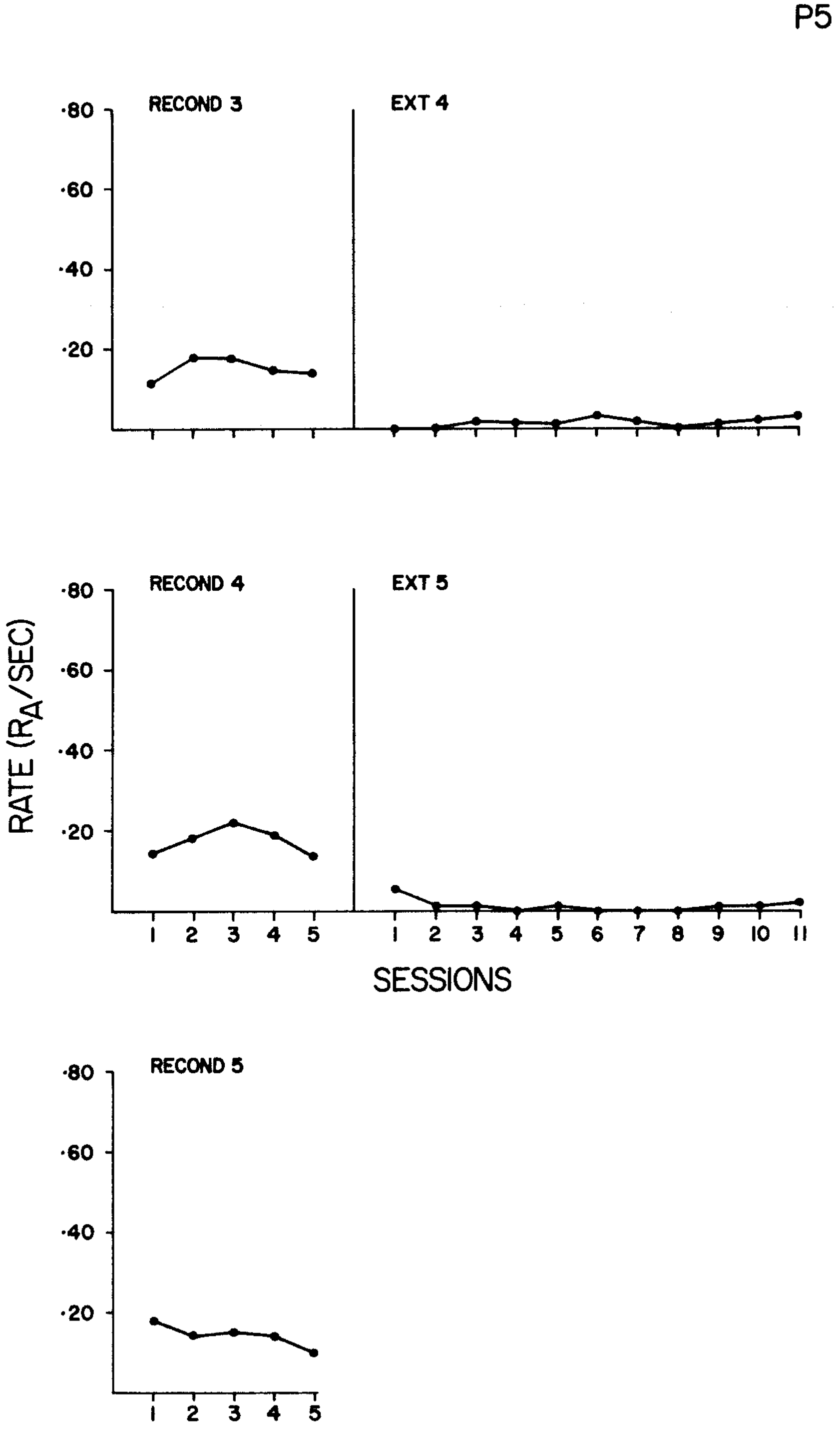

P5
RECOND 3
EXT 4
RECOND 4
EXT 5
RECOND 5
·80
·60
·40
·20
RATE (R_A/SEC)
1
2
3
4
5
6
7
8
9
10
11
SESSIONS

Fig. 41: Time/A (total amount of time spent in A divided by the total number of entries into A) as a function of successive periods of extinction and reconditioning for P4 and P5 [recovery at the (1,1) point from Exp. I is abbreviated "REC"; extinction is abbreviated "EXT"; reconditioning is abbreviated "RECOND"].

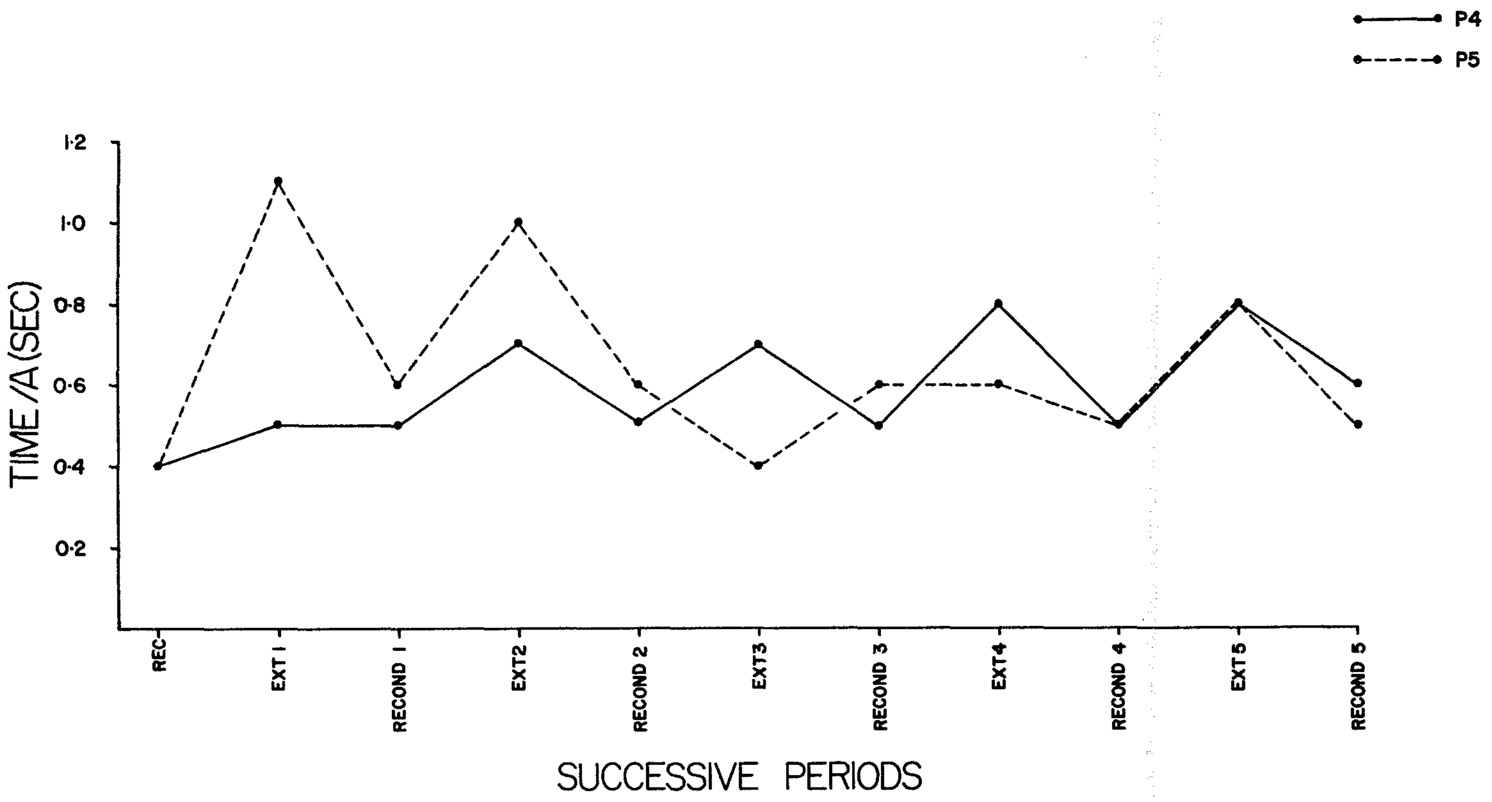

P4
P5
TIME /A (SEC)
1·2
1·0
0·8
0·6
0·4
0·2
REC
EXT 1
RECOND 1
EXT2
RECOND 2
EXT3
RECOND 3
EXT4
RECOND 4
EXT 5
RECOND 5
SUCCESSIVE PERIODS

Fig. 42: Rate as a function of the five 3-sec intervals of a T-cycle for the recovery at the (1,1) point from Exp. I and the first reconditioning period for P4 [the rate within a T-cycle function for the (0,0) point is from the last session of the preceding extinction period].

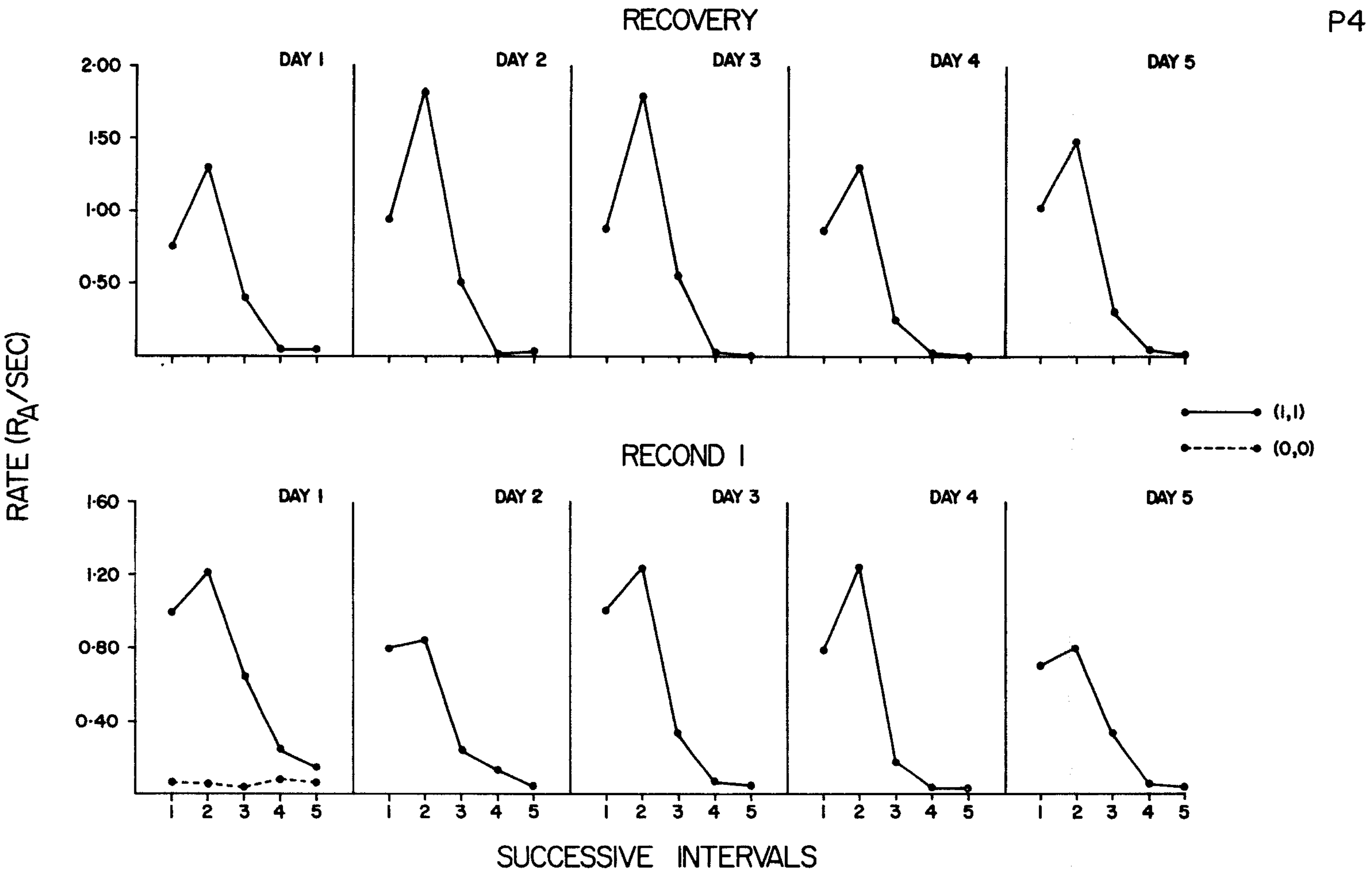

RECOVERY
P4
DAY 1
DAY 2
DAY 3
DAY 4
DAY 5
2·00
1·50
1·00
0·50
RATE (R_A/SEC)
(1,1)
(0,0)
RECOND 1
DAY 1
DAY 2
DAY 3
DAY 4
DAY 5
1·60
1·20
0·80
0·40
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
SUCCESSIVE INTERVALS

Fig. 43: Rate as a function of the five 3-sec intervals of a T-cycle in the second and third reconditioning periods for P4 [the rate within a T-cycle function for the (0,0) point is from the last session of the preceding extinction period].

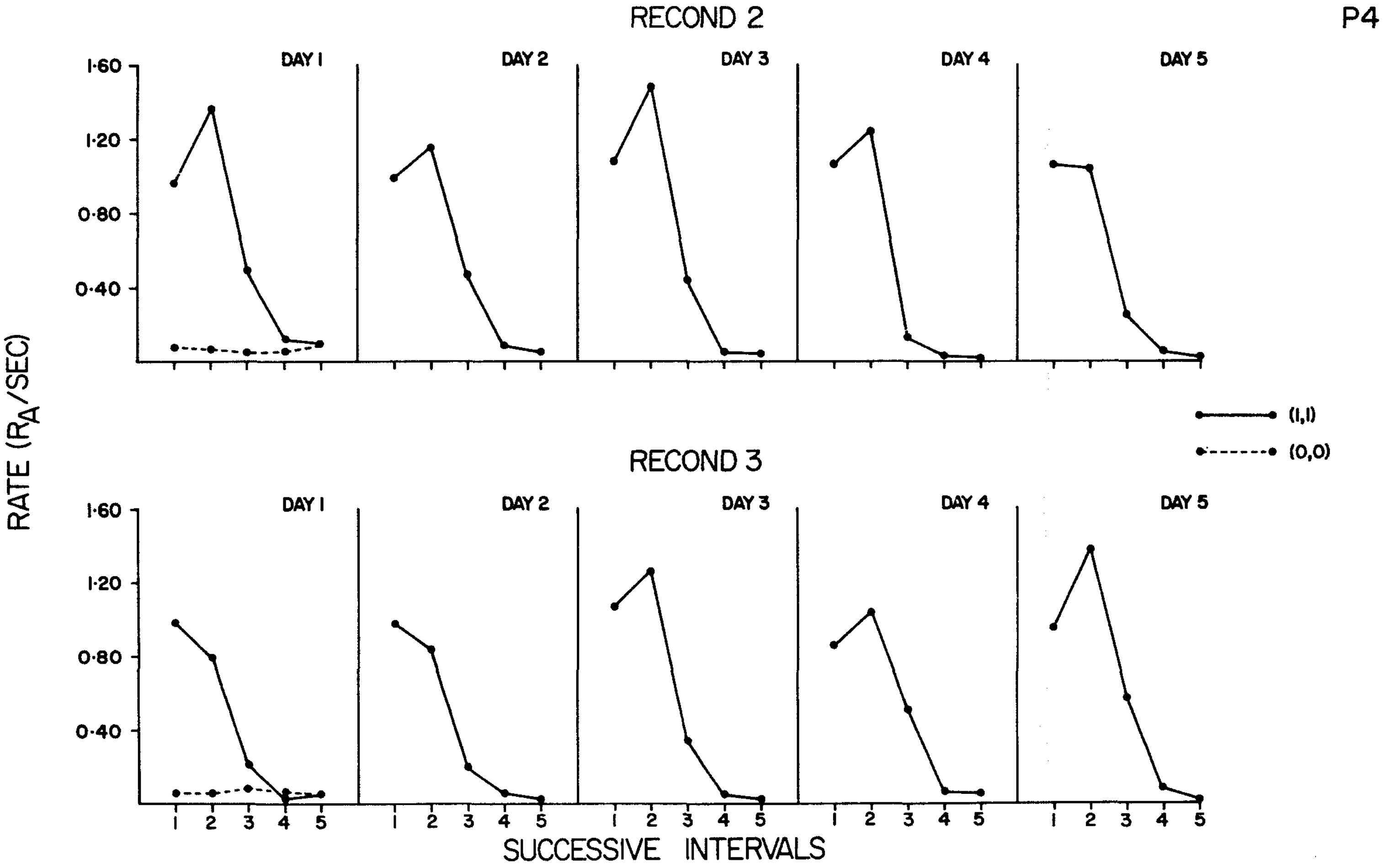

RECOND 2
P4
DAY 1
DAY 2
DAY 3
DAY 4
DAY 5
1·60
1·20
0·80
0·40
RATE (R_A/SEC)
(1,1)
(0,0)
RECOND 3
DAY 1
DAY 2
DAY 3
DAY 4
DAY 5
1·60
1·20
0·80
0·40
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
SUCCESSIVE INTERVALS

Fig. 44: Rate as a function of the five 3-sec intervals of a T-cycle in the fourth and fifth reconditioning periods for P4 [the rate within a T-cycle function for the (0,0) point is from the last session of the preceding extinction period].

