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INSTRUCTIONS AS DISCRIMINATIVE STIMULI

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Four undergraduates were exposed to a fixed-ratio schedule under an instruction to respond slowly and to a differential-reinforcement-of-low-rate 5-s schedule under an instruction to respond rapidly. Following this, a fixed-interval schedule was in effect under those same two sets of instructions. For 3 of 4 subjects, response rates were higher with the instruction to respond slowly than with the instruction to respond rapidly during the fixed-interval schedule. For the remaining subject, low-rate responding with the instruction to respond rapidly continued during the first 17 reinforcements of the fixed-interval schedule. Such control by instructions was not observed for other subjects exposed only to a fixed-interval schedule, with or without instructions. The results demonstrate that the effect of instructions can be altered by contingencies and suggest that instructions can function as discriminative stimuli.

Key words: instructions, discriminative stimulus, behavioral history, fixed-interval schedules, screen touch, humans

Instructions may be structurally defined as stimuli that consist of words used in a verbal community of the listeners, and as antecedents of the behavior of listeners. Functionally, in contrast, instructions have been considered to be discriminative stimuli (e.g., Skinner, 1969). Although several investigators have argued that some functions of instructions are not easily classified as discriminative, they also accept that instructions can function as discriminative stimuli (e.g., Schlinger, 1993). However, has the discriminative function of instructions been demonstrated clearly?

Catania (1991) defined discrimination as any difference in responding in the presence of different stimuli and described any stimulus having such a discriminative function as a discriminative stimulus. Although this seems to be accepted generally as a functional definition of discriminative stimuli, it is too broad. That is, according to this definition, stimuli in the presence of which a response is more probable than in its absence are regarded as discriminative stimuli, regardless of their origin. Because functions of stimuli established by differential reinforcement may be different from those of stimuli established without such histories (Baron, Kaufman, & Stauber, 1969; Galizio, 1979; S. C. Hayes, Brownstein, Haas, & Greenway, 1986; S. C. Hayes, Brownstein, Zettle, Rosenfarb, & Korn, 1986), a distinction between them seems necessary. Thus, the following definition may be more valid: A discriminative stimulus is a stimulus in the presence of which a response is highly probable, and the increase in response probability occurs because that response has been differentially reinforced in the presence of the stimulus (Schlinger, Blakely, Fillhard, & Poling, 1991). As a restricted usage, Catania (1991) also defined discrimination as a difference in responding resulting from differential consequences of responding in the presence of different stimuli. Some stimuli, however, function like discriminative stimuli, but not because of differential reinforcement. Instead, their discriminative-like function results from what have been called *contingency-specifying stimuli* (Schlinger & Blakely, 1987) or *function-altering stimuli* (Schlinger, 1993).

Considerable research has been devoted to analyzing the influence of instructions on human operant behavior (see reviews by Baron & Galizio, 1983; Kerr & Keenan, 1997; Vaughan, 1989). With the exception of Galizio (1979), however, the discriminative function of instructions has not been examined experimentally. Galizio attempted to demonstrate that instructions can function as discriminative stimuli by showing that instructions possess some properties shared by discriminative stimuli. He confirmed that re-

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sponding controlled by instructions (i.e., instructional control) was extinguished when responding led to aversive consequences (Experiment 2), that the instructional control was under control of conditional stimuli (Experiment 3), and that those instructions functioned as conditioned reinforcers (Experiment 4). Although in Galizio's experiments, instructions shared those properties with discriminative stimuli, the instructions do not meet the criterion of the preferred functional definition of a discriminative stimulus given above (Schlinger et al., 1991). That is, the instructional control was not established by a history of differential reinforcement in the presence of the instructions.

Because instructions usually control behavior specified by the instructions prior to the start of the experiment, the development of instructional control may be difficult to demonstrate. Thus, establishing novel instruction–behavior relations may be one resolution. If differential reinforcement can establish instructional control that has not been observed prior to the experiment, this would support the view that instructions can function as discriminative stimuli.

