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# The effects of verbal consequences for rule-following on sensitivity to programmed contingencies of reinforcement

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THE EFFECTS OF VERBAL CONSEQUENCES FOR RULE-FOLLOWING

ON SENSITIVITY TO PROGRAMMED CONTINGENCIES

OF REINFORCEMENT

by

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This study examined the effects of two types of verbal consequences for rule-following and their impact on subject's responses to programmed schedules of reinforcement. The first type of consequence involved feedback on the correspondence between the subject's behavior and the behavior specified in an antecedent rule. A second type of consequence involved this same feedback plus feedback on the number of points earned for task performance. Some subjects were given accurate feedback with respect to rule-following and some were told that the rule was being followed regardless of behavior.

The task involved moving a circle through a grid on a video screen using telegraph keys operating on a multiple schedule of reinforcement. Successful task performance resulted in the delivery of a point, exchangeable for chances at a cash prize. The subjects were given an accurate rule that specified the appropriate behavior for a DRL 6/FR 18 multiple schedule of reinforcement with two-minute components. After 32 minutes of responding, this schedule was changed, without announcement, to a FR 1/FI Yoked schedule of reinforcement. The change from the DRL 6 to the FR 1 enabled an increase in effectiveness (more points could be earned in a given unit of time) and the change from the FR 18 to the FI Yoked enabled an increase in efficiency (fewer responses could earn the same number of points). The changed contingencies were kept in place for 64 minutes.

Verbal consequences began 12 minutes before the schedule change and remained in effect for 32 minutes after the change. Verbal consequences were removed for the final 32 minutes.

Rule-following feedback did not affect the subject's response to the efficiency-based or effectiveness-based change. Accurate rule-following feedback plus feedback on task performance produced comparatively lower response rates following the effectiveness-based transition in spite of the fact that high response rates produced more points. This effect was still evident following the withdrawal of the verbal consequences. Rule-following feedback plus feedback on task performance was posited to increase the specificity of the feedback as well as to result in a change in the consequential function of points.

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This dissertation is dedicated to the memory of Madeline Ryan Targonski.

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# CHAPTER I

## Introduction

Much of human affairs involves verbal interactions. Education, management, government, and psychotherapy all involve one person altering or affecting the behavior of another person via the use of language. The efficacy of changing behavior by instruction is assumed in these major human endeavors.

Understandably, instructional control has received much attention in behavior-analytic research and theory. In his theoretical analysis of problem-solving, Skinner (1969), discussed the effects of rules or instructions on human learning. The role of verbal stimuli or instructions in the control of human behavior has received much empirical attention in operant psychology in recent years (Baron & Galizio, 1983). In behavioral terms, people learn both by experiencing the programmed contingencies first hand and by being told about these contingencies in the form of instructions. The bulk of human operant research to date indicates that instructions often exert stronger control over behavior than do the programmed reinforcers (Baron & Galizio, 1983). Although many studies have demonstrated control by instructions (eg., Baron, Kaufman, & Stauber, 1969; Buskist, Bennett, & Miller, 1981; Hayes, Brownstein, Zettle, Rosenfarb, & Korn, 1986b; Kaufman, Baron, & Kopp, 1966; Lippman & Meyer, 1967; Shimoff, Catania, & Matthews, 1981), more work is necessary in order to understand more fully the parameters of this control. Some variables, such as the effects of social factors on adherence to instructions, have received empirical examination (Brey 1987; Hayes, Rosenfarb, Wulfert, Munt, Korn, & Zettle, 1985; Reuger, Gaydos, Quinn, & Deitz, 1986; Rosenfarb & Hayes, 1984) while others have not yet been addressed.

One factor that seems to have received little empirical attention is feedback from the verbal community regarding instruction following. That such feedback plays a role seems obvious. Phrases such as "You did a good job following instructions" or "See, reading instructions makes it much easier to finish your homework quickly" are phrases that might be heard in an educational setting. Even though feedback is a common everyday concept, there is little human operant research on the role of verbal consequences and their interaction with rule-governed behavior.

The present study explores this general issue with respect to rule-governed behavior. It is concerned with how verbal consequences related to rule-following influence the way that rules control behavior.

More is known about the role of verbal stimuli as antecedents than about their role as consequences. Thus, my strategy in this introduction will first be to examine the literature on control by antecedent verbal stimuli and the variables that influence it. This review will then be used as a guide to the identification of variables that might influence the effects of verbal consequences and how verbal consequences might interact with rule-governed behavior.

## Behavior-Analytic Research on Instructional Control

Research on the interaction of instructions and programmed contingencies leads to one strong conclusion: Instructions exert strong control over human behavior to the extent that they consistently override control by programmed contingencies of reinforcement (Buskist et al., 1981; Kaufman et al., 1966; Matthews, Shimoff, Catania, & Sagvolden, 1977). So strong is this control under some conditions that it has been said that "insensitivity is a defining property of instructional control" (Shimoff et al., 1981) "Insensitivity," however, is but a description of an outcome and begs the question of what contingencies actually produce instructional control.

