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RULE-GOVERNED BEHAVIOR AND SENSITIVITY TO CHANGING CONSEQUENCES OF RESPONDING

STEVEN C. HAYES, AARON J. BROWNSTEIN, ROBERT D. ZETTLE,[1] IRWIN ROSENFARB, AND ZAMIR KORN

UNIVERSITY OF NORTH CAROLINA-GREENSBORO

Humans were presented with a task that required moving a light through a matrix. Button presses could produce light movements according to a multiple fixed-ratio 18/differential-reinforcement-of-low-rate 6-s schedule, with components alternating every 2 min. Moving the light through the maze earned points worth chances on money prizes. In Experiment 1 four conditions were assessed through between-subject comparisons: minimal instructions, instructions to press rapidly, instructions to press slowly, and instructions that sometimes rapid responding would work while at other times a slow rate would work best. Subjects responded in three successive sessions of 32 min each. The results suggested that instructions affected the nature of the contact made with the programmed consequences and thus subsequent performance. In some cases, responding seemed to result from added contingencies introduced by stating rules. In Experiment 2 the relative contribution of these two effects was assessed by presenting and then withdrawing two lights that had been paired with two specific instructions: "Go Fast" or "Go Slow." There were three conditions. In one condition, only the Go Fast light was on; in a second, only the Go Slow light was on; and in a third, the lights alternated each minute. In each condition, half the subjects had all instruction lights turned off after the first session. The results once again showed an effect of instructions on contact with the programmed consequences. However, responding sometimes continued in a manner consistent with added contingencies for rule-following even when the programmed consequences had been contacted and would have controlled a different type of responding in the absence of instructions. The relevance of added contingencies for rule-following in determining the effects of explicitly programmed consequences is emphasized.

Key words: rule-governed behavior, verbal control, contingency insensitivity, multiple schedules, pliance, tracking, button press, humans

Human operant behavior often differs significantly from the behavior of other species. In many situations, human behavior is relatively insensitive to changes in the programmed consequences of responding (Ader & Tatum, 1961; Harzem, Lowe, & Bagshaw, 1978; Matthews, Shimoff, Catania, & Sagvolden, 1977; Shimoff, Catania, & Matthews, 1981); sometimes it shows patterns of schedule performance that differ systematically from those of other animals (Leander, Lippman, & Meyer, 1968; Lowe, Harzem, & Hughes, 1978; Weiner, 1964, 1969); and sometimes human behavior shows greater intersubject variability (Lippman & Meyer, 1967; Lowe, 1979). Some of these differences may be due to the effects of verbal behavior on human performance (e.g., see Baron & Galizio, 1983; Harzem et al., 1978; Lowe, 1983; Skinner, 1969).

Evidence for this "language hypothesis" comes from several findings. Before they acquire language, human infants have been reported to perform like other animals on simple schedules of reinforcement (Lowe, Beasty, & Bentall, 1983). Human behavior is greatly influenced by verbal instructions (see Baron & Galizio, 1983, for a review). In general, human performance is more like that of other animals when the task is indirect or complex and steps are taken to reduce the likelihood of direct verbal involvement in accomplishment of the task (e.g., Lowe, Harzem, & Bagshaw, 1978; Lowe et al., 1978). Compared to shaped

[1] Robert D. Zettle is now at Wichita State University.

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responding, instructed performances are less sensitive to changes in programmed consequences of responding (Matthews et al., 1977; Shimoff et al., 1981). Instructions about the schedules themselves can produce performances that mimic responding of other animals (Baron & Galizio, 1983), but if the programmed contingencies subsequently change, humans tend to persist in the instructed pattern of responding (Hayes, Brownstein, Haas, & Greenway, in press).

There are several accounts of the effect of verbal stimuli in reducing the control exerted over behavior by changes in the programmed consequences of responding (the "insensitivity effect"). One suggestion (Galizio, 1979) is that verbal stimuli generate patterns of responding that preclude effective contact with these changes. Yet insensitivity has been observed even when such contact has been made (Shimoff et al., 1981). Another account suggests that instructions tend to be delivered by others mainly when insensitivity is required (Matthews et al., 1977), and thus "insensitivity is a defining property of instructional control" (Shimoff et al., 1981, p. 207). A third suggestion is that insensitivity to one set of contingencies can be due to additional contingencies brought into play by instructional control. According to this view, the "insensitivity effect" is not a reduction in contingency control but rather an effect of competing contingencies, such as social consequences for rule-following (Hayes, Rosenfarb, Wulfert, Munt, Korn, & Zettle, 1985; Hayes & Wolf, 1984; Rosenfarb & Hayes, 1984; Zettle & Hayes, 1982).

One preparation used to evaluate sensitivity to changes in the programmed consequences of responding has been to develop steady-state responding on a given schedule, and then to change the schedule parameters (e.g., Galizio, 1979; Shimoff et al., 1981). Another has involved the use of multiple schedules (e.g., Baron, Kaufman, & Stauber, 1969). Baron and Galizio (1983) have discussed several advantages of the multiple-schedule procedure, a major one being that this procedure provides a direct and continuous measure of sensitivity to repeated alternations in the programmed consequences of responding.

The present experiments used a multiple schedule; schedule values were selected that made reinforcement contingent upon two very different response rates. Rate-related instructions were given in relation to one or both components. In this way, instructions within the same procedure could lead to different contact with the contingencies.

EXPERIMENT 1

METHOD

Design

Button pushing was reinforced with delivery of points (worth chances on money prizes) according to a multiple fixed-ratio/differential-reinforcement-of-low-rate (FR/DRL) schedule. Subjects were instructed to respond slowly, or quickly, or both slowly and quickly, or they were given no instructions regarding rate of responding. Thus it was possible to assess sensitivity to changes in programmed consequences, which would be expected to produce higher rates of responding or lower rates of responding, as a function of the presence versus absence of rate-related instructions.

Subjects

Subjects were 17 undergraduate college students (both males and females) who received credit in an introductory psychology class for participating.

Apparatus

The experimental apparatus (Figure 1) consisted of a 5 by 5 matrix (8 cm square) of small white lights mounted in a box with a slanted front. This box was mounted above a larger (28 cm wide) slanted-front box, which had two small round lights and a counter along the left side of the front panel, two square lights at the top of the panel, and three buttons at the bottom. The small box in the upper right with the lights labeled "Go Fast" and "Go Slow" was used only in Experiment 2 and will be described later.

The experiment took place in a small room (1.8 m by 2.7 m) that contained a chair, a table, the experimental apparatus, earphones, and a tape player. Electromechanical recording and control equipment was in an adjoining room.

Procedure

Subjects were randomly assigned to one of four groups: Minimal Instructions, Go Slow,

Go Fast, or Accurate Rate Instructions (n = 4 or 5/group). They worked individually for three 32-min sessions, with a 5-min break between each. At the beginning of the first session, all subjects were given the following printed instructions:

> Please read these instructions with me as I say them aloud. This is an experiment in learning, not a psychological test. We are interested in certain aspects of the learning process which are common to all people.
>
> During the session you will be alone in this booth. You should wear these earphones at all times.
>
> When the session begins, the white light that says "ready" will light. When the session is over it will go out. There will be three sessions today, with a short break between each.
>
> Occasionally the small round red light above the ready light will go on. When it does, a push on the middle button will advance the counter one point. Try to see how many points you can get. At the end of this experiment, the subject with the most points in a single session will get $20. The next highest will get $10. The next highest will get $5. You will have three sessions today, and each one will count separately toward the money.
>
> Your getting the small red light to go on involves the buttons and the lights. The red light will go on when the white light in the lower right hand corner of the light panel is lit.

The Minimal Instructions group received no additional instructions regarding rate of responding. The Go Slow group was told:

> Pushes on the buttons with several seconds in between them will work best.

The Go Fast group was told:

> Rapid pushes on the buttons will work the best.

The Accurate Rate group was told:

> The lights just above the buttons are important. When one of them is lit, rapid pushes on the buttons will work the best. When the other is lit, pushes with several seconds in between them will work the best.

Finally, all groups were told:

> If you have any questions, ask them now because during the session the experimenter will not be able to answer any questions.

If the subjects asked questions, they were answered by repeating the relevant part of the instructions. After leaving the room, the experimenter started the session.

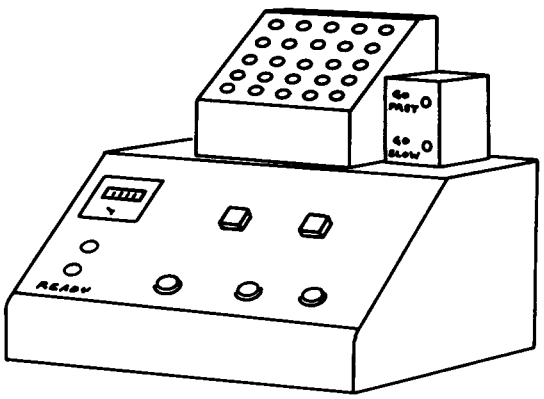

Fig. 1. The apparatus used in Experiment 2. In Experiment 1, the small box with the words "Go Slow" and "Go Fast" was not present.