The present study attempted to establish novel instructional control by differential reinforcement. Instructions and behavior topographically opposite to that specified by the instructions were selected as elements of a novel instruction–behavior relation. Such instructions seemed unlikely to control topographically opposite behavior unless a particular history were given. That is, many studies have shown that behavior can be controlled by being told what to do unless the behavior led to aversive consequences (e.g., Baron et al., 1969; Buskist & Miller, 1986; Galizio, 1979; Hackenberg & Joker, 1994; S. C. Hayes, Brownstein, Haas, & Greenway, 1986; S. C. Hayes, Brownstein, Zettle, Rosenfarb, & Korn, 1986; Lippman & Meyer, 1967).

A procedure similar to that used by Freeman and Lattal (1992, Experiment 1) was used. Freeman and Lattal initially exposed pigeons to fixed-ratio (FR) and differential-reinforcement-of-low-rate (DRL) schedules under different stimulus conditions. Following this, an identical fixed-interval (FI) schedule was arranged in the presence of both stimulus conditions. They found that response rates remained higher in the presence of the stimulus that had previously been correlated with the FR schedule than in the presence of the stimulus that had previously been correlated with the DRL schedule. In the present study, subjects were exposed first to an FR schedule under an instruction to respond slowly and to a DRL schedule under an instruction to respond rapidly, although the schedule contingencies usually generate rapid responding under such an FR and slow responding under the DRL. Following this training, an FI schedule was arranged with those same instructions. If the response rates in the presence of the instruction to respond slowly were higher than those in the presence of the instruction to respond rapidly during the FI schedule for these subjects, and if this phenomenon was not observed for subjects exposed to the FI schedule without the multiple FR DRL history, instructional control would have been established by differential reinforcement.

METHOD

Subjects

Three male and 9 female undergraduates recruited from an introductory psychology class at Osaka Kyoiku University served as subjects. They were 19 to 25 years old, and none had experience with operant conditioning experiments. Japanese was the native language of each subject.

Apparatus

The experimental room was 1.70 m wide, 2.20 m deep, and 2.17 m high. A Nihon Electric Company PC-9821AP microcomputer, located in an adjacent room, was used to control the experiment. The subject sat facing a color display monitor (25 cm wide by 18 cm high) equipped with a Nisha Intersystems touch screen on a desk. A colored circle (5.5 cm diameter) was presented in the center of the display monitor, and each touch on the circle (operandum) was defined as a response. All interevent times were recorded, with 50-ms resolution, in real time for within-session data analysis. A white circle (3.0 cm diameter) was presented in the bottom left of the monitor, and each touch on that circle (defined as a consummatory response) produced 100 points. Each touch to the circles was accompanied by a 4-ms sound through a speaker beneath the desk. Points accumulated in the session and instructional stimuli were presented, respectively, on the top right and the top left of the monitor.

Procedure

Subjects were informed that average earnings were 460 yen (approximately $4.22 U.S.) per 90-min experimental period. They agreed to remain in the experiment for a maximum of eight experimental periods. At the beginning and the end of the experiment, each subject was asked not to speak to anyone other than the experimenter about the study in an attempt to prevent discussion about the contingencies among subjects (Horne & Lowe, 1993). At the end of the experiment, each subject was asked whether he or she had any other information to offer about the study. All reported that they did not.

A 90-min experimental period was conducted once per day, two times per week. During this 90-min period, a maximum of seven sessions occurred. Sessions were separated by 2- to 3-min breaks during which the experimenter recorded the data and changed the schedules or schedule values if that was called for by the research plan. Upon completion of the experiment, subjects were paid for their participation (100 yen per 90 min) and performance (1 yen per 100 points) and were debriefed.

On the 1st day of the experiment, after being escorted into the room, each subject was asked to read silently the general instructions. The instructions were written in Japanese, and their English translation follows:

> Your task is to earn as many points as you can. A hundred points are worth one yen. In addition, you will be paid 100 yen for every day you spend in the experiment. Total payment will be made at the end of the experiment.
>
> A circle will be shown in the center of the display monitor. If you touch the circle in the right way, the center circle will disappear and a small circle will appear in the bottom of the display monitor. By touching the small circle, you can earn points. Accumulated points will be shown in the top right of the display monitor.
>
> The words ''READY'' and ''GO'' will appear in sequence on the display monitor. When the word ''GO'' disappears, do the task until the words ''GAME OVER'' appear on the display monitor.
>
> During the task, the word ''WAIT'' may appear on the display monitor. When this word appears, please wait until the center circle reappears.

