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UNINSTRUCTED HUMAN RESPONDING: SENSITIVITY OF LOW-RATE PERFORMANCE TO SCHEDULE CONTINGENCIES

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College students' presses on a telegraph key occasionally turned on a light in the presence of which button presses produced points later exchangeable for money. Initially, responding was maintained by low-rate contingencies superimposed on either random-interval or random-ratio schedules. Later, the low-rate contingencies were relaxed. Low-rate key pressing had been established for some students by shaping and for others by demonstration and written instructions. After the low-rate contingencies were relaxed, higher response rates generally did not increase point earnings with random-interval scheduling, but did so with random-ratio scheduling. In both cases, shaped responding usually increased, and instructed responding usually continued at an unchanged low rate. The insensitivity of instructed responding typically occurred despite contact with the contingencies. The differential sensitivity to schedule contingencies of shaped responding relative to instructed responding is consistent with the different properties of contingency-governed and rule-governed behavior and is not rate-dependent.

Key words: instructions, rule-governed behavior, shaping, contingency sensitivity, DRL, random interval, random ratio, telegraph key, humans

Human operant behavior should by definition be sensitive to its consequences. But sometimes human responding is insensitive to such contingency differences as those of fixed-interval (FI) versus fixed-ratio (FR) schedules (e.g., Weiner, 1969, 1970), or even those of response-dependent versus response-independent schedules (e.g., Striefel, 1972). If sensitivity to contingencies is fundamental to adaptive behavior, it is puzzling that human behavior should sometimes be insensitive. (This view does not require that human behavior show sensitivity to contingencies in the same way as does the behavior of other species: cf. Lowe, 1979; Lowe, Harzem, & Hughes, 1978.)

When sensitivity of human operant behavior to contingencies was assessed within pairs of variable-ratio (VR) and yoked variable-interval (VI) schedules, both schedules maintained high rates with responding established by instructions, but ratio response rates were consistently higher than those maintained by yoked-interval schedules with shaped responding (Matthews, Shimoff, Catania, & Sagvolden, 1977). Thus, instructed responding was insensitive to the difference between ratio and interval contingencies and shaped responding was sensitive. In other words, human behavior is sometimes insensitive to contingencies when responding is initiated by instructions. In fact, such insensitivity is a defining property of instructional control.

Insensitive instructed performances are characterized by high, steady response rates (e.g., Baron, Kaufman, & Stauber, 1969; Harzem, Lowe, & Bagshaw, 1978; Kaufman, Baron, & Kopp, 1966; Matthews et al., 1977). The present research asks whether low rates also can be insensitive to contingencies. The question is important for several reasons. First, sensitivity to contingencies must be determined by experimental analysis. For example, a history of differential reinforcement of low rates (DRL) can produce low-rate FI responding (Weiner, 1964); would such low-rate FI performances be sensitive to transitions to other contingencies (e.g., ratio scheduling) which typically maintain high-rate responding? Simi-

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larly, low rates can be generated with observing responses (Lowe et al., 1978). Do these low rates depend on contingency sensitivity or on some aspect of the instructions? To assume that low rates are prima facie evidence of contingency sensitivity implies that explicit testing for sensitivity is sometimes unnecessary; on the other hand, if low rates can be insensitive, the effects of instructions must be assessed even with low-rate performances.

Low-rate sensitivity may also simplify procedures for producing contingency-sensitive responding. If low-rate responding is always sensitive to contingencies, shaping may be circumvented by instructing the response and then reducing rates with a low-rate contingency. Low-rate insensitivity, however, precludes this procedure.

More important, the contingency-sensitivity of low-rate responding may be relevant to the insensitivity induced by instructions. One account of insensitivity (Galizio, 1979) is that high rates generated by instructions often preclude contact with contingencies. For example, if the low rates maintained by interval schedules depend on the differential reinforcement of long interresponse times (IRTs) inherent in interval schedules, instructions might induce insensitivity by producing high rates with no long IRTs available to be reinforced. Alternatively, insensitive responding might remain insensitive despite contact with contingencies. In comparisons of shaped and instructed responding, these possibilities cannot be assessed if instructed responding is always characterized by high rates.

The present experiments examined sensitivity of low-rate responding and used a within-subject design less cumbersome than the earlier yoked-control procedure (Matthews et al., 1977). Low rates were maintained either by random-interval (RI) or by random-ratio (RR) schedules with superimposed DRL contingencies; only responses terminating IRTs longer than those specified by the DRL contingency were eligible to produce points exchangeable for money. Sensitivity was tested by relaxing the DRL contingency; responding would increase if sensitive to the contingencies, but not otherwise. With pigeons, rate increases reliably follow the relaxation of low-rate contingencies superimposed on either interval or ratio schedules (e.g., Ferster & Skinner, 1957, Chapter 9).

EXPERIMENT 1
LOW-RATE AND INTERVAL CONTINGENCIES

In this experiment, low rates were maintained by superimposing a DRL contingency on an RI schedule, and sensitivity was assessed by terminating the contingency. With this change, increased response rates could not substantially increase point earnings. Thus, even weak instructional control might maintain low response rates, but increased response rates with the DRL contingency absent would convincingly demonstrate contingency sensitivity.

Method

Subjects and Apparatus

Twenty-one students participated as an option in satisfying Introductory Psychology course requirements. In sessions at two- to four-day intervals, each was seated in a sound-attenuating cubicle facing a console that contained a red button 15 cm below an earnings counter mounted between two red lamps. When these lamps were lit, presses of at least 15.0 N on the 2.4-cm-diameter red button produced counts on the earnings counter. Between the red button and the earnings counter were an amber lamp labeled "WAIT" and a green one labeled "SESSION ON." A black telegraph key requiring 1.9 N for operation was mounted on the table in front of the counter. The frame and contacts of the telegraph key were covered by a 10 by 12.5 by 8-cm aluminum Minibox, so that only the 2.7-cm-diameter black key was visible. A small lamp that blinked off for about 30 msec after each response was also mounted above the key. White noise was presented through headphones during sessions to eliminate auditory cues from the standard electromechanical scheduling apparatus in an adjacent room.