### The Human Operant Research Strategy

The research paradigm for human operant research is typically a simple extension of the operant chamber used to study nonhuman schedule performance. Human subjects work in small rooms with levers, buttons, or telegraph keys as manipulanda, colored lights as stimuli, and points or money as consequences. The schedules of point delivery (e.g., interval and ratio schedules) are identical to the schedules of reinforcement that have been studied with non-humans (e.g., Ferster & Skinner, 1957).

### Evidence of Instructional Control

Human responses to schedules of reinforcement are often altered by the presence of very subtle verbal cues. Demonstrating one button push (Matthews et al., 1977), mentioning that a response is necessary (Kaufman et al., 1966), and telling a subject to earn the maximum number of consequences possible in a set time limit (Buskist et al., 1981) can result in very high rates of responding even when high response rates were not required to satisfy the contingency. Given these findings, it is not surprising that more detailed verbal instructions often exert strong control over behavior in spite of competing programmed contingencies.

## The Interaction of Instructions and Programmed Contingencies

Two main strategies have been used to assess the joint effects of instructions and programmed contingencies. One strategy examines the effects of instructions on behavior patterns observed on single schedules of reinforcement (Buskist et al., 1981; Buskist & Miller, 1986; Kaufman et al., 1966). Another examines the sensitivity of instruction-produced behavior to changes in programmed contingencies of reinforcement. Multiple schedules of reinforcement (Baron et al., 1969; Hayes et al., 1986b), and unannounced changes in schedules are employed in this strategy (Hayes, Brownstein, Haas, & Greenway, 1986a; Shimoff et al., 1981).

## The Effects of Instructions on Human Schedule Performance

Studies concerned with schedule patterns typically examine the effects of instructions on behavior which is also exposed to a programmed schedule of reinforcement. It sometimes appears that accurate instructions which specify the actual programmed contingency can produce behavior that maximizes reinforcement and that appears similar to non-human schedule patterns (Baron et al., 1969; Kaufman et al., 1966) as well as to the patterns produced by uninstructed humans (Buskist et al., 1981).

However, a closer look reveals that inaccurate instructions which specify a response rate appropriate for a different schedule can induce response rates that are not similar to non-human performance on the actual programmed schedule (Buskist & Miller, 1986; Kaufman et al., 1966; Lippman & Meyer, 1967). In addition, when different instructions are given to different groups of subjects working on the same schedule, their behavior appears to be controlled by the respective instructions rather than the programmed schedule (Buskist et al., 1981; Kaufman et al., 1966). Finally, the strength of instructional control is emphasized by the finding that subjects who are instructed to respond at various rates have responded for as long as two or three hours in extinction sessions in which their responses were never followed by a programmed consequence (Kaufman et al., 1966).

Research on schedule patterns shows that instructions can evoke behavior across a wide range of situations. Instructions which specify a contingency can evoke behavior that appears appropriate to that contingency (Baron et al., 1969; Kaufman et al., 1966). However, under some conditions (Buskist & Miller, 1986; Kaufman et al., 1966; Lippman & Meyer, 1967), it does not matter if the contingency specified in the instructions is actually programmed or not. Early suggestions that instructions can be used to generate schedule-sensitive behavior similar to that of nonhuman subjects (Baron et al., 1969) need to be qualified in light of the latter findings.

The research on schedule patterns is not completely adequate for studying the interaction of rules and programmed contingencies. In this paradigm, sensitivity is measured in two ways: a) by the behavioral differences between subjects given instructions and subjects given minimal instructions, and b) by the degree to which human schedule patterns correspond to schedule patterns shown in nonhuman subjects. A problem with minimal instructions is that they can produce their own type of instructional control which is also capable of overriding control by the programmed instructions (Matthews et al., 1977; Shimoff et al., 1981). In addition, when humans produce "non-human like" behavior patterns, this behavior itself may still be under instructional control (Shimoff et al., 1981). Similar human and non-human behavior patterns may still be under the control of grossly different variables.

The Effects of Instructions on Sensitivity to Schedule Changes

When instructions produce behavior that appears to be controlled by the programmed contingencies, the behavior may still be controlled by instructions (Hayes et al., 1986a; Shimoff, Matthews, & Catania, 1986). The controlling variables can be determined by an unannounced change in the programmed contingencies. If a behavior change is observed following a change in programmed contingencies, then the contingencies are said to control the behavior. If no change in behavior is observed, then the rule is said to control the behavior.

