SENSITIVITY OF TIME ALLOCATION TO CONCURRENT-SCHEDULE REINFORCEMENT

MATTHEW ALDISS AND MICHAEL DAVISON

UNIVERSITY OF AUCKLAND, NEW ZEALAND

Four pigeons were trained on concurrent variable-interval schedules programmed on a center response key, with access to those schedules controlled by responses on left or right side keys. Two procedures were used. In one, the pigeon was given limited access, in that each side-key response produced 3-s access to a center-key schedule, and in the other procedure, access was unlimited. Data were analyzed using the generalized matching law. Comparison of sensitivities to reinforcement of interchangeover time for both procedures showed them to be of similar magnitude. Response sensitivities were also similar in magnitude for both procedures. From the limited-access procedure a second time measure that was available, switched-in time, was relatively uncontaminated by time spent emitting behavior other than key pecking. Sensitivities to reinforcement for the switched-in time measure were always smaller than interchangeover-time sensitivities for either procedure, and were approximately equal to response sensitivities for the limited-access procedure. Two other access times (5 and 7.5 s) were studied to validate the choice of 3 s as the main access time. These results indicate that when time spent emitting other behavior is excluded from interchangeover time, time and response sensitivities will be approximately equal.

Key words: concurrent schedules, time allocation, response allocation, generalized matching law, sensitivity to reinforcement, key peck, pigeons

In concurrent schedules the subject is presented with a choice between two or more simultaneously available schedules of reinforcement (Findley, 1958; Herrnstein, 1961). Ratios of times allocated by the subject between the alternatives are power functions of the ratio of reinforcements obtained at each alternative (Baum, 1974, 1979; Baum & Rachlin, 1969). This relation is known as the generalized matching law and in logarithmic terms is:

$$\log (T_g/T_r) = a_T \log (R_g/R_r) = \log b_T. \quad (1)$$

In Equation 1, T_g and T_r are times allocated between alternatives identified with green and red discriminative stimuli and R_g and R_r are obtained reinforcers. The parameter $\log b_T$ is a

measure of inherent bias towards one or other response alternative caused by constant factors in the experimental situation, and the parameter a_T describes the sensitivity of the time ratio to changes in the reinforcer ratio. A similar relation describes the response ratio (P_g/P_r) to the reinforcer ratio, as given in Equation 2:

$$\log (P_g/P_r) = a_p \log (R_g/R_r) = \log b_p. \quad (2)$$

Typical values for response sensitivities (a_p) in concurrent variable-interval (VI VI) schedules are about 0.8 (Baum, 1979; Davison & Hunter, 1976; Lobb & Davison, 1975; Myers & Myers, 1977; Trevett, Davison, & Williams, 1972), whereas time sensitivities (a_T) are much closer to 1.0 (Baum, 1979; Baum & Rachlin, 1969; Brownstein & Pliskoff, 1968; Davison & Hunter, 1976; Trevett, Davison, & Williams, 1972).

In concurrent schedules, measures of T_g and T_r are usually obtained by recording interchangeover times (Silberberg & Fantino, 1970; Tustin & Davison, 1979), in which case the sum of T_g and T_r equals total session duration. However, if we admit Herrnstein's (1970,

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1974) assumption that some time (T_o) is also spent emitting some other, undefined, behavior (P_o) in the experimental situation, the total session time should equal $T'_g + T'_r + T_o$, where T'_g and T'_r are times allocated to responding during the green and red alternatives ("switched-in" time), excluding other behavior. The traditional interchangeover-time measure of time allocation, T_g and T_r , therefore includes T_o . In the present study we asked whether values for sensitivity to reinforcement differed from those based on traditional time measures (T_g/T_r) if time allocated to other types of behavior was extracted to give measures of T'_g and T'_r . That is, assuming that ratios of switched-in time are also predicted by the generalized matching law, does a_T in Equation 1 differ from a'_T in Equation 3,

$$\log (T'_g/T'_r) = a'_T \log (R_g/R_r) + \log b'_T. \quad (3)$$

To resolve this question we needed a procedure that allowed differentiation of T_o from time allocated to responding T'_g and T'_r . This was achieved through a procedure in which the subject had limited access for fixed durations to the two current VI VI schedules, via two switching-key responses.