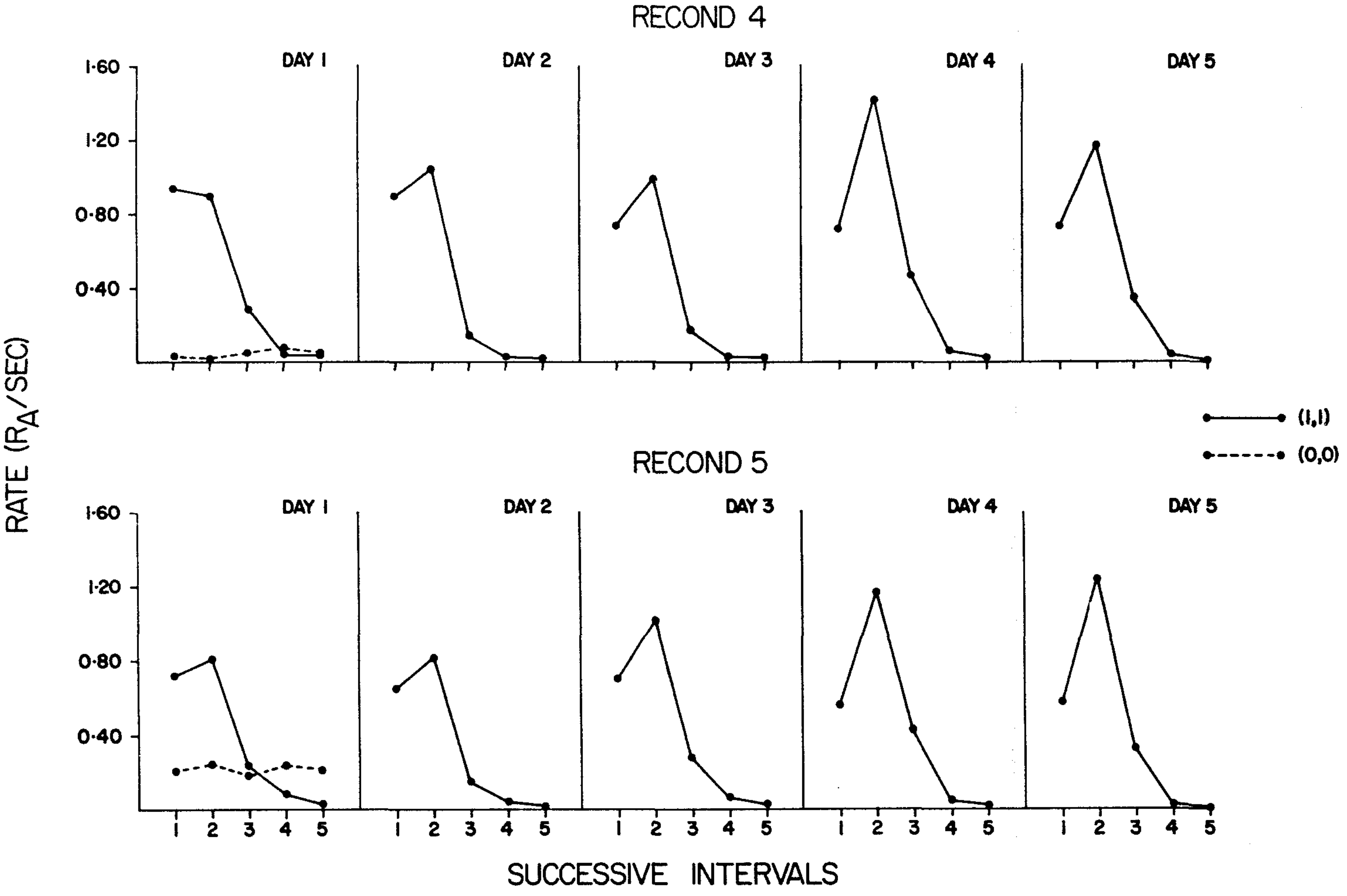

RECOND 4
P4
DAY 1
DAY 2
DAY 3
DAY 4
DAY 5
1·60
1·20
0·80
0·40
RATE (R_A/SEC)
(1,1)
(0,0)
RECOND 5
DAY 1
DAY 2
DAY 3
DAY 4
DAY 5
1·60
1·20
0·80
0·40
1
2
3
4
5
SUCCESSIVE INTERVALS

Fig. 45: Rate as a function of the five 3-sec intervals of a T-cycle for the recovery at the (1,1) point from Exp. I and the first reconditioning period for P5 [the rate within a T-cycle function for the (0,0) point is from the last session of the preceding extinction period].

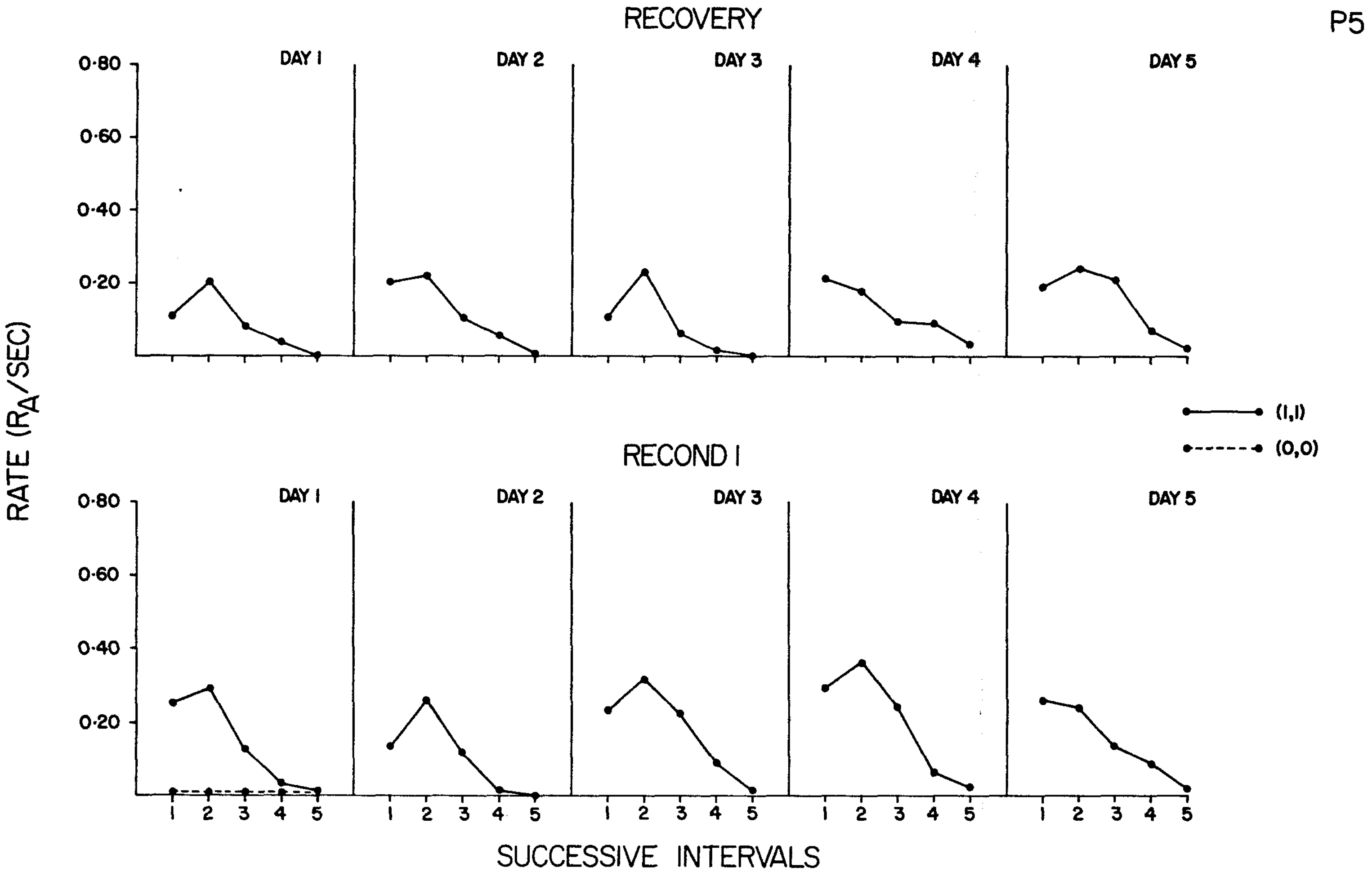

RECOVERY
P5
DAY 1
DAY 2
DAY 3
DAY 4
DAY 5
0·80
0·60
0·40
0·20
RATE (R_A/SEC)
(1,1)
(0,0)
RECOND I
DAY 1
DAY 2
DAY 3
DAY 4
DAY 5
0·80
0·60
0·40
0·20
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
SUCCESSIVE INTERVALS

Fig. 46: Rate as a function of the five 3-sec intervals of a T-cycle in the second and third reconditioning periods for P5 [the rate within a T-cycle function for the (0,0) point is from the last session of the preceding extinction period].

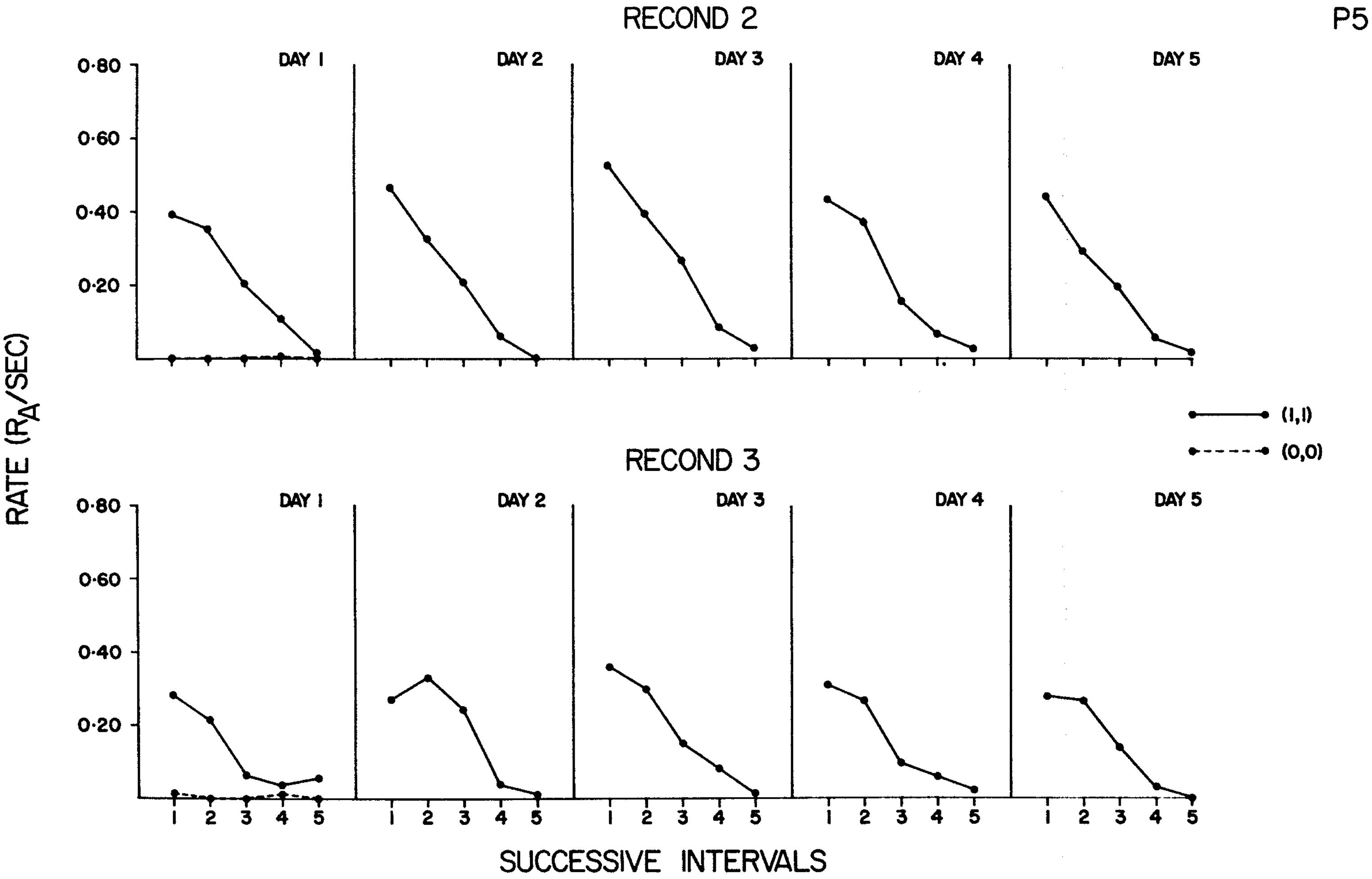
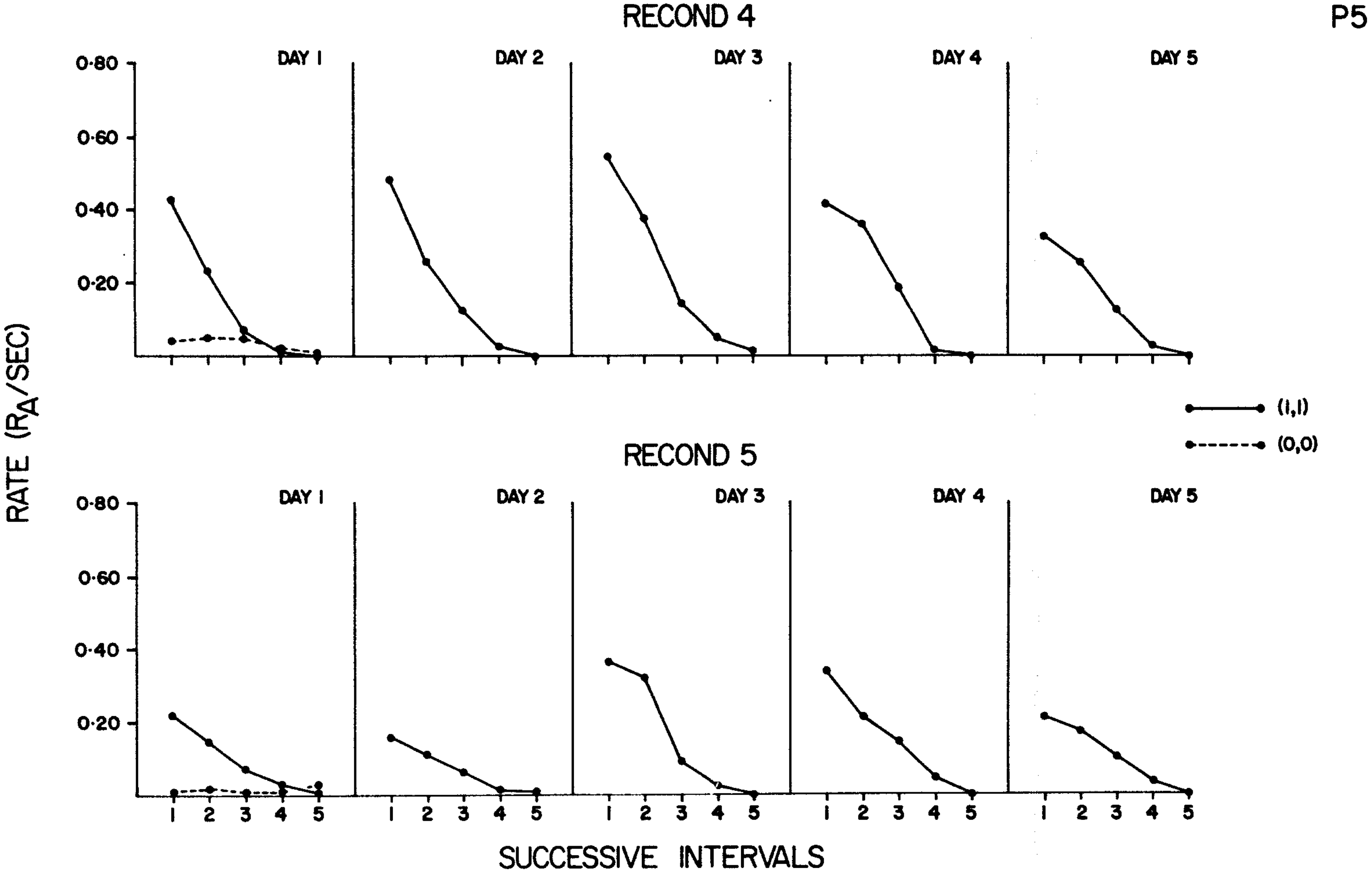

RECOND 2
P5
RATE (R_A/SEC)
0·80
0·60
0·40
0·20
DAY 1
DAY 2
DAY 3
DAY 4
DAY 5
(1,1)
(0,0)
RECOND 3
1
2
3
4
5
SUCCESSIVE INTERVALS

Fig. 47: Rate as a function of the five 3-sec intervals of a T-cycle in the fourth and fifth reconditioning periods for P5 [the rate within a T-cycle function for the (0,0) point is from the last session of the preceding extinction period].