Procedure

After being escorted into the cubicle, each participant was asked to read the following instructions mounted on the wall above the console:

> Please read carefully. Do not ask for additional information about what you are to do.
>
> Your task is to earn as many points as you can. Points are shown on the counter at the center

of the console. Each point is worth 1 cent. For example, if you earn 200 points, you will be paid $2.00. Whenever the RED LIGHTS beside the counter are on, each press of the RED BUTTON will add one point to your total.

The blue light above the red button is a "wait" light; while the "wait" light is on, the equipment is temporarily disconnected. The session will begin when the blue "EXPERIMENT ON" light comes on. Put on the headphones now, and do not remove them until the session is over.

When a response was eligible for reinforcement, it turned off the light above the telegraph key and lit the red lamps next to the earnings counter; a press of the red button then added one point to the earnings counter, turned off the red lamps, and reinstated the light above the key.

For 11 participants, successively closer approximations to presses on the telegraph key were shaped. For 10 others, the key press was established by the following additional instruction, inserted above as the next-to-last paragraph:

To make the RED LIGHTS come on, you must press the BLACK BUTTON. You must press slowly; pressing too rapidly will not work.

When the instructions had been read by the participants, the experimenter demonstrated key pressing by producing two or three IRTs of about 3 sec, and then left the cubicle.

Once responding was established, either by instructions or shaping, the RI and DRL contingencies were introduced gradually, with the terminal schedule values usually attained within 15 minutes. Sessions lasted 50 min each. The RI schedule (Farmer, 1963) arranged consequences for the first response after a variable duration determined by selecting with a probability of .10 pulses generated at a rate of one per 1.5 sec; this defined an RI 15-sec schedule, with $t=1.5$ sec and $p=.10$. The DRL requirement was 3 sec, so that 15 sec (on the average) after each collection of a point the first response terminating an IRT greater than 3 sec turned on the red lamps. The RI DRL schedule remained in effect until the 10th min of a subsequent session (usually the third), when the DRL contingency was discontinued; no stimulus changes accompanied this change.

Results

Figures 1 through 4 show cumulative records from the sessions in which the DRL contingency was discontinued; after the first 10 minutes (at reset) responding was maintained by the RI schedule without DRL. Sessions are shown in their entirety; in some cases, additional sessions were run, and representative samples of the later portions of these sessions (marked as +1, +2, or +3) are also included.

Records of five performances established by shaping are shown in Figure 1. In the first three, response rate increased within about 15 min after the DRL contingency was discontinued. For 7RI-S, the increase came toward the end of the session and was maintained in the next session. For 2RI-S, the increase toward the end of the session was transient; rates were lower in the next two sessions, whereas performance in a third session (+3) was erratic and marked by long periods of nonresponding. Observation through a one-way window suggested 2RI-S was asleep during part of some sessions.

Records of six other shaped performances are shown in Figure 2. The response rate of 10RI-S increased when the DRL was discontinued whereas that of 11RI-S decreased slightly. In the case of 3RI-S, several brief high-rate episodes followed the contingency change, but only in the following session were high rates maintained for substantial periods of time. For 5RI-S, 6RI-S, and 8RI-S, response rates with DRL were so low that typical sessions included relatively few IRTs shorter than 3 sec; when the DRL contingency was discontinued, rates remained low. For the two of these three cases for which it was possible to schedule an additional session (+1), low rates continued even into that session.

Four records of instructed performance are shown in Figure 3. For 6RI-I and 9RI-I, rates increased shortly after the DRL contingency was discontinued, and for 2RI-I, they increased in the next session. For 8RI-I, local rates remained low, although episodes of high-rate responding began during the transition session and became more frequent in the next session (+1). Cumulative records for the six remaining instructed responders are presented in Figure 4. In each case responding included IRTs both longer and shorter than 3 sec; in none, however, did rates systematically increase after the contingency change.

Table 1 shows response rates, percentage of responses terminating IRTs greater than 3 sec, and rate of point-earnings for the session