Behavior that is shaped or established by minimal instructions is often relatively sensitive to changes in programmed contingencies (Hayes et al., 1986a; Matthews et al., 1977; Shimoff et al., 1981). However, behavior that is established by more detailed instructions is often quite insensitive to schedule changes (Hayes et al., 1986a; Matthews et al., 1977; Shimoff et al., 1981). This insensitivity is observed when instructions evoke both high (Matthews et al., 1977) and low (Shimoff et al., 1981) rates of responding.

Instructed subjects show less behavior change than uninstructed subjects in response to several different types of schedule changes: Changes that result in no potential increase in consequence delivery (Shimoff et al., 1981), changes that result in a great potential increase in consequences (Shimoff et al., 1981), changes that allow for a substantial decrease in responding with no change in the rate of consequence delivery (Galizio, 1979), and changes that totally remove all programmed consequences (Hayes et al., 1986a; Matthews et al., 1977).

Multiple schedules have also been used to study sensitivity to changes in programmed schedules. A multiple schedule involves a set of rapidly alternating schedule components. The different schedules should in principle generate distinctly different response rates (e.g., a fixed ratio normally generates very high response rates, and a fixed interval generates much lower response rates). If the subject's behavior shows distinctly different response rates in each component, the programmed schedules are thought to control the behavior.

Uninstructed subjects often show undifferentiated responding in multiple schedules, especially if they contain several components (Baron et al., 1969; Galizio, 1979; Hayes et al., 1986a, 1986b). Instructions which specify the contingencies operating in each component of a multiple schedule appear to readily generate response differentiation or sensitivity to the different components

(Baron et al., 1969; Galizio, 1979; Hayes et al., 1986a, 1986b). However, this behavior is still not necessarily sensitive to the programmed schedules involved.

Response differentiation is also evident in instructed subjects who do not receive immediate contingent feedback when schedule requirements are met (Baron et al., 1969). In addition, instructions that accurately specify only one component in a two-part multiple schedule can evoke similar behavior in both components (Hayes et al., 1986b). Finally, behavior produced by instructions may appear to be sensitive to the separate schedules but still fail to change when one or both components in a multiple schedule are changed to a new schedule (Hayes et al., 1986a; Shimoff et al., 1986).

Taken together, the research on the interaction of instructions and programmed contingencies shows that instructions often override control by programmed contingencies of reinforcement. The research reviewed thus far demonstrates the powerful control that can be exerted by instructions. It does not demonstrate how instructions come to exert this control. In the following sections, the theory and research that addresses this issue will be reviewed.

## Contingency-Shaped and Rule-Governed Behavior

Skinner (1969) described rules as a complex type of stimulus. He made a distinction between contingency-shaped behavior and a subset of contingency-shaped behavior called rule-governed behavior. Contingency-shaped behavior is behavior that is shaped by direct contact with its consequences. It is essentially another name for operant behavior.

The card game of draw poker provides an example of contingency-shaped behavior. Some poker players learn to play by direct experience. The behavior of these players is subtly shaped by the consequences of drawing new cards across a wide range of circumstances. For example, they may learn to avoid drawing to an inside straight. If asked why, they may not be able to give reasons verbally . They might say that they act on "intuition" or "hunches." In this case, poker playing is an example of contingency-shaped behavior.

In Skinner's view, rule-governed behavior is behavior that is controlled by a special type of stimulus: one which specifies a contingency. The behavior of a poker player who is playing according to a book on the statistical odds of getting each type of poker hand is an example of rule-governed behavior. This player's play is controlled by the rules in the book which specify the contingencies involved in playing poker. In this case, the poker playing is rule-governed.

Rules and exposure to contingencies may generate behavior that appears similar. For example, both persons discussed above may turn out to be excellent poker players. However, their card-playing behavior may actually be quite different because it is controlled by different variables. For example, if some cards were removed from the deck, it may be more conceivable that contingency-shaped playing would adjust to the new circumstances while the rule-governed playing would not. For the contingency-shaped behavior, the controlling variables (the probability of certain hands occurring) would have changed while for the rule-governed behavior the controlling variables (the rules in the book) remain the same. This example is of course a simple one.

Depending on the history of the player whose behavior is under the control of the rules, she might eventually look for a new book or stop following the rules. The sensitivity of the contingency-shaped play might only be shown sooner than a change in rule-governed play.

The distinction between contingency-shaped and rule-governed behavior serves as a reminder that human behavior can be controlled by complex forms of verbal stimuli as well as by consequences of behavior. In Skinner's view, this distinction does not point to two different functional classes of behavior. Both contingency-shaped and rule-governed behavior are controlled by contingencies of reinforcement. Rule-governed behavior is only different in that it involves a special type of antecedent stimulus. For Skinner, the distinction between rule-governed and contingency-shaped behavior is a purely formal one designed to highlight all of the relevant variables that control human behavior.