RECOND 4
P5
DAY 1
DAY 2
DAY 3
DAY 4
DAY 5
0·80
0·60
0·40
0·20
RATE (R_A/SEC)
(1,1)
(0,0)
RECOND 5
DAY 1
DAY 2
DAY 3
DAY 4
DAY 5
0·80
0·60
0·40
0·20
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
SUCCESSIVE INTERVALS

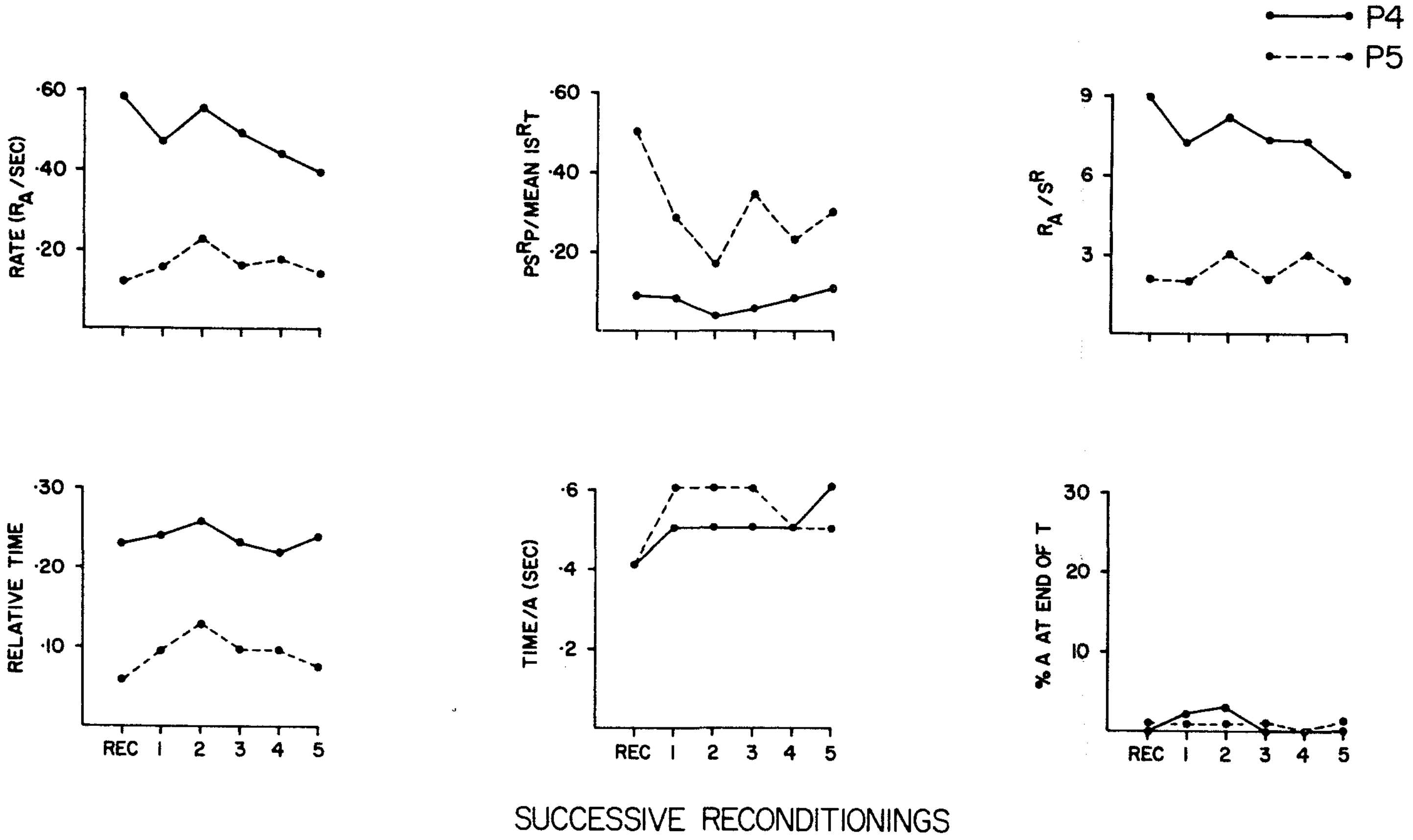
(Figs. 15 and 16). As compared to the flat rate functions obtained at operant level, and at all final extinction sessions, both subjects showed a maximum rate shortly after reinforcement followed by a progressive decrease in rate as the time for the next reinforcement approached. The only permanent change was for P5. In the last session of the first reconditioning period, the maximum rate for P5 shifted from the second to the first interval of a T-cycle; this change, except for one session, was subsequently maintained. P4 showed the same change between the last session of the second reconditioning period and the first two sessions of the third reconditioning period. This change, however, was transient as it appeared only once more after the second session of the third reconditioning period.

Fig. 48 presents, for both subjects, rate, PS^RP/Mean IS^RT, relative time in _A_, Time/A, and percent _A_ at the end of T at each reconditioning period with recovery from Exp. I included; data were calculated from all five sessions of a reconditioning period. Time/A and percent _A_ at the end of T were generally flat across reconditioning periods. Relative time went through a maximum, and PS^RP/Mean IS^RT went through a minimum. Rate was decreasing after the second reconditioning period for both subjects. The rate decreases were reflected for P4 in R_A/S^R, but not for P5 because R_A/S^R were rounded to the nearest whole number. In general, however, there were no large changes in any of these functions except in rate for P4.

The reliability of the shape of the functions for rate within a T-cycle, both between and within reconditioning periods, and the failure to consistently find large changes in the functions of Fig. 48 indicated that the behavior reconditioned under noncontingent reinforcement was not necessarily susceptible, as Skinner (1948) found, to a change in response class.

Numerical values of means and standard deviations for each subject in Exp. II are found in Appendix B.

Fig. 48: Rate, PS^RP/Mean IS^RT, R_A/S^R, relative time in A, Time/A, and Percent A at the end of a T-cycle at each reconditioning period for P4 and P5 [recovery at the (1,1) point from Exp. I is abbreviated "REC"].


P4
P5
RATE (R_A/SEC)
·60
·40
·20
PS^RP/MEAN IS^RT
·60
·40
·20
R_A/S^R
9
6
3
RELATIVE TIME
·30
·20
·10
TIME/A (SEC)
·6
·4
·2
% A AT END OF T
30
20
10
REC
1
2
3
4
5
SUCCESSIVE RECONDITIONINGS

Exp. III: Noncontingent To Contingent Reinforcement

Cole (1970) and Schoenfeld et al. (1972) have examined the effects of a gradual change from contingent to noncontingent reinforcement on the key peck response of pigeons. Cole initially maintained the key peck response on a random interval reinforcement schedule (T = 6 sec, P = .1, T/P = 60 sec). A noncontingent schedule was then introduced concurrently with the contingent schedule; the T-cycle was also 6 sec for the noncontingent schedule. Upon the introduction of the noncontingent schedule, the probability of noncontingent reinforcement was .05, and the probability of reinforcement for R was reduced to .05; the sum of these two probabilities was kept at .1 throughout the experiment. The proportion of contingent and noncontingent reinforcements was then varied by decreasing the probability of reinforcement for R and increasing the probability of noncontingent reinforcement until all reinforcements were noncontingent. Schoenfeld et al. also maintained the key peck response of a pigeon on a random interval reinforcement schedule (T = 6 sec, P = .1, T/P = 60 sec). A noncontingent reinforcement schedule was introduced concurrently with the contingent schedule (T = 6 sec, P = .1, T/P = 60 sec) without an initial reduction in the probability of reinforcement for R. The proportion of contingent and noncontingent reinforcements was then varied by holding the probability of noncontingent reinforcement constant and decreasing the probability of reinforcement for R until all reinforcements were noncontingent. The outcome of both of these studies was the same: response rates decreased as the shift was made to completely noncontingent reinforcement.

A continuum which has at its extremes contingent and noncontingent reinforcement is found in Fig. 2 on the top horizontal from (0,1) to (1,1) where $P(S^R|A) = 1$ and $P(S^R|\not{A})$ varies between 0 and 1. Points on this continuum may be described by the proportion of T-cycles in which reinforcer presentation was noncontingent. Reinforcer presentation in a T-cycle was noncontingent when reinforcement was available both for $\underline{A}$ and $\underline{\not A}$. Since reinforcement, on this continuum, was always available for $\underline{A}$ at the end of T, noncontingent reinforcement occurred when reinforcement was also available for $\underline{\not A}$ at the end of T. Reinforcement was available for $\underline{\not A}$ at probability $P(S^R|\not A)$, or the proportion of cycles in which reinforcement was noncontingent was $P(S^R|\not A)$. The proportion of cycles in which reinforcement was contingent was $1 - P(S^R|\not A)$. At one extreme of the continuum, the (1,1) point, noncontingent reinforcement occurred in all of the cycles. At the other extreme, the (0,1) point, there were no cycles in which noncontingent reinforcement occurred; all reinforcements were contingent on the organism being in $\underline{A}$ at the end of T. The closer the intermediate points were to (0,1), the lower the proportion of cycles in which reinforcer presentation was noncontingent.

The present investigation of the top horizontal of Fig. 2 beginning at the (1,1) point and proceeding to the (0,1) point extended the work of Cole and Schoenfeld et al. in two ways: 1) the effects of reinforcement contingent on spatial arrangements were investigated rather than the effects of reinforcement contingent on transitions between spatial arrangements (i.e., responses), and 2) the effects of passing from noncontingent to contingent reinforcement were investigated rather than the effects of passing from contingent to noncontingent reinforcement.

Method

Subjects

Three birds from Exp. I: P1, P2, and P3, were maintained at 80% ± 15 gm of free-feeding body weight.

Apparatus

Same as Exp. I.

Procedure

After recovery at the (1,1) point in Exp. I, these subjects were exposed at T = 15 sec to the following order of points lying on the top horizontal of Fig. 2: (.5,1); (.25,1); (.125,1); (0,1); and then a return to the (1,1) point. In order to clearly designate the two exposures to the (1,1) point, the following notation was used: the recovery of the (1,1) point from Exp. I was called, in this experiment, the (1,1) point; the return to the (1,1) point after the (0,1) point was called recovery. Subjects were exposed to each point for 20 sessions; each session was 60 T-cycles. Criterion sessions were the last five at each point. Procedures were, otherwise, the same as in Exp. I.

Results And Discussion

The progression from (1,1) to (0,1) along the top horizontal of Fig. 2 was similar to a shaping procedure in that there was a gradual progression to the condition where reinforcer presentation was contingent on a single, pre-specified behavioral class. It is usual, in a shaping procedure, for the behavioral class on which reinforcement becomes solely contingent to have an initially low frequency of occurrence. The result of a shaping procedure is to increase the frequency of occurrence of this behavioral class. Figs. 49-51 present percent *A* at the end of each of the five intervals of a T-cycle as a function of $P(S^R|\not{A})$ for P1, P2, and P3, respectively. [All abscissas involving $P(S^R|\not{A})$ were reversed so that changes along the abscissas would correspond to the order in which subjects were exposed to the experimental points.] Reinforcement for *A* occurred when the subject was in *A* at the end of T (i.e., the end of the fifth interval of a T-cycle). As can be seen in these figures, percent *A* for the fifth interval was initially low at $P(S^R|\not{A}) = 1$ for all subjects. As the proportion of T-cycles in which reinforcement was contingent on *A* occurring at the end of T increased (i.e., the proportion of cycles in which reinforcement was noncontingent decreased) the percent *A* at the end of the fifth interval increased throughout the first four experimental points. At the fifth point, P1 showed a large decrease; P2 showed a large increase; and P3 showed a small decrease. In any case, the percent *A* at the end of the fifth interval of a T-cycle was higher at the (0,1) point than at the (1,1) point for all subjects. For each subject, the shape of the percent *A* functions for the end of the other four intervals was similar to the shape of the function for the fifth interval. Relative time in *A* as a function of $P(S^R|\not{A})$ is given in Fig. 52. The relative time function for each subject was similar in shape to the corresponding percent *A* functions. Percent *A* at the end of all five intervals of a T-cycle, for each experimental point, is shown in Figs. 53-55. As $P(S^R|\not{A})$ decreased, the peak of these functions

Fig. 49: Percent $\underline{A}$, for each interval of a T-cycle, as a function of $P(S^R|\not{A})$ for P1 (interval is abbreviated "INT").

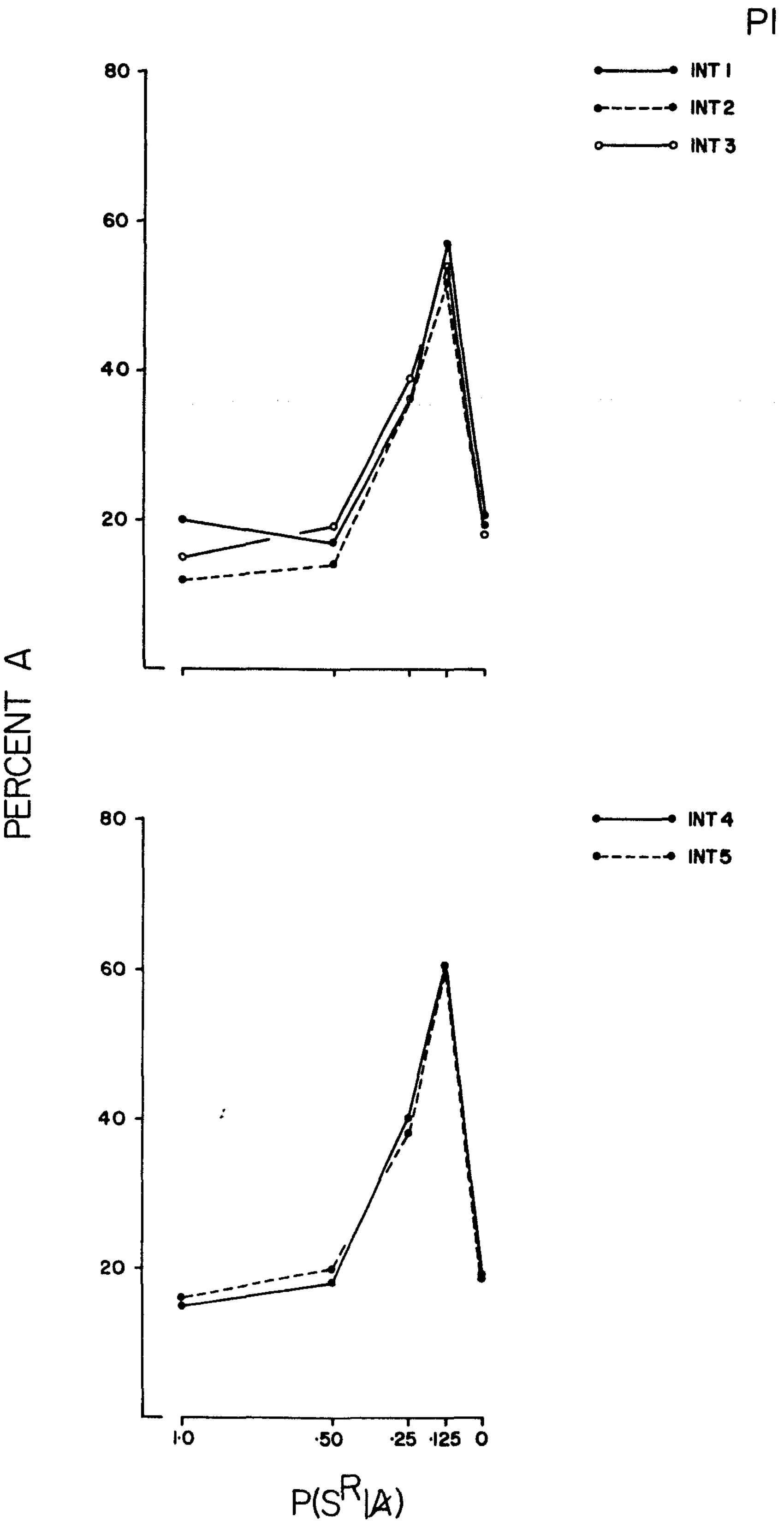

PI
INT 1
INT 2
INT 3
INT 4
INT 5
80
60
40
20
PERCENT A
1·0
·50
·25
·125
0
P(S^R|A)

Fig. 50: Percent $\underline{A}$, for each interval of a T-cycle, as a function of $P(S^R | \not{A})$ for P2 (interval is abbreviated "INT").

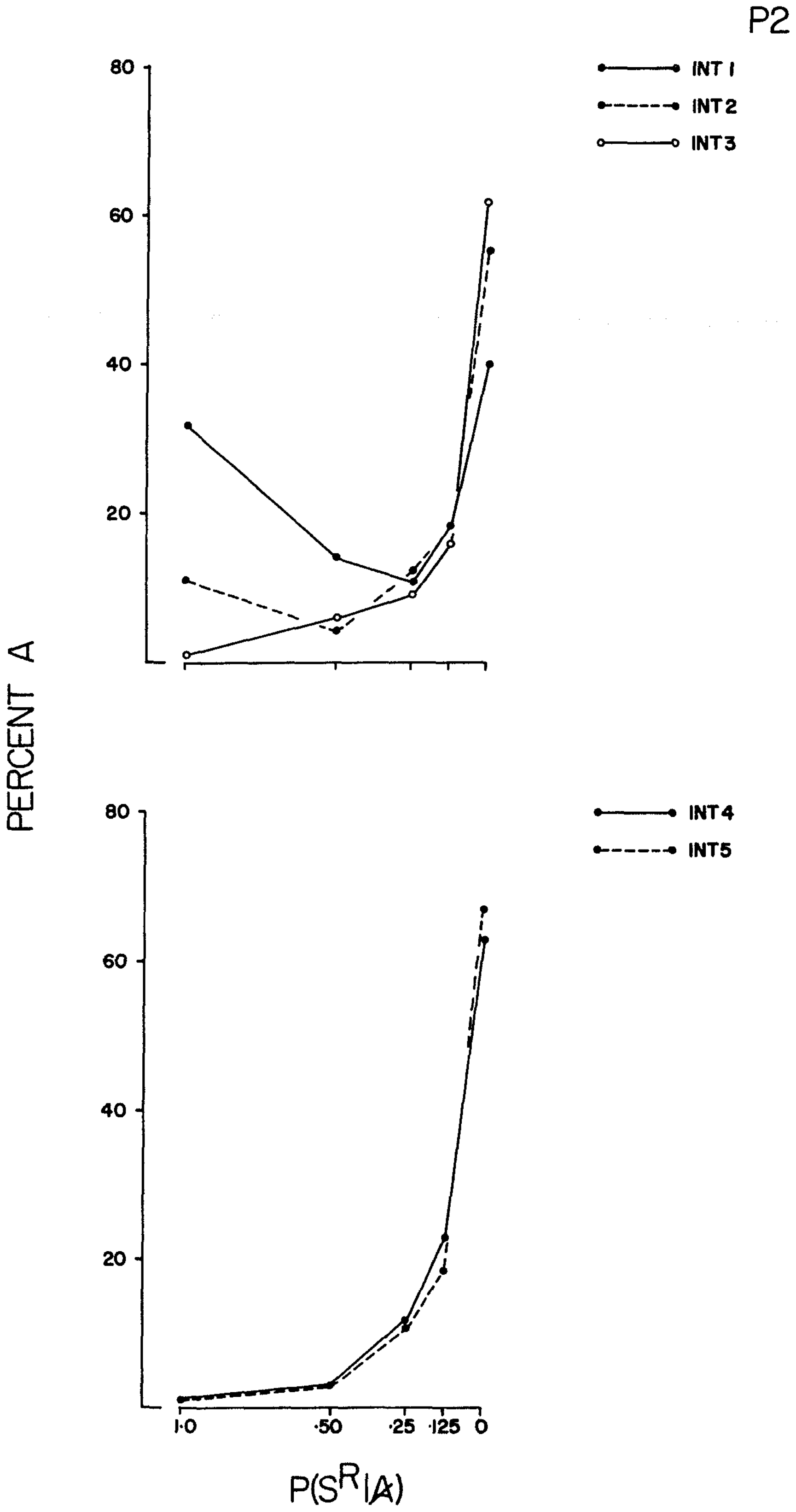

P2
INT 1
INT 2
INT 3
80
60
40
20
PERCENT A
INT 4
INT 5
80
60
40
20
1·0
·50
·25
·125
0
P(S^R|A)

Fig. 51: Percent $\underline{A}$, for each interval of a T-cycle, as a function of $P(S^R|\not{A})$ for P3 (interval is abbreviated "INT").