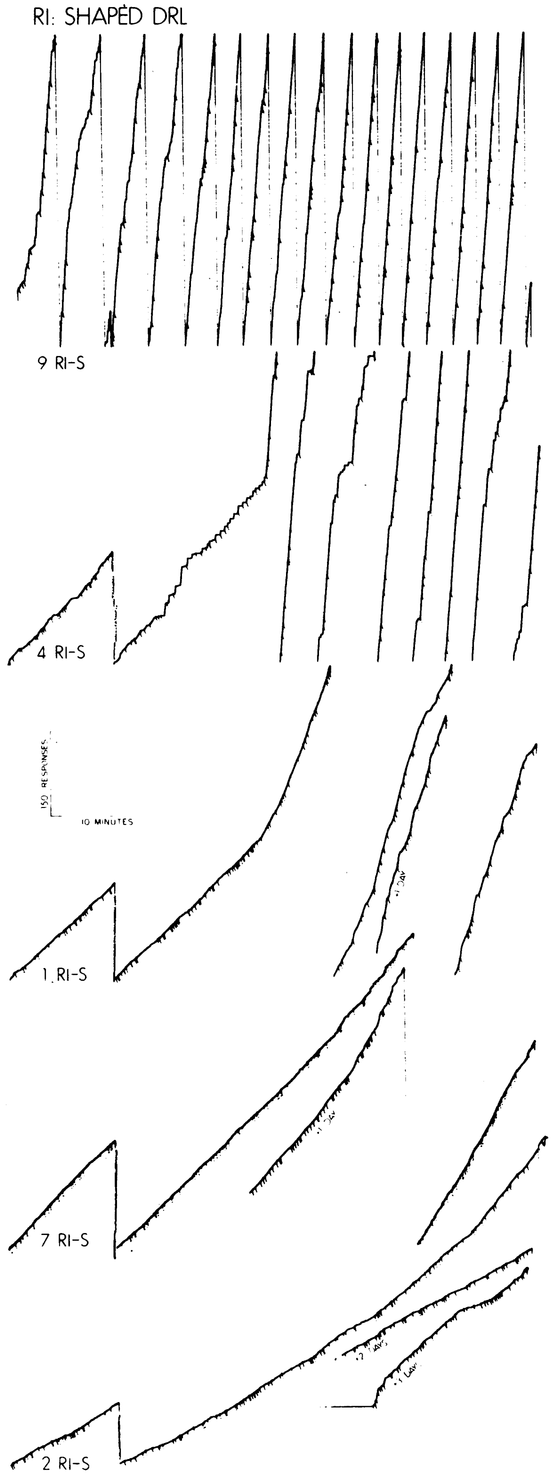

Fig. 1. Cumulative records of shaped responding maintained by random-interval (RI) 15-sec scheduling of point earnings. An interresponse-time contingency (DRL 3-sec) was discontinued after the first 10 min of the session. Terminal segments from later records are shown for cases in which additional sessions (+1, +2, +3) were arranged.

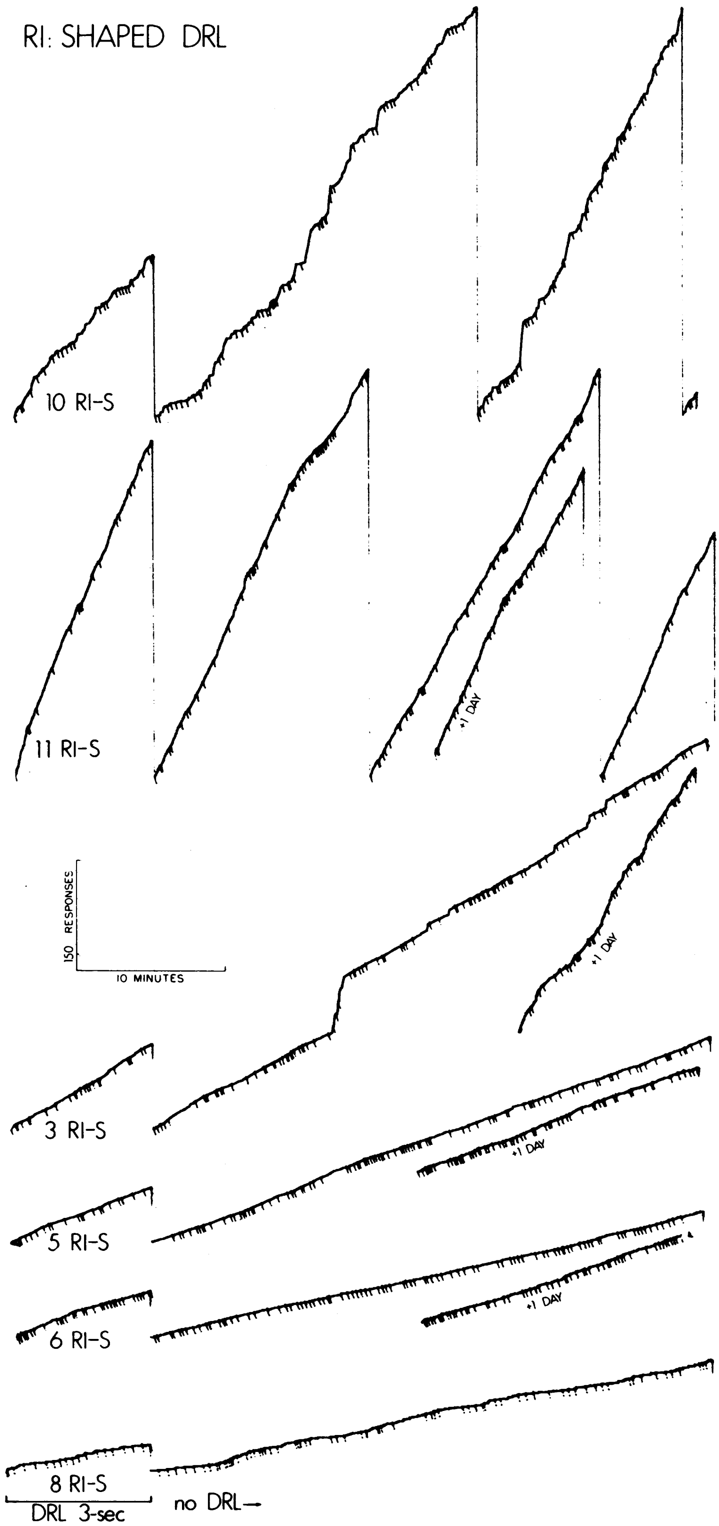

Fig. 2. Cumulative records of shaped responding maintained by RI 15-sec scheduling of point earnings. Details as in Figure 1.