Galizio (1979) empirically studied the hypotheses that rules acted as discriminative stimuli. As is the case with nonverbal discriminated operants, rule-governed behavior can be brought under the control of a conditional discriminative stimulus. One stimulus was only present when instructions led to effective contact with the programmed consequences and another was only present when instructions did not lead to effective contact. Subjects followed instructions in the presence of the first stimulus and did not follow instructions in the presence of the second stimulus. In a further attempt to demonstrate similarity between rules and nonverbal discriminative stimuli, Galizio's experiment also demonstrated that rules can act as reinforcers, a characteristic that is readily demonstrated with nonverbal discriminative stimuli in the non-human literature. Subjects responded on a button-pushing task when the consequence was access to session rules.

Galizio interpreted these data to mean that rules do function like other types of discriminative stimuli. The implication is that rules exert their control solely via discriminative processes; understanding their effects requires no other additional analytic concepts. While these data show that rules possess some of the same qualities as discriminative stimuli, recent work has questioned whether typical demonstrations of control by rules meet the strict definitional criteria (Michael, 1980) of a discriminative stimulus (Blakely & Schlinger, 1987; Schlinger & Blakely, 1987). In addition to evoking behavior, rules seem to alter the function of environmental events. A more thorough account of how function-altering may work will be presented in a later section. Function-altering seems to require a more complex account of how stimuli acquire functions. For purposes of the immediate discussion, it is sufficient to say that Galizio's study does not provide definitive evidence that rules function purely as discriminative stimuli. If other processes are involved in establishing control by rules, it is conceivable that rule-following could still be brought under conditional control and that rules would function as reinforcers. What is important about Galizio's findings is that they provide evidence that rules as stimuli seem to participate in contingencies of reinforcement much like other stimuli. In the following section, more discussion will be devoted to the types of contingencies that establish control by rules.

## The Pliance-Tracking Distinction

Zettle and Hayes (1982) have developed an analytic framework for describing classes of rule-governed behavior. They define rule-governed behavior as behavior which is controlled by an antecedent stimulus which is verbal in nature. In addition, rule-governed behavior is characterized by its potential contact with two different contingencies of reinforcement: Contingencies in the natural non-arbitrary environment and contingencies which are arbitrarily established by the social community.

Zettle and Hayes (1982) distinguished between two main classes of rule-governed behavior based on the types of contingencies that are involved in their formation and maintenance. While each class of rule-governed behavior involves behavior that is under the control of a verbal discriminative stimulus, the division is based on the different contingencies of reinforcement which shape and maintain that discriminative control.

Rules can evoke behavior that contacts contingencies existing in the natural environment. Tracking is the name used when rule-following is based on a history of experience with the specification of behavior-consequence relations that are actually present in the natural environment (both social and non-social). The discriminative control exerted by the rule is established by natural reinforcement for the behavior it evokes. In addition, the behavior that is generated by tracks produces reinforcing stimuli even if the track is not present. For example, a rule might state "To go from Reno to Carson City take route 395 South." If the person follows such a rule because similar rules in the past have lead to specific consequences, then this is tracking and the rule is a track. If a person follows this specific rule due to such a history, we assume that getting to Carson City is already reinforcing. Driving route 395 would lead to Carson City even if the person was never given the rule. The rule evokes behavior that contacts this natural contingency.

Pliance refers to rule-produced discriminative control that is shaped by the verbal community when it provides reinforcement for a correspondence between a rule and behavior. The contingencies which are laid down by the verbal community may be independent of the natural consequence of this behavior. In other words, the verbal community provides reinforcement for rule-following in and of itself. A rule that participates in such contingencies is called a ply. An example would be a parent who enforces the rule "Clean up your room before you go outside!" When the child asks "How come?" a parent employing a ply might say "Because I told you so. That's how come."

The verbal community establishes rules as discriminative stimuli by reinforcing appropriate behavior in the presence of rules and punishing inappropriate behavior. In pliance, the stimulus control exerted by rules is maintained by social contingencies supporting a correspondence between the rule and the behavior. Other sources of reinforcement that might naturally follow the behavior in question (e.g. being able to find things more readily in a clean room) are not involved in pure pliance. The listener follows the speaker's rule, because of a history of reinforcement for obedience and a history of punishment for noncompliance. Unlike tracking, which can involve social consequences, pliance must involve them, because only the social community can explicitly identify and deliver consequences for the rule-behavior correspondence.

In the preceding analysis, the case is made that these two distinct sets of contingencies can establish distinct types of rule-following: Tracking and pliance. In the examples employed, the same rule could be either a track or a ply depending on the contingencies that produce rule-following. Because of the two different sources of control, it is possible that plys and tracks evoke behavior with different characteristics. On the one hand, behavior produced by the kind of contingencies involved in tracking is expected to be controlled by and thus sensitive to the natural contingencies in the environment and specified in the rule. Pliance, on the other hand, leads to control by the behavioral specification in the rule as opposed to any other contingencies that may be present in the natural environment.