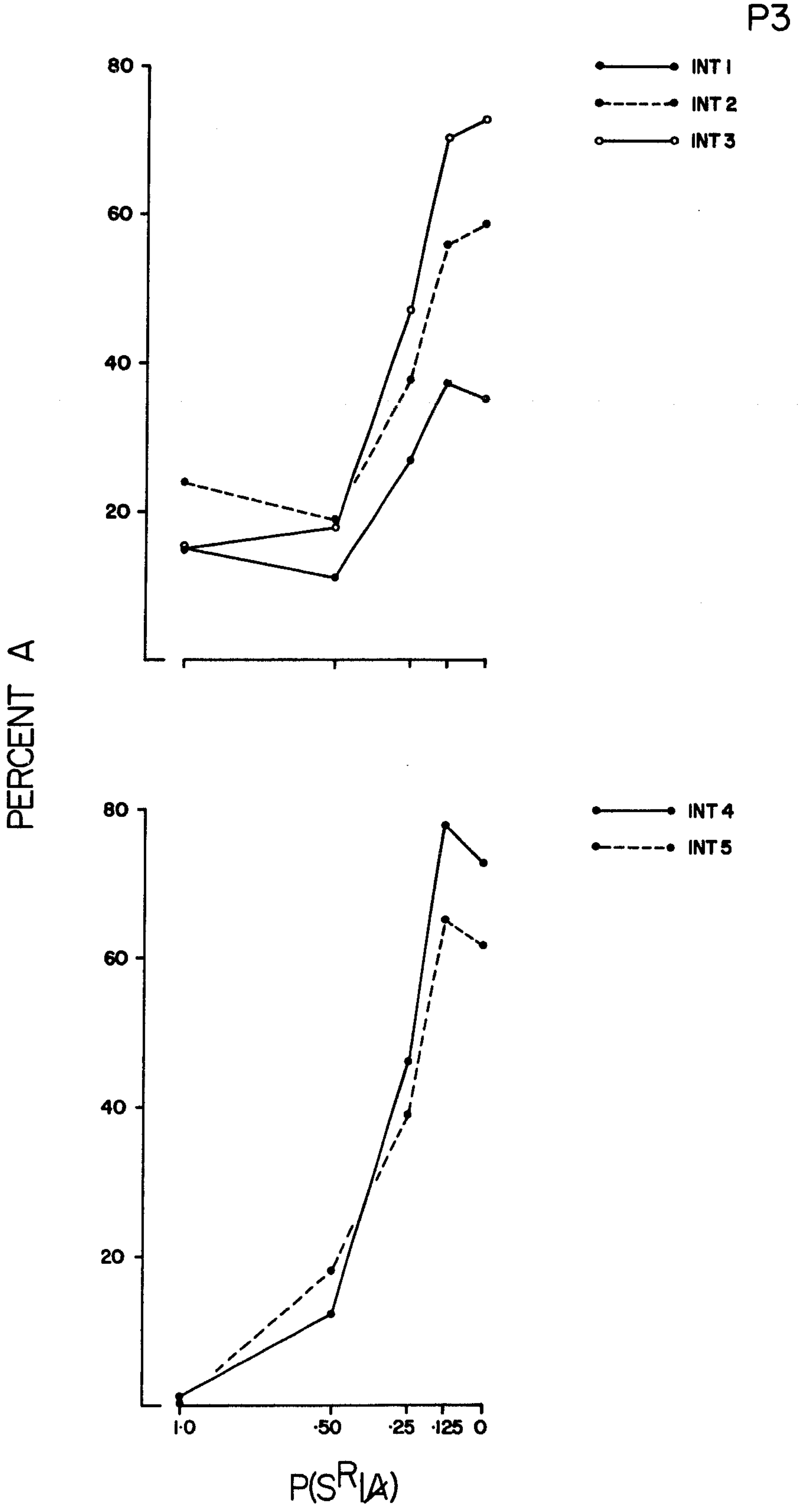

P3
INT 1
INT 2
INT 3
INT 4
INT 5
80
60
40
20
PERCENT A
1·0
·50
·25
·125
0
P(S^R|A)

Fig. 52: Relative time in *A* as a function of $P(S^R|\cancel{A})$ for all subjects [unconnected data points are the relative times for the recovery at the (1,1) point].

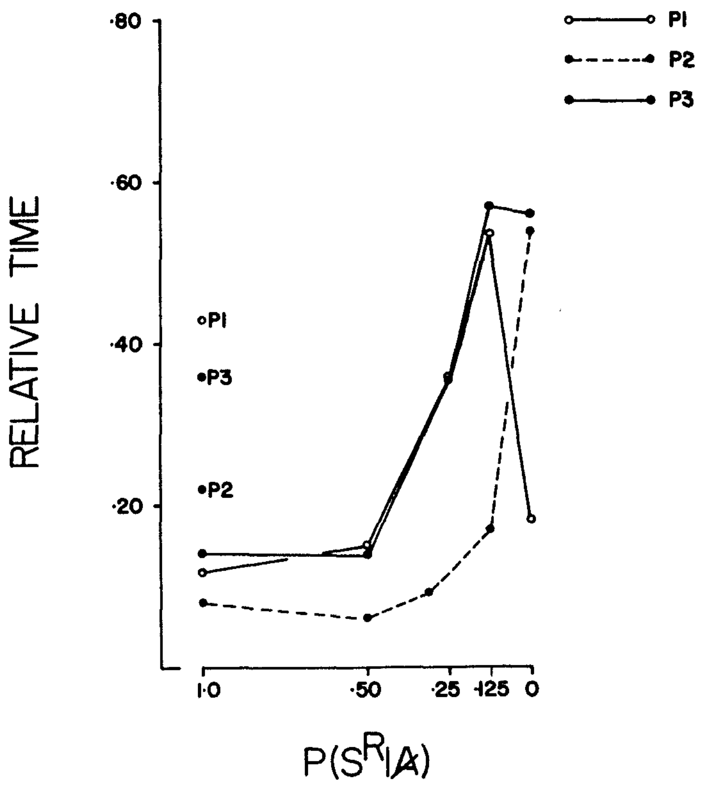

·80
·60
·40
·20
RELATIVE TIME
○P1
●P3
●P2
1·0
·50
·25
·125
0
P(S^R|A̸)
P1
P2
P3

Fig. 53: Percent *A*, at each experimental point, as a function of the five 3-sec intervals of a T-cycle for P1 [recovery is a return to the (1,1) point after the (0,1) point].

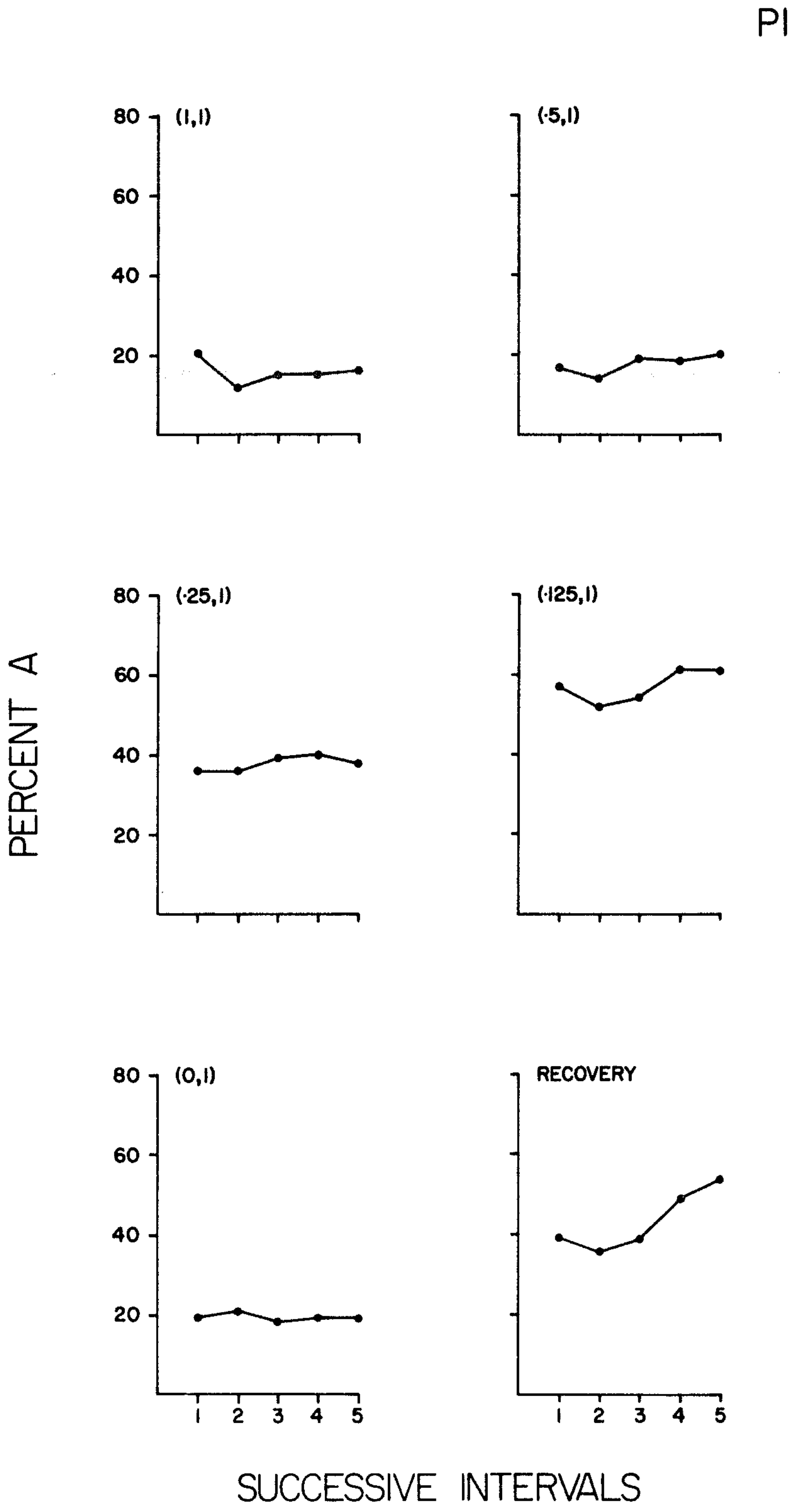

PI
(1,1)
(·5,1)
(·25,1)
(·125,1)
(0,1)
RECOVERY
80
60
40
20
PERCENT A
1
2
3
4
5
SUCCESSIVE INTERVALS

Fig. 54: Percent A, at each experimental point, as a function of the five 3-sec intervals of a T-cycle for P2 [recovery is a return to the (1,1) point after the (0,1) point].

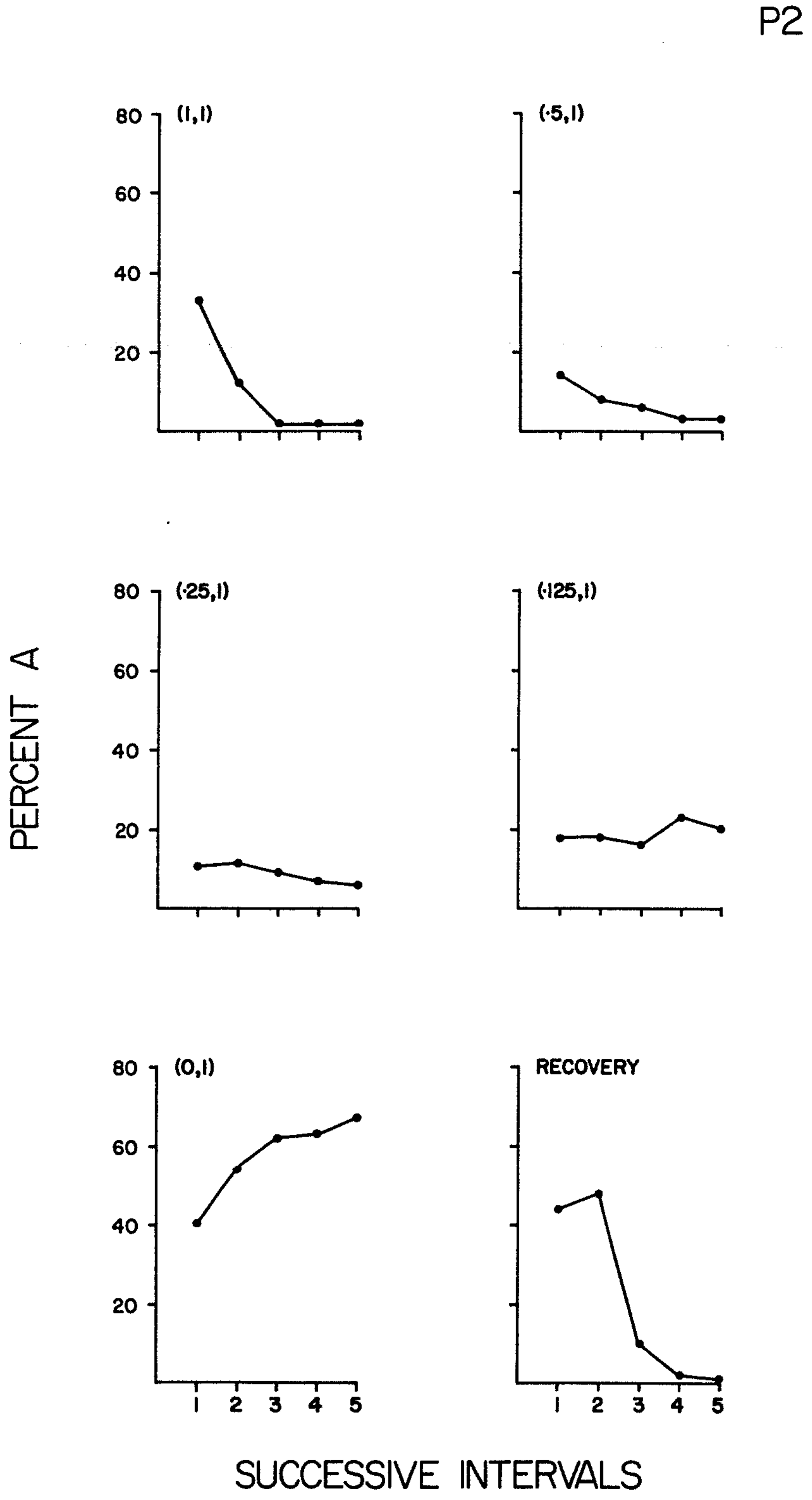
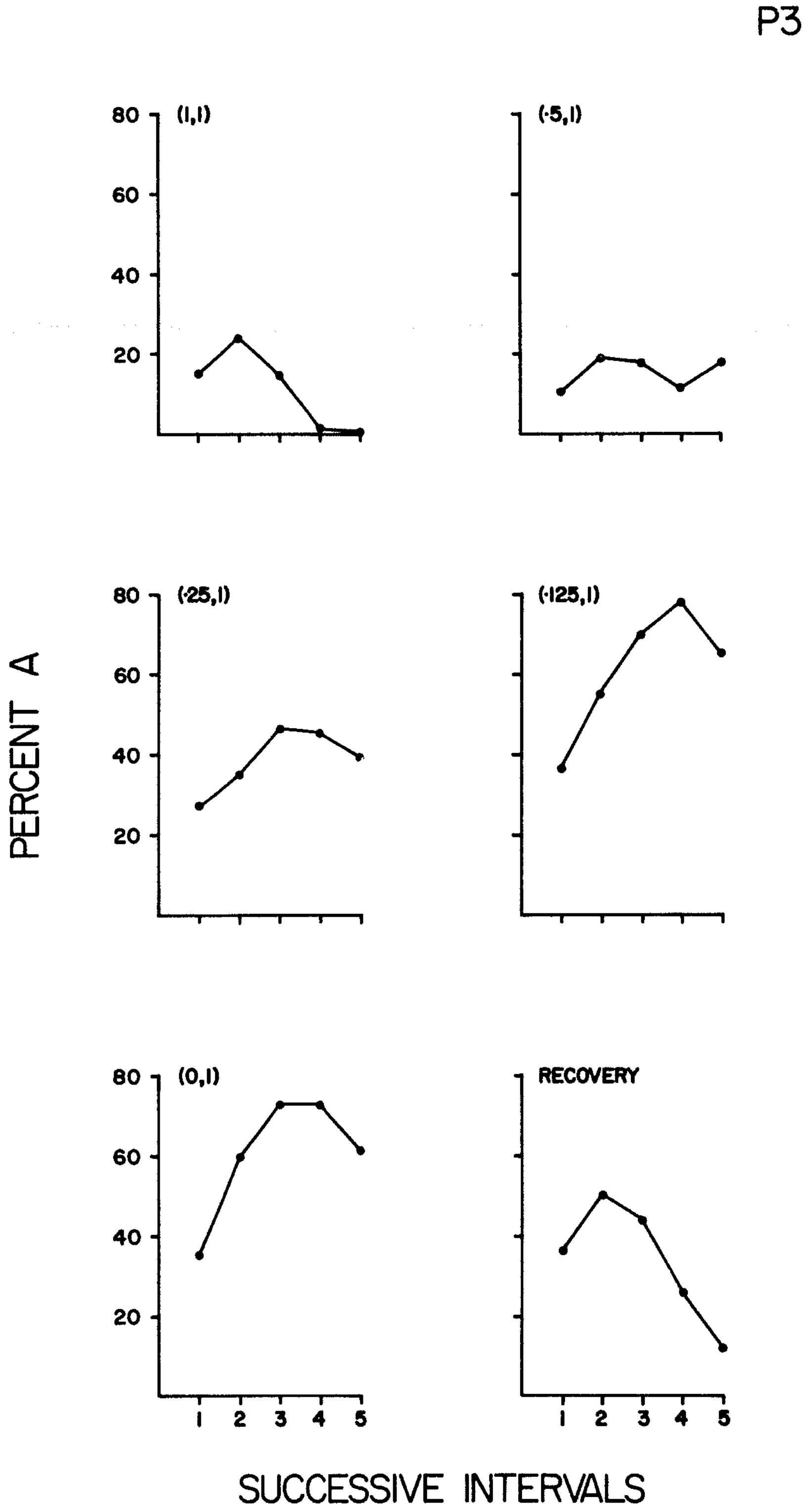

P2
80
60
40
20
(1,1)
(·5,1)
(·25,1)
(·125,1)
(0,1)
RECOVERY
PERCENT A
1
2
3
4
5
SUCCESSIVE INTERVALS

Fig. 55: Percent A, at each experimental point, as a function of the five 3-sec intervals of a T-cycle for P3 [recovery is a return to the (1,1) point after the (0,1) point].