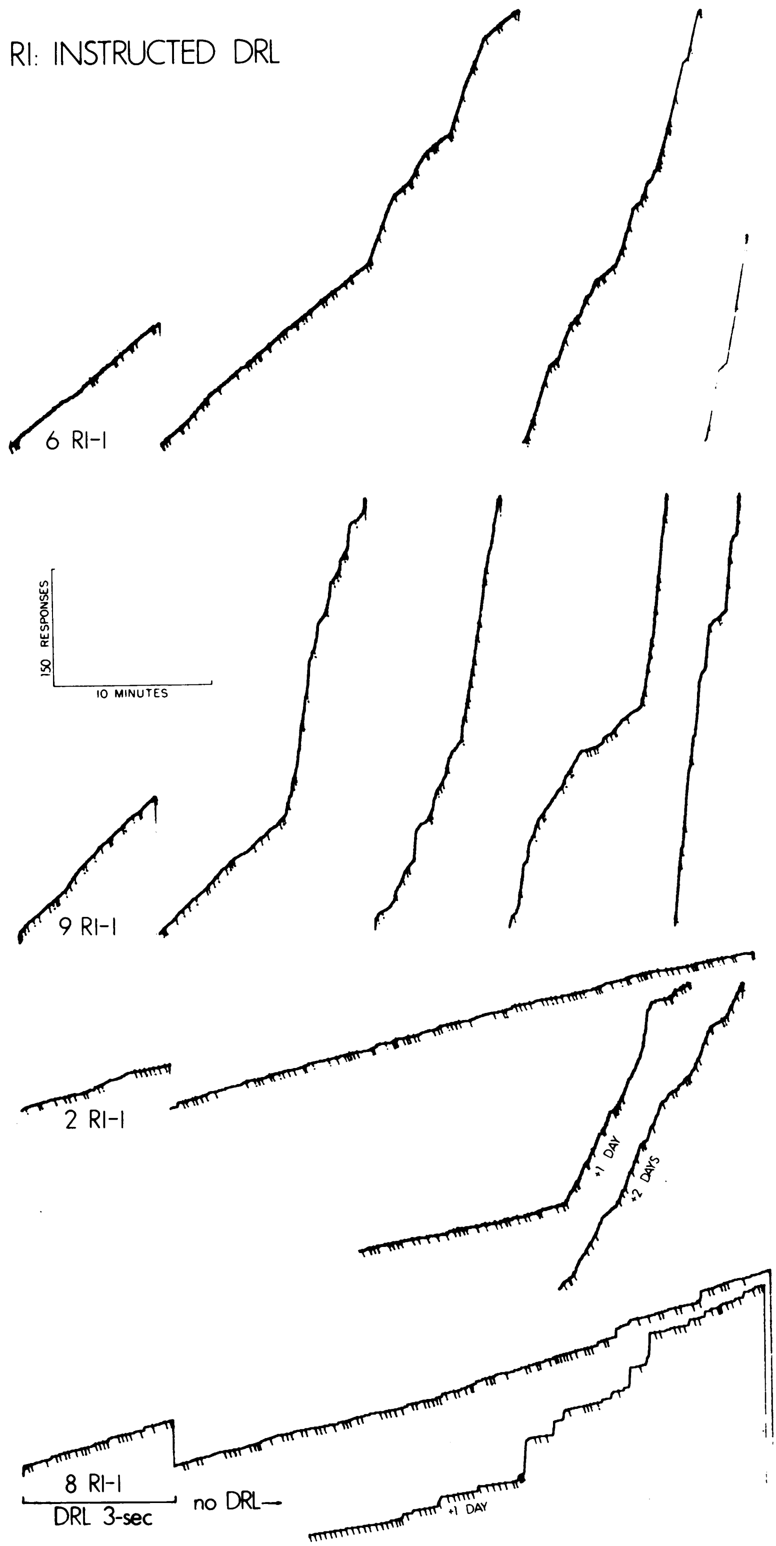

Fig. 3. Cumulative records of instructed responding maintained by RI 15-sec scheduling of point earnings. Details as in Figure 1.

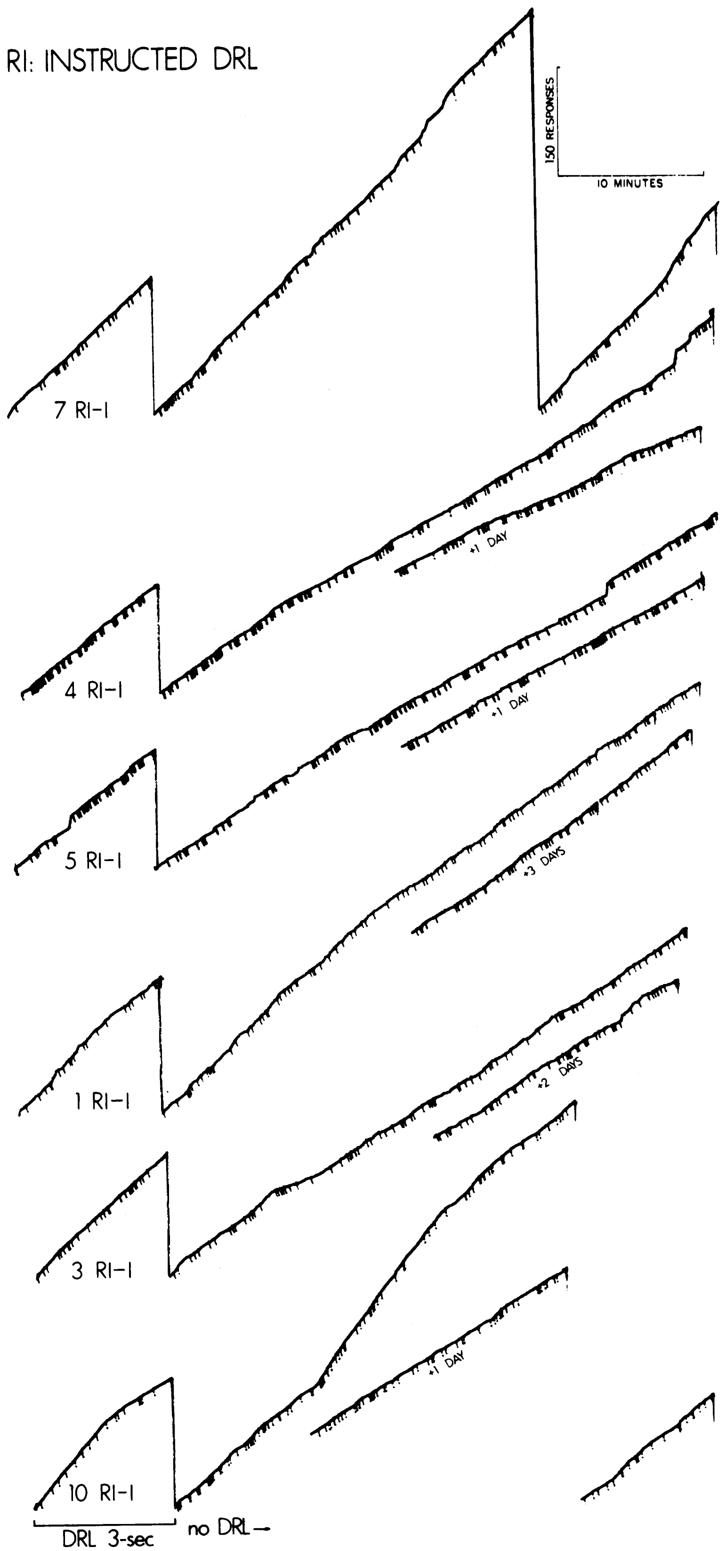

Fig. 4. Cumulative records of instructed responding maintained by RI 15-sec scheduling of point earnings. Details as in Figure 1.