Very little research has dealt with tracking or situations in which rules actually enhance control by natural contingencies. In fact, when rules appear to induce behavior that is controlled by programmed contingencies, this behavior has later been shown to actually be rule-governed (Hayes et al., 1986a). The almost exclusive concern with the "insensitivity" effect has geared most research toward pliance-related issues. Empirical evidence for the contingencies involved in tracking can be gleaned from some of these studies, but the data are slim and loosely tied together. We do know that rules sometimes control behavior and sometimes do not. Hayes et al. (1986a) demonstrated that 50% of the instructed subjects showed substantial decreases in responding when the schedule changed from an FR 18 to extinction. The behavior of subjects who were not insensitive to the contingency change provides an example of behavior that was initially established by rules yet was ultimately sensitive to changes in the programmed contingencies of reinforcement. One interpretation of this effect would be that the reinforcement history for these "sensitive" subjects heavily supported control by natural contingencies as opposed to compliance with the rule regardless of cost. However, this remains an interpretation given that such a history was not actually manipulated in that study.

There is some evidence that subjects discriminate between contexts in which rules are successful and not successful in achieving natural consequences. Galizio (1979) demonstrated that subjects can discriminate between contexts in which rules produce behavior that contacts programmed consequences and contexts in which they do not. This would be expected if rule-following was actually supported by the programmed contingencies as opposed to contingencies for compliance.

Additional empirical support for a tracking analysis comes from differential effects of rules with distinctly different forms. Contingency descriptions seem to produce more sensitivity to programmed contingencies than performance descriptions (Matthews, Catania, & Shimoff, 1985). Specifying the entire contingency would be expected to induce sensitivity to the contingency while a performance specification is more likely to produce correspondence between actual performance and the performance specified in the rule. The verbal community may specify programmed consequences for rule-following when ultimate control by these consequences is desired. When only compliance is desired, the form of the behavior is all that is specified. However, this is only an interpretation of existing data and direct empirical support for a tracking based analysis is lacking.

The hypothesized mechanism in pliance has some indirect empirical support from research that examines the role of social influence in increasing adherence to rules. Remember that pliance depends on a social community which evaluates rule-behavior correspondence and doles out reinforcement when such a correspondence is observed. Rules seem to exert less control in private situations where the influence of the verbal community is minimized (Brey, 1987). If the social community has no access to the rule or the subjects' behavior, then current consequences for compliance are difficult to provide. This is not to say that subjects in a private setting would not show pliance. A history of experience with such contingencies could affect behavior regardless of current contingencies in the private setting. However, manipulations that insure privacy and thus minimize the contingency for pliance have been shown to affect the degree to which rules control behavior. For example, the presence of another person in the experimental room tends to increase the likelihood of rule-following (Reuger et al., 1986).

People with higher levels of social anxiety may be more sensitive to the contingencies involved in pliance. Scores on a personality inventory that assesses "rigidity" have been shown to be correlated with observed rule-following (Wulfert, Shull, Hayes, & Greenway, 1987). The scale used in this study was loaded towards the factor of social anxiety. People who are anxious in social situations may respond more readily to social reinforcement or punishment. Doing what is socially accepted is a way of avoiding aversive stimulation in social situations.

Data on the effectiveness of instruction-based therapies indicates that modeling (Rosenfarb & Hayes, 1984), self-coping statements (Hayes & Wolf, 1984; Zettle & Hayes, 1983), self-reinforcement (Hayes et al., 1985), and goal setting (Hayes et al., 1985) are much more effective when conducted in public settings than in private. In addition, self-instructions were not effective at all in the private settings provided in these studies. This suggests that even things that people say to themselves seem to be controlled by their possible participation in public contingencies provided by the community. This evidence from the applied arena further suggests the importance of the social community in establishing control by rules and lends support to the notion of pliance.

Data on the effects of rule form are also supportive of the plausibility of a pliance-based account of persistence in rule-following. Performance descriptions generate stronger rule-following than contingency descriptions (Matthews et al., 1985). It seems plausible that the social community uses performance descriptions when doing what one is told despite other sources of control (i.e., pliance) is in the best interest of the community. Orders or commands often take the form of performance descriptions. Contingency descriptions may be used when coming under effective control by the specified contingencies is to the advantage of the community (what is usually called advice or descriptions). Specific rules have also been shown to generate more rule-following than general rules (Olson & Hayes, 1984). When a specific rule is present, it may be easier for the community to evaluate the degree of rule-behavior correspondence. Less variability in rule-following would be expected in these conditions. When subjects' guesses about rules are shaped by the experimenter, more compliance is produced than when the experimenter instructs subjects what to guess (Catania, Matthews, & Shimoff, 1982). When guesses are generated by shaping, persons might be under increased social pressure to behave in accordance with their own guesses than if they were told what to guess. People are rarely told explicitly what to say and then held accountable for a correspondence between this saying and relevant behavior.