P3
(1,1)
(·5,1)
(·25,1)
(·125,1)
(0,1)
RECOVERY
80
60
40
20
1
2
3
4
5
PERCENT A
SUCCESSIVE INTERVALS

moved for all subjects from early in the T-cycle to later in the T-cycle.

Time/A as a function of $P(S^R|\not{A})$ is presented in Fig. 56 and shows that Time/A increased as $P(S^R|\not{A})$ decreased. Time/A as a function of the five 3-sec intervals of a T-cycle is given in Figs. 57-59. These functions were relatively flat at $P(S^R|\not{A}) = 1$; as $P(S^R|\not{A})$ decreased, Time/A within a T-cycle became markedly curved for all subjects.

Rate as a function of $P(S^R|\not{A})$ is shown in Fig. 60. The rate function for P1 and P3 went through a maximum, while the rate function for P2 went through a minimum. Since Time/A as a function of $P(S^R|\not{A})$ was replicated on all subjects, these discrepancies in the rate functions must have been due to discrepancies in changes in Time/$\not{A}$, as shown in Table 3. Rate as a function of the five 3-sec intervals of a T-cycle is presented in Figs. 61-63. These functions, at the (1,1) point, were more curved than the functions at the (0,1) point. R_A/S^R, shown in Fig. 64, went through a maximum for all subjects, and PS^RP/Mean IS^RT, shown in Fig. 65, decreased as $P(S^R|\not{A})$ decreased.

Upon a return to the (1,1) point, there was an increase over the initial exposure to the (1,1) point (in this experiment) in Time/A (Fig. 56), rate (Fig. 60) and consequently in relative time in *A* and R_A/S^R for all subjects. There was a decrease in PS^RP/Mean IS^RT for all subjects. In Figs. 53-55, it can be seen that the high percent *A* at the end of intervals early in a T-cycle at the (1,1) point and the lower percent *A* at the end of intervals late in a T-cycle at the (1,1) point were recovered for P2 and P3 but not for P1. The change from the (0,1) point to the (1,1) point was an immediate shift from contingent to noncontingent reinforcement. For P2 and P3, this shift resulted in a decrease in percent *A* at the end of T. That is, noncontingent reinforcement resulted in a decrease in the frequency of behavior established by contingent reinforcement. This effect has been similarly found for response rates when a shift is made from interval or ratio schedules to noncontingent reinforcement (see Introduction to Exp. I for references). The shapes of the functions describing

Fig. 56: Time/A (total amount of time spent in A divided by the total number of entries into A) as a function of $P(S^R|\not{A})$ for all subjects [unconnected data points are the Time/A for the recovery at the (1,1) point].

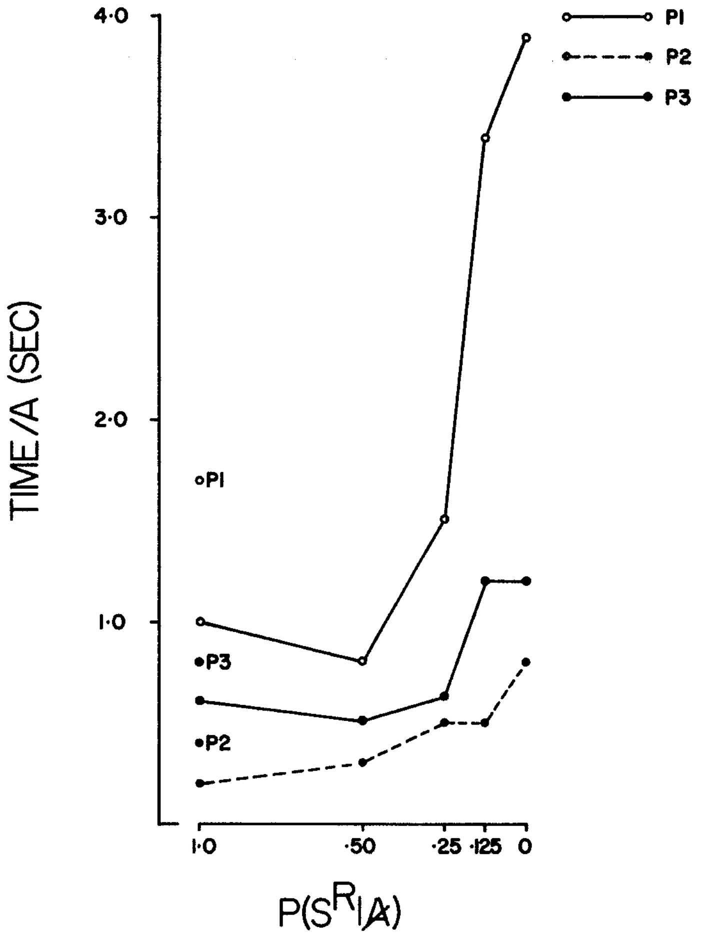

4·0
3·0
2·0
1·0
TIME/A (SEC)
∘P1
•P3
•P2
1·0
·50
·25
·125
0
P(S^R|A̸)
P1
P2
P3

Fig. 57: Time/A (total amount of time spent in A divided by the total number of entries into A), at each experimental point, as a function of the five 3-sec intervals of a T-cycle for P1 [recovery is a return to the (1,1) point after the (0,1) point].

PI

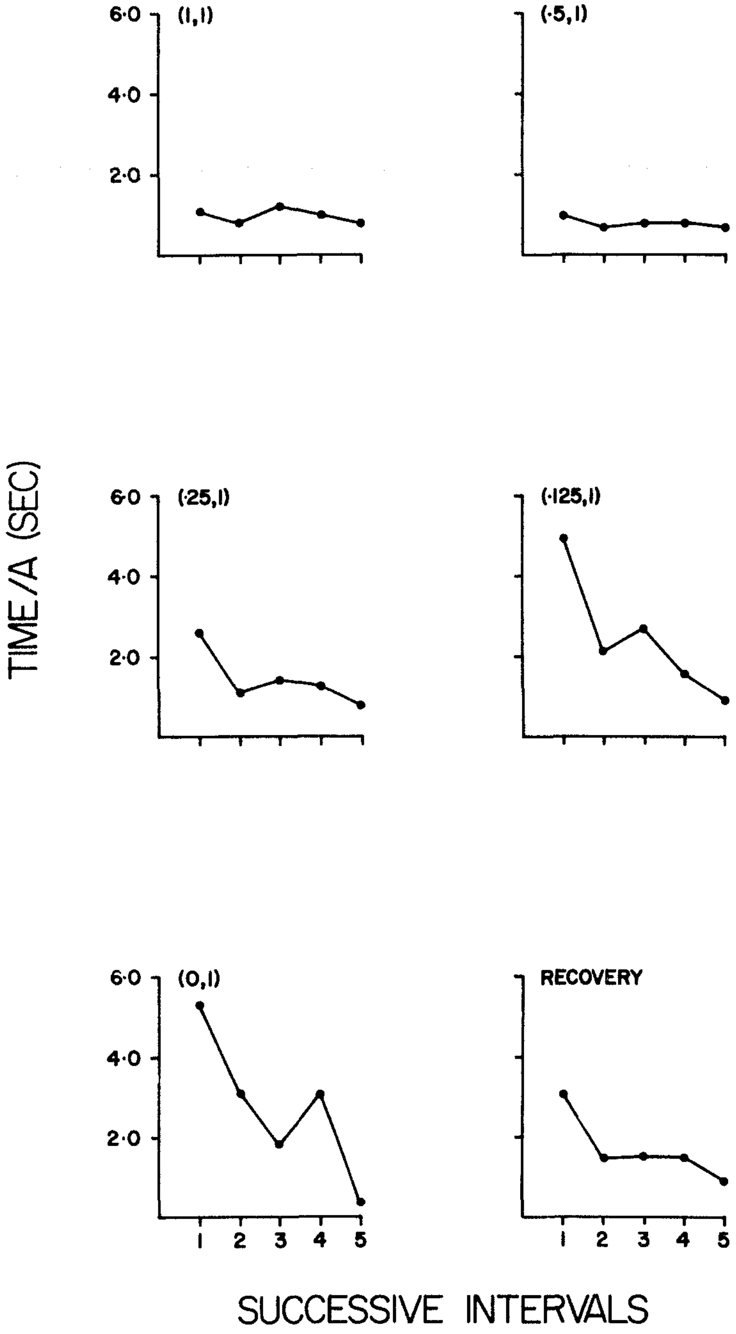

TIME/A (SEC)
6·0
4·0
2·0
(1,1)
(·5,1)
(·25,1)
(·125,1)
(0,1)
RECOVERY
1
2
3
4
5
SUCCESSIVE INTERVALS

Fig. 58: Time/A (total amount of time spent in _A_ divided by the total number of entries into _A_), at each experimental point, as a function of the five 3-sec intervals of a T-cycle for P2 [recovery is a return to the (1,1) point after the (0,1) point].

P2

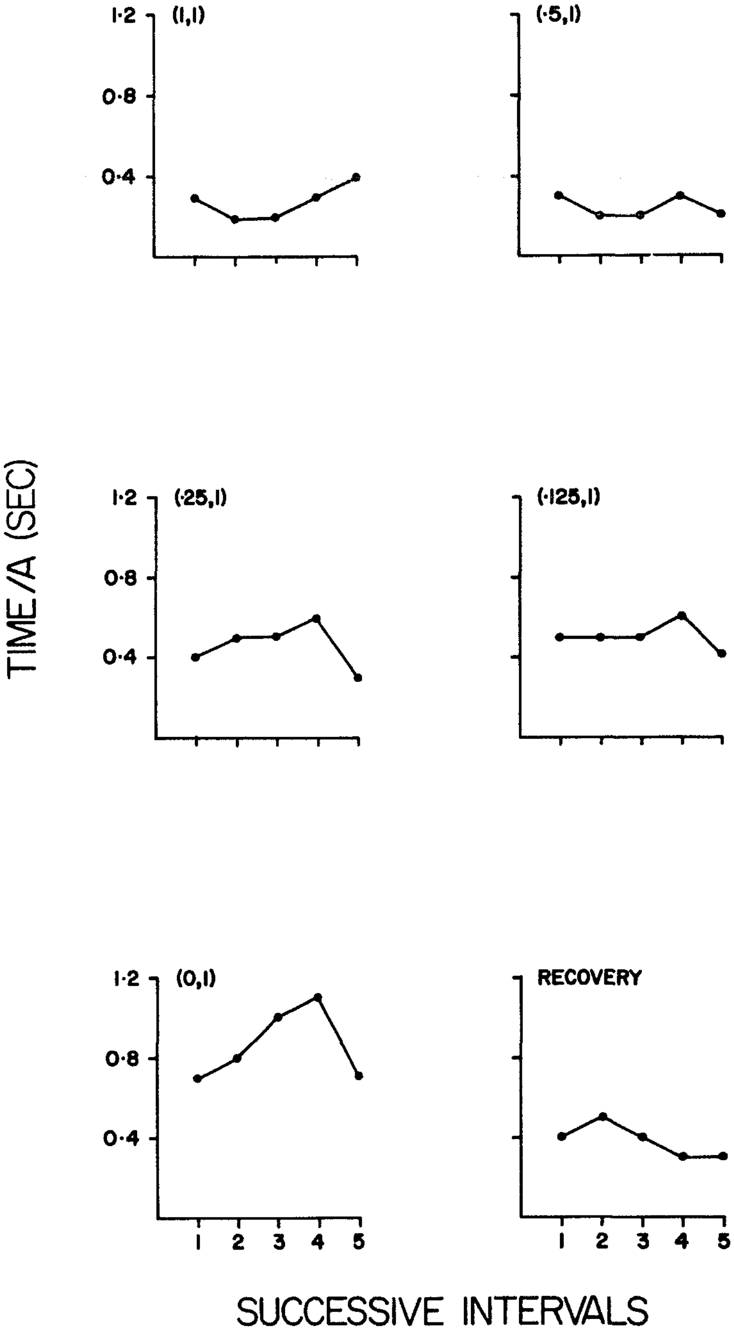

(1,1)
(·5,1)
(·25,1)
(·125,1)
(0,1)
RECOVERY
1·2
0·8
0·4
1 2 3 4 5
TIME/A (SEC)
SUCCESSIVE INTERVALS

Fig. 59: Time/A (total amount of time spent in A divided by the total number of entries into A), at each experimental point, as a function of the five 3-sec intervals of a T-cycle for P3 [recovery is a return to the (1,1) point after the (0,1) point].

P3

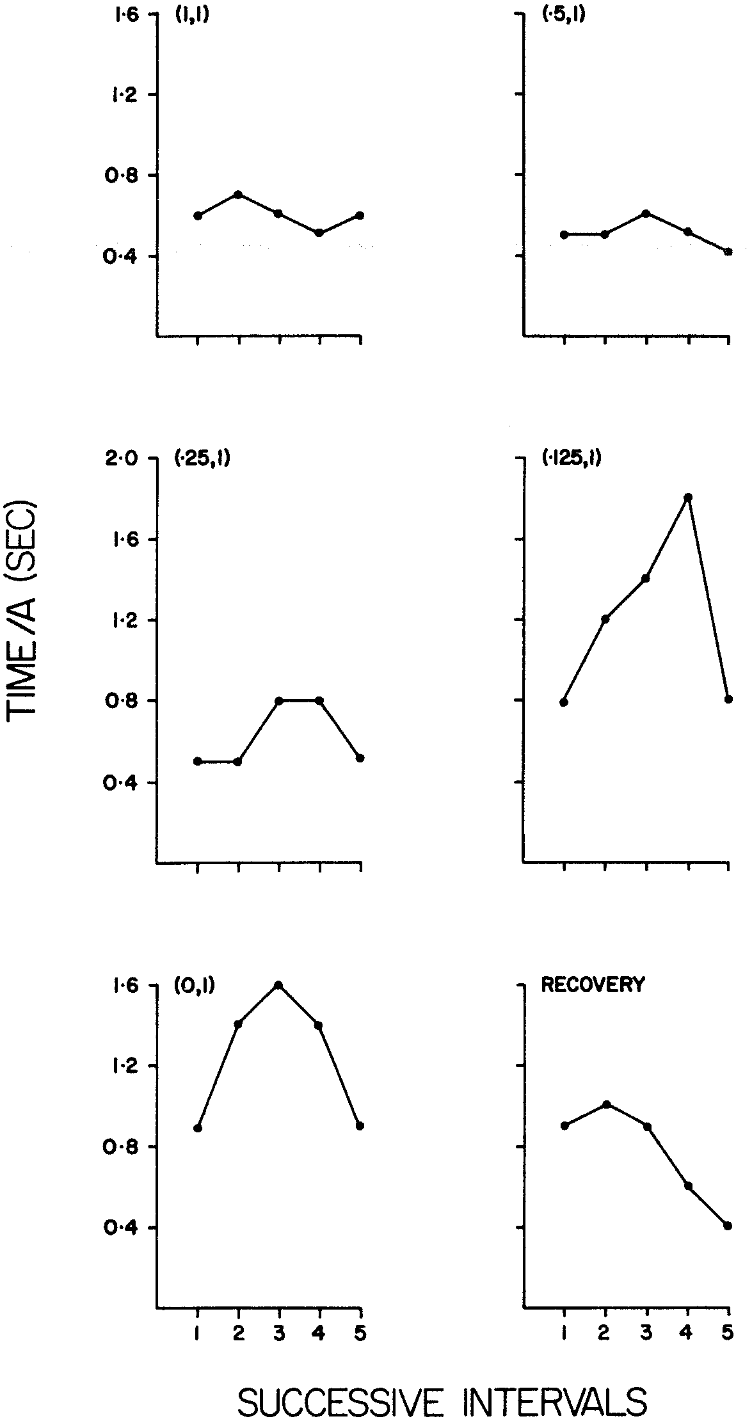

(1,1)
(·5,1)
(·25,1)
(·125,1)
(0,1)
RECOVERY
1·6
1·2
0·8
0·4
2·0
1·6
1·2
0·8
0·4
1·6
1·2
0·8
0·4
1 2 3 4 5
1 2 3 4 5
TIME/A (SEC)
SUCCESSIVE INTERVALS

Fig. 60: Rate as a function of $P(S^R|\cancel{A})$ for all subjects [unconnected data points are the rates for the recovery at the (1,1) point].