in which the DRL contingency was discontinued. These data confirm the conclusions based on the cumulative records. In addition, they demonstrate the limited contact with the contingency change (in terms of the percentage of responses terminating IRTs less than 3 sec) for 5RI-S, 6RI-S, and 8RI-S. Finally, response rate increases after removal of the DRL contingency often occasioned no substantial increment in point earnings.

In short, for button-pressing established by shaping, removal of the DRL contingency increased response rate in six of the seven instances in which rates were high enough for contingency contact. When responding was established by instructions, however, rates increased during the transition session in only three instances (6RI-I, 8RI-I, and 9RI-I), and in a following session for a fourth case (2RI-I); in the remaining six instances, there were no systematic rate increases.

EXPERIMENT 2
LOW-RATE AND RATIO CONTINGENCIES

The first experiment focused on the sensitivity of shaped responding under circumstances in which increases in response rate did

Table 1

Button-pressing, point-earnings, and percentage of IRTs greater than 3 sec in the transition session.

		Resp/min		*Points/min*		*% IRTs > 3 sec*	
		DRL	*No DRL*	*DRL*	*No DRL*	*DRL*	*No DRL*
1	R1-S	16.7	37.7	2.2	3.1	66	11
2	R1-S	10.7	14.2	2.8	2.7	89	60
3	R1-S	11.5	13.2	2.4	2.5	88	74
4	R1-S	19.7	106.3	2.4	2.7	36	3
5	R1-S	7.3	6.9	2.2	2.4	100	99
6	R1-S	6.1	4.2	3.0	2.3	97	100
7	R1-S	18.1	22.7	2.1	3.1	60	42
8	R1-S	3.4	3.8	1.8	1.8	82	82
9	R1-S	115.3	209.9	2.3	3.3	7	1
10	R1-S	21.6	28.2	2.3	2.6	34	21
11	R1-S	45.4	35.6	1.7	2.8	21	33
1	RI-I	18.5	14.8	2.1	2.5	59	64
2	RI-I	5.5	4.8	1.8	2.3	89	94
3	RI-I	16.6	11.9	2.6	2.2	67	79
4	RI-I	14.8	13.0	3.7	2.7	100	82
5	RI-I	16.0	11.9	3.2	2.4	65	66
6	RI-I	17.3	55.1	2.7	2.5	71	9
7	RI-I	18.6	20.7	2.3	2.3	73	63
8	RI-I	5.8	6.0	2.4	2.0	83	75
9	RI-I	15.3	34.0	1.5	2.9	95	27
10	RI-I	17.4	17.4	1.6	2.8	45	51

not substantially increase point earnings. That response rates did increase testifies to the sensitivity of the performance to changes in the contingencies. Given the relative independence of response rate and point earnings, however, it is not surprising that the rates of instructed responses remained low when the DRL contingency was discontinued. Experiment 2 arranged contingencies more likely to override the insensitivity induced by instructions. Responding was maintained by an RR schedule with a 4-sec DRL contingency subsequently reduced to 1 sec. In this case, increased responding up to a rate of one response per sec after the DRL contingency is shortened proportionately increases point earnings. Insensitivity is demonstrated when low rates are maintained under conditions in which higher rates would increase point earnings. In Experiment 1, shaped responding increased after a DRL contingency was discontinued. Experiment 2, however, addressed the question whether instructed response rates would remain low even when higher rates would increase point earnings.

METHOD

Apparatus and procedures were similar to those for Experiment 1. For eight participants, responding was instructed; for another six, key pressing was established by shaping. All participants received the following written instructions:

> Please read carefully. Do not ask for additional information about what you are to do.
>
> Your task is to earn as many points as you can. Points are shown on the counter at the center of the console. Each point is worth 1 cent. For example, if you earn 200 points, you will be paid $2.00. Whenever the RED LIGHTS beside the counter are on, each press of the RED BUTTON will add one point to your total.
>
> When the session begins, the small white light will come on, and you will hear a hissing sound through the headphones. Please put on the headphones now, and do not remove them until the session is over.

Those whose responding was instructed also received a demonstration of two or three 4-sec IRTs and the following inserted as the next-to-last paragraph of the instructions:

> To make the RED LIGHTS come on, you must press the BLACK BUTTON. You must press *slowly;* pressing too rapidly will not work.