The concurrent procedure used here was a modification of Findley's (1958) changeover-key procedure. Green or red stimuli on a center key, and their correlated VI schedules, could be alternated by side-key switching responses, with left responses producing green and right responses producing red. In the limited-access version of this procedure, left or right switching responses produced a center-key stimulus for only 3 s. Center-key responses were effective only during the 3-s access times although the VI schedules ran throughout the sessions, as in the standard concurrent VI VI procedure. Measures of T'_g and T'_r were thus obtained by cumulating 3-s access times over a session. That is, switched-in time consisted of the times when the center key was lit. We compared sensitivities for time allocation based on the access-time measures to those based on interchangeover-time measures for both limited-access and unlimited-access concurrent procedures.

METHOD

Subjects

Four homing pigeons, numbered 181, 183, 185, and 186, were maintained at $85\% \pm 15$ g of their free-feeding body weights. They had previously served in concurrent-chains procedures and so required no preliminary training.

Apparatus

The sound-attenuating experimental chamber, in which extraneous noise was masked by an exhaust fan, was situated remotely from solid-state control equipment. The internal dimensions of the chamber were 33 cm high, 33 cm deep, and 31 cm wide. It contained three response keys, 2 cm in diameter, 11.5 cm apart, and 25 cm from the grid floor. These keys could be operated by pecks exceeding about 0.1 N and could be lit green or red. Beneath the center key and about 10 cm from the floor was a food magazine that provided access to wheat. When the magazine was operated, the grain was illuminated and the keylights were extinguished. There was no other illumination in the chamber.

Procedure

The sequence of conditions in the main experiment is shown in Table 1. The limited-access procedure was used (with a 3-s access time) in Conditions 1 to 5 and the unlimited-access procedure in Conditions 6 to 10. Subsequently, 13 further conditions were run, with limited-access times of 5 and 7.5 s. Details of these conditions are given in the Appendix. In the limited-access procedure, the session commenced with the left key lit green and the right key lit red. A single peck on either side key turned off both side keys, turned on the center key, and started a changeover delay of 1.4 s. Every access period began with a changeover delay. The center key was illuminated green after a left (green) side-key peck, or red after a right (red) side-key peck, and each of these two center-key colors signaled access to a different, independent, concurrently arranged VI schedule (Table 1). The center key remained on for a fixed period of time ("access time" in Table

Table 1

Main sequence of experimental conditions, arranged VI schedules, access durations, and number of sessions for each condition. VI schedules and access times are in seconds.

Condition	Green	Red	Sessions
<i>3-s access time</i>			
1	VI 60	VI 60	26
2	VI 300	VI 32	28
3	VI 32	VI 150	21
4	VI 150	VI 32	20
5	VI 32	VI 300	18
<i>Unlimited access time</i>			
6	VI 60	VI 60	17
7	VI 150	VI 32	25
8	VI 32	VI 300	15
9	VI 300	VI 32	14
10	VI 32	VI 150	19

1), and during this time, but after the changeover delay had elapsed, responses on the center key could produce reinforcers (2.7-s access to wheat). At the end of the access time, the center keylight extinguished and the side keys were reilluminated. The two concurrent VI schedules ran throughout the session—that is, during both side-key and center-key phases.

The unlimited-access procedure allowed subjects to switch into the alternative concurrent schedule at any time. Sessions commenced in the same way as above, but one of the center-key stimuli was also presented. At any time, pecks on the green left key produced the green center-key conditions and pecks on the red right key produced the red center-key conditions. In addition, left and right keys remained illuminated green and red throughout the session except during reinforcement. If, for example, the center key was green and the green side key was pecked, no change in the center-key color occurred. However, all side-key pecks, whether effective or ineffective, started a 1.4-s changeover delay. Center-key responses could produce 2.7-s reinforcers only after the 1.4-s changeover delay had elapsed. There was no limit on access time to either center-key stimuli and schedules.