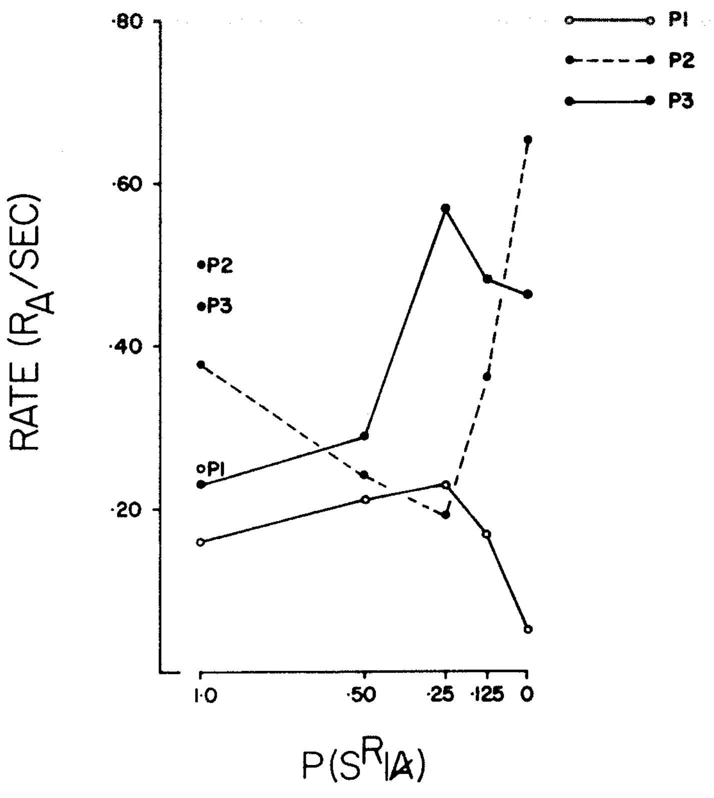

RATE (R_A/SEC)
·80
·60
·40
·20
1·0
·50
·25
·125
0
P(S^R|A̸)
•P2
•P3
○P1
P1
P2
P3

Table 3

Time/$\not{A}$ (sec) As A Function Of $P(S^R|\not{A})$ For All Subjects [Time/$\not{A}$ was calculated from: Time/$\not{A}$ = $(1/R_A$ rate) - (Time/A).]

$P(S^R\|\not{A})$	P1	P2	P3
1.0	5.3	2.4	3.7
0.5	3.9	3.9	2.9
0.25	2.8	4.8	1.2
0.125	2.5	2.3	0.9
0.0	14.6	0.7	1.4
Recovery At The (1,1) Point	2.3	1.6	1.4

Fig. 61: Rate, at each experimental point, as a function of the five 3-sec intervals of a T-cycle for P1 [recovery is a return to the (1,1) point after the (0,1) point].

PI

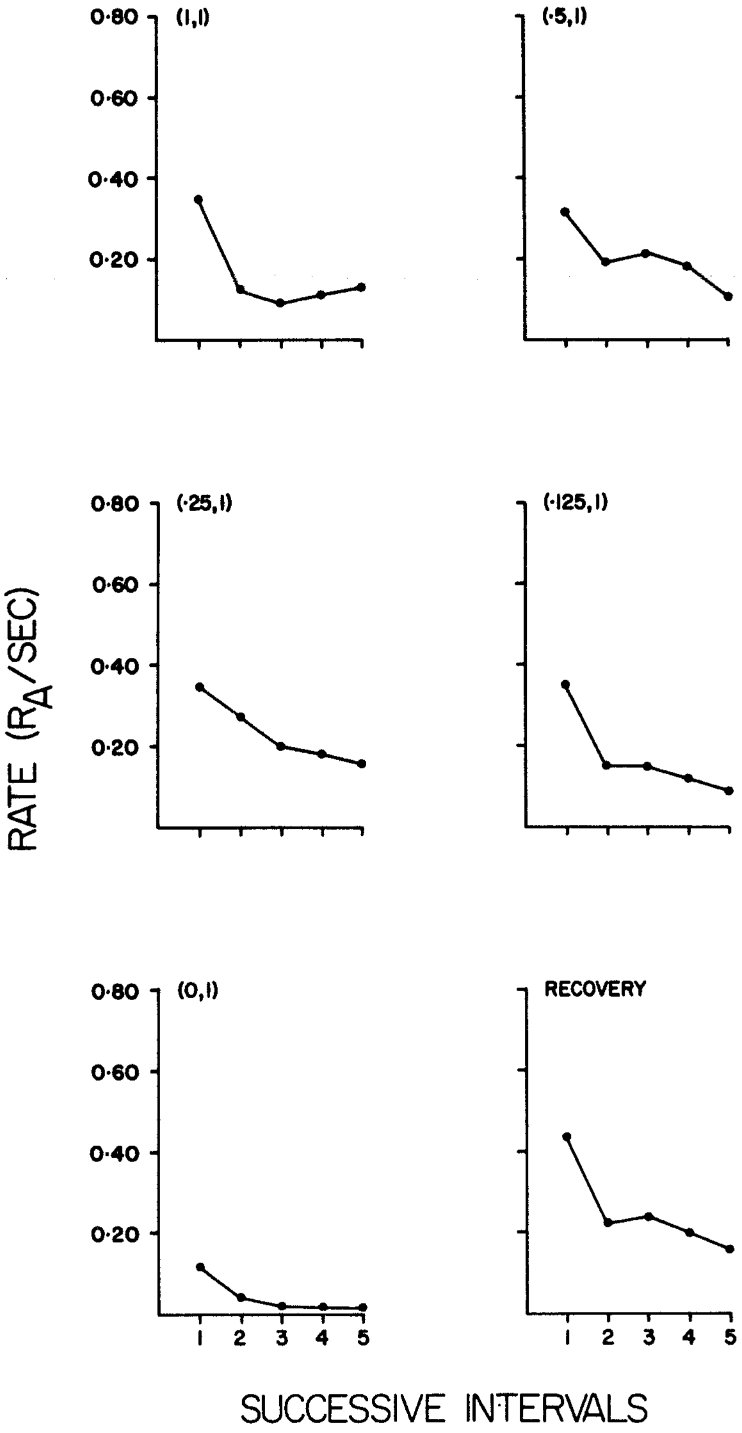

(1,1)
(·5,1)
(·25,1)
(·125,1)
(0,1)
RECOVERY
0·80
0·60
0·40
0·20
RATE (R_A/SEC)
1
2
3
4
5
SUCCESSIVE INTERVALS

Fig. 62: Rate, at each experimental point, as a function of the five 3-sec intervals of a T-cycle for P2 [recovery is a return to the (1,1) point after the (0,1) point].

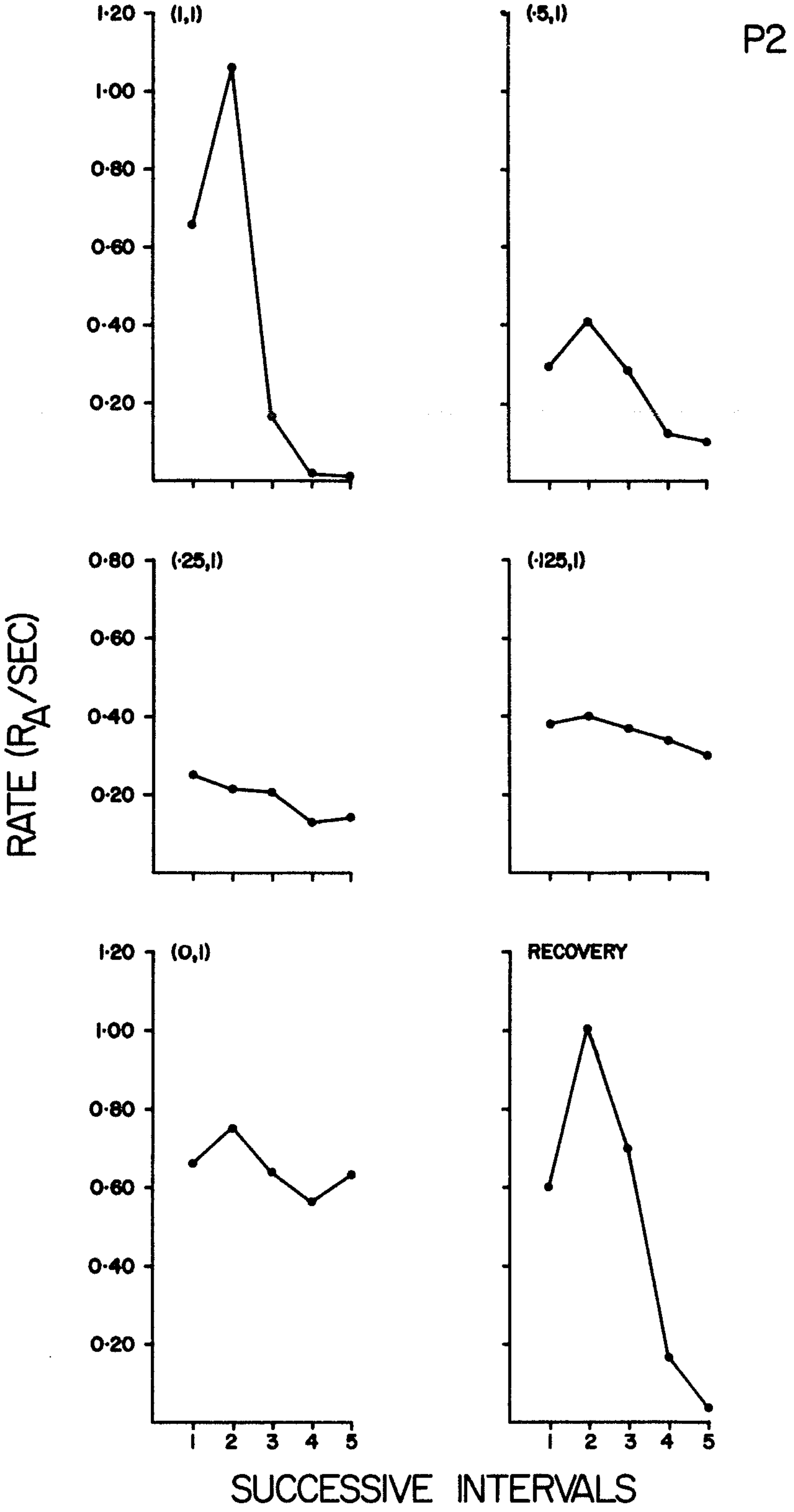

P2
(1,1)
(·5,1)
(·25,1)
(·125,1)
(0,1)
RECOVERY
RATE (R_A/SEC)
1·20
1·00
0·80
0·60
0·40
0·20
1
2
3
4
5
SUCCESSIVE INTERVALS

Fig. 63: Rate, at each experimental point, as a function of the five 3-sec intervals of a T-cycle for P3 [recovery is a return to the (1,1) point after the (0,1) point].

P3

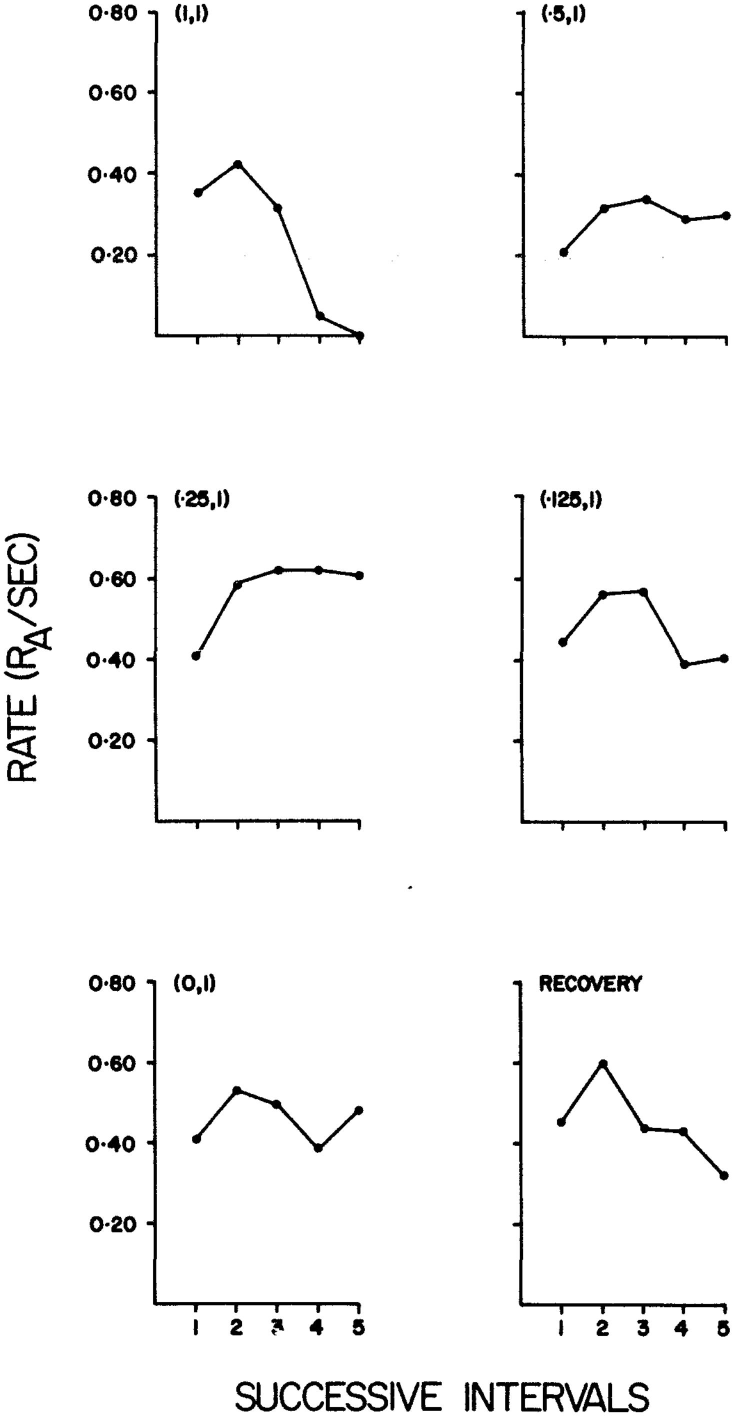
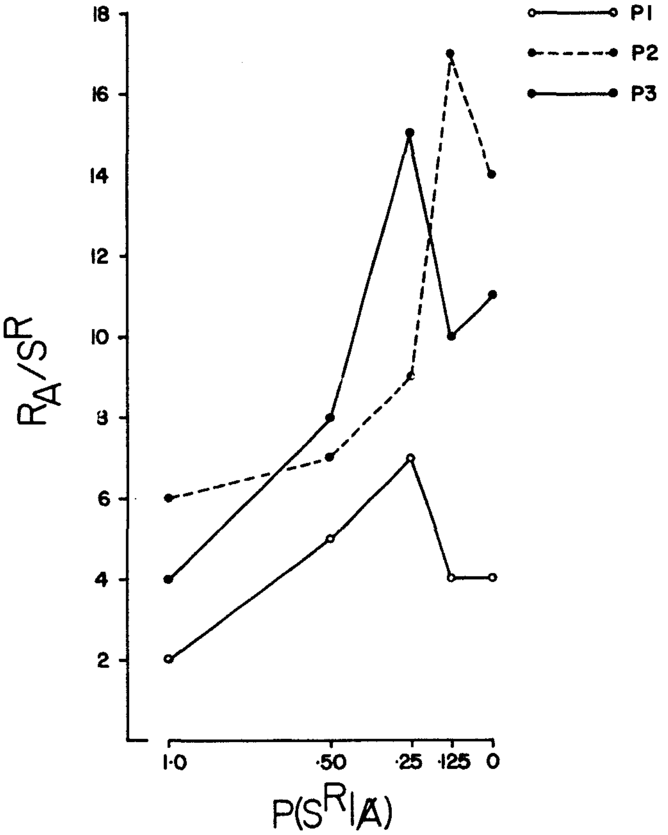
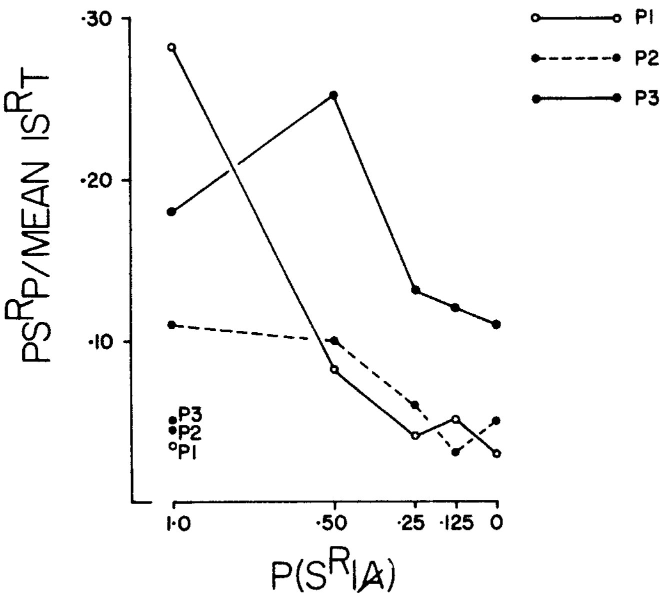

(1,1)
(·5,1)
(·25,1)
(·125,1)
(0,1)
RECOVERY
0·80
0·60
0·40
0·20
RATE (R_A/SEC)
1
2
3
4
5
SUCCESSIVE INTERVALS

Fig. 64: R_A/S^R as a function of $P(S^R|\not{A})$ for all subjects.



P1
P2
P3
18
16
14
12
10
8
6
4
2
R_A/S^R
1·0
·50
·25
·125
0
$P(S^R|\bar{A})$

Fig. 65: PS^RP/Mean IS^RT as a function of $P(S^R|\not{A})$ for all subjects [unconnected data points are the PS^RPs/Mean IS^RT for the recovery at the (1,1) point].



$PS^RP/MEAN\ IS^RT$
·30
·20
·10
1·0
·50
·25
·125
0
$P(S^R|\not{A})$
P1
P2
P3
P3
P2
P1

Time/λ within a T-cycle were not recovered, although the shapes of the functions for rate within a T-cycle were recovered.

Numerical values of means and standard deviations for each subject in Exp. III are found in Appendix C.

Appendix A

Data From Exp. I

(See Results And Discussion section of Exp. I for a description of the measures and the degree of accuracy of each measure. Data were pooled over criterion sessions and means were computed. Standard deviations were computed from the data collected in each criterion session to give an indication of day to day variability. Standard deviations for Time/A were not computed for operant level because in a substantial number of sessions no entries into A occurred. Operant level was abbreviated "OL".)