The typed set of general instructions remained on the desk throughout the experiment. Questions regarding the experimental procedure were answered by telling the subject to reread the appropriate sections of the general instructions. Then the words ''READY'' and ''GO'' were presented in sequence in the top left of the display monitor. After the word ''GO'' disappeared, a circle, which served as the operandum, was presented in the center of the display monitor.

When the schedule requirement was met, the center circle was darkened and the white circle for the consummatory response was presented in the bottom left of the display. A touch during a 3-s consummatory response period darkened the circle and accumulated 100 points on the top right counter, followed by a timeout. The timeout was used to bring the total time for the latency for the consummatory response plus the timeout to 3 s. If the subject did not touch the circle during the consummatory response period, neither point accumulation nor timeout followed, but this rarely occurred.

A two-component multiple schedule was used. Each component was presented once per session and lasted until 30 reinforcers occurred. The interval between components was 1 min, during which the word ''WAIT'' was presented at the top left of the monitor. After the second component ended, the words ''GAME OVER'' appeared at the top left of the monitor.

Four subjects each were randomly assigned to one of three conditions: (a) contradictory instruction history/inaccurate instruction, (b) no history/inaccurate instruction, or (c) no history/no instruction. Contradictory instruction history/inaccurate instruction subjects were exposed to a preliminary training phase, a differential training phase, and a nondifferential phase in that order. No-history/inaccurate instruction and no-history/no-instruction subjects were exposed only to the nondifferential phase.

Contradictory instruction history/inaccurate instruction. Table 1 summarizes the procedure

Table 1

Procedure in effect during the preliminary training phase for subjects in the contradictory instruction history/inaccurate instruction group. The labels ''Slowly'' and ''Rapidly'' describe the instructional stimuli ''Please touch the circle slowly with a pause,'' and ''Please touch the circle rapidly many times,'' respectively.

	FR schedule component			DRL schedule component		
Session	Schedule value	Color of circle	Instructions	Schedule value	Color of circle	Instructions
Subjects 1, 4, and 6						
1	18	Green	None	2 s	Red	None
2	27	Green	None	3 s	Red	None
3	45	Green	None	5 s	Red	None
4	45	Green	Slowly	5 s	Red	Rapidly
5	45	White	Slowly	5 s	White	Rapidly
Subject 5						
1[a]	18	Green	None	2 s	Red	None
2	2	Green	None	2 s	Red	None
3	6	Green	None	2 s	Red	None
4	9	Green	None	3 s	Red	None
5	9	Green	None	5 s	Red	None
6	9	Green	Slowly	5 s	Red	Rapidly
7	9	White	Slowly	5 s	White	Rapidly

[a] Session 1 for Subject 5 was discontinued after 18 reinforcers occurred during the FR component because her responding remained at a low rate. See text for details.

in the preliminary training phase. First, the multiple FR DRL schedule without instructional stimuli was in effect. The center circle on the display monitor was green in the FR schedule component and red in the DRL schedule component. The schedule value in each component was increased progressively over several sessions. In the fourth session, the instructional stimuli ''Please touch the circle slowly with a pause'' and ''Please touch the circle rapidly many times'' were presented at the top left of the display monitor during the FR and the DRL components, respectively. In the fifth session, the center circle on the display monitor was white in both components, whereas the instructional stimuli were presented in the same way as in the fourth session. In the fifth session, therefore, the instructional stimuli were the only stimuli correlated with schedule components, because the circle was always white regardless of the instruction in effect. The FR schedule component always preceded the DRL in the preliminary training phase. All but Subject 5 experienced five sessions in this phase.

Subject 5's first session was discontinued after about 1 hr because her low rate of responding had produced only 18 reinforcers to that point. A decreased FR value (multiple FR 2 DRL 2 s) in the next session increased the rate of responding in the FR component. To prevent ratio strain for Subject 5, the FR value in subsequent sessions was lower than for other subjects (see Table 1). Subject 5 experienced seven sessions in the preliminary training phase.