In pilot testing, this task was found to be sufficiently complex to keep human subjects actively involved. At the beginning of the session, a white light in the upper left corner of the light matrix was lit. Moving the light to the lower right corner depended on pushes of the left and right buttons. Button pushes produced light movements on a multiple DRL 6-s/FR 18 schedule. During the DRL the first button push after 6 s moved the light. If the left button was pushed, the light moved down one row; if the right button was pushed the light moved right one column. During the FR, presses on either the left or right button counted toward a single ratio. If the 18th response was on the left button, the light moved down; if it was on the right, the light moved right. If the light was in the right column, moves further to the right caused the light to reset in the upper left corner. If the light was in the bottom row, moves down also caused a reset. Thus, for example, in the DRL condition any combination of four light movements produced by presses on the left button and four on the right put the light in the lower right corner and lit the small red reinforcer light below the counter. If five light movements were produced by either button, however, the light reset and no points were earned.

The DRL and FR components of the schedule were presented every 2 min according to a randomly determined sequence, the same sequence being presented in all sessions.

Each schedule was operative for eight 2-min intervals each session. While the DRL was in effect, a large square red light above the buttons was lit. While the FR was in effect, a large square orange light above the buttons was lit.

During the session, subjects wore headphones through which music masked extraneous sounds. If subjects did not make any responses in 2 min at the beginning of the first session, the session was stopped and the instructions were read once again. No more than 1 subject in each group received repeated instructions.

After Sessions 1 and 2, subjects were given a short break. When the session began again, they were told:

> We will now begin another session. The instructions are the same as the first time. If you do not remember the instructions, please take a moment to consult your instruction sheet.

Results and Discussion

Because the focus of the project was on the impact of rate-related instructions on different schedules of reinforcement that independently favored highly different rates of responding, the main data of interest are overall rates of responding (on the left and right buttons combined) for each 2-min component of the multiple schedule. These data are shown for each group of subjects in Figures 2 through 5.

In the Minimal Instructions group (Figure 2), by the third session all subjects were responding at different rates on the two schedules, but none obtained more than two points on both schedules. Subjects 1, 2, and 3 obtained points primarily in the FR component, whereas Subject 4 obtained them primarily in the DRL component (see Table 1). Response rates in the final session varied widely across subjects and schedule components. For all subjects, however, rates of responding were higher in the ratio component of the multiple schedule. Only Subject 2 showed large differences in rates of responding under the two schedules (see Figure 2).

In the Go Slow group (Figure 3), 3 subjects (5, 6, & 8) responded at different rates on the two schedules. Four of 5 subjects earned points primarily in the DRL component. Only Subject 7 earned points primarily in the ratio component. During the final session, 3 of 4 subjects in the Minimal Instructions group earned points primarily in the ratio component, and all subjects responded at a higher rate in the ratio component; in contrast, 4 of 5 subjects in the Go Slow group earned points primarily in the DRL component, and 2 of the 5 responded more rapidly during the ratio components. For all subjects who received the Go Slow instructions, rates of responding in the ratio component were below those of 3 of the 4 subjects who received Minimal Instructions.

All subjects in the Go Fast group developed distinct patterns of responding by the end of the third session, with higher response rates during the ratio components of the multiple schedule; 2 subjects earned points only in the ratio component, and the other 2 earned points in both components. In contrast, none of the subjects in the Minimal Instructions group received more than two points in the two components.

In the Accurate Rate Instructions group (see Figure 5 and Table 1), all 4 subjects almost immediately showed distinct responding on the two schedules with higher rates on the ratio component. By the third session, all subjects earned at least 15 points in both components of the multiple schedule.

Previous studies have found relatively little sensitivity to changing consequences of responding when instructions produced high rates (e.g., Baron et al., 1969; Harzem et al., 1978; Matthews et al., 1977) or low rates (Shimoff et al., 1981) of responding. The use of a multiple schedule in this experiment allowed a direct comparison of contingency sensitivity produced by high-rate and low-rate instructions. Responding in the Go Slow condition was particularly insensitive to changes in the schedules. Conversely, 2 of the 4 Go Fast subjects clearly responded effectively in the DRL component, and are the only instructed subjects in Experiment 1 who showed unequivocal control by the changing consequences of responding.

The results appear to show that responding on the schedules was a joint product of current consequences of responding and instructional control. Without instruction, none of the subjects made extensive contact with both types of programmed consequences. One response pattern persisted in both components. One way to describe the effects of instructions is that

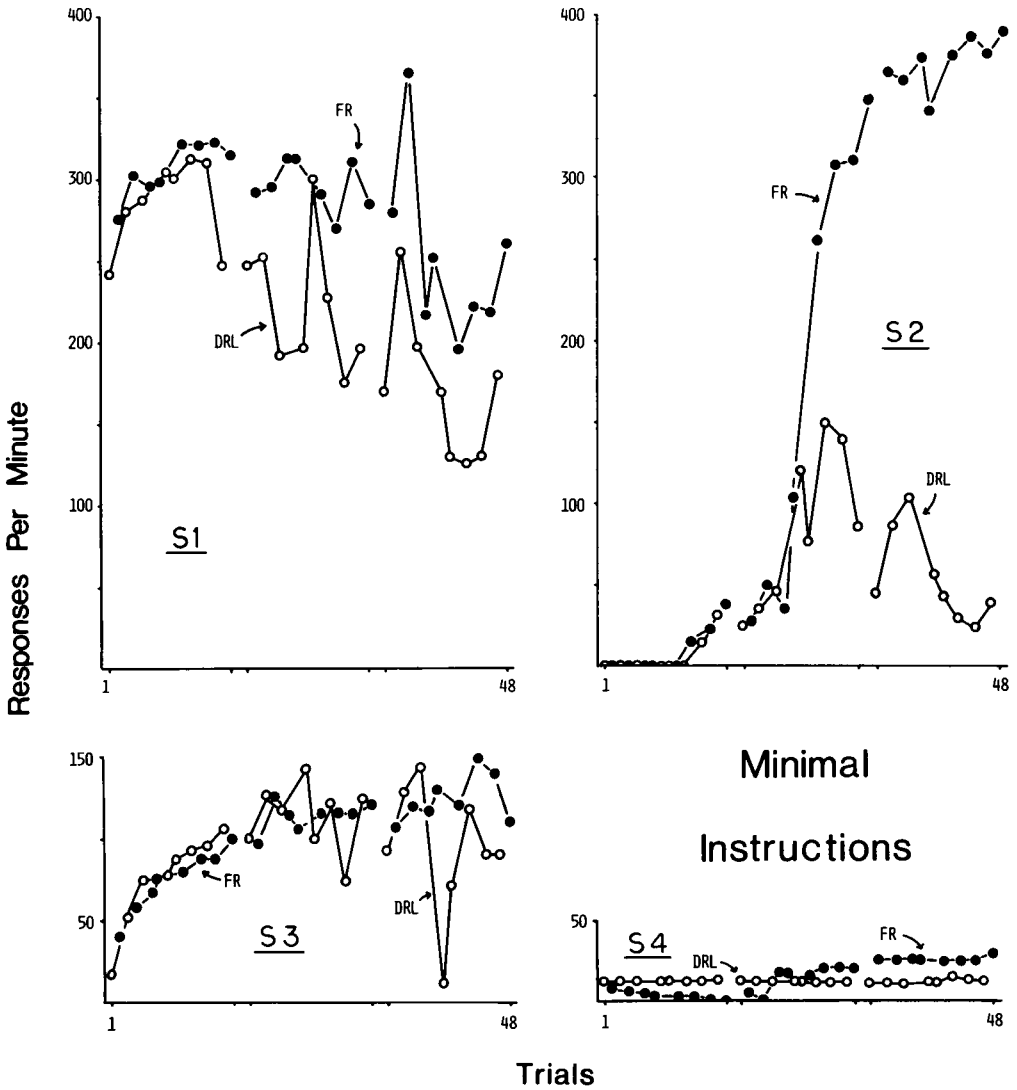

Fig. 2. Rate of responding in successive trials (2-min exposures to FR and DRL contingencies under a multiple schedule) for subjects in the Minimal Instructions group (S1–S4). Breaks in the data indicate session breaks. Filled circles represent responding in the FR; open circles represent responding in the DRL.

they determined the range of behavior, thus influencing whether contact was made with the programmed contingencies. For the Go Slow subjects, following the rule essentially led to a multiple DRL/extinction (EXT). If responding in the non-DRL component was low (as instructed), few movements of the light (and points) were produced and responding in that component extinguished or remained low. If Go Fast subjects followed the rule, they were essentially in a multiple FR/EXT. As responding in the non-FR component declined, light movements (and points) would result from the spaced responding and behavior appropriate to the multiple FR/DRL would be observed.