Table 4

Means (M) And Standard Deviations (SD) For P1 Across Criterion Sessions

Experimental Point	Rate	Rate In The Five 3-sec Intervals of T 1	2	3	4	5	R_A/S^R	PS^RP/Mean IS^RT	Relative Time
OL									
M	.01	.01	.01	.01	.01	.02	-	-	.24
SD	.02	.01	.01	.01	.02	.03	-	-	.34
(1,1)									
M	.17	.50	.18	.07	.06	.07	3	.09	.18
SD	.02	.02	.05	.03	.02	.04	0	.03	.07
(.5,.5)									
M	.11	.24	.13	.06	.06	.05	3	.17	.12
SD	.05	.08	.06	.04	.04	.03	1	.21	.04
(.25,.25)									
M	.23	.29	.24	.20	.22	.19	14	.02	.24
SD	.03	.05	.04	.03	.03	.05	1	.00	.03
(.125,.125)									
M	.09	.12	.08	.07	.08	.08	10	.01	.53
SD	.05	.04	.04	.05	.05	.05	5	.00	.10
(.084,.084)									
M	.08	.09	.09	.08	.08	.07	16	.04	.13
SD	.03	.03	.03	.03	.03	.04	4	.04	.05
Recovery At The (1,1) Point									
M	.16	.35	.12	.09	.11	.12	2	.28	.16
SD	.07	.06	.09	.09	.11	.11	1	.11	.05

Table 4 (Continued)

Means (M) And Standard Deviations (SD) For P1 Across Criterion Sessions

Experimental Point	Time/A	Time/A In The Five 3-sec Intervals Of T					Percent A For The Five 3-sec Intervals Of T				
		1	2	3	4	5	1	2	3	4	5
OL											
M	20.5	28.0	42.3	18.5	.1	24.5	25	24	25	23	24
SD	-	-	-	-	-	-	35	35	35	32	35
(1,1)											
M	1.1	1.2	1.0	.7	.8	.7	39	13	8	9	11
SD	.4	.3	.5	.5	.4	.3	14	8	6	5	7
(.5,.5)											
M	1.1	1.3	.9	1.0	.8	.7	22	12	6	7	6
SD	.2	.2	.5	.6	.4	.2	8	4	2	3	3
(.25,.25)											
M	1.1	1.2	1.5	1.0	.8	1.0	25	27	23	23	21
SD	.2	.5	.2	.1	.1	.2	4	4	3	4	3
(.125,.125)											
M	6.0	10.9	4.5	4.1	4.3	3.5	55	53	53	52	52
SD	4.4	6.4	3.5	2.8	5.8	2.9	8	12	10	10	10
(.084,.084)											
M	1.7	1.9	1.7	1.5	1.8	1.4	14	14	13	13	13
SD	.3	1.1	.8	1.0	1.7	.6	5	5	5	4	4
Recovery At The (1,1) Point											
M	1.0	1.1	.8	1.3	1.0	.8	20	12	15	15	16
SD	.2	.4	.3	.4	.3	.3	11	8	9	9	10

Table 5
Means (M) And Standard Deviations (SD) For P2 Across Criterion Sessions

Experimental Point	Rate	Rate In The Five 3-sec Intervals Of T					R_A/S^R	PS^RP/Mean IS^RT	Relative Time
		1	2	3	4	5			
OL									
M	.00	.00	.00	.00	.01	.00	-	-	.00
SD	.01	.01	.01	.00	.01	.01	-	-	.01
(1,1)									
M	.40	.38	.68	.61	.24	.06	6	.22	.13
SD	.04	.10	.10	.13	.10	.02	1	.03	.01
(.5,.5)									
M	.61	.57	.88	.78	.47	.40	19	.05	.18
SD	.02	.05	.02	.04	.03	.03	0	.01	.01
(.25,.25)									
M	.61	.55	.72	.72	.58	.52	37	.03	.21
SD	.02	.03	.04	.04	.04	.03	3	.00	.02
(.125,.125)									
M	.34	.33	.35	.36	.35	.32	39	.02	.06
SD	.05	.05	.07	.05	.05	.06	9	.00	.01
(.084,.084)									
M	.49	.46	.50	.51	.50	.49	84	.02	.08
SD	.09	.09	.10	.09	.10	.09	17	.00	.01
Recovery At The (1,1) Point									
M	.38	.66	1.06	.17	.02	.01	6	.11	.08
SD	.04	.06	.16	.03	.02	.01	1	.02	.01

Table 5 (Continued)
Means (M) And Standard Deviations (SD) For P2 Across Criterion Sessions

Experimental Point	Time/A	Time/A In The Five 3-sec Intervals Of T					Percent A For The Five 3-sec Intervals Of T				
		1	2	3	4	5	1	2	3	4	5
OL											
M	.3	-	-	.3	.1	.7	0	0	1	0	0
SD	-	-	-	-	-	-	0	0	1	0	0
(1,1)											
M	.3	.3	.3	.4	.4	.3	15	18	11	3	2
SD	0.0	0.0	0.0	.1	.1	.1	4	3	6	1	1
(.5,.5)											
M	.3	.2	.2	.3	.3	.3	17	22	18	10	11
SD	0.0	0.0	0.0	0.0	0.0	0.0	3	4	3	4	2
(.25,.25)											
M	.4	.3	.3	.3	.4	.4	19	27	23	20	16
SD	0.0	0.0	0.0	0.0	0.0	0.0	2	2	3	4	4
(.125,.125)											
M	.2	.2	.2	.2	.2	.2	6	6	5	5	4
SD	0.0	0.0	0.0	0.0	0.0	0.0	2	2	1	1	1
(.084,.084)											
M	.2	.2	.2	.2	.2	.2	9	10	8	7	7
SD	0.0	0.0	0.0	0.0	0.0	0.0	2	2	1	2	2
Recovery At The (1,1) Point											
M	.2	.3	.2	.2	.3	.4	32	10	1	1	1
SD	0.0	0.0	0.0	0.0	.1	.1	4	5	1	1	1

Table 6

Means (M) And Standard Deviations (SD) For P3 Across Criterion Sessions

Experimental Point	Rate	Rate In The Five 3-sec Intervals Of T					R_A/S^R	PS^RP/Mean IS^RT	Relative Time
		1	2	3	4	5			
OL									
M	.00	.00	.00	.00	.00	.00	-	-	.00
SD	.00	.00	.00	.01	.00	.00	-	-	.00
(1,1)									
M	.02	.01	.03	.02	.01	.00	0	.95	.01
SD	.01	.01	.02	.02	.01	.01	0	.03	.00
(.5,.5)									
M	.02	.01	.06	.01	.01	.01	1	.75	.01
SD	.01	.01	.02	.00	.00	.01	0	.06	.00
(.25,.25)									
M	.02	.03	.03	.01	.02	.02	1	.61	.01
SD	.01	.01	.01	.01	.01	.01	0	.07	.00
(.125,.125)									
M	.13	.13	.14	.14	.14	.13	17	.27	.05
SD	.10	.09	.10	.11	.10	.11	11	.11	.04
(.084,.084)									
M	.06	.05	.06	.06	.06	.05	11	.13	.02
SD	.02	.03	.03	.03	.02	.02	0	.02	.01
Recovery At The (1,1) Point									
M	.23	.35	.43	.32	.05	.00	3	.17	.14
SD	.01	.02	.07	.05	.02	.01	0	.02	.01

Table 6 (Continued)

Means (M) And Standard Deviations (SD) For P3 Across Criterion Sessions

Experimental Point	Time/A	Time/A In The Five 3-sec Intervals Of T					Percent A For The Five 3-sec Intervals Of T				
		1	2	3	4	5	1	2	3	4	5
OL											
M	.2	-	-	.6	-	-	0	0	0	0	0
SD	-	-	-	-	-	-	0	0	0	0	0
(1,1)											
M	.4	.5	.3	.4	.6	.3	1	0	1	1	1
SD	.1	.2	.2	.5	.3	0.0	0	0	0	0	0
(.5,.5)											
M	.5	.8	.5	.6	.6	.6	3	1	1	1	1
SD	.1	.3	.1	.3	.3	1.6	1	1	1	0	1
(.25,.25)											
M	.4	.4	.4	.4	.5	.3	2	1	0	1	1
SD	0.0	.1	.1	.1	.1	.1	1	3	4	3	1
(.125,.125)											
M	.4	.4	.4	.4	.3	.3	5	5	5	4	4
SD	0.0	0.0	.1	.1	0.0	0.0	4	3	4	3	3
(.084,.084)											
M	.4	.5	.4	.4	.4	.3	2	3	3	2	2
SD	.1	.2	.1	.1	0.0	.1	1	1	1	1	3
Recovery At The (1,1) Point											
M	.6	.6	.7	.6	.5	.6	15	24	15	1	0
SD	.1	.1	.2	.1	.2	.4	5	6	5	1	1

Table 7
Means (M) And Standard Deviations (SD) For P4 Across Criterion Sessions

Experimental Point	Rate	Rate In The Five 3-sec Intervals Of T					R_A/S^R	PS^RP/Mean IS^RT	Relative Time
		1	2	3	4	5			
OL									
M	.00	.01	.00	.01	.01	.00	-	-	.00
SD	.01	.01	.01	.02	.00	.00	-	-	.00
(1,1)									
M	.51	.87	1.00	.47	.15	.08	8	.08	.18
SD	.10	.03	.25	.19	.07	.05	2	.01	.02
(.5,.5)									
M	.32	.43	.58	.40	.13	.06	10	.04	.16
SD	.06	.07	.10	.07	.06	.04	2	.01	.02
(.25,.25)									
M	.76	.71	.95	.86	.66	.61	54	.02	.27
SD	.04	.06	.06	.05	.05	.04	8	.00	.02
(.125,.125)									
M	.64	.60	.68	.68	.63	.61	73	.02	.23
SD	.05	.04	.06	.06	.05	.05	9	.01	.03
(.084,.084)									
M	.66	.62	.68	.68	.67	.66	114	.02	.25
SD	.04	.04	.04	.03	.04	.03	20	.01	.02
Recovery At The (1,1) Point									
M	.58	.90	1.57	.41	.02	.01	9	.09	.22
SD	.07	.09	.24	.12	.01	.01	1	.02	.03

Table 7 (Continued)

Means (M) And Standard Deviations (SD) For P4 Across Criterion Sessions

Experimental Point	Time/A	Time/A In The Five 3-sec Intervals Of T					Percent A For The Five 3-sec Intervals Of T				
		1	2	3	4	5	1	2	3	4	5
OL											
M	.2	.2	-	.1	.3	-	1	0	1	0	0
SD	-	-	-	-	-	-	1	0	1	0	0
(1,1)											
M	.4	.5	.4	.2	.1	.1	55	32	2	2	1
SD	0.0	.1	.1	0.0	.1	.1	7	5	3	1	1
(.5,.5)											
M	.5	.6	.6	.4	.3	.3	32	25	11	2	3
SD	0.0	.1	.1	.1	0.0	.1	4	4	5	1	1
(.25,.25)											
M	.4	.4	.4	.4	.3	.3	30	34	25	18	22
SD	0.0	0.0	0.0	0.0	0.0	0.0	4	2	6	3	4
(.125,.125)											
M	.4	.4	.4	.4	.3	.3	23	27	24	20	19
SD	0.0	0.0	0.0	.1	0.0	0.0	4	3	4	4	5
(.084,.084)											
M	.4	.4	.4	.4	.4	.4	24	28	24	24	24
SD	0.0	0.0	0.0	.1	0.0	0.0	2	1	2	3	1
Recovery At The (1,1) Point											
M	.4	.6	.3	.3	.4	.5	67	34	3	0	0
SD	.1	.1	0.0	0.0	.1	.7	6	7	2	0	0

Table 8

Means (M) And Standard Deviations (SD) For P5 Across Criterion Sessions

Experimental Point	Rate	Rate In The Five 3-sec Intervals Of T 1	2	3	4	5	R_A/S^R	PS^RP/Mean IS^RT	Relative Time
OL									
M	.05	.04	.05	.05	.07	.07	-	-	.07
SD	.03	.03	.03	.11	.04	.04	-	-	.07
(1,1)									
M	.15	.16	.31	.16	.08	.03	2	.36	.07
SD	.03	.05	.08	.04	.03	.02	0	.03	.01
(.5,.5)									
M	.08	.08	.11	.09	.07	.08	3	.42	.09
SD	.03	.03	.03	.05	.02	.02	1	.13	.03
(.25,.25)									
M	.25	.23	.26	.26	.25	.24	15	.06	.35
SD	.03	.04	.03	.04	.06	.02	2	.01	.06
(.125,.125)									
M	.27	.25	.27	.28	.27	.27	32	.05	.28
SD	.07	.07	.07	.07	.06	.07	10	.02	.05
(084,.084)									
M	.25	.24	.25	.25	.25	.25	50	.05	.14
SD	.03	.03	.04	.03	.03	.03	13	.02	.02
Recovery At The (1,1) Point									
M	.11	.16	.22	.11	.05	.01	2	.50	.05
SD	.03	.05	.02	.05	.03	.02	0	.09	.02

Table 8 (Continued)
Means (M) And Standard Deviations (SD) For P5 Across Criterion Sessions

Experimental Point	Time/A	Time/A In The Five 3-sec Intervals Of T 1	2	3	4	5	Percent A For The Five 3-sec Intervals Of T 1	2	3	4	5
OL											
M	1.0	1.2	1.1	1.4	.7	.9	7	8	6	5	7
SD	-	-	-	-	-	-	6	8	4	7	7
(1,1)											
M	.5	.5	.6	.5	.4	.3	20	11	4	2	0
SD	.1	.1	.1	.1	.3	.2	7	4	3	2	1
(.5,.5)											
M	1.0	1.0	.8	1.1	1.2	1.2	11	10	9	10	11
SD	.1	.2	.1	.2	.4	.2	6	6	5	6	4
(.25,.25)											
M	1.4	1.4	1.4	1.3	1.5	1.5	30	36	34	39	40
SD	.3	.3	.4	.4	.3	.2	4	4	8	7	5
(.125,.125)											
M	1.1	1.1	1.0	1.1	1.1	1.1	27	26	28	29	30
SD	.1	.2	.1	.2	.1	.2	3	7	5	5	6
(.084,.084)											
M	.5	.6	.6	.5	.5	.6	12	13	14	13	14
SD	.1	.1	.1	.1	.1	.1	3	3	3	2	2
Recovery At The (1,1) Point											
M	.4	.4	.4	.5	.4	.7	10	6	5	3	1
SD	.1	.1	.1	.2	.2	.4	4	4	5	1	1

Appendix B

Data From Exp. II

(See Results And Discussion section of Exp. I for a description of the measures and the degree of accuracy of each measure. Data which refer to more than one session were pooled over criterion sessions and means were computed. Standard deviations were computed from the data collected in each criterion session to give an indication of day to day variability.)

Table 9
Data For P4

First Extinction Period

Session	Rate	Rate In The Five 3-sec Intervals Of T				
		1	2	3	4	5
1	.61	.58	.63	.62	.63	.59
2	.55	.52	.58	.53	.57	.54
3	.46	.42	.46	.49	.48	.43
4	.24	.28	.21	.24	.24	.21
5	.24	.23	.25	.26	.23	.23
6	.06	.06	.07	.06	.06	.06
7	.06	.07	.04	.06	.07	.06
8	.05	.04	.05	.06	.06	.04
9	.11	.08	.15	.08	.11	.12
10	.03	.03	.02	.04	.04	.04
11	.06	.06	.06	.05	.08	.07

Time/A over the first five extinction sessions had a mean of .5 sec and a standard deviation of .1 sec.

Table 10
Data For P4

First Reconditioning Period

Daily Data

Session	Rate	Rate In The Five 3-sec Intervals Of T 1	2	3	4	5
1	.60	.89	1.21	.53	.23	.13
2	.39	.80	.84	.23	.06	.03
3	.51	.91	1.23	.31	.05	.03
4	.45	.79	1.23	.17	.02	.02
5	.39	.71	.81	.33	.05	.03

Data Computed Over The Five Reconditioning Sessions
(means are presented in the first row; standard deviations are presented in the second row)

Rate	R_A/S^R	PS^RP/Mean IS^RT	Relative Time	Time/A	%A At The End Of T
.47	7	.08	.23	.5	2
.08	1	.02	.03	0.0	2

Table 11
Data For P4

Second Extinction Period

Session	Rate	Rate In The Five 3-sec Intervals Of T				
		1	2	3	4	5
1	.12	.10	.11	.16	.13	.11
2	.21	.18	.16	.28	.22	.22
3	.31	.28	.33	.31	.29	.33
4	.11	.14	.14	.11	.08	.09
5	.25	.26	.24	.28	.25	.23
6	.07	.07	.08	.06	.07	.06
7	.15	.16	.15	.16	.11	.15
8	.06	.07	.05	.04	.04	.08
9	.03	.05	.03	.03	.03	.03
10	.14	.14	.12	.10	.18	.14
11	.07	.08	.07	.05	.06	.09

Time/A over the first five extinction sessions had a mean of .7 sec and a standard deviation of .1 sec.

Table 12
Data For P4

Second Reconditioning Period

Daily Data

Session	Rate	Rate In The Five 3-sec Intervals Of T				
		1	2	3	4	5
1	.61	.97	1.37	.48	.11	.09
2	.55	.99	1.17	.44	.08	.04
3	.62	1.07	1.49	.42	.04	.04
4	.46	1.06	1.24	.12	.02	.01
5	.48	1.06	1.04	.24	.04	.01

Data Computed Over The Five Reconditioning Sessions

(means are presented in the first row; standard deviations are presented in the second row)

Rate	R_A/S^R	PS^RP/Mean IS^RT	Relative Time	Time/A	%A At The End Of T
.55	8	.03	.25	.5	3
.06	1	.01	.01	0.0	2

Table 13
Data For P4

Third Extinction Period

		Rate In The Five 3-sec Intervals Of T				
Session	Rate	1	2	3	4	5
1	.17	.17	.18	.15	.16	.18
2	.12	.11	.10	.09	.16	.14
3	.20	.18	.19	.18	.22	.20
4	.08	.07	.09	.09	.06	.09
5	.07	.08	.07	.06	.08	.06
6	.05	.05	.05	.04	.06	.06
7	.06	.04	.06	.07	.08	.04
8	.09	.10	.10	.10	.07	.07
9	.07	.04	.06	.09	.06	.07
10	.10	.12	.09	.09	.09	.10
11	.07	.06	.06	.09	.07	.07

Time/A over the first five extinction sessions had a mean of .7 sec and a standard deviation of .1 sec.