In the differential training phase, the center circle color on the monitor was white in both components and the instructional stimuli specified a response rate opposite the one that typically would be generated by the schedule contingencies in each component. Thus, the instructional stimuli were the only stimuli correlated with the components of the multiple FR DRL in the differential training phase. The DRL schedule value was fixed at 5 s. The FR schedule value in the first session of this condition was 9 for Subject 5 and 45 for the others. During the next four sessions, responding under the DRL schedule in the immediately preceding session determined the next FR requirement in order to equate reinforcement rate in the two components. The mean interreinforcer interval (IRI) (component time minus consummatory response time divided by number of reinforcers) was calculated for each DRL component. The FR requirement in each subsequent ses-

Table 2

Final value of the FR and the mean interreinforcer interval (ranges in parentheses) in each component of the multiple FR DRL schedule in the last five sessions of the differential training phase for each subject in the contradictory instruction history/inaccurate instruction condition.

Subject	FR value	Interreinforcer interval (in seconds) FR	DRL
1	41	10.2 (5.6–16.6)	8.2 (7.4–9.1)
4	54	8.8 (7.8–9.4)	7.9 (6.6–9.1)
6	11	12.0 (7.3–19.4)	10.9 (9.1–13.5)
5	11	6.7 (5.9–7.8)	7.6 (7.1–8.0)

sion was set by multiplying the number of responses per second in the FR component of the immediately preceding session by the mean IRI in the DRL component of the same session. For the remainder of the sessions in the differential training phase, the FR values were fixed. Table 2 shows the final FR value and the mean IRI in each schedule component for the last five sessions in each component for each subject. For each subject, the mean IRIs for the FR and DRL components were similar to each other, and the ranges of the IRIs for the FR and DRL components overlapped. Thus, the reinforcement rates in the FR and DRL components were approximately equal. The DRL component preceded the FR in the first session of this phase. In the remainder of the sessions, the order of the two components was random, with the restriction that the same order could not occur for more than three consecutive sessions. This phase lasted for 10 sessions.

Following the differential training phase, a multiple FI FI schedule, defining the nondifferential phase, was in effect for 20 sessions. The procedure in the nondifferential phase was identical to that of the differential training phase except that an FI schedule was in effect in both components. The instructional stimuli remained the same as in the differential training phase, but now the schedules correlated with these stimuli were identical. For each subject, the FI value was determined by averaging the mean IRIs of the two components of the final five sessions of the differential training phase. These values were 9.2, 8.4, 11.4, and 7.2 s for Subjects 1, 4, 6, and 5, respectively. The order of the two instructional stimulus components was random, with the restriction that the same order could not occur for more than three consecutive sessions.

No history/inaccurate instruction. The procedure of this condition was identical to that of the contradictory instruction history/inaccurate instruction condition with the following exceptions. Subjects were exposed only to the nondifferential phase. The FI values and the order of the two instructional stimulus components for Subjects 2, 8, 9, and 11, respectively, were yoked to those for Subjects 1, 4, 6, and 5 in the contradictory instruction history/inaccurate instruction condition.

No history/no instruction. The procedure of this condition was identical to that of the contradictory instruction history/inaccurate instruction condition with the following exceptions. Subjects were exposed only to the nondifferential condition. The FI values for Subjects 3, 7, 10, and 12, respectively, were yoked to those for Subjects 1, 4, 6, and 5 in the contradictory instruction history/inaccurate instruction condition. No instructional stimulus was presented on the display monitor during each FI schedule component.

RESULTS

Contradictory Instruction History/ Inaccurate Instruction

Figure 1 shows the response rates of each subject for each session. Prior to the introduction of instructional stimuli, response rates for Subjects 1, 4, and 6, who were in the contradictory instruction history/inaccurate instruction condition, were higher in the FR schedule component than in the DRL schedule component. This differentiation deteriorated during the first session when instructional stimuli specifying a response rate opposite to the schedule contingencies were introduced. For Subject 4, response rates reversed, so that response rates were higher in the DRL component than in the FR component. For Subject 5, response rates between the two schedule components were not differentiated prior to the introduction of instructional stimuli. When the instructional stimuli were introduced, the response rates for that subject were, for one session, higher in DRL than in FR.