In both procedures, responses on unilluminated keys had no consequences and were not counted. Sessions ended in blackout when 50 reinforcers for the limited-access or 40 rein-

forcers for the unlimited-access procedure had been obtained. The VI schedules consisted of an irregular order of the first 12 terms of an arithmetic progression in which the smallest interval was one twelfth of the mean interval. For all conditions, totals of approximately two reinforcers per minute were arranged; the distribution of these reinforcers between the two center-key colors was varied between conditions. The combinations of schedules were chosen so that in each condition there was a predetermined proportionality between the arranged reinforcement rates of 10:1, 5:1, or 1:1 (Table 1). Conditions were changed for all subjects when each subject had reached a stability criterion five, not necessarily consecutive, times. The criterion required that the median relative number of responses on the two center-key colors over five sessions was less than .05 different from the median of the five immediately preceding sessions. Stability could therefore be achieved only after a minimum of 14 sessions. Experimental sessions were conducted at about the same time each day. After a session, the birds were returned to their home cages where water and grit were always available, and they were fed sufficient mixed grain to maintain their designated body weights.

The data collected were: (1) the numbers of responses (P) emitted on both the green (P_g) and red (P_r) center keys; (2) the numbers of food reinforcers (R) obtained on both the green (R_g) and the red (R_r) center keys; (3) the cumulative interchangeover time—that is, the time between the first peck on one side key to the first peck on the other side key (T_g and T_r). In the limited-access procedure, we also measured the cumulative amount of time spent switched into either the green or red schedules (T'_g and T'_r). The difference between total interchangeover time ($T_g + T_r$) and switched-in time ($T'_r + T'_g$) was due to time while the center key was unlit. That is, the sum of T_g and T_r equaled the sum of the times when the center key was lit *plus* the time when the center key was unlit. T'_g and T'_r consisted of only the times when the center key was lit. Reinforcement time was not included in any of the time measures.

Table 2

Numbers of responses emitted on the two center-key schedules, conventionally measured minutes allocated to the two schedules, minutes spent switched into these schedules, and numbers of reinforcements obtained on the two schedules as well as number of switches for the unlimited-access procedure. The data were averaged over the last five sessions of each of the first 10 experimental conditions.

Condition	Responses		Minutes Allocated		Minutes Switched-In		Reinforcements		Switches
	Green	Red	Green	Red	Green	Red	Green	Red	
Bird 181									
1	640	484	15.09	11.87	11.30	9.47	25.2	24.8	-
2	967	257	20.54	4.84	15.75	4.31	45.2	4.8	-
3	151	792	6.27	17.01	5.17	12.05	8.4	41.8	-
4	854	154	18.89	4.51	15.33	4.08	41.6	8.4	-
5	169	1059	5.34	19.55	4.59	13.12	4.8	45.2	-
6	605	523	9.18	9.97	-	-	19.6	20.4	162
7	170	678	2.31	13.26	-	-	6.8	33.2	74
8	892	115	15.17	2.15	-	-	36.4	3.6	72
9	124	772	1.55	15.74	-	-	3.4	36.6	57
10	810	139	12.79	3.08	-	-	33.0	7.0	94
Bird 183									
1	837	827	12.45	13.46	10.65	11.67	24.8	25.2	-
2	1632	120	21.26	3.29	15.58	2.80	44.8	5.2	-
3	303	1445	5.56	17.38	4.43	13.57	8.8	41.2	-
4	1339	367	15.80	7.16	13.43	6.53	41.0	9.0	-
5	169	1935	3.27	17.67	2.60	16.28	4.2	45.8	-
6	958	644	10.21	9.61	-	-	20.2	19.8	260
7	234	781	3.30	13.29	-	-	6.4	33.6	100
8	996	146	15.66	2.06	-	-	36.4	3.6	79
9	157	1268	2.74	14.59	-	-	3.6	36.4	77
10	958	184	13.00	3.03	-	-	33.4	6.6	102
Bird 185									
1	523	462	13.65	12.67	10.40	9.94	25.2	24.8	-
2	992	199	20.71	4.94	12.73	3.97	44.6	5.4	-
3	268	783	5.62	17.18	4.68	12.13	9.2	40.8	-
4	766	373	15.40	8.15	10.83	6.96	40.2	9.8	-
5	226	929	5.96	18.95	4.98	13.46	4.8	45.2	-
6	612	484	11.03	8.95	-	-	19.6	20.4	195
7	168	602	3.39	12.76	-	-	6.8	33.2	83
8	715	97	16.39	1.58	-	-	36.8	3.2	47
9	138	774	3.13	14.46	-	-	3.8	36.2	72
10	661	216	13.15	3.47	-	-	33.6	6.4	90
Bird 186									
1	963	898	13.56	11.79	11.15	9.89	25.2	24.8	-
2	1716	324	20.98	4.19	17.07	3.65	45.0	5.0	-
3	536	1039	7.66	15.32	6.81	12.66	9.2	40.8	-
4	1314	430	16.02	5.64	13.30	5.64	41.0	9.0	-
5	444	1273	6.02	18.90	5.25	15.27	5.0	45.0	-
6	940	927	10.45	9.63	-	-	20.4	19.6	321
7	218	795	2.57	13.98	-	-	5.8	34.2	91
8	917	308	14.51	3.66	-	-	36.6	3.4	125
9	162	875	1.98	15.70	-	-	3.2	36.8	66
10	810	467	11.91	4.60	-	-	33.6	6.4	152