Although this analysis is plausible, it only partially describes the results. The instructions did not simply alter contact with the programmed consequences. The behavior of some subjects (e.g., Subject 7) made contact with consequences that contradicted the rule specified by the instructions and yet still followed that rule. It is possible that the instructions

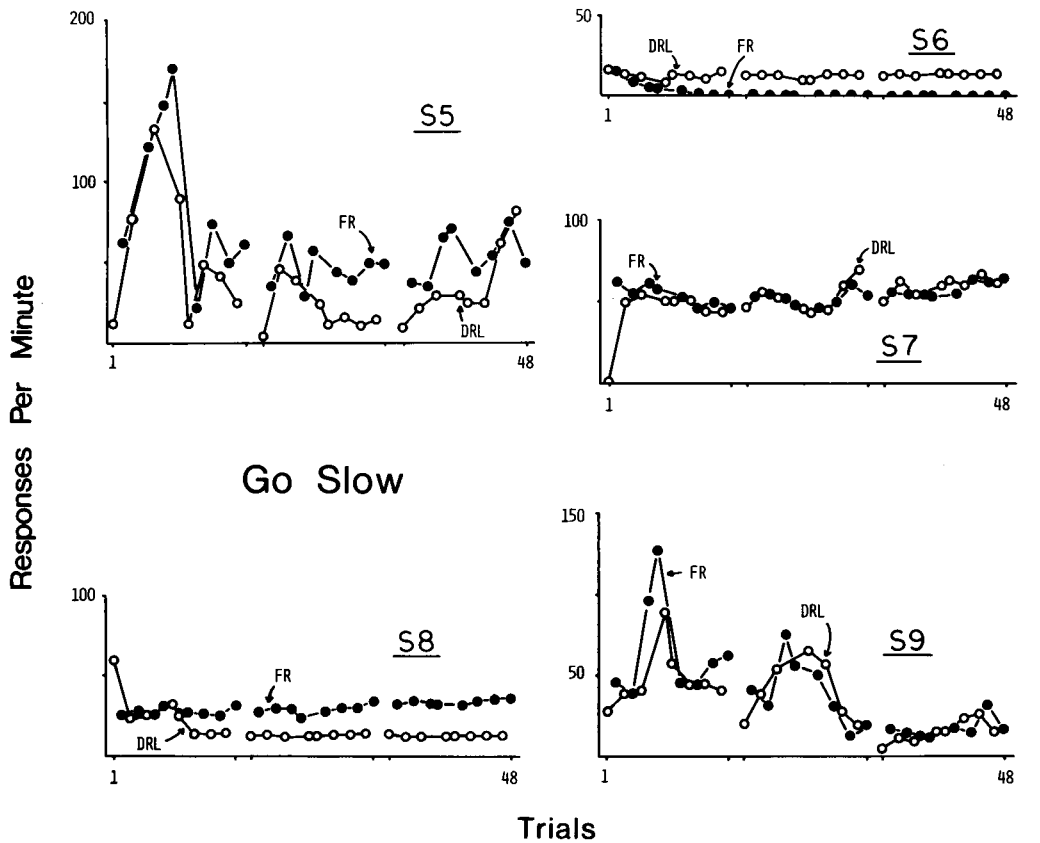

Fig. 3. Rate of responding in successive 2-min exposures to FR and DRL contingencies under a multiple schedule (trials) for subjects in the Go Slow group (S5–S9). Breaks in the data indicate session breaks. Filled circles represent responding in the FR; open circles represent responding in the DRL.

continued to affect responding because of a history of consequences for responding as specified. For example, people undoubtedly have long histories of consequences delivered by the verbal community for "doing what they are told," regardless of the other consequences such responding might produce. Responding controlled by such a history could be little affected by the consequences for responding programmed within a brief experiment, because it has been produced by an entirely different set of contingencies. Several studies in our laboratory (Hayes, Brownstein, Devany, Kohlenberg, & Shelby, 1985; Hayes & Wolf, 1984; Rosenfarb & Hayes, 1984; Zettle & Hayes, 1983) have shown that a variety of therapeutic interventions function only when socially mediated consequences for rule-following are possible.

Experiment 2 attempted to compare instructional effects attributable to two separate sources of control: (1) changes in the range of behavior available to make contact with the programmed consequences, and (2) a history of consequences supplied by the verbal community, contingent upon rule-following. To separate these two sources of control, the experimental strategy was to introduce instructions and later to withdraw them. When an instruction is withdrawn, the history of consequences for responding in compliance with rules should be less a factor. Thus, responding controlled by this history should change. Instructional effects caused by altering the contact between behavior and contingencies, however, should continue after the instructions are withdrawn, so long as the contingencies themselves continue to be in force. It is impossible fully to withdraw instructions. In Experiment 2, however, this was partially accomplished by pairing specific instructions with specific signals. These signals could then

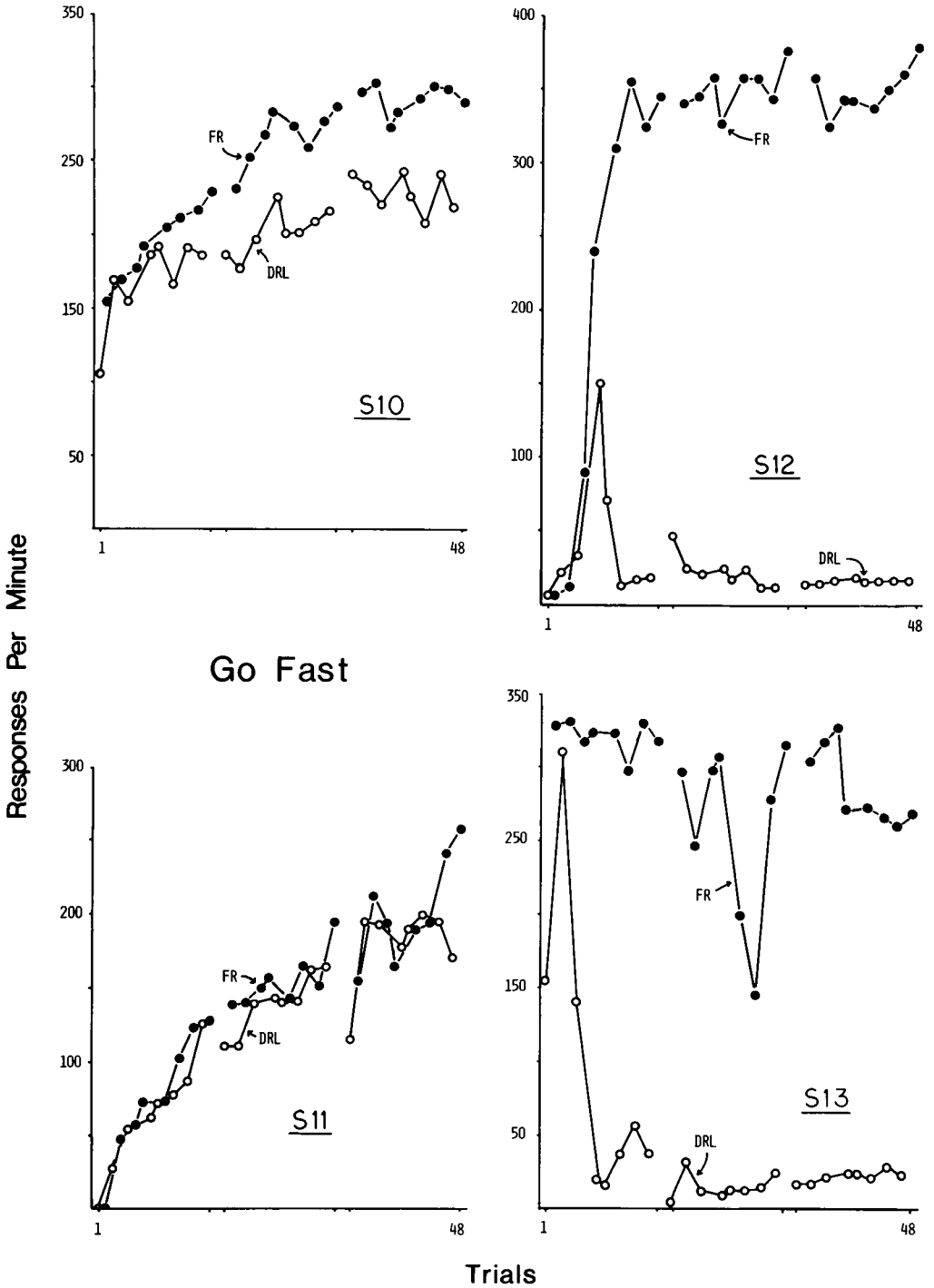

Fig. 4. Rate of responding in successive 2-min exposures to FR and DRL contingencies under a multiple schedule for subjects in the Go Fast group (S10–S13). Breaks in the data indicate session breaks. Filled circles represent responding in the FR; open circles represent responding in the DRL.