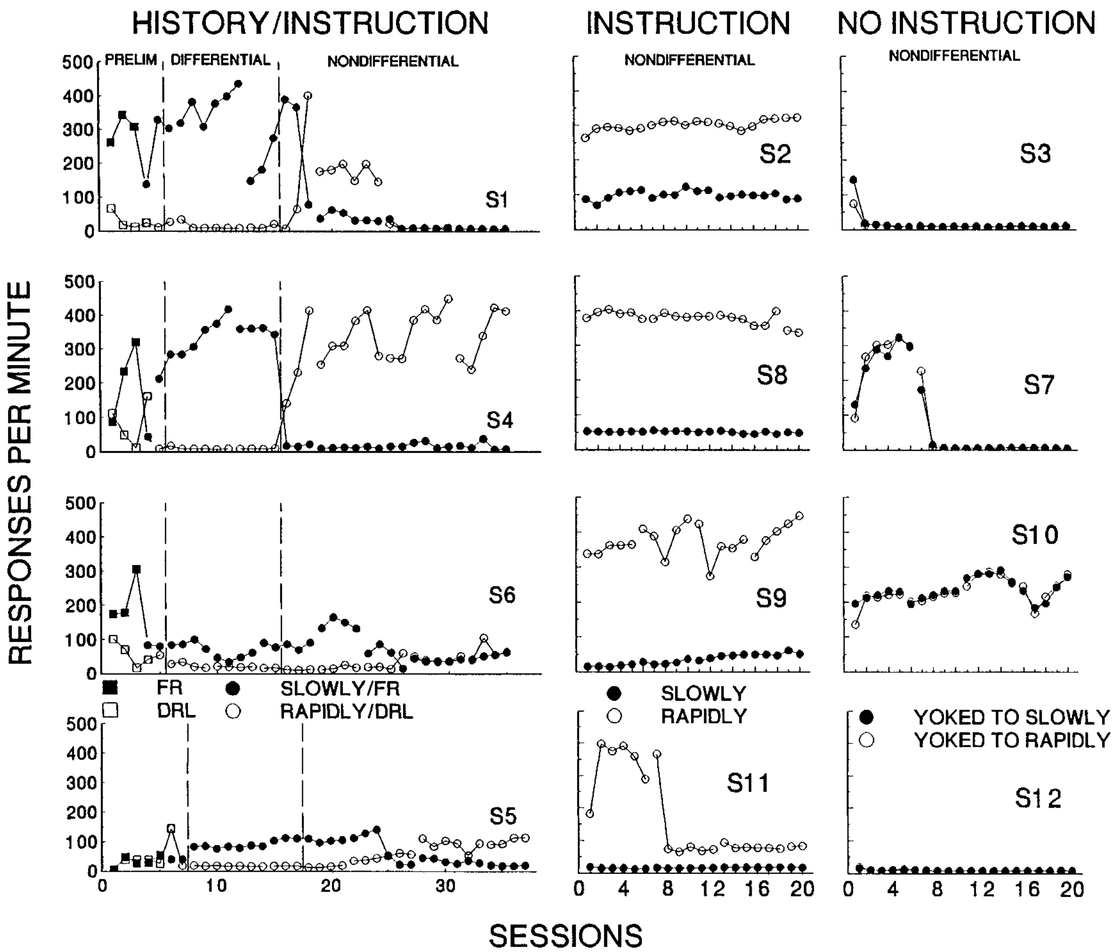

Fig. 1. Response rates in each session for each subject in the contradictory instruction history/inaccurate instruction (left), the no-history/inaccurate instruction (center), and the no-history/no-instruction (right) conditions. PRELIM and DIFFERENTIAL identify the preliminary training and the differential training phases in which a multiple FR DRL schedule was in effect (see text for values). NONDIFFERENTIAL identifies the nondifferential phase in which a multiple FI FI schedule was in effect for the first two groups of subjects and a mixed FI FI was in effect for the third group of subjects. Filled and open squares represent responding without instructional stimuli under the FR and the DRL schedules, respectively. Filled circles in the preliminary and differential phases represent responding under the instructional stimulus "Please touch the circle slowly with a pause" in the FR component, whereas open circles represent responding under the instructional stimulus "Please touch the circle rapidly many times" in the DRL component. In the nondifferential phase for the instructed conditions, filled and open circles represent responding under the same instructions. In the no-history/no-instruction condition, no instructional stimuli were presented, and filled and open circles represent responding in components in which the FI value was yoked, respectively, to the values for the "slowly" and "rapidly" instructions for the other two conditions. The FI values in the nondifferential phases were the same for each row of subjects. Data connected by lines are for successive sessions within a 90-min experimental period.