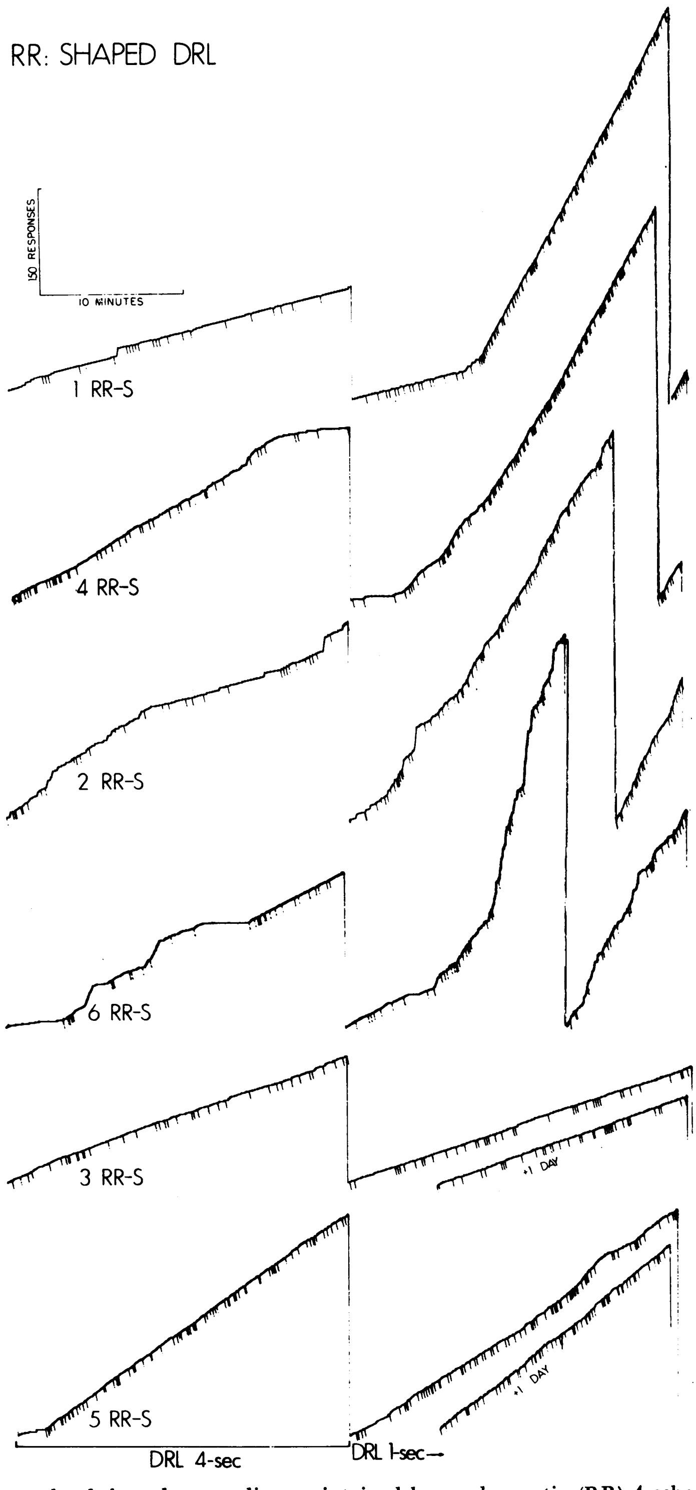

Fig. 5. Cumulative records of shaped responding maintained by random-ratio (RR) 4 scheduling of point earnings. An interresponse-time contingency (DRL) of 4 sec was shortened to 1 sec during the second half of the session and in subsequent sessions (+1), for which terminal segments are shown.

Responding was maintained by a random-ratio (RR) schedule with an added DRL contingency. Every response that met the DRL requirement was eligible to produce points with a probability of .25. For the first session and for the first 25 min of the second session, the DRL value was 4 sec. For the remainder of the second session and for any later sessions, the DRL value was shortened to 1 sec (in two cases, IRR-S and 6RR-I, the transition was deferred to the third session).

Results

Cumulative records for the transition session in which the DRL was shortened are shown in Figures 5, 6, and 7. For the first half of the session (up to the reset), responding was maintained by the RR schedule with DRL 4-sec; the schedule was then shortened to DRL 1-sec. Response rates and point-earning rates under these two conditions in the transition session are shown in Table 2. Figure 5 presents responding established by shaping. For the top four records, rates increased substantially within 10 min of the DRL reduction; in the remaining two cases, rates remained unchanged even in the following session.

Performances after instructions are shown in Figures 6 and 7. In the five records of Figure 6, rates did not increase after the DRL was shortened, and they remained unchanged through the next 50-min session (no additional session could be arranged for 2RR-I). Figure 7 presents three records of increased response rates. These increases, however, developed more slowly than those of shaped responding (Figure 5).

Response rates for 4 of 6 shaped key-presses increased soon after the DRL was shortened, but when key pressing was instructed, rates either did not increase (5 cases) or increased relatively late (3 cases). Thus, instructions substantially reduced sensitivity to contingencies, even though response rates were positively correlated with point earnings.

Table 2

Button Pressing and Point Earning in the Transition Session

	Resp/min		*Points/min*	
	DRL 4-sec	*DRL 1-sec*	*DRL 4-sec*	*DRL 1-sec*
1 RR-S	7.9	29.7	1.2	7.0
2 RR-S	13.9	37.8	*	*
3 RR-S	8.9	8.1	2.0	2.0
4 RR-S	12.5	30.1	2.4	6.9
5 RR-S	15.5	15.9	3.9	4.0
6 RR-S	10.9	43.2	1.6	3.4
1 RR-I	20.5	20.1	3.0	3.9
2 RR-I	9.1	10.0	1.7	2.5
3 RR-I	13.9	14.3	3.2	2.4
4 RR-I	30.8	21.9	3.3	4.7
5 RR-I	14.1	12.2	3.6	3.4
6 RR-I	12.2	12.8	3.2	3.0
7 RR-I	11.6	14.0	2.8	3.8
8 RR-I	14.7	14.7	3.8	3.8

*Data lost

GENERAL DISCUSSION

Both experiments showed that low-rate responding established by shaping is generally sensitive to changes in contingencies, but that instructions may produce low-rate responding insensitive to contingencies. In Experiment 1, low-rate responding established by shaping and maintained by an RI DRL schedule increased when the DRL contingency was removed in 6 of 7 instances in which there was contact with the contingencies, even though rate increases did not always increase point earnings. In Experiment 2, instructed responding maintained by an RR DRL schedule remained low when the DRL contingency was shortened, even though increased responding proportionately increased point earnings. Thus, the effects of instructions are apparently robust; shaped responding can be sensitive to subtle changes in contingencies, whereas instructed responding is often insensitive even to major changes in contingencies.