RESULTS AND DISCUSSION

Means of responses and reinforcers for the

last five sessions of each condition are given in Table 2. These data were used in the quantitative analysis of time- and response-allocation

Fig. 1. Results obtained with limited-access procedure: the logarithm of the ratio of responses, $\log_{10} (P_s/P_r)$, cumulative interchangeover time, $\log_{10} (T_s/T_r)$, and time switched-in, $\log_{10} (T'_s/T'_r)$, as a function of the logarithm of the ratio of obtained reinforcers, $\log_{10} (R_s/R_r)$. The bird numbers and equations of the best-fitting straight lines are shown, together with estimates of the variance accounted for.

matching. Least-squares linear regression analyses on log ratios were carried out for both the limited-access and unlimited-access procedures to find the values of a_T and a'_T in Equations 1 and 3. All logarithms were taken to the base 10.

The results of the analyses for the limited-access procedure are shown in Figure 1. This figure shows the log ratios of responses, $\log (P_s/P_r)$, total time, $\log (T_s/T_r)$, and switched-in time, $\log (T'_s/T'_r)$, plotted against the log ratio of obtained reinforcers $\log (R_s/R_r)$. The equations of the best fitting straight lines are shown in Figure 1, together with estimates of the variance accounted for (VAC). The slopes of the lines quantify the sensitivity of time or response ratios to changes in the reinforcement ratio, and the constant measures a constant bias towards one of the two alternatives across all conditions. Figure 1 shows that the magnitudes of the response-allocation sensitivities (a_P) were similar to those previously found for other

Fig. 2. Results obtained with unlimited-access procedure: the logarithm of the ratio of responses, $\log_{10} (P_s/P_r)$, and cumulative interchangeover time, $\log_{10} (T_s/T_r)$, as a function of the logarithm of the ratio of obtained reinforcers, $\log_{10} (R_s/R_r)$. The bird numbers, and equations of the best-fitting straight lines are shown, together with estimates of the variance accounted for.

concurrent-schedule procedures (Baum, 1979; Davison & Hunter, 1976). The mean response-allocation sensitivity was 0.67 (range 0.50 to 0.79). The fits were good with generally high VACs. The mean total-time sensitivity (a_T) was 0.80 (range 0.75 to 0.86) and the mean switched-in time sensitivity (a'_T) was 0.70 (range 0.64 to 0.80). Sensitivity values for switched-in time measures were smaller than those for total-time measures for each of the 4 birds. Again the fits were good with high VACs. Values of bias ($\log b$) given in Figure 1 were generally small.

Figure 2 shows the log ratio of times

Table 3

Estimates of sensitivity (a_T , a'_T , a_P) and bias ($\log_{10} b_T$, b'_T , b_P) for total time, switched-in time, and response-allocation measures, and estimates of variance accounted for (VAC), for each bird and each access time.