Taken together, these data suggest that the contingencies described in pliance may be responsible for occurrence of persistent rule-following even when the subject contacts changes in programmed contingencies. Russell (1986), in an attempt to study directly the contingencies involved in pliance, examined the effects of social feedback for rule-following on the response to changes in the programmed contingencies. This feedback did not seem to increase rule-following above and beyond that seen in the presence of task instructions alone. However, in this study, behavior that corresponded to the rule was periodically followed by the word "good" which appeared on the television monitor displaying the task. The subjects were never told that "good" was for following rules, and the data suggested that this stimulus either served as a reinforcer only for task performance (not rule- following) or did not act as reinforcer at all.

In summary, the theoretical analyses presented by Skinner (1969) and Zettle and Hayes (1982) have received moderate amounts of empirical support.

These accounts are based on explanations of the types of contingencies that establish rules as stimuli that directly evoke behavior. However, in addition to direct evocative effects on behavior, the specification of a contingency also seems to affect the functions of antecedents and consequences for behavior. In other words, rules affect behavior as well as the function of the environmental events that surround it. This issue is related to a general interest in the "special" nature of contingency specification and how it comes to actually affect behavior and the function of environmental events. Some recent theoretical work has addressed these issues.

## The Function-Altering Effects of Rules

Schlinger and Blakely (Blakely & Schlinger, 1987; Schlinger & Blakely, 1987) argue that rules work in one of two ways. On the one hand rules often work directly, as when one person says "stand up" to another. They view this kind of control as simple discriminative control and not deserving of a special term or label. They further argue that a true discriminative stimulus evokes behavior almost immediately (Michael, 1980). On the other hand, there are often long temporal delays between the presentation of the rule and the behavior indicative of rule-following. Furthermore, rules also seem to alter the function of environmental events, a trait not traditionally ascribed to discriminative stimuli. Based on these two points, Schlinger and Blakely argue that rules are not discriminative stimuli at all. They prefer to reserve the term "rule" for contingency-specifying stimuli that alter the function of environmental events. Take for example the following rule: "When the bell rings, take the cake out of the oven and I will pay you one dollar." A person hearing this rule may in fact take the cake out of the oven at the sound of the bell even after a significant amount of time has elapsed since the rule was given. Taking the cake out of the oven does not occur immediately following rule delivery. Furthermore the bell now evokes this behavior when in the past it may not have. The function of the bell has changed from neutral to evocative.

Rules can alter the functions of antecedent stimuli, as in the example above, or consequential stimuli. The statement, "No pain, no gain!" may establish muscle strain as a reinforcer for weight lifting when it previously may have functioned as a punishing stimulus for this same behavior.

The function-altering account in effect describes an observable outcome of contingency specification. The mechanism by which this occurs has not been well developed by Schlinger and Blakely or by other writers who have discussed it (Cerutti, 1989; Vaughn, 1989). The literature on stimulus equivalence, however, provides an empirical preparation where function-altering has been directly observed and manipulated (Hayes & Hayes, 1989).

Stimulus-equivalence research typically involves a matching-to-sample paradigm in which human subjects are trained to pick stimulus B in the presence of stimulus A and to pick stimulus C in the presence of stimulus A. Following such training, human subjects will pick stimulus C in the presence of stimulus B and vice versa even though they were never trained to do so. B now evokes the response to C and vice versa. The evocative functions of B and C have been altered as a result of such training. Furthermore, recent research has shown that if stimulus C is established as a discriminative stimulus or a conditioned reinforcer, the other stimuli in the triad take on these functions without specific training (Hayes, Brownstein, Devany, Kohlenberg, & Shelby, 1987; Hayes, Tilley, & Hayes, 1988; Wulfert & Hayes, 1988; Kohlenberg, Hayes & Hayes, in press; Hayes, Kohlenberg, & Hayes, in press).

Hayes and Hayes (1989) argue that the words in rules participate in equivalence classes with events in the natural environment and could alter the function of these events in a similar manner. They provide the following interpretation of the effects of the rule: "If the bell rings, then get the cake from the oven." The words bell, rings, get, cake, and oven participate in equivalence classes with actual bells, rings, the action of getting, cakes, and ovens. Because of the "equivalent" relationship between the words and actual events, functions established with respect to the words transfer to the actual events.

The rule is in the form of an "if then" stimulus frame which has been reinforced as a generalized frame into which various objects and actions can be inserted (cf. Gewirtz & Stingle, 1968). For example, with direct reinforcement for use of various particulars of this frame such as: "If red then stop." or "If green then go." humans respond to novel combinations such as: "If blue then push fast." even if "blue" and "push fast" had never been presented in an "if then" frame. Presumably there would have to have been a history with respect to the words blue and push fast in other contexts.