In most cases instructed responding remained insensitive despite contact with the contingencies. Thus, instructionally induced insensitivity is not limited to performances that preclude contact with contingencies. Obviously, instructed responding need not remain immune to contingencies; it would be maladaptive indeed for behavior to remain indefinititely under instructional control. Instructions that delay sensitivity might not permanently preclude its development. In Experiment 2, this is illustrated in the delayed rate increase in three cases of instructed responding. So long as there is some contact with contingencies, sensitivity may eventually develop. Under some conditions, of course, instructions may exert more long-lasting effects by precluding contact with contingencies, as for the three low-rate responders of Experiment 1.

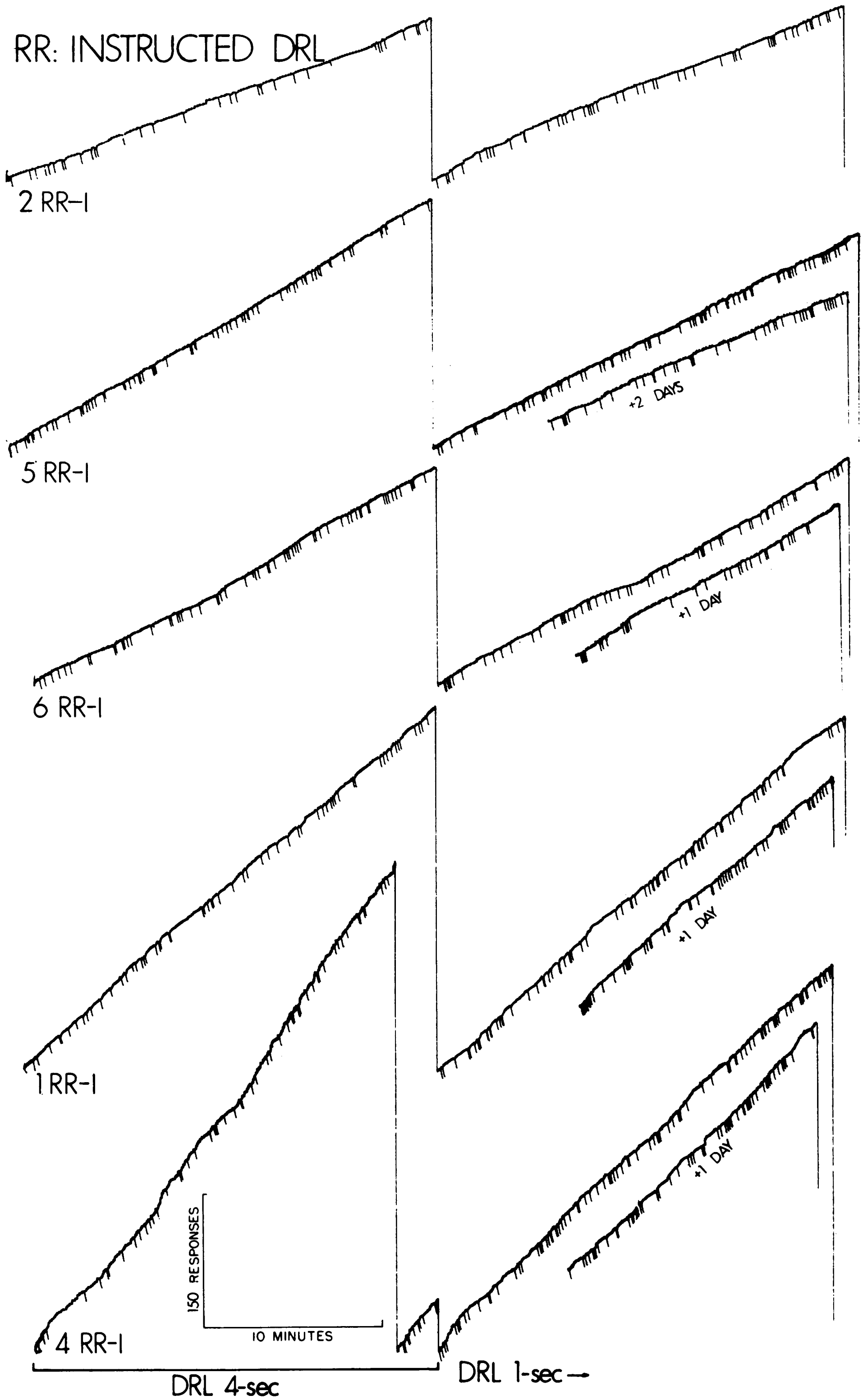

Fig. 6. Cumulative records of instructed responding maintained by RR 4 scheduling of point earnings. Details as in Figure 5.