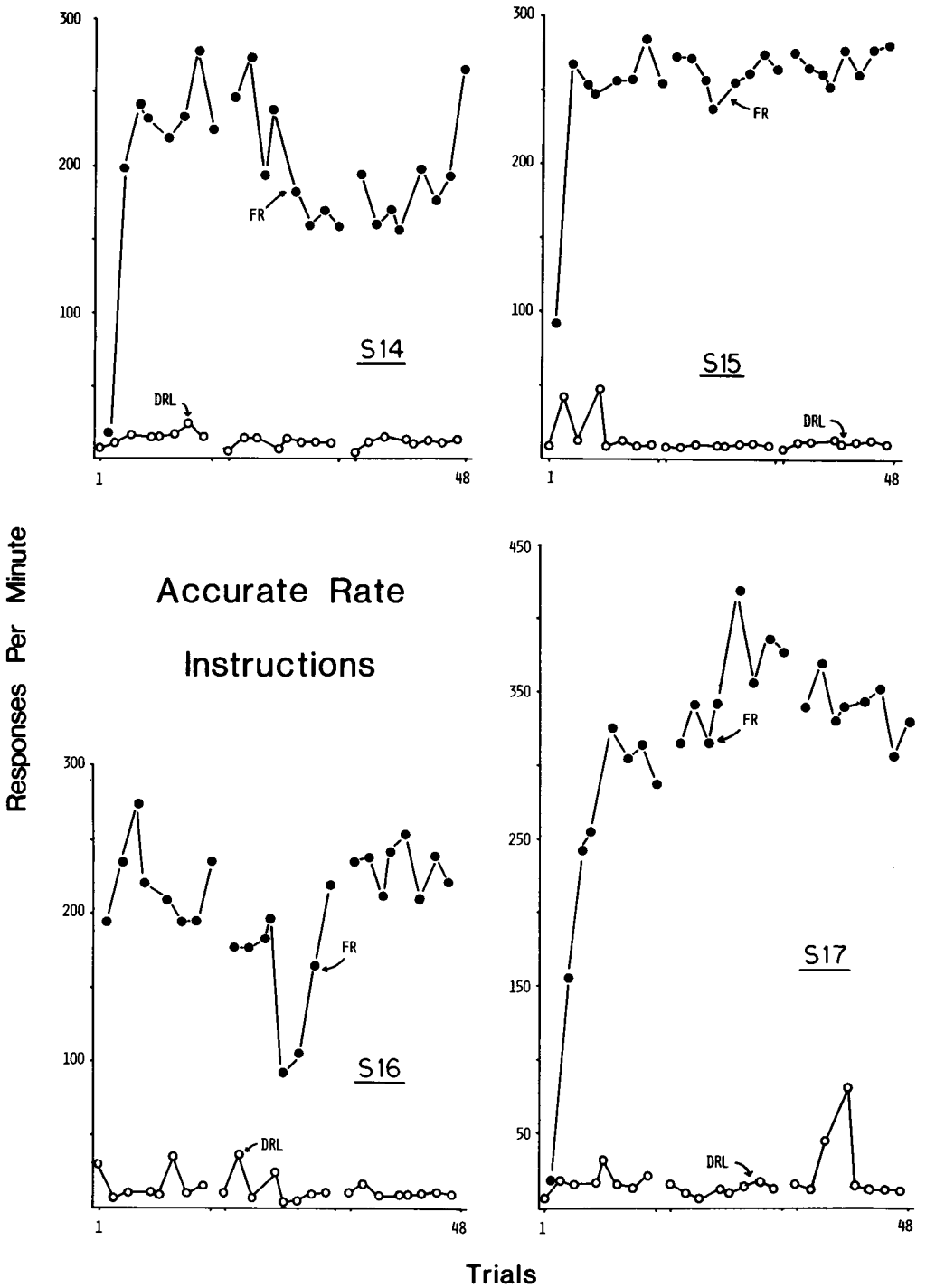

Fig. 5. Rate of responding in successive 2-min exposures to FR and DRL contingencies under a multiple schedule for subjects in the Accurate Rate Instructions group (S14–S17). Breaks in the data indicate session breaks. Filled circles represent responding in the FR; open circles represent responding in the DRL.

Table 1

Total number of points received per session in each schedule for each subject in Experiment 1.

Instructions	Session 1			Session 2			Session 3		
	DRL	FR	Total	DRL	FR	Total	DRL	FR	Total
Minimal Instructions									
S1	0	19	19	0	30	30	0	24	24
S2	2	1	3	1	18	19	2	37	39
S3	0	1	1	0	11	11	2	9	11
S4	17	0	17	23	1	24	22	2	24
Go Slow									
S5	6	7	13	8	4	12	11	2	13
S6	10	0	10	21	0	21	22	0	22
S7	0	5	5	0	5	5	0	6	6
S8	9	2	11	20	1	21	17	2	19
S9	1	5	6	5	6	11	17	3	20
Go Fast									
S10	0	14	14	0	27	27	0	30	30
S11	0	5	5	0	5	5	0	13	13
S12	14	21	35	14	38	52	27	32	59
S13	15	30	45	23	22	45	29	35	64
Accurate Rule									
S14	24	20	44	27	21	48	24	25	49
S15	10	24	34	14	28	42	15	28	43
S16	2	0	2	5	6	11	17	23	40
S17	17	23	40	21	46	67	26	45	71

be presented or withdrawn and the effects on behavior could be noted.

EXPERIMENT 2

METHOD

Subjects

Subjects were 25 additional undergraduate students (both male and female) selected in the same manner as in Experiment 1.

Apparatus and Setting

The setting and apparatus were the same as in Experiment 1, except that immediately to the right of the light matrix box (see Figure 1) was a 10-cm by 5-cm box displaying two large (1.5-cm) round lights: The bottom light was red and had a small (2-cm) sign next to it saying "Go Slow"; the top light was green and said "Go Fast."

Procedure

Subjects worked in the same manner as in Experiment 1, and the same general instructions were used, except that all subjects were also told:

> The best way to push the buttons is rapidly when the green light saying "Go Fast" is lit, and to push them slowly, with several seconds between each push, when the red light saying "Go Slow" is lit.

All subjects were exposed to the same multiple schedule as in Experiment 1 (multiple DRL 6 s/FR 18).

There were six conditions in Experiment 2, depending on the pattern of "Go Fast" and "Go Slow" instruction lights. Two groups each were given only the "Go Slow" light, only the "Go Fast" light, or the "Go Fast" and "Go Slow" lights alternately for 1-min periods so that in each schedule component each instruction light was on half the time. In each of these three conditions, one group had the light(s) lit for all three sessions, and the other for only the first session after which no instruction lights were presented. Subjects were randomly assigned to conditions.

RESULTS AND DISCUSSION

The results for the six groups are shown in Figures 6 through 11. Of most importance are the comparisons between presentations of an