Bird	Total Time			Switched-In Time			Responses		
	a_T	$\log_{10} b_T$	VAC	a'_T	$\log_{10} b'_T$	VAC	a_P	$\log_{10} b_P$	VAC
<i>3-s access time</i>									
181	.86	.03	1.00	.80	.03	.99	.50	.04	.93
183	.80	.05	1.00	.71	.06	.99	.79	.12	1.00
185	.75	-.08	1.00	.64	-.08	1.00	.68	.00	.99
186	.77	.14	1.00	.66	.02	.99	.69	.14	1.00
<i>5-s access time</i>									
181	.66	.07	.98	.59	.09	.98	.83	-.02	.94
183	.77	-.03	.98	.73	-.04	.98	1.08	.01	.99
185	.68	.00	.98	.50	-.02	.96	.68	.01	.98
186	.63	.06	.99	.59	.06	.99	.66	.10	.99
<i>7.5-s access time</i>									
181	.56	.00	1.00	.55	.00	1.00	.87	.04	1.00
183	.63	.01	1.00	.63	-.01	.99	1.08	-.08	.99
185	.50	-.08	.99	.47	-.06	1.00	.76	-.05	1.00
186	.51	-.02	.99	.52	-.02	.99	.73	.03	.99

($\log T_g/T_r$) and responses ($\log P_g/P_r$), plotted against the log ratio reinforcers ($\log R_g/R_r$), for the unlimited-access procedure. The mean time-allocation sensitivity (a_T) was 0.82 (range 0.73 to 0.94) and the mean response-allocation sensitivity (a_P) was 0.77 (range 0.56 to 0.88). The fits were good, with high VACs and small biases.

Comparison of Figure 1 and Figure 2 shows that sensitivities based on interchangeover times (a_T) for the limited-access and unlimited-access procedures were of similar magnitudes. Although both sets of sensitivities fell short of the value of 1.0 given by Baum (1979), they were within the range of typically obtained values (Baum, 1979; Davison & Hunter, 1976). The response-allocation sensitivities (a_P) for both procedures tended to approximate the typical value of 0.8 (Baum, 1979; Wearden & Burgess, 1982). These results indicate that the limited-access procedure produced sensitivities to reinforcement for time allocation similar to those typical of standard concurrent-schedule procedures.

Switched-in time sensitivities (a'_T) were smaller than the two time-allocation sensitivities based on interchangeover times (a_T) and approximately the same as the response-allocation sensitivities (a_P) for the limited-access procedure. What these results suggest is that

the sensitivity of the conventional measure of time allocation (T_g/T_r) to scheduled reinforcement may have been overestimated by virtue of inclusion of T_o in the interchangeover-time measure.

Time allocated to an activity must be measured in discrete units. Those units are specified by the procedure. For example, the unit of measurement in the present study was 3 s, as defined by the access procedure. Smaller units were deemed impracticable in the context of the present procedure, given the necessity of including a changeover delay and allowing some minimal time for pecking to occur. Longer time units might possibly make a difference in assessment of sensitivity to reinforcement; in the limit, it is obvious that as the size of the unit tends towards one half the duration of a session, there will be more and more constraint on variations in the time measure. That is, larger units of time may result in attenuated sensitivity. It should be noted that this problem is common to other methods of time-allocation measurement as well. For example, Catania (1961) defined time spent responding (a "run") as time during which responses separated by IRTs of 2 s or smaller were emitted. Changing the criterion IRT would result in a change in measured time allocation. Another measure that has been em-

played involves time spent on a small platform while responding (McLean, 1979; Pear & Rector, 1979). An increase in platform size would result in measured time allocation becoming a greater proportion of total session time, with a resultant constraint on variation in the time measure (McLean, 1979). It may be noted that all these procedures involved fixing the size of the time unit. Similarly, the procedure of the present study did not allow the subject to switch out of the access period. Any instances where the subject engaged in other behavior during that period would thus result in confounding the measure of switched-in time with time allocated to other behavior.