Figure 2 shows cumulative records for each subject in the contradictory instruction history/inaccurate instruction condition in the last three sessions of the preliminary training phase. Consistent with the overall-rate data in Figure 1, these within-session data indicate that with the introduction of the instructional stimuli, responding initially changed consistent with the normal meaning of the instructions. With continued multiple FR DRL exposure, response-rate differentiation was either reinstated (for Subjects 1, 4, and 6) or developed (for Subject 5), as shown in Figure 1. During all sessions of the differential train-

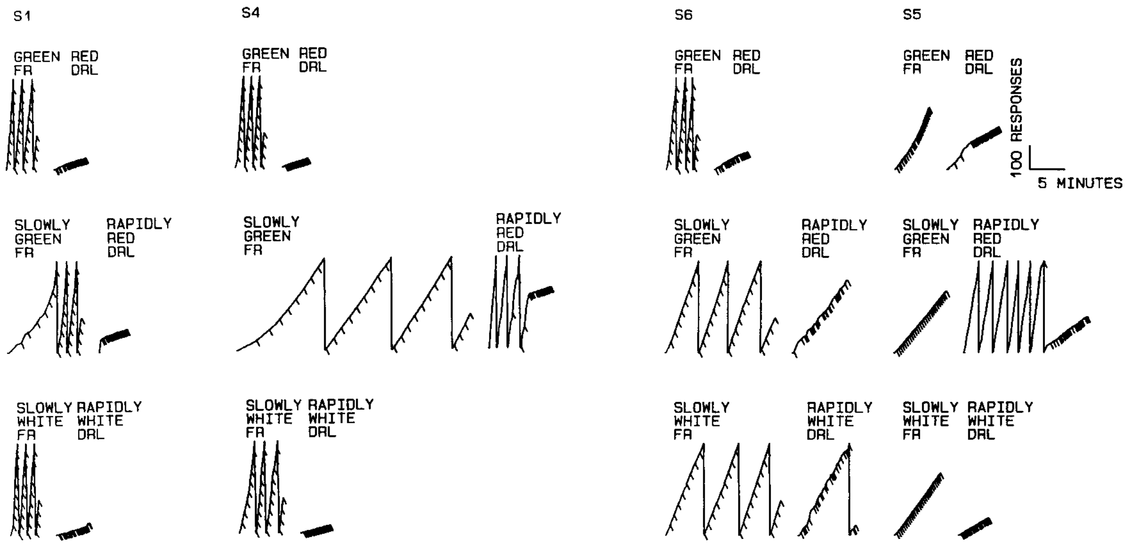

Fig. 2. Cumulative records of responding for the contradictory instruction history/inaccurate instruction subjects during the last three sessions of the preliminary training phase. From left to right, records of Subjects 1, 4, 6, and 5 are shown. Records are from the session immediately before exposure to the instructional stimuli (upper) and the sessions of the first exposure to the stimuli (middle) and to the second exposure (bottom). Order of components shown is the order in which they occurred in a session. SLOWLY and RAPIDLY identify the components with the instructional stimuli ''Please touch the circle slowly with a pause'' and ''Please touch the circle rapidly many times,'' respectively. GREEN, RED, and WHITE describe color of the circle (operandum) in each component.

ing phase, response rates for all subjects were higher under FR than DRL.

Following introduction of the FI schedule in both components, response rates remained higher in the presence of the instructional stimulus ''slowly,'' which had previously been correlated with the FR schedule, than those in the presence of the instructional stimulus ''rapidly,'' which had previously been correlated with the DRL schedule, during the first two, eight, and 10 sessions for Subjects 1, 5, and 6, respectively (Figure 1). The response rates under the different instructional stimuli became nondifferentiated or reversed with continued FI exposure for these subjects. For Subject 1, response rates were higher in the ''rapidly'' component than in the ''slowly'' component for seven sessions before the rates in the two components became indistinguishable. For Subject 5, response rates were higher in the ''rapidly'' component than in the ''slowly'' component for the last 12 sessions in the nondifferential phase, whereas the rates in the two components for Subject 6 were indistinguishable for the last 10 sessions. For Subject 4, response rates were higher in the ''rapidly'' component than in the ''slowly'' component during all sessions of the nondifferential phase.