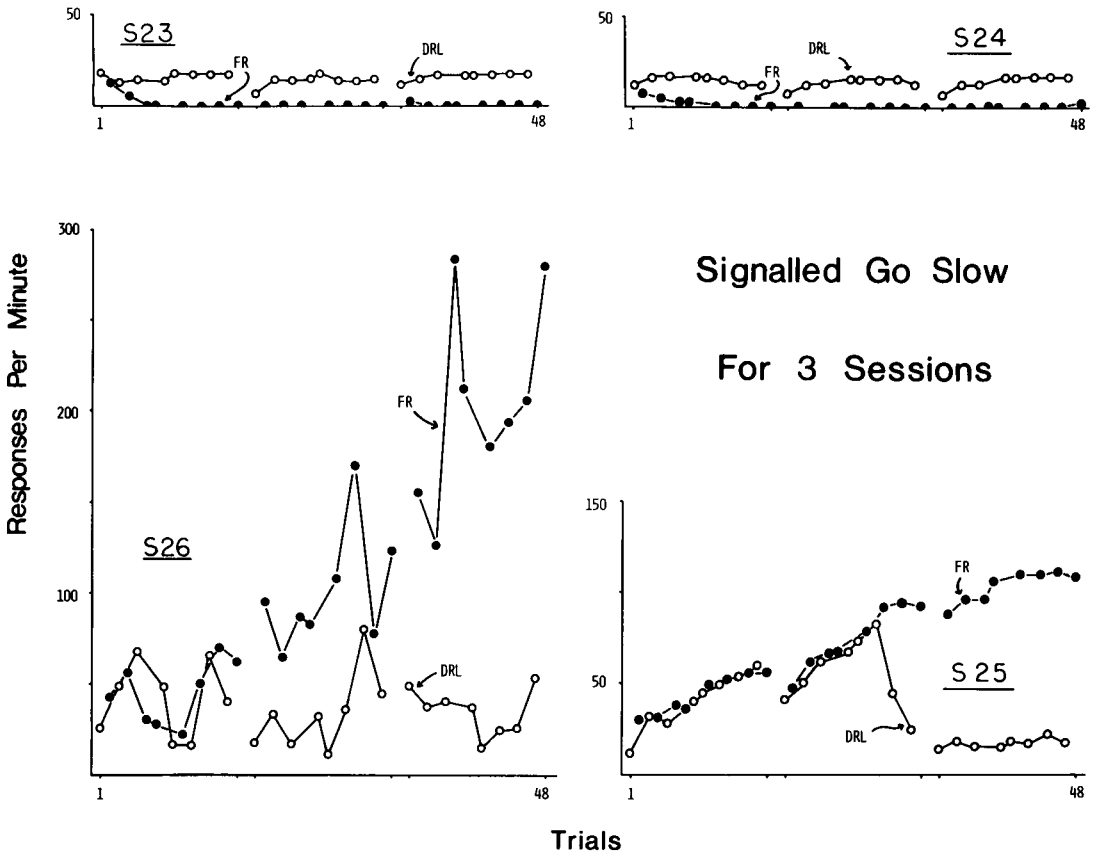

Fig. 6. Rate of responding in successive 2-min exposures to FR and DRL contingencies under a multiple schedule for subjects in the Signaled Go Slow–Three Sessions group (S23–S26). Breaks in the data indicate session breaks. Filled circles represent responding in the FR; open circles represent responding in the DRL.

instruction condition for one session and its presentation for three sessions. If no differences are seen, effects initially due to the rule are apparently maintained by the point contingency. If large differences are seen, additional consequences present only when rules are in effect may be implicated. Evidence for both types of effects was found.

Go Slow Conditions

The Signaled Go Slow–Three Sessions subjects (23–26) showed two response patterns (see Figure 6 and Table 2). Subjects 23 and 24 both started at very low rates. They quickly made contact with the DRL component. As indicated in Table 2, no points were earned in the FR component and, like Subject 6 in Experiment 1, both subjects soon stopped responding altogether on the FR component. Subjects 25 and 26 both showed gradual increases in rate, followed by clear differential responding in the two components.

Performances of subjects in the Signaled Go Slow–One Session condition (31–34) looked similar to those of subjects in the corresponding three-session condition (see Figure 7 and Table 2). Two subjects showed low-rate performance throughout (31 & 32), while another shifted to high-rate FR responding in the middle of the third session (33). Only Subject 34 showed a change in the second session after the rule was withdrawn. This subject, like Subject 26 in the Three Session group, showed early moderate-rate responding in the first session, which was sufficiently rapid to be reinforced in the FR component.

Subjects in both Go Slow groups showed increasingly differentiated rates of responding across sessions. The control exerted by the instructions was quite strong, especially given

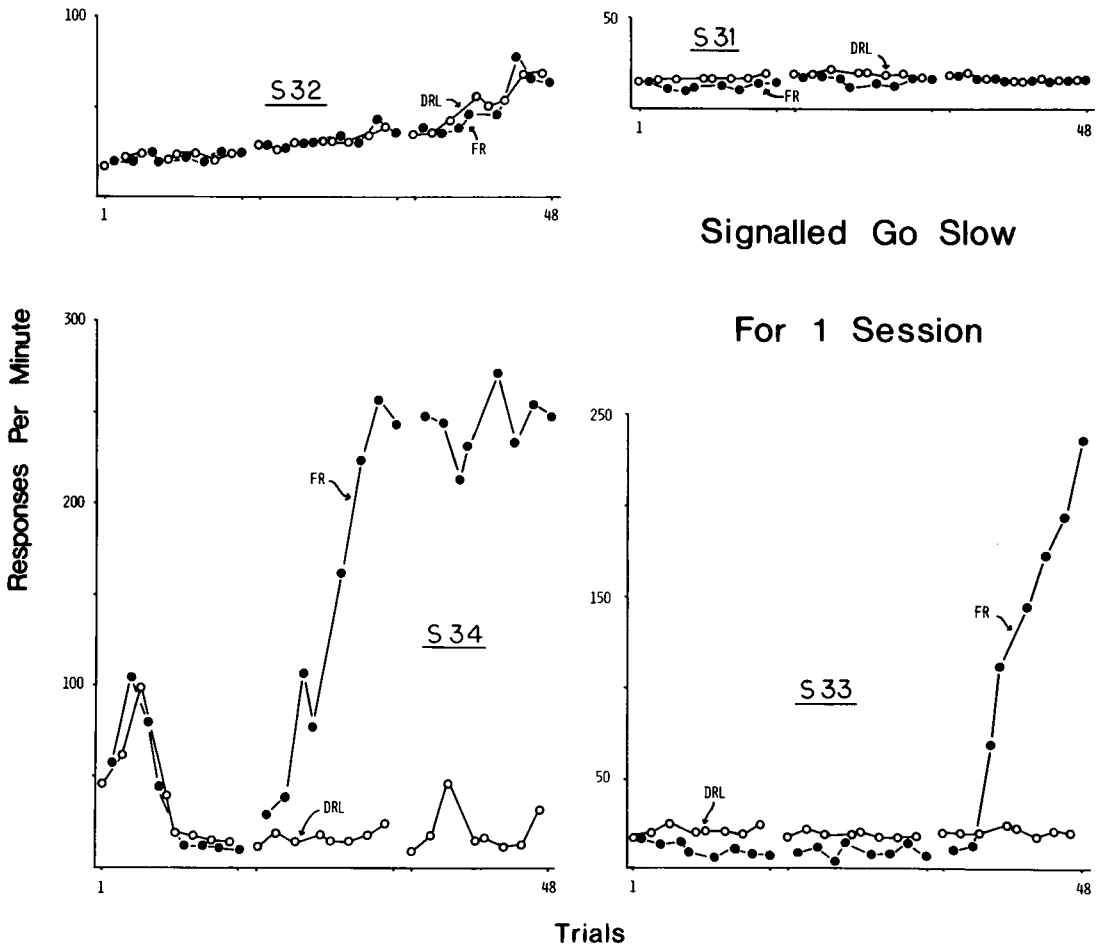

Fig. 7. Rate of responding in successive 2-min exposures to FR and DRL contingencies under a multiple schedule for subjects in the Signaled Go Slow–One Session group. Breaks in the data indicate session breaks. Filled circles represent responding in the FR; open circles represent responding in the DRL.

that both the instructions and the instruction lights listed the two rate alternatives (like the Accurate Rule condition and unlike the Go Slow condition in Experiment 1). The 3 subjects with the most responses in Session 1 (25, 26, & 34) all showed differential responding on the schedules by Session 3. None of the 3 slowest subjects in Session 1 (23, 24, & 31) did so. Thus, if the Go Slow instruction generated very low rates, insensitive performances resulted even after the instruction was withdrawn. In cases where that instruction did not generate low rates, sensitivity to the schedules emerged even if the instruction was maintained. Only Subject 34 showed any indication that removal of the instruction light resulted in increased control by the programmed consequences, and this is balanced against the fact that similar patterns were shown by a subject in the Go Slow–Three Sessions group.

Go Fast Conditions

All individuals except Subject 30 within the signaled Go Fast–Three Sessions condition showed different rates of responding in the two schedules (see Figure 8). In 2 of the subjects (27 & 29), different rates of responding appeared before the end of the first session. Only Subject 30 showed a high rate of responding under both schedules across all three sessions.

Subjects in the condition in which the Go Fast signal was on only for the initial session