To investigate the problem of a suitable criterion for the time measure, we can consider the data from the conditions run with access times of 5 and 7.5 s. The data were analyzed in the same fashion as the previous sets of data. Table 3 gives the sensitivities and VACs for total time, time switched-in, and responses, for the 3-s, 5-s, and 7.5-s access times. Response and reinforcer frequencies for the 5- and 7.5-s access times are given in the Appendix. The main result was that the sensitivity to reinforcement, of each time measure, decreased with increasing access time. There was also a general increase in the response sensitivities. Both the similarity of the limited-access procedure to typical concurrent-schedule response- and time-allocation sensitivities and the data on the effect of longer access times validate the choice of 3 s as being the shortest practicable access time placing the least constraint on the animal's behavior. Figure 3 shows the average visit duration (in seconds) as a function of proportion of reinforcement for the unlimited-access procedure. It can be seen that the average minimum visit duration for each of the 4 birds was slightly over 3 s. Being a minimum duration, it is likely that this time was filled with responding. Figure 3 therefore provides further strong support for the choice of a 3-s access time.

Further support for this conclusion is provided by a study reported by Newby (1980) in which a limited-access procedure similar to the present one was used, but with a single-reinforcer differential between the concurrently a-

Fig. 3. Average visit duration in seconds for both green and red center keys, in the unlimited-access procedure, as a function of the proportion of reinforcement obtained on the two keys. Bird numbers are shown in the top left corner of each graph.

available random-interval schedules. Newby varied the "imposed-stay" duration or access time in the limited-access procedure in relation to the average interchangeover time observed in a preceding condition with an unlimited-access procedure. He found that time allocation matched the proportion of reinforcers when access time equaled the interchangeover time in the unlimited-access procedure.

The present conclusions may require qualification in view of changeover-delay effects that may have occurred in both the limited- and unlimited-access procedures. In the limited-access procedure, every access period began with a changeover delay (COD). Because COD bursts tend to be insensitive to changes in the reinforcer ratio, sensitivity to reinforcement should decrease as the COD burst becomes an increasing proportion of the re-

sponses during an access period (i.e., as access time becomes shorter). Although the way the COD was arranged may influence sensitivity of response allocation to reinforcement, as suggested by the increase in a_p values with increasing access periods (Table 3), it is unlikely to have influenced sensitivity measures for time allocation because time allocation is measured by the number of access times that are produced, and was thus not constrained by the COD that occurred during each access period.

The main result of the present experiment was that values for sensitivity of ratios of time allocation to red and green schedules were smaller when time was measured as switched-in time than when time was measured as interchangeover time. Further, sensitivity values based on interchangeover times did not differ between the 3-s limited-access and unlimited-access procedures. A possible account for the present results is that ratios based on interchangeover times are inflated by inclusion of T_o in the time measure. Previous comparisons of sensitivities to reinforcement of time and response allocation must therefore be qualified according to the measures of time allocation that were employed. The results of the present study suggest that if time allocated to behavior other than responding is excluded, sensitivities to reinforcement of time and response allocation are very similar. It is unlikely that the difference in sensitivities for total time and switched-in time measures resulted from any specific aspects of the present procedure because, first, the total-time sensitivity for the limited-access procedure approximated that for the more conventional unlimited-access procedure, and second, the comparisons between total-time and switched-in time measures were made within the same procedure.

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APPENDIX

Number of responses emitted on the two center-key schedules, minutes spent switched into these schedules, conventionally measured minutes allocated to the two schedules, and numbers of reinforcers obtained on the two schedules, as well as the VI schedules, in seconds. The data were averaged over the last five sessions of each experimental condition. Conditions 11 to 17 had a 5-s access time and Conditions 18 to 23 had a 7.5-s access time.