Figure 3 shows cumulative records from the first session in which response rates were higher in the ''rapidly'' component than in the ''slowly'' component in the nondifferential phase. Records from the preceding and subsequent sessions are also presented. For Subject 4, response rates were low in the ''rapidly'' DRL component and high in the ''slowly'' FR component in the final differential training session (Figure 3). When the schedule changed to a multiple FI FI, low-rate responding in the ''rapidly'' component continued for the first 17 reinforcements. However, performance was more variable than in the preceding session. For example, across 30 reinforcer deliveries in the final DRL component, only 30 responses occurred, and the IRIs ranged from 5.6 to 9.1 s. On the other hand, 24 responses occurred and the IRIs ranged from 8.6 to 19.2 s across the first 17 reinforcer deliveries in the ''rapidly'' component in the first nondifferential session. Following the 17th reinforcement, responding shifted abruptly to a high rate. In the following session, response rates were low in the

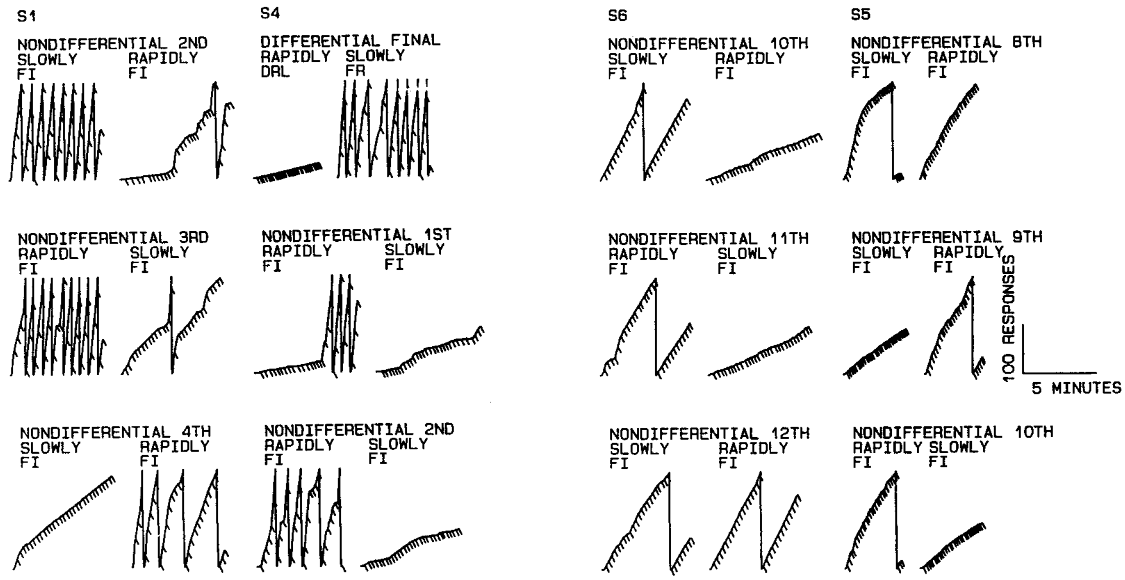

Fig. 3. Cumulative records of transition from a multiple FR DRL schedule to a multiple FI FI for the contradictory instruction history/inaccurate instruction subjects. From left to right, records of Subjects 1, 4, 6, and 5 are shown. Records are from the second (upper), third (middle), and fourth (bottom) sessions in the nondifferential phase for Subject 1; from the final session in the differential training phase (upper) and the first (middle) and second (bottom) sessions in the nondifferential phase for Subject 4; from the 10th (upper), 11th (middle), and 12th (bottom) sessions in the nondifferential phase for Subject 6; and from the eighth (upper), ninth (middle), and 10th (bottom) sessions in the nondifferential phase for Subject 5. Details as in Figure 2.

''slowly'' component and high in the ''rapidly'' component. Thus, analysis of the cumulative records indicates that responding for Subject 4 was under control of the contradictory instructions similar to that of the other 3 subjects, although the control for this subject was short-lived. Figure 3 also illustrates within-session deterioration of the established instructional control for Subjects 1, 6, and 5.