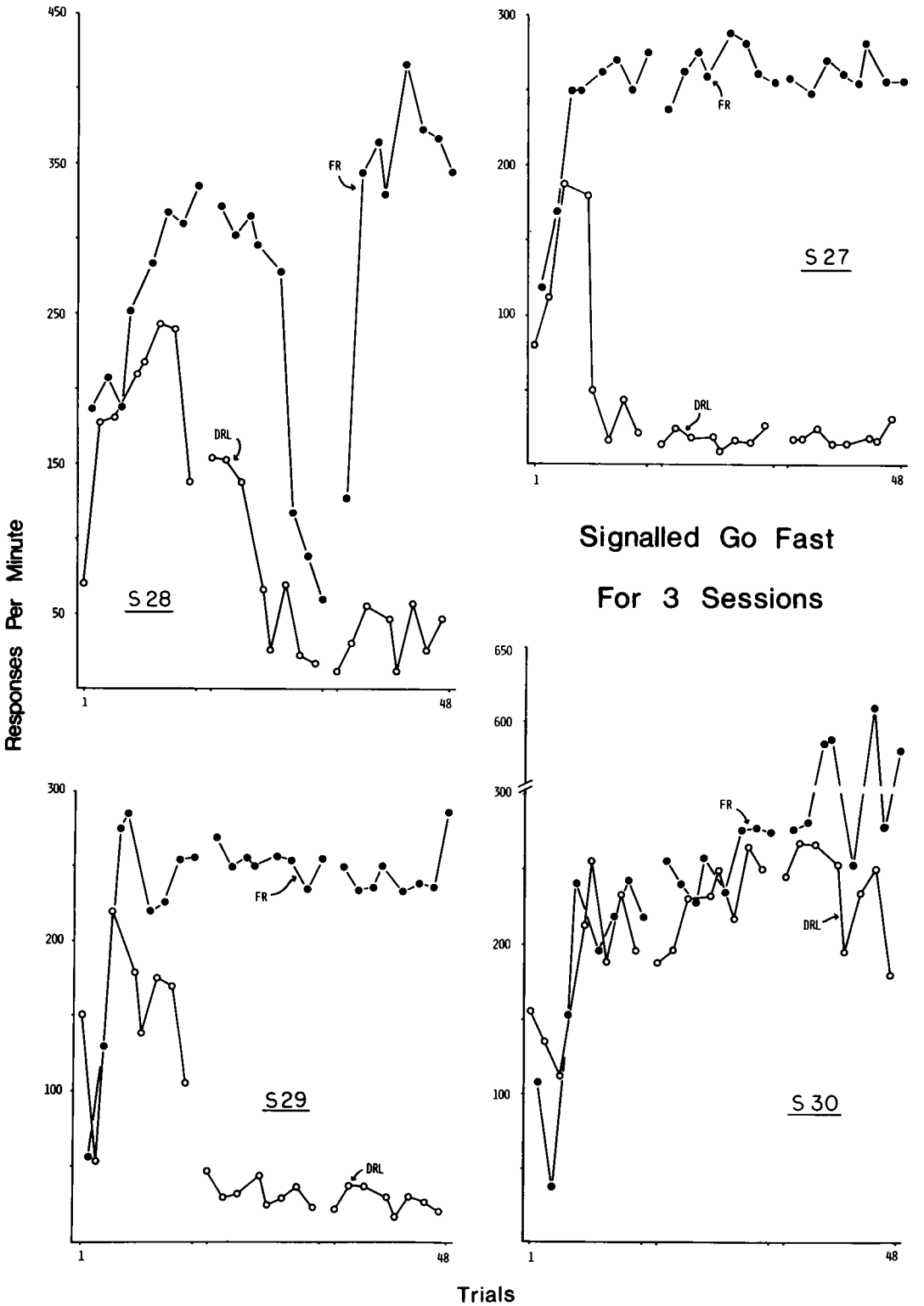

Fig. 8. Rate of responding in successive 2-min exposures to FR and DRL contingencies under a multiple schedule for subjects in the Signaled Go Fast–Three Sessions group (S27–S30). Breaks in the data indicate session breaks. Filled circles represent responding in the FR; open circles represent responding in the DRL.

Table 2

Total number of points received per session in each schedule for each subject in Experiment 2.

	Session 1			Session 2			Session 3		
Instructions	DRL	FR	Total	DRL	FR	Total	DRL	FR	Total
Signaled Go Slow									
3 sessions									
S23	24	0	24	27	0	27	28	0	28
S24	26	0	26	26	0	26	26	0	26
S25	1	4	5	7	7	14	24	12	36
S26	9	4	13	21	11	32	19	23	42
Signaled Go Slow									
1 session									
S31	23	0	23	31	1	32	29	0	29
S32	8	3	11	1	2	3	0	5	5
S33	25	2	27	29	1	30	26	13	39
S34	10	6	16	23	16	39	25	25	50
Signaled Go Fast									
3 sessions									
S27	11	22	33	23	27	50	24	27	51
S28	0	15	15	12	10	22	26	47	73
S29	3	22	25	15	26	41	19	23	42
S30	1	15	16	0	26	26	0	29	29
Signaled Go Fast									
1 session									
S35	0	1	1	0	1	1	0	2	2
S36	15	18	33	31	23	54	31	25	56
S37	1	28	29	4	35	39	30	33	63
S38	2	6	8	0	20	20	20	10	30
Signaled Fast & Slow									
3 sessions									
S18	0	4	4	0	5	5	1	1	2
S19	6	12	18	8	15	23	8	13	21
S20	13	13	26	16	13	29	16	14	30
S21	0	5	5	14	14	28	14	12	26
S22	11	8	19	15	4	19	13	30	43
Signaled Fast & Slow									
1 session									
S39	9	4	13	26	20	46	24	26	50
S40	3	5	8	21	20	41	27	35	62
S41	1	13	14	27	26	53	25	26	51
S42	13	3	16	30	19	49	29	25	54

showed rates of responding (Figure 9) very similar to those for subjects in the Go Fast condition for three sessions. Three of the 4 subjects (36, 37, & 38) showed evidence of schedule control by the end of the first session. The other subject (35) gained very few points (a total of four for all sessions) and responded at a uniformly high rate on both schedules across all three sessions.

The removal of the instruction light did not result in increased control by the different schedules of programmed consequences. As in the Go Fast group in Experiment 1 and in the Go Fast–Three Sessions group in this experiment, sensitivity to the changing schedules was already evident while the instructions were present.

Go Fast/Go Slow Conditions

A fairly consistent pattern of responding was obtained when the Go Fast and Go Slow signals were alternated for all three sessions (see Figure 10). All subjects, with the exception of Subject 22 late in the third session, showed control by the instruction signals. That is, they responded at rapid and slow rates to the Go

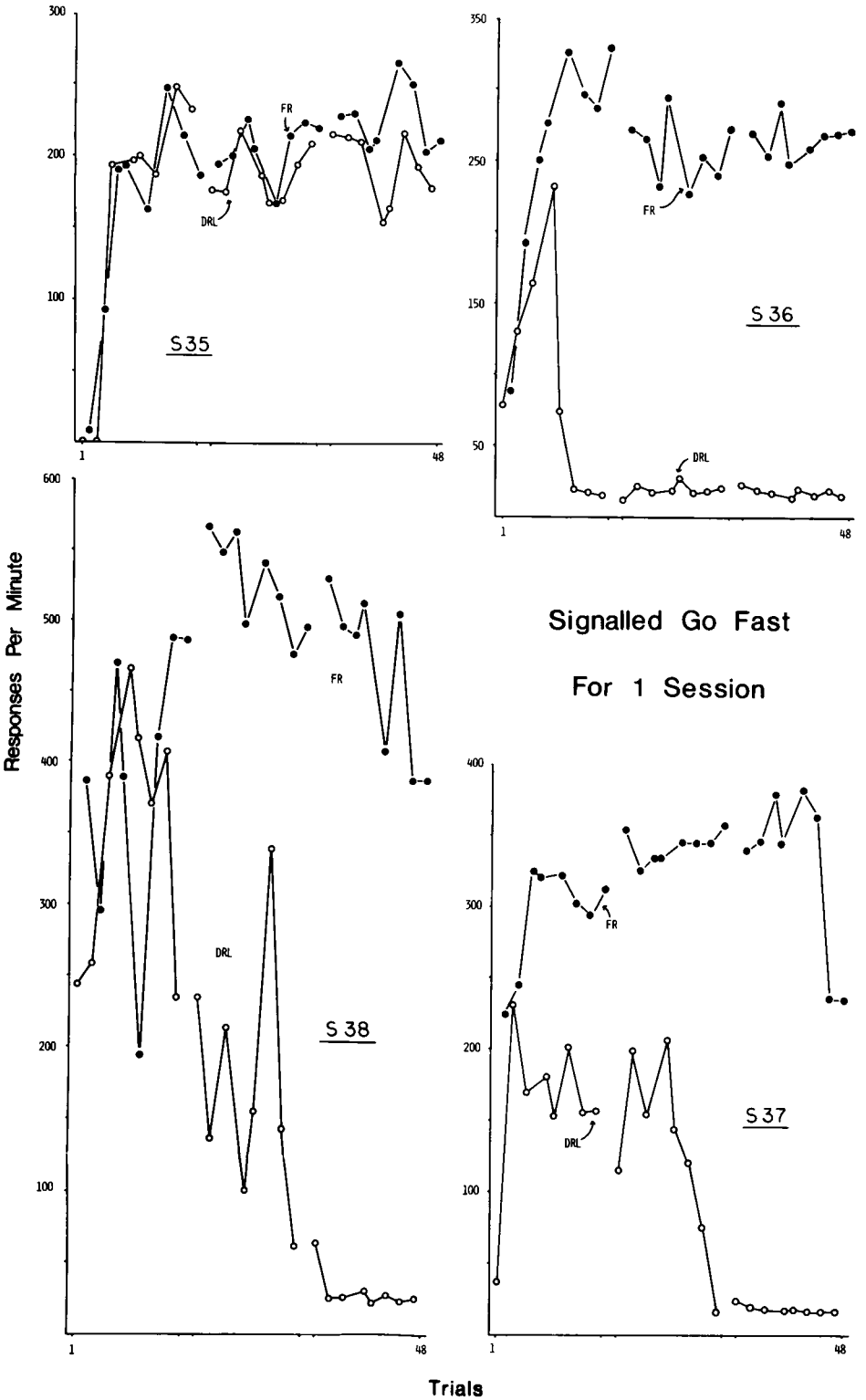

Fig. 9. Rate of responding in successive 2-min exposures to FR and DRL contingencies under a multiple schedule for subjects in the Signaled Go Fast–One Session group (S35–S38). Breaks in the data indicate session breaks. Filled circles represent responding in the FR; open circles represent responding in the DRL.