Table 14
Data For P4

Third Reconditioning Period

Daily Data

Session	Rate	Rate In The Five 3-sec Intervals Of T 1	2	3	4	5
1	.40	.97	.79	.21	.02	.03
2	.41	.98	.83	.19	.04	.02
3	.54	1.07	1.26	.34	.02	.01
4	.50	.84	1.03	.51	.04	.04
5	.60	.95	1.39	.56	.07	.01

Data Computed Over The Five Reconditioning Sessions
(means are presented in the first row; standard deviations are presented in the second row)

Rate	R_A/S^R	PS^RP/Mean IS^RT	Relative Time	Time/A	%A At The End Of T
.49	7	.05	.22	.5	0
.08	1	.01	.01	0.0	1

Table 15
Data For P4

Fourth Extinction Period

Session	Rate	Rate In The Five 3-sec Intervals Of T				
		1	2	3	4	5
1	.20	.22	.19	.19	.19	.20
2	.23	.25	.26	.21	.22	.23
3	.19	.18	.16	.21	.20	.18
4	.22	.20	.21	.23	.21	.22
5	.15	.13	.14	.18	.15	.16
6	.27	.27	.24	.26	.30	.29
7	.04	.05	.03	.04	.03	.04
8	.10	.13	.12	.08	.08	.07
9	.07	.05	.09	.09	.10	.04
10	.10	.09	.10	.12	.11	.08
11	.05	.04	.02	.06	.08	.05

Time/A over the first five extinction sessions had a mean of .8 sec and a standard deviation of .1 sec.

Table 16
Data For P4

Fourth Reconditioning Period

Daily Data

Session	Rate	Rate In The Five 3-sec Intervals Of T				
		1	2	3	4	5
1	.43	.93	.89	.28	.03	.03
2	.42	.89	1.04	.14	.02	.02
3	.38	.73	.99	.16	.02	.02
4	.52	.71	1.43	.39	.05	.02
5	.46	.73	1.18	.32	.03	.01

Data Computed Over The Five Reconditioning Sessions
(means are presented in the first row; standard deviations are presented in the second row)

Rate	R_A/S^R	PS^RP/Mean IS^RT	Relative Time	Time/A	%A At The End Of T
.44	7	.08	.21	.5	0
.05	1	.01	.02	.1	1

Table 17
Data For P4

Fifth Extinction Period

Session	Rate	Rate In The Five 3-sec Intervals Of T				
		1	2	3	4	5
1	.10	.11	.13	.11	.08	.09
2	.09	.08	.09	.09	.07	.08
3	.18	.20	.18	.16	.16	.20
4	.04	.03	.03	.06	.06	.05
5	.15	*	*	*	*	*
6	.17	.19	.14	.19	.16	.18
7	.05	.06	.09	.03	.04	.05
8	.17	.19	.14	.18	.13	.20
9	.14	.16	.13	.16	.11	.13
10	.10	.09	.13	.07	.13	.08
11	.22	.21	.24	.19	.23	.22

Time/A over the first five extinction sessions had a **mean of** .8 sec and a standard deviation of .1 sec.

*Indicates data which were lost due to an apparatus failure.

Table 18
Data For P4

Fifth Reconditioning Period

Daily Data

Session	Rate	Rate In The Five 3-sec Intervals Of T 1	2	3	4	5
1	.36	.71	.80	.21	.07	.02
2	.32	.64	.81	.13	.03	.01
3	.39	.69	.92	.28	.04	.01
4	.44	.56	1.16	.42	.03	.01
5	.43	.57	1.24	.32	.02	.00

Data Computed Over The Five Reconditioning Sessions
(means are presented in the first row; standard deviations are presented in the second row)

Rate	R_A/S^R	PS^RP/Mean IS^RT	Relative Time	Time/A	%A At The End Of T
.39	6	.10	.23	.6	0
.04	1	.02	.03	0.0	1

Table 19
Data For P5

First Extinction Period

Session	Rate	Rate In The Five 3-sec Intervals Of T 1	2	3	4	5
1	.12	.11	.11	.16	.12	.12
2	.15	.17	.14	.14	.16	.14
3	.07	.09	.06	.08	.06	.04
4	.09	.10	.08	.08	.10	.10
5	.08	.08	.10	.07	.10	.08
6	.03	.01	.02	.05	.03	.02
7	.06	.08	.06	.05	.06	.04
8	.06	.06	.08	.06	.06	.06
9	.04	.05	.03	.05	.03	.02
10	.02	.02	.02	.01	.01	.02
11	.01	.01	.01	.01	.01	.01

Time/A over the first five extinction sessions had a mean of 1.1 sec and a standard deviation of .2 sec.

Table 20
Data For P5

First Reconditioning Period

Daily Data

Session	Rate	Rate In The Five 3-sec Intervals Of T 1	2	3	4	5
1	.14	.25	.29	.12	.03	.01
2	.10	.13	.26	.11	.02	.00
3	.17	.23	.32	.22	.08	.01
4	.19	.29	.36	.24	.06	.02
5	.15	.26	.24	.13	.09	.02

Data Computed Over The Five Reconditioning Sessions
(means are pesented in the first row; standard deviations are presented in the second row)

Rate	R_A/S^R	PS^RP/Mean IS^RT	Relative Time	Time/A	%A At The End Of T
.15	2	.28	.09	.6	1
.03	0	.07	.01	.1	1

Table 21
Data For P5

Second Extinction Period

Session	Rate	Rate In The Five 3-sec Intervals Of T 1	2	3	4	5
1	.03	.02	.01	.02	.03	.08
2	.01	.02	.01	.00	.01	.01
3	.01	.01	.01	.01	.01	.01
4	.00	.00	.00	.01	.00	.00
5	.03	.02	.03	.03	.03	.04
6	.04	.04	.05	.04	.04	.03
7	.03	.04	.03	.02	.03	.04
8	.00	.01	.00	.00	.00	.00
9	.02	.02	.01	.03	.02	.02
10	.05	.05	.04	.06	.06	.03
11	.00	.00	.00	.00	.01	.00

Time/A over the first five extinction sessions had a mean of 1.0 sec and a standard deviation of .5 sec.

Table 22
Data For P5

Second reconditioning Period

Daily Data

Session	Rate	Rate In The Five 3-sec Intervals Of T 1	2	3	4	5
1	.22	.39	.36	.20	.12	.02
2	.21	.46	.33	.21	.06	.00
3	.26	.52	.39	.27	.08	.03
4	.21	.43	.37	.15	.07	.03
5	.20	.44	.29	.19	.05	.02

Data Computed Over The Five Reconditioning Sessions
(means are presented in the first row; standard deviations are presented in the second row)

Rate	R_A/S^R	PS^RP/Mean IS^RT	Relative Time	Time/A	%A At The End Of T
.22	3	.20	.12	.6	1
.02	0	.04	.01	0.0	1

Table 23
Data For P5

Third Extinction Period

Session	Rate	Rate In The Five 3-sec Intervals Of T				
		1	2	3	4	5
1	.00	.00	.00	.00	.00	.00
2	.00	.00	.00	.00	.00	.00
3	.01	.02	.01	.01	.01	.01
4	.00	.00	.00	.00	.00	.00
5	.00	.00	.00	.00	.00	.00
6	.00	.00	.00	.00	.00	.00
7	.00	.00	.00	.00	.00	.00
8	.01	.02	.02	.00	.01	.00
9	.01	.02	.01	.00	.00	.02
10	.00	.00	.00	.00	.00	.00
11	.01	.01	.00	.00	.01	.00

Time/A over the first five extinction sessions had a mean of .4 sec and a standard deviation of .2 sec.

Table 24
Data For P5

Third Reconditioning Period

Daily Data

Session	Rate	Rate In The Five 3-sec Intervals Of T				
		1	2	3	4	5
1	.12	.28	.21	.05	.03	.05
2	.18	.27	.34	.24	.03	.01
3	.18	.36	.30	.15	.08	.01
4	.15	.31	.27	.09	.06	.02
5	.14	.28	.27	.14	.03	.00

Data Computed Over The Five Reconditioning Sessions
(means are presented in the first row; standard deviations are presented in the second row)

Rate	R_A/S^R	PS^RP/Mean IS^RT	Relative Time	Time/A	%A At The End Of T
.15	2	.34	.09	.6	1
.02	0	.04	.02	.2	1

Table 25
Data For P5

Fourth Extinction Period

Session	Rate	Rate In The Five 3-sec Intervals Of T				
		1	2	3	4	5
1	.00	.00	.00	.00	.01	.00
2	.00	.00	.00	.00	.00	.00
3	.02	.03	.02	.01	.01	.02
4	.01	.01	.00	.02	.00	.00
5	.01	.01	.00	.02	.00	.01
6	.03	.03	.01	.03	.04	.03
7	.02	.00	.01	.01	.03	.02
8	.00	.00	.00	.01	.01	.01
9	.01	.01	.00	.01	.01	.03
10	.02	.01	.02	.01	.02	.02
11	.03	.04	.05	.05	.02	.01

Time/A over the first five extinction sessions had a mean of .6 sec and a standard deviation of .1 sec.

Table 26
Data For P5

Fourth Reconditioning Period

Daily Data

Session	Rate	Rate In the Five 3-sec Intervals Of T				
		1	2	3	4	5
1	.14	.42	.23	.06	.01	.00
2	.18	.48	.26	.12	.02	.00
3	.22	.54	.37	.14	.04	.01
4	.19	.41	.36	.17	.01	.00
5	.14	.32	.26	.12	.02	.00

Data Computed Over The Five Reconditioning Sessions
(means are presented in the first row; standard deviations are presented in the second row)

Rate	R_A/S^R	PS^RP/Mean IS^RT	Relative Time	Time/A	%A At The End of T
.17	3	.22	.09	.5	0
.03	0	.04	.01	.1	0

Table 27
Data For P5

Fifth Extinction Period

Session	Rate	Rate In The Five 3-sec intervals Of T				
		1	2	3	4	5
1	.05	.04	.02	.04	.06	.08
2	.01	.01	.02	.02	.00	.02
3	.01	.01	.01	.01	.01	.01
4	.00	.00	.00	.00	.00	.00
5	.01	.00	.01	.02	.02	.01
6	.00	.00	.01	.01	.00	.00
7	.00	.00	.00	.00	.00	.00
8	.00	.00	.00	.00	.00	.00
9	.01	.01	.01	.02	.00	.01
10	.01	.00	.00	.00	.00	.02
11	.02	.01	.02	.01	.01	.03

Time/A over the first five extinction sessions had a mean of .8 sec and a standard deviation of .3 sec.

Table 28
Data For P5

Fifth Reconditioning Period

Daily Data

Session	Rate	Rate In The Five 3-sec Intervals Of T 1	2	3	4	5
1	.18	.22	.14	.07	.03	.01
2	.14	.16	.11	.06	.01	.01
3	.15	.36	.27	.09	.02	.00
4	.14	.33	.21	.14	.04	.00
5	.10	.21	.17	.10	.03	.00

Data Computed Over The Five Reconditioning Sessions
(means are presented in the first row; standard deviations are presented in the second row)

Rate	R_A/S^R	PS^RP/Mean IS^RT	Relative Time	Time/A	%A At The End Of T
.14	2	.30	.07	.5	1
.03	0	.13	.02	.1	1

Appendix C

Data From Exp. III

(See Results And Discussion section of Exp. I for a description of the measures and the degree of accuracy of each measure. Data were pooled over criterion sessions and means were computed. Standard deviations were computed from the data collected in each criterion session to give an indication of day to day variability.)

Table 29
Means (M) And Standard Deviations (SD) For P1 Across Criterion Sessions

Experimental Point	Rate	Rate In The Five 3-sec Intervals Of T 1	2	3	4	5	R_A/S^R	PS^RP/Mean IS^RT	Relative Time
(1,.5)									
M	.22	.32	.19	.22	.19	.11	6	.08	.15
SD	.08	.06	.06	.09	.19	.09	2	.03	.02
(1,.25)									
M	.23	.35	.27	.20	.18	.16	7	.04	.36
SD	.05	.04	.08	.08	.08	.08	2	.02	.06
(1,.125)									
M	.17	.35	.15	.15	.12	.09	4	.05	.54
SD	.06	.09	.06	.11	.09	.09	2	.02	.21
(1,0)									
M	.05	.12	.04	.02	.02	.02	4	.03	.18
SD	.05	.18	.05	.08	.06	.02	2	.01	.29
Recovery At The (1,1) Point									
M	.25	.44	.22	.24	.20	.16	4	.07	.43
SD	.12	.06	.09	.17	.15	.13	2	.02	.10

Table 29 (Continued)

Means (M) And Standard Deviations (SD) For P1 Across Criterion Sessions

Experimental Point	Time/A	Time/A In The Five 3-sec Intervals Of T					Percent A For The Five 3-sec Intervals Of T				
		1	2	3	4	5	1	2	3	4	5
(1,.5)											
M	.8	1.0	.7	.8	.8	.7	17	14	19	18	20
SD	.2	.4	.2	.7	.6	.1	2	4	5	6	4
(1,.25)											
M	1.5	2.6	1.1	1.4	1.3	.8	36	36	39	40	38
SD	.5	.8	.6	.8	.1	.1	9	6	5	10	10
(1,.125)											
M	3.4	4.9	2.1	2.7	1.6	.9	57	52	54	61	61
SD	1.9	2.3	1.5	1.6	.8	.8	21	21	23	21	24
(1,0)											
M	3.9	5.3	3.1	1.8	3.1	.4	19	21	18	19	19
SD	2.8	2.2	2.4	.6	2.5	.2	32	31	30	32	32
Recovery At The (1,1) Point											
M	1.7	2.5	1.4	1.5	1.5	.9	39	36	39	49	54
SD	1.3	1.7	1.2	1.6	1.2	.2	11	13	10	15	15

Table 30

Means (M) And Standard Deviations (SD) For P2 Across Criterion SEssions

Experimental Point	Rate	Rate In The Five 3-sec Intervals Of T					R_A/S^R	PS^RP/Mean IS^RT	Relative Time
		1	2	3	4	5			
(1,.5)									
M	.24	.29	.41	.28	.12	.10	7	.10	.06
SD	.06	.06	.15	.10	.02	.03	1	.04	.01
(1,.25)									
M	.19	.25	.22	,21	.13	.14	9	.06	.09
SD	.04	.04	.07	.05	.03	.03	2	.02	.02
(1,.125)									
M	.36	.38	.40	.37	.34	.30	17	.03	.17
SD	.04	.04	.05	.06	.07	.03	2	.01	.03
(1,0)									
M	.65	.66	.75	.64	.56	.63	14	.05	.54
SD	.03	.04	.04	.03	.04	.08	1	.01	.02
Recovery At The (1,1) Point									
M	.50	.60	1.00	.70	.17	.04	8	.09	.22
SD	.04	.07	.02	.15	.09	.02	1	.01	.02

Table 30 (Continued)

Means (M) And Standard Deviations (SD) For P2 Across Criterion Sessions

Experimental Point	Time/A	Time/A In The Five 3-sec Intervals Of T 1	2	3	4	5	Percent A For The Five 3-sec Intervals Of T 1	2	3	4	5
(1,.5)											
M	.3	.3	.2	.2	.3	.2	14	8	6	3	3
SD	.1	.1	.1	.2	.1	.1	4	4	2	2	2
(1,.25)											
M	.5	.4	.5	.5	.6	.3	11	12	9	7	6
SD	.1	.1	.1	.2	.2	.1	1	3	3	3	4
(1,.125)											
M	.5	.5	.5	.5	.6	.4	18	18	16	23	19
SD	.1	.1	.1	0.0	.1	.1	7	5	4	8	3
(1,0)											
M	.8	.7	.8	1.0	1.1	.7	40	55	62	63	67
SD	0.0	.1	.1	.1	.1	0.0	3	4	7	7	2
Recovery At The (1,1) Point											
M	.4	.4	.5	.4	.3	.3	44	48	10	2	1
SD	0.0	0.0	0.0	.1	.1	.1	8	5	5	2	1

Table 31

Means (M) And Standard Deviations (SD) For P3 Across Criterion Sessions

Experimental Point	Rate	Rate In The Five 3-sec Intervals Of T 1	2	3	4	5	R_A/S^R	PS^RP/Mean IS^RT	Relative Time
(1,.5)									
M	.29	.21	.32	.34	.29	.30	8	.25	.14
SD	.11	.05	.14	.15	.12	.15	3	.08	.06
(1,.25)									
M	.57	.41	.59	.62	.62	.61	15	.13	.36
SD	.05	.05	.05	.09	.07	.07	2	.04	.04
(1,.125)									
M	.48	.44	.56	.58	.39	.40	10	.12	.57
SD	.03	.04	.05	.04	.06	.02	1	.03	.04
(1,0)									
M	.46	.41	.53	.50	.39	.48	11	.11	.56
SD	.07	.04	.06	.09	.13	.08	2	.02	.03
Recovery At The (1,1) Point									
M	.45	.45	.60	.44	.43	.32	7	.10	.36
SD	.08	.05	.10	.11	.11	.12	1	.01	.07

Table 31 (Continued)
Means (M) And Standard Deviations (SD) For P3 Across Criterion Sessions

Experimental Point	Time/A	Time/A In The Five 3-sec Intervals Of T					Percent A For The Five 3-sec Intervals Of T				
		1	2	3	4	5	1	2	3	4	5
(1,.5)											
M	.5	.5	.5	.6	.5	.4	11	19	18	12	18
SD	.1	.1	.1	.1	.1	0.0	5	14	10	6	8
(1,.25)											
M	.6	.5	.5	.8	.8	.5	27	35	47	46	39
SD	.1	.1	.1	.1	.2	.1	3	3	9	10	6
(1,.125)											
M	1.2	.8	1.2	1.4	1.8	.8	37	56	70	78	65
SD	.1	.1	.1	.1	.2	.1	13	6	7	5	4
(1,0)											
M	1.2	.9	1.4	1.6	1.4	.8	35	59	73	73	62
SD	.2	.6	.4	.4	.2	.1	8	10	7	3	4
Recovery At The (1,1) Point											
M	.8	.9	1.0	.9	.6	.4	36	50	44	26	12
SD	.1	.1	.3	.2	.1	0.0	10	16	17	12	7

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