No History/Inaccurate Instruction

Rate of responding in the ''rapidly'' component for Subject 11 in the no-history/inaccurate instruction condition decreased in the eighth session; thereafter, the rates stabilized (Figure 1). Although there was some response-rate variability across subjects and sessions as described above, response rates for all subjects were higher in the ''rapidly'' component than in the ''slowly'' component during all sessions.

No History/No Instruction

The graphs in the last column of Figure 1 show the response rates of each subject in the no-history/no-instruction condition for each session in the nondifferential phase. Although there were no stimuli distinguishing the two components of the FI schedule in each session, the rates of responding were plotted as matching their order of components to that for the yoked subject in the contradictory instruction history/inaccurate instruction condition. First, rates of responding for Subject 7 increased, then decreased; thereafter, the rates were stable and low for the last 13 sessions. Responding during the final sessions was also at a low rate for Subjects 3 and 12, but was at a high rate for Subject 10. During all sessions, however, response rates in the two components for all subjects were indistinguishable. These results indicate that differences in the response rates across the two components in the nondifferential phase for the contradictory instruction history/inaccurate instruction or the no-history/inaccurate instruction subjects could not have been an artifact of the order.

DISCUSSION

Exposure to a multiple FR DRL schedule with contradictory instructions led to higher response rates with the instruction to respond slowly and to lower response rates with the instruction to respond rapidly under a subsequent FI schedule for 3 of 4 subjects. The behavior of the remaining subject also showed evidence of short-lived control by the instructions because this subject exhibited low-rate responding with the instruction to respond rapidly during first 17 reinforcements of the FI schedule. This instruction–behavior relation was not observed for subjects who were exposed only to an FI schedule with or without instructions. Thus, these results indicate that instructional control was established by differential reinforcement in the presence of the instructions.

In Freeman and Lattal's (1992) Experiment 1, response rates in the presence of the two stimulus conditions carried over to a subsequently common FI schedule, then converged for 2 pigeons and reversed for 1 pigeon with continued FI exposure for 18 to 41 sessions. In the present experiment, response rates in the two instructional stimulus conditions carried over to an FI schedule, then converged for 2 human subjects and reversed for others in 1 to 11 sessions. Although the instructional control was short-lived, the general correspondence between these two studies suggest that the results of Freeman and Lattal were partially replicated across species (pigeons vs. humans) and stimuli (nonverbal stimuli vs. verbal stimuli).

The results of the no-history/inaccurate instruction subjects show that behavior is controlled by being told what to do at the start of the experiment without a certain history of experimental contingencies. This finding is common in the literature of instructional control (e.g., Baron et al., 1969; Buskist & Miller, 1986; Galizio, 1979; Hackenberg & Joker, 1994; S. C. Hayes, Brownstein, Haas, & Greenway, 1986; S. C. Hayes, Brownstein, Zettle, Rosenfarb, & Korn, 1986; Lippman & Meyer, 1967), and it may be one of the reasons that some functions of instructions are said to be not classified as discriminative (Schlinger, 1993). Several studies of stimulus equivalence have demonstrated that a stimulus can acquire control of responding by transfer of function within an equivalence class even though the responding is not directly reinforced in the presence of the stimulus (e.g., Barnes & Keenan, 1993; L. J. Hayes, Thompson, & Hayes, 1989). Although these studies showed transfer of function across nonverbal stimuli, the findings suggest that instructions without any histories of differential reinforcement could acquire control of responding by transfer of function within an equivalence class.

The effects of instructions sometimes have been analyzed based on the structure, or on the so-called *meaning*, generally used in the listeners' verbal community. For example, many investigators have regarded behavior as instruction controlled when the behavior was more similar to behavior specified by those instructions than to what would be expected under the schedule contingencies (e.g., DeGrandpre & Buskist, 1991; Hackenberg & Joker, 1994). However, as shown in the present study, if behavior is differentially reinforced in the presence of an instruction, the behavior can be controlled by the instruction even though the behavior is dissimilar to that specified by the instruction. Instructions that are structurally identical can be functionally different. For example, the "rapidly" instruction was a discriminative stimulus for slow responding for the contradictory instruction history/inaccurate instruction subjects, whereas it evoked rapid responding for the no-history/inaccurate instruction subjects. The present results suggest that instructions should be analyzed according to their function rather than their structure.

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