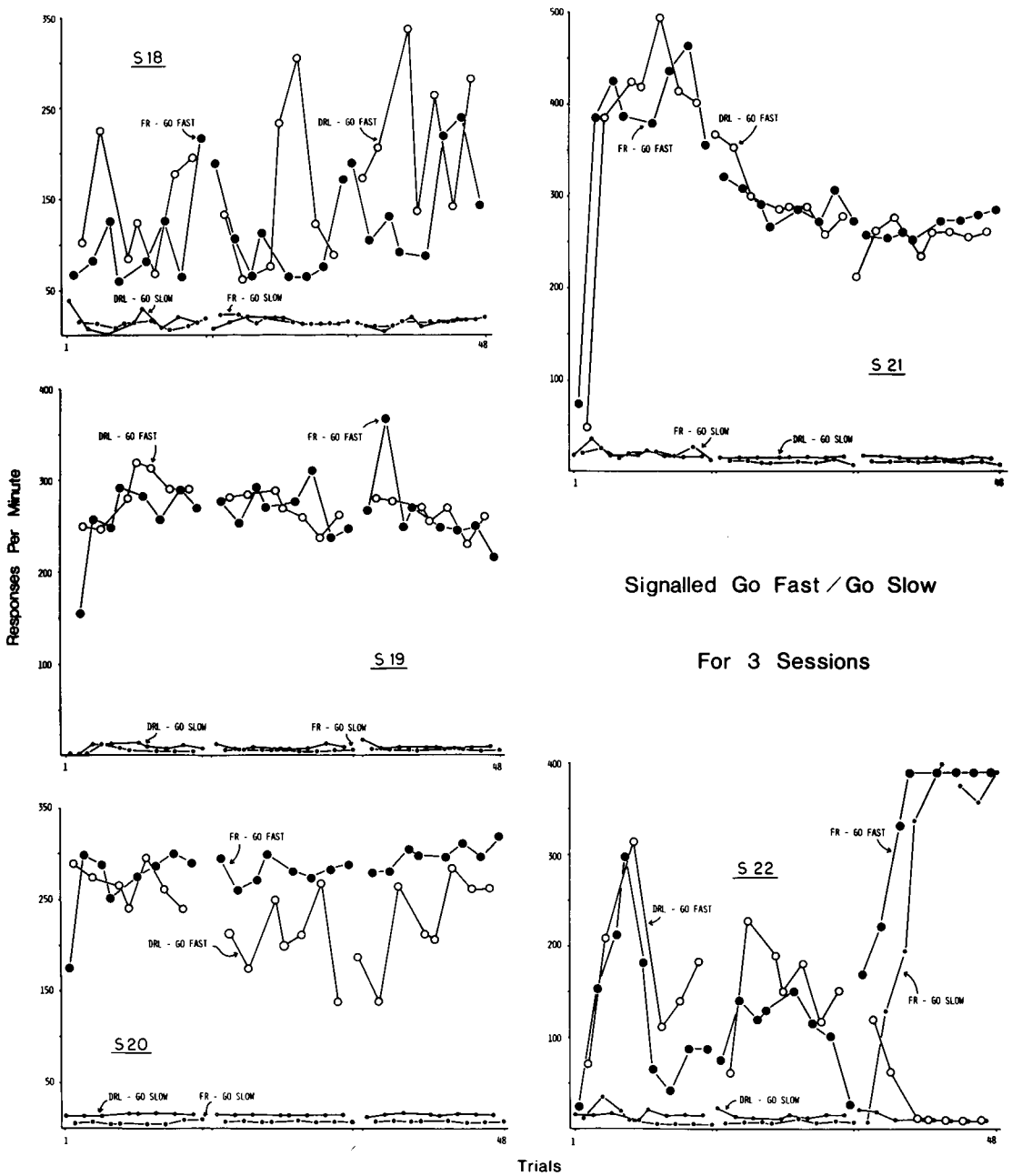

Fig. 10. Rate of responding in each 2-min component (trial) of a multiple schedule using FR and DRL contingencies for subjects in the Signaled Go Fast/Go Slow–Three Sessions group (S18–S22). Breaks in the data indicate session breaks. Filled circles represent responding in the FR; open circles represent responding in the DRL. Large circles represent data when the "Go Fast" light was on; small circles represent data when the "Go Slow" light was on.

Fast and Go Slow signals, respectively, regardless of which schedule component was operative. The majority of points obtained by all subjects in this condition occurred when the signal lights matched the schedule in operation.

Response rates for subjects who were exposed to the Go Fast–Go Slow alternating signals for only one session differed from those in the previous group (see Figure 11). All 4 subjects showed control by the instruction lights for the initial session in which they were

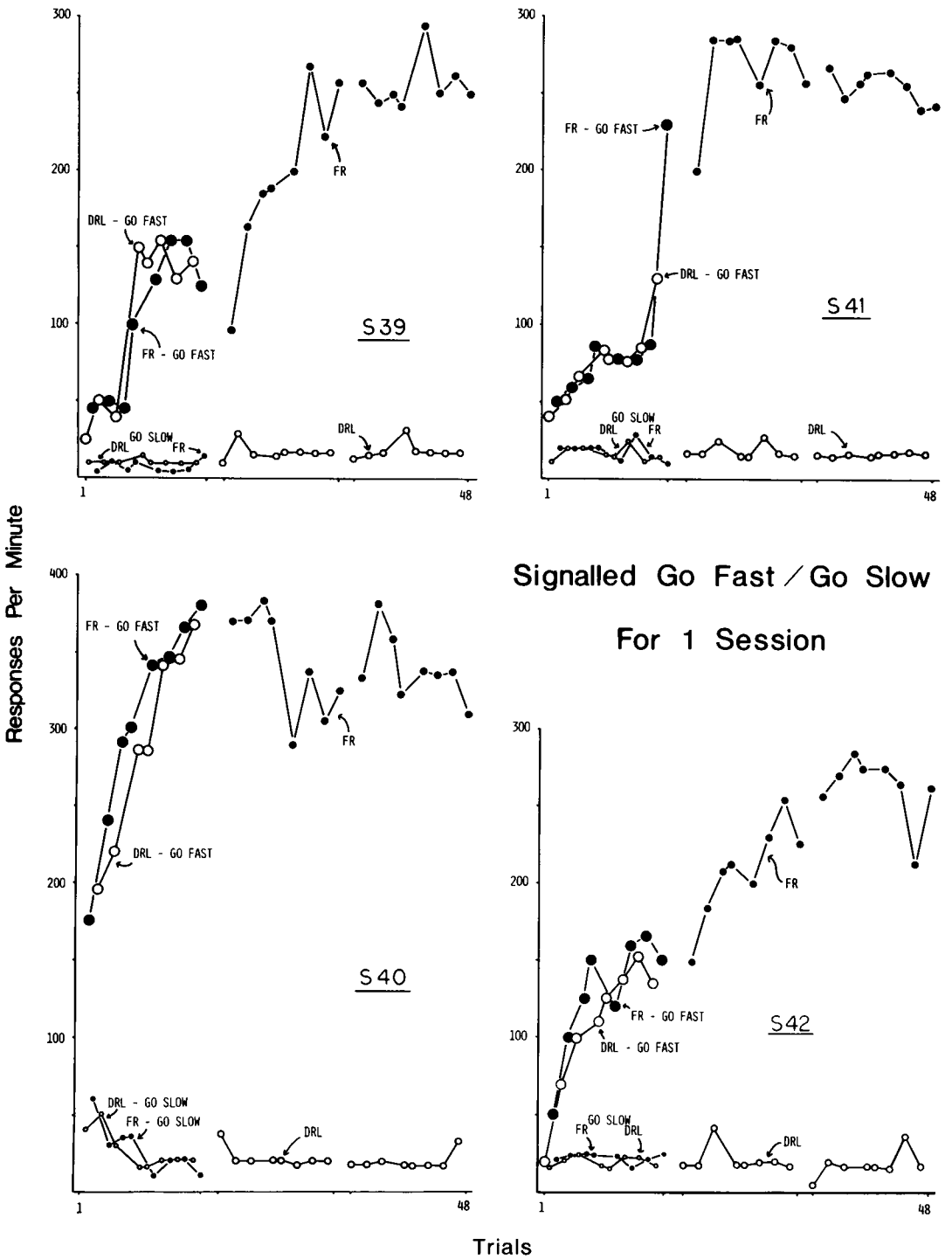

Fig. 11. Rate of responding in each 2-min component (trial) of a multiple schedule using FR and DRL contingencies for subjects in the signaled Go Fast/Go Slow–One Session group (S39–S42). Breaks in the data indicate session breaks. Filled circles represent responding in the FR; open circles represent responding in the DRL. Large circles represent data when the "Go Fast" light was on; small circles represent data when the "Go Slow" light was on.

operative. When the lights were removed, all subjects immediately displayed schedule control. For example, all showed response rates in the first 2-min DRL component after the instruction lights were turned off that approached those seen at the end of the third session. An analysis of the temporal patterns during which subjects obtained points in the first session indicates that, with very few exceptions, points were obtained when the instructional lights matched the schedule components. The control exerted by the signal lights thus ensured contact with both schedule components. It was only after the instruction lights were removed that differential rates of responding appropriate to the schedule components appeared.