The if then frame also establishes a conditional relationship between the stimulus and the action. The functions of "getting the cake" are transferred to "bell" and "ring" via this frame. Technically, we could say that the frame establishes the words bell and ring as conditional stimuli in the presence of which the oven is a discriminative stimulus for approach, and the cake a discriminative stimulus for getting. The participation of the actual words in classes with actual objects transfers these functions to the objects.

Function-altering as a descriptive process offers several advantages in the analysis of the effects of rules. It appears to describe more aptly the effects of rules (Blakely & Schlinger, 1987, Cerutti, 1989) while still using a vocabulary consistent with behavior-analytic principles. Relating function-altering to stimulus equivalence brings a rapidly growing empirical literature to bear on this essentially theoretical analysis. The analyses by Hayes and Hayes (1989) further tie these two literatures together in a way that begins to make sense of what it means to specify a contingency, a concept which has had little scrutiny in past behavior-analytic theory and research. The promise for each of these ways of thinking is that they will eventually improve our ability to predict and control human behavior.

## Rules and Their Use as Consequences in Feedback

The review thus far has focused on the theory and research that is relevant to control by verbal antecedents or rules. Although, comparatively little research and theory has focused on control by verbal consequences or feedback, it may be that much of what is known about verbal antecedents is generalizable to verbal consequences. In ongoing social interactions, rules are stated, and restated. If a rule is followed, the verbal community points this out; if a rule is not followed, a corrective statement is given. This type of verbal shaping of control by rules is commonly referred to as feedback.

Some practical examples of this type of feedback are as follows. A parent tells her child: "Take your shoes off before you come in the house, so that the carpet won't get dirty." When the child enters the door and takes her shoes off, the parent gives the following feedback: "You remembered to take your shoes off. Good job. Because you did what you are told, you can go into the kitchen and get a cookie."

The training that a beginning mechanic might receive provides another illustration. The beginning mechanic's behavior is often under the control of the rules specified in a repair manual. If the instructions are followed carefully, the car will be fixed. Instructors may note this explicitly in verbal consequences that are delivered, such as "You did a good job reading the specs. It runs great."

These examples illustrate common uses of feedback -- the use of a verbal consequence -- to shape and strengthen behavior. In these examples, behavior evoked by a rule was followed by verbal feedback taking the form of a contingency-specifying stimulus. In the first example, the parent verbally noted appropriate rule-following and resultant socially-mediated consequences for it (the cookie). In the second, the instructor noted the relation between rule-following and the natural consequences that resulted (the car running well).

What is especially noteworthy here is that the distinction between verbal antecedents and verbal consequences begins to blur when actual examples are considered. Verbal feedback often takes the form of a contingency-specifying verbal formula. While there is little research in the human operant literature on verbal consequences, this similarity suggests that the research and theory on verbal antecedents might be relevant to the understanding of verbal consequences as well.

In my earlier analysis of verbal antecedents I made three major points:

a) Verbal rules often compete with direct contingencies for the control of behavior.

b) Control by verbal antecedents may involve at least two different kinds of contingencies: social contingencies for rule-following per se or natural contingencies for behavior evoked by a rule.

c) Rules may control behavior by altering the functions of other stimuli in the environment.

Each of these three points seem to have relevance for ways in which verbal consequences may affect behavior.

<u>Competition Between Verbal Consequences and Other Contingencies</u>

Verbal antecedents can exert strong control over behavior often overriding control by other contingencies and verbal consequences may well do likewise. Verbal consequences that reinforce compliance with a rule may result in continued rule-following even when rule-following no longer results in programmed consequences. In addition, inaccurate feedback may control behavior much as inaccurate antecedent instructions do.

The interaction between feedback and rules is also of interest. Feedback may act to augment already existing control exerted by antecedent stimuli, resulting in a greater degree of correspondence between rules and behavior. Feedback may also establish correspondence between rules and behavior in situations where rules have shown no previous control. Conversely, some types of feedback may override contingencies supporting rule control and result in less correspondence between rules and behavior.

Contingency Analyses of the Effects of Verbal Consequences

The observed effects of verbal consequences may be amenable to a contingency-based analysis similar to those presented by Skinner (1969) and Zettle and Hayes (1982). The examples of the child and the mechanic illustrate how feedback may focus either on the correspondence between rules and behavior as related to socially mediated consequences (pliance) or the relationship between the correspondence between rules and behavior and the natural consequences (tracking).

Both types of feedback specify a rule-behavior relation and may result in an increase in rule-following. However, on the one hand, feedback that specifies the relation between the achievement of direct consequences and rule-following might lead to subsequent control by direct consequences if the rule-behavior correspondence no longer results in the specified consequences. Conversely, feedback that specifies the relation between observed rule-behavior correspondence and the achievement of social consequences specifically meted out for this correspondence might lead to continued control by the rules, even if the rule-behavior correspondence no longer results in the delivery of some other direct consequence.