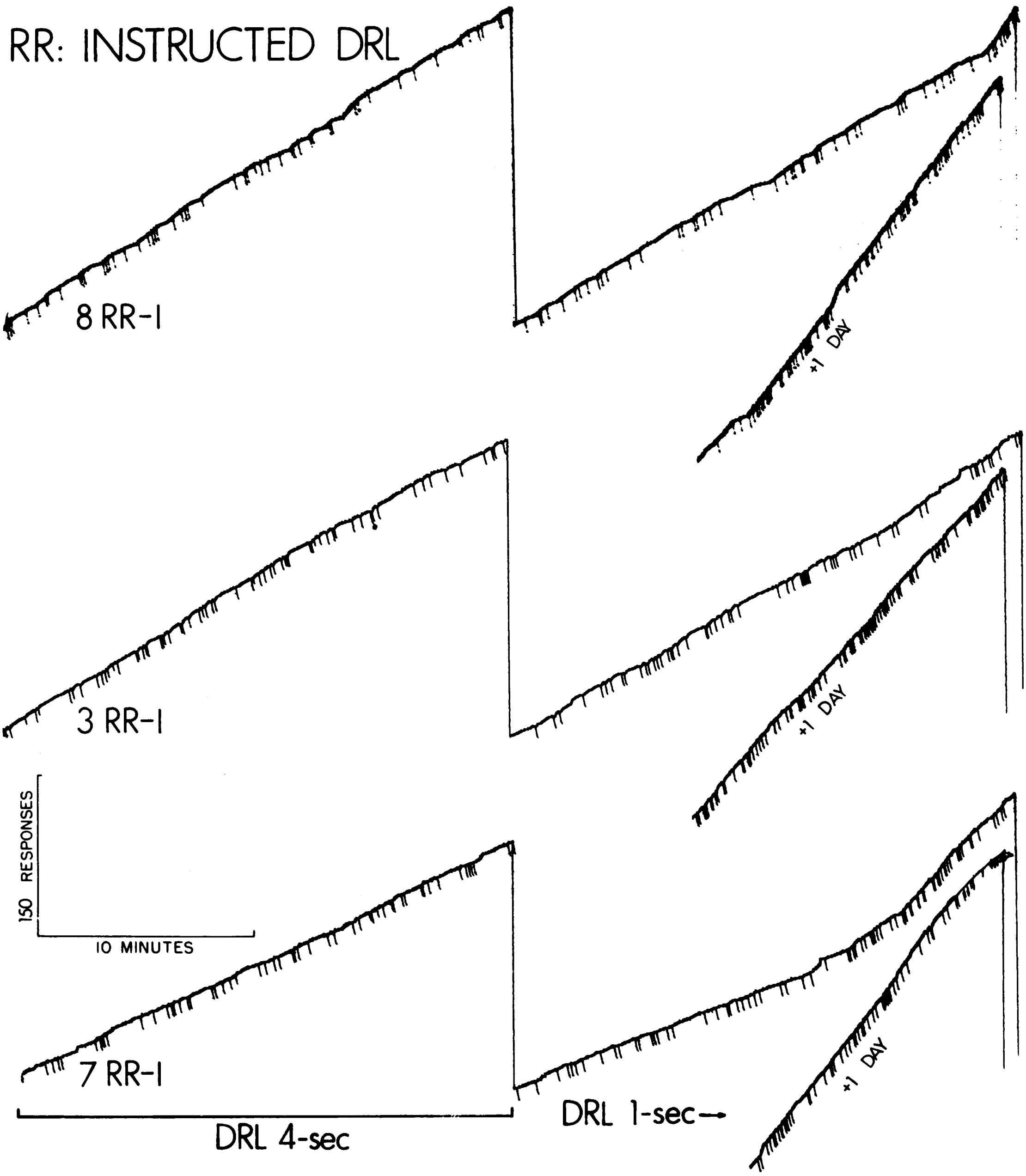

Fig. 7. Cumulative records of instructed responding maintained by RR 4 scheduling of point earnings. Details as in Figure 5.

Conversely, uninstructed (shaped) responding is not invariably sensitive to contingencies, as illustrated by one participant in Experiment 1 and two in Experiment 2. Perhaps covert verbal behavior has instructional functions (Lowe, 1979). College students presumably have extensive histories of instructing the performances of others as well as restating instructions originally presented by others to them; such verbal behavior may limit sensitivity. The common practice of obtaining verbal reports in post-experimental interviews, however, cannot adequately address this issue. In an experimental analysis, our task is not to treat verbal reports as causes, but rather to see how verbal reports, like the nonverbal behavior they accompany, are affected by environmental variables. Both the status of such reports and their correlation with other behavior are problematical (Ericsson & Simon, 1980; Nisbett & Wilson, 1977). Uncertainties will persist in the absence of adequate accounts of verbal reports as responses. The development of procedures to make possible such an experimental analysis remains an important challenge (Brewer, 1974).

An implication of the present findings is that rate per se is not consistently correlated with sensitivity to contingencies; low rates (Experiment 2) and high rates (Matthews et al., 1977) can be insensitive. It is thus critical that studies of human operant behavior test explicitly for sensitivity to contingencies, to ensure that scheduled consequences in fact control responding. In some experiments, internal evidence suggests that instructions may have influenced performances. In one case, for example, substantial responding was maintained when button presses earned points according to a VI 171-sec schedule and lost points according to a VI 170-sec schedule, so that responding actually reduced earnings (Bradshaw, Szabadi, & Bevan, 1978). Similarly, the roughly equal rates maintained by avoidance schedules of point-loss postponement with values from 10 to 60 sec (Galizio, 1979) suggest that the minimal instructions used in that procedure had been sufficient to produce insensitivity to contingencies.

It is often difficult to determine whether a particular performance is under the control of contingencies or instructions. Some have suggested that the presence of response patterns typical of infrahuman performances, such as the FI scallop, should be the criterion by which we identify schedule sensitivity. The ultimate criterion for determining sensitivity is whether performance changes appropriately when contingencies change. The question of schedule-typical performance is orthogonal; one can readily imagine instructionally induced FI scallops that might not be sensitive to changes in contingencies (e.g., from response-produced to response-independent reinforcers).

Sensitivity to contingencies is a property of a particular response dimension within a particular context, and it would be misleading to suggest that an organism or a behavior class is sensitive or has sensitivity. In fact, it may be important within a given experimental setting to distinguish among contingencies on the basis of the sensitivity of responding to each. For example, instructed response rates in a study of concurrent signaled and unsignaled VI schedules were high and roughly constant across different overall rates of point earnings, but the distributions of responses to the alternative schedules varied with schedule parameters (Bradshaw, Szabadi, Bevan, & Ruddle, 1979). According to one interpretation of these results, instructions may have generated a performance in which rate of responding was insensitive to variable-interval contingencies, but allocation of responding was sensitive to differences among the concurrent schedules. It would be of interest to design instructions that generated concurrent responding in which the overall rate but not the allocation of responding was sensitive to schedule parameters. Such a demonstration would illustrate how sensitivity can be specific to particular relations between response properties and schedule parameters.

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