In summary, when the instruction produced only partial contact with the point contingency, as in the Go Slow or the Go Fast conditions, removing the prompting light did not increase the control exerted by the programmed point contingency. When the instruction ensured contact with both components of the schedule, however, control by the point contingency was masked by effects of the instruction light. The point contingency exerted strong control over behavior only when use of the instruction light was discontinued.

GENERAL DISCUSSION

The present studies show that (a) instructions affect the range of behavior available to make contact with the programmed contingencies, and (b) instructional prompts can override or modify control by the programmed contingencies. Button pressing in the present case simultaneously participated in three sets of relations: pressing for points and two types of rule-following. The actual rate and pattern of button pressing was the result of an interaction between these three sets of relations.

It is possible to identify at least two sets of contingencies that may establish functionally distinct classes of rule-governed behavior (there may be additional classes as well; see Hayes, in press; Zettle & Hayes, 1982). In the first, rules are followed because of a past history of a correspondence between the rule and natural (i.e., nonarbitrary) contingencies, both social and nonsocial. This type of rule-following is termed *tracking* (to denote following a verbally established path) and a rule that functions in this way is termed a *track* (Zettle & Hayes, 1982). For example, if following the rule, "The way to get to Boston is to follow Route 1," makes it more likely that the listener will get to Boston, and if getting to Boston is a reinforcing event, then getting to Boston by following this rule will make it more likely that the listener will follow similar tracks from similar rule-givers in the future. In the present case, tracking may have altered the behavior available to make contact with the programmed contingencies.

Behavioral effects are produced by the contacted contingencies, not by programmed contingencies (Anger, 1956; Herrnstein, 1970; Skinner, 1938). When instructions determine the initial form of behavior, they may determine the actual reinforcement contingencies. The resulting behavior may differ from what would be observed with the same programmed contingencies in the absence of instructions. The present results, however, show effects that cannot be explained solely on the basis of this analysis. It is necessary to examine the ways in which instructions may establish additional contingencies which then compete with programmed point contingencies.

This second type of rule-following can be called *pliance*. In pliance, a rule is followed because of a past history of socially mediated reinforcement for a *correspondence* between similar rules and relevant behavior. The rule itself is termed a *ply*. Reinforcement of pliance requires that members of the verbal community discriminate the presentation of a rule and discriminate the occurrence of behavior in correspondence with the rule. Reinforcement of pliance is arbitrary in the sense that it is the correspondence between the ply and behavior that leads to reinforcement, not the terminal behavior alone. This should be distinguished from tracks that specify social consequences for behavior when a rule–behavior correspondence is not the source of reinforcement.

The presence of pliance was shown most clearly with the subjects in the two Signaled Go Fast/Go Slow conditions in Experiment 2. In the Signaled Go Fast/Go Slow–One Session condition, moment-to-moment applicability of the rule was eliminated by discontinuing use of the instruction lights. Thus, rule–behavior correspondence could no longer

be reinforced. Subjects undoubtedly have a long history with respect to such situations. When the rule no longer functioned as a ply, subjects immediately showed schedule-typical behavior. In the present experiments, no social reinforcers for pliance were presented, but pliance is a class of rule-following that can be invoked whenever a prior history of socially mediated consequences for a rule–behavior correspondence is the source of the effects seen, whether or not they are immediately present.

Thus, the same topographical behavior may be an instance of three distinct operants: pliance, tracking, or purely contingency-shaped behavior directly controlled by delivery of points. In many cases, all three response classes could be present to some degree. For example, the rules presumably functioned to some degree as plys for all subjects in Experiment 2, not just those in the Go Fast/Go Slow groups.

The pliance/tracking distinction is consistent with some literature in social psychology (e.g., Deutsch & Gerard, 1955), showing that instructional procedures often lose their effectiveness when the possibility of access to the rule by an audience is completely removed. In behavior therapy, "coping self-statements" are known to be of some effectiveness in modifying avoidance when those statements are delivered publicly by a therapist (Meichenbaum, 1972). If, however, it is discriminable to subjects that no one, not even their therapist, can ever know the exact coping instructions given, the effects disappear (Hayes & Wolf, 1984; Rosenfarb & Hayes, 1984; Zettle & Hayes, 1983). Similar effects have been shown with goal-setting and self-reinforcement procedures (Hayes et al., 1985) and even with modeling (Rosenfarb & Hayes, 1984). Apparently human subjects are very sensitive to stimuli that accompany social consequences of behaving in conformity with publicly presented antecedent stimuli. This suggests that in research on humans' operant behavior, we must be very careful about the possible social dimensions of verbal manipulations. For example, the differential effects of shaped versus experimenter-given rules (Catania, Matthews, & Shimoff, 1982) could be due not to shaping but to the differential social contingencies that may surround publicly declared rules that are supposedly self-generated as opposed to those manded by others.

While pliance is readily distinguished from contingency-shaped behavior, because of the correspondence between the rule and relevant behavior, tracking is distinguishable from direct contingency control because the controlling antecedent is a verbal stimulus. Research on equivalence classes (e.g., Sidman, Rauzin, Lazar, Cunningham, Tailby, & Carrigan, 1982; Sidman & Tailby, 1982) indicates that humans respond to symbolic relations in special ways, and thus there may be important differences between control exerted by symbolic as opposed to other stimuli. Recent evidence indicates that stimuli participating in equivalence classes can acquire discriminative or conditioned reinforcing effects without direct training when other members of the class are given these functions (Hayes et al., 1985). It might be worthwhile to think of "rules" as discriminative or establishing stimuli that exert this control in part because of their participation in equivalence classes established by the verbal community. Indeed, this may be what it means to "specify" a contingency. Because of the ubiquitous presence of symbolic stimuli, it may be that *purely* contingency-shaped behavior is rarely found in verbal humans.

A multiple FR/DRL schedule is one of the more extreme preparations in which to examine the effects of instructions because under this schedule two very different response patterns lead to points. This has notable advantages. It is possible to use instructions that impact on one aspect of the multiple and thus provide a continuous measure of the effects of instructions. Because the response patterns are so different, the subject's behavior is likely to come into contact with the inaccuracy of particular instructions—a condition that has been said to be required before instructional control will be abandoned (Kaufman, Baron, & Kopp, 1966).

Abandonment of control by instructions in our study required inaccuracy, contact with the inaccuracy, weakening of pliance, and an extended period of ineffective responding controlled by the rule. When rules were accurate (e.g., in the Accurate Rule condition in Experiment 1), they were followed indefinitely, as would be expected. All other rule conditions in the present experiments were to some degree inaccurate. Subjects who made contact with the inaccuracy in the most salient way were most likely to abandon control by the

rule. For example, subjects who responded at a fairly rapid rate when given a Go Slow instruction made contact with the inaccuracy of the rule when reinforcement occurred in the FR component; thus, they were subsequently more likely to show responding that was sensitive to the programmed consequences. The results in Experiment 2 also show that contact with the inaccuracy of rules was not, alone, enough to weaken pliance. The contact had to occur over an extended period. In Experiment 2, subjects in all groups could, by following the rule, receive point reinforcers about half of the time. Pliance weakened more in the Go Slow or Go Fast groups, however, which had more extended periods (2 min) during which responding in accord with the rule was ineffective in producing points, than in the Go Fast/Go Slow groups, where periods of receiving points due to rule-following were not longer than about 1 min. Failure to discriminate the inaccuracy of the instructions cannot explain the pliance of the Go Fast/Go Slow subjects to those instructions because their performance changed immediately when the instructions were removed.

Studies of the effects of rules on the listener may provide an important new avenue to studying verbal behavior more generally. The power of verbal control suggests that verbal stimuli should not be deliberately used without serious consideration of their long-term effects (see Catania, 1984, for a discussion of this issue). The pervasiveness of verbal stimuli would appear to allow rules to exert profound control over human action.

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