Concurrent random interval schedules of reinforcement

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Two pigeons were trained on concurrent random interval schedules of reinforcement. The parameters of the schedules were then changed to make them progressively more ratio-like, while maintaining their average interreinforcement intervals of 32 and 64 sec. Both the relative response rate and the relative amount of time spent on each schedule matched the relative rate of reinforcement, as it varied from 36% to 2%. Preference became extreme when the changeover delay was increased from 2 to 5 sec, but matching was still obtained.

Herrnstein (1970) has recently promulgated a model of choice behavior which seems to account for an extensive range of data. Despite the radical differences between interval and ratio schedules, the model makes the same prediction for both: confronted with any two reinforcement schedules, animals will allocate their responses to one or the other in proportion to the number of reinforcements they receive for such responding. They will "match" relative response rate to relative reinforcement rate. But this most basic prediction is found true only if one agrees to a particular interpretation of the independent variable. Given a choice between two ratio schedules, animals will almost always choose the shorter schedule exclusively, and the matching rule can be saved only by asserting that the proper independent variable is the obtained rather than the programmed rate of reinforcement (cf. Rachlin, 1971). For when an organism consistently chooses one schedule, he is consistently reinforced by that one schedule and his exclusive preference "matches" his exclusive reinforcement more closely than it matches the programmed values of the schedules. Most of the experiments in support of Herrnstein's model have employed concurrent interval schedules, which seldom engender such extreme preferences. It would seem impossible to meaningfully test the model for concurrent ratio schedules because of the speed with which the relative rate of reinforcement is driven to 0 (or 1). But an approximation to such a test is possible, insofar as approximations to ratio schedules are possible. In the following experiment, random interval schedules are gradually transformed into ratio schedules and choice behavior is measured to see if there is any systematic deviation from matching as preference becomes more and more extreme.

METHOD

Two Silver King pigeons, both with extensive experimental histories, were maintained at 80% of their free-feeding weights. The experimental chamber, an ice chest with two translucent pigeon keys mounted above a feeder aperture, was kept in a room separate from the control logic. One of the keys was always white; responses on it would change the color of the other key from green to red, or red to green, and also initiate a 2-sec period of time during which reinforcement was unavailable (2-sec COD). Correlated with these red and green keys were various random interval schedules of reinforcement.

Random interval schedules (cf. Farmer, 1963) are typically programmed by recycling a timer with a period of T sec. The first response in each period is reinforced with a probability of p; subsequent responses are not reinforced until the timer recycles. When p has a value of 1, this is a fixed interval of T sec. When p is less than 1, it is a random interval schedule with a minimum interreinforcement interval of T sec. As T decreases, the probability of reinforcement for pausing decreases and the schedules become more ratio-like. For values of T less than the minimum interresponse time, each response is reinforced with probability p and the schedule is essentially variable ratio.

The values of T and p used in this experiment are shown in Table 1. The probability of reinforcement for a response on the green key was always twice that on the red key. As T was decreased, the probabilities were decreased, so as to keep the mean interreinforcement intervals constant at 32 and 64 sec. About 15 daily sessions were conducted for each condition. Values of T equal to 16, 8, and 4 sec were investigated, and then the 8-sec condition was recovered. Finally, the COD was increased to 5 sec, with T remaining at 8 sec.

RESULTS AND DISCUSSION

Table 1 shows the probability of a response on the red key, the relative amount of time spent responding on the red key, and the relative number of reinforcements obtained for responding on the red key. The average deviation from matching was 4% for relative responses and 3% for relative time. Inspection of Table 1 reveals no systematic change in these deviations as the schedules become more ratio-like. Pigeons match not only when on interval and ratio schedules, but also when on random interval schedules somewhere between the two. This is important because the peculiar construction of these schedules places severe constraints on the types of models which will be able to account for the more molecular properties of choice behavior. The longer an animal refrains from responding on a standard interval schedule, the more likely it is that the ensuing response will be reinforced. But on random interval schedules, reinforcement probability is 0 until the timer recycles and remains at p thereafter. In concurrent experiments, the probability that an animal will be reinforced for switching increases with the time since his last switch. For standard variable interval schedules, this increase is relatively continuous and asymptotes at 1.0; for random interval schedules, the increase is discontinuous and asymptotes at p. In the present experiment, as p decreased, switching behavior also decreased, leading to greater and greater assymetries of reinforcement. Throughout this process, only one relation seemed to remain invariant:

Table 1
Values of T and P for Pigeons 50 and 65. Also shown is relative rate of responding (R), relative amount of time spent in each schedule (t), and relative number of reinforcements obtained on each schedule (S^R).

			Pigeon 50			Pigeon 65		
T	P(G)	P(R)	R	t	S^R	R	t	S^R
16			.29	.33	.26	.38	.37	.36
8			.44	.40	.34	.22	.21	.21
4			.08	.09	.06	.05	.06	.03
8*			.37	.35	.30	.16	.12	.12
8†			.03	.05	.05	.02	.03	.02

Indicates second determination; †indicates 5-sec COD

the relative number of responses on a schedule matched the relative number of reinforcers obtained on that schedule.

Silberberg & Fantino (1970) have speculated that preference for variable interval schedules might become exclusive when the value of the COD becomes extreme. In the present experiment, preference became extreme when the COD was increased to 5 sec, a value appreciably less than half the 32-sec random interval schedule. More information about schedules than their mean interreinforcement intervals will be necessary to make accurate and general predictions of COD effects. The matching law is impressive because it does not seem to require such qualification.

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