Condition	Responses		Minutes Switched in		Minutes Allocated		Reinforcers		VI Schedules	
	Green	Red	Green	Red	Green	Red	Green	Red	Green	Red
<i>Bird 181</i>										
11	640	484	11.30	9.47	15.09	11.87	25.2	24.8	60	60
12	967	257	15.75	4.31	20.54	4.84	45.2	4.8	32	300
13	257	945	4.14	14.12	4.63	17.13	8.0	42.0	150	32
14	854	154	15.33	4.08	18.89	4.51	41.6	8.4	32	150
15	169	1059	4.59	13.12	5.34	19.55	4.8	45.2	300	32
16	1061	4	16.35	0.04	25.58	0.18	50.0	0.0	30	EXT
17	6	1157	0.41	17.53	0.49	24.98	0.0	50.0	EXT	30
18	726	607	11.56	11.00	13.06	12.15	25.4	24.6	60	60
19	1071	5	20.75	0.38	25.61	0.44	50.0	0.0	30	EXT
20	1115	165	17.47	5.43	18.56	5.75	44.8	5.2	32	300
21	218	959	5.72	15.38	5.86	16.12	7.8	42.2	150	32
22	943	214	15.15	6.72	15.20	6.85	41.8	8.2	32	150
23	177	924	5.02	16.32	5.28	18.05	5.2	44.2	300	32
<i>Bird 183</i>										
11	837	827	10.65	11.67	12.45	13.46	24.8	25.2	60	60
12	1632	120	15.58	2.80	21.26	3.29	44.8	5.2	32	300
13	142	1514	3.71	13.61	4.55	17.25	7.2	42.8	150	32
14	1339	367	13.43	6.53	15.80	7.16	41.0	9.0	32	150
15	169	1935	2.60	16.28	3.27	17.67	4.2	45.8	300	32
16	2257	2	19.41	0.04	24.73	0.05	50.0	0.0	30	EXT
17	4	1973	0.10	18.80	0.10	24.74	0.0	50.0	EXT	30
18	790	1109	11.03	11.79	12.71	12.98	25.2	24.8	60	60
19	2453	5	21.04	0.18	25.35	0.19	50.0	0.0	30	EXT
20	1514	168	17.66	4.09	19.30	4.18	46.0	4.0	32	300
21	197	1297	5.61	14.13	6.25	15.19	8.0	42.0	150	32
22	1391	239	15.39	5.97	16.71	6.05	41.6	8.4	32	150
23	119	1873	3.68	15.87	4.19	19.02	4.4	45.6	300	32
<i>Bird 185</i>										
11	523	462	10.40	9.94	13.65	12.67	25.2	24.8	60	60
12	992	199	12.73	3.97	20.71	4.94	44.6	5.4	32	300
13	216	991	4.17	13.06	4.87	16.26	8.2	41.8	150	32
14	766	373	10.83	6.96	15.40	8.15	40.2	9.8	32	150
15	226	929	4.98	13.46	5.96	18.95	4.8	45.2	300	32
16	1110	12	16.04	0.25	25.26	0.28	50.0	0.0	30	EXT
17	3	869	0.04	16.12	0.05	25.87	0.0	50.0	EXT	30
18	488	573	10.25	11.54	12.05	14.43	24.6	25.4	60	60
19	1146	8	18.85	0.23	26.40	0.29	50.0	0.0	30	EXT
20	1148	273	14.70	6.65	16.43	7.46	44.8	5.2	32	300
21	234	746	6.06	13.63	6.43	15.65	9.0	41.0	150	32
22	911	252	13.50	6.43	15.23	7.06	41.0	9.0	32	150
23	189	1133	4.88	14.87	5.30	18.23	4.6	45.4	300	32
<i>Bird 186</i>										
11	963	898	11.15	9.89	13.56	11.79	25.2	24.8	60	60
12	1716	324	17.07	3.65	20.98	4.19	45.0	5.0	32	300
13	463	1164	6.32	13.17	6.83	14.77	9.2	40.8	150	32
14	1314	430	13.30	5.64	16.02	6.34	41.0	9.0	32	150
15	444	1273	5.25	15.27	6.02	18.90	5.0	45.0	300	32
16	2112	7	20.11	0.08	24.61	0.09	50.0	0.0	30	EXT

APPENDIX (cont.)										
Condition	Responses		Minutes Switched in		Minutes Allocated		Reinforcers		VI Schedules	
	Green	Red	Green	Red	Green	Red	Green	Red	Green	Red
<i>Bird 186 (cont.)</i>										
17	3	1808	0.04	19.66	0.04	24.90	0.0	50.0	EXT	30
18	1072	788	11.49	11.30	12.81	12.41	24.6	25.4	60	60
19	1729	1	22.03	0.03	25.58	0.03	50.0	0.0	30	EXT
20	1440	280	16.65	5.71	17.49	6.04	45.6	4.4	32	300
21	303	1185	5.59	15.43	5.70	15.71	7.8	42.2	150	32
22	1135	360	14.17	6.37	14.62	6.73	41.0	9.0	32	150
23	218	1082	4.95	17.44	5.24	18.01	4.2	45.8	300	32