As will be seen later, this analysis of the direct contingencies that might be responsible for control by verbal consequences suggested a methodology for the current study.

The Function-Altering Effects of Verbal Consequences

Verbal consequences may also alter the functions of stimuli in the programmed or natural environment. For example, a parent might encourage a child to get a job doing yard work. The child returns announcing that she has charged $10 for her work. The parent then says: "I'm glad that you did what I asked but you should only have charged $5." This feedback might alter the reinforcing qualities of amounts over $5 for this kind of work. Receiving more money for the yard work may now have some aversive properties because more money would be associated with some increased probability of parental detection and correction. Verbal consequences may not just compete with other contingencies in a quantitative sense but may alter the qualitative nature of environmental events. By designing feedback that could possibly alter the function of programmed consequences, empirical methods could be brought to bear on the issue of function-altering.

## Summary of Introductory Review

Common-sense examples suggest that verbal consequences may be very important in establishing control by antecedent verbal stimuli. While there has been considerable research and theorizing on rules as antecedent stimuli, the study of verbal consequences and their interaction with the control by antecedent verbal stimuli has been neglected. There are no published basic behavior-analytic studies that have explicitly examined the effects of verbal feedback on the control exerted by rules. Because the use of verbal feedback appears to be as widespread as the use of instructions themselves, they should be brought into the empirical base of research on instructional control.

Verbal stimuli as consequences possess similarities to rules and may be different from verbal stimuli as antecedents only in their position in the behavior stream and in the functions that they possess (reinforcing versus discriminative). Research on antecedent verbal stimuli may have implications for how we look at consequential verbal stimuli. In particular, verbal consequences may involve both pliance and tracking-like contingencies and may affect behavior by changing the functions of other stimuli in the rule-followers environment.

## Statement of Purpose

The primary goal of the present study was to explore how verbal consequences for rule-following interact with the control exerted by rules. As discussed above, the effects of rules have been studied extensively within the human operant research paradigm. The effects of verbal consequences for rule-following have not yet been addressed in human operant research. Because of the scarcity of experimental research and formal theorizing concerning verbal consequences for rule-following, the study was exploratory in nature. It was neither designed to test a particular theory nor to resolve a theoretical debate. The aim of this study was to bring empirical methods to bear on a neglected but seemingly influential variable that may affect the control exerted by rules.

Experimental Setting

In the experiment reported here, subjects worked on a task involving a multiple schedule of reinforcement with points exchangeable for chances at a cash prize as the programmed consequences. Each time a point was delivered, the subjects were also told how many points they had earned thus far. In the beginning of the session, the subjects were given a rule that specified the actual schedules of reinforcement. At a later point in the experiment, the schedules changed without the subject being notified. One schedule change enabled subjects to greatly increase point earnings or effectiveness with respect to maximum consequence delivery and another enabled the subject to respond at a lower response rate with no change in point earning thus increasing efficiency. In previous research (Hayes et al., 1986a, 1986b), similar preparations have been used to study the effects of rules on the sensitivity to changes in schedules of reinforcement. In this study, verbal consequences were interjected as a means of further impacting the subject's response to the schedule changes. The interactions between rules, programmed contingencies and verbal consequences was observed.

Types of Verbal Consequences for Rule-Following

Two types of verbal consequences were chosen for study: rule-following feedback and rule-following feedback plus task performance feedback. The actual form of these consequences and the rationale for their choice are presented below.

Rule-Following Feedback. Rule-following feedback specified the correspondence between the subject's behavior and the behavior that was specified in the antecedent rule. In the present experiment, it took the following form: "You are (not) following the rule that you were given at the beginning of the session."

There are at least two reasons to study rule-following feedback as a type of verbal consequence. First, since I was primarily interested in the relation between verbal consequences and rule-following, it seemed logical to manipulate the presence or absence of verbal consequences that addressed rule compliance. Second, rule-following feedback may be a means to manipulate some of the contingencies that support rule-following. The direct manipulation of contingencies supporting rule-following addressed a key theoretical issue. Several accounts of rule-induced "insensitivity" to programmed contingencies have suggested the presence of collateral contingencies that support compliance with rules (Catania, Shimoff, & Matthews, 1989; Cerutti, 1989; Skinner, 1969; Zettle & Hayes, 1982). These collateral contingencies have been relegated to inferred reinforcement histories and have themselves received little direct study. It seems appropriate for the study of verbal consequences to address this key issue early on. This is especially relevant given that observation of the use of verbal consequences in everyday life suggests that they may be quite frequently used to shape and maintain control by rules.

Rule-Following Feedback Plus Task Performance Feedback. The second type of feedback involved feedback on rule-following identical to the first type of feedback. In addition, subjects were also given feedback on task performance or how many points they had earned. In the present experiment, this type of consequence took the following form: "You are (not) following the rule that you were given at the beginning of the session. You earned X point(s) in the last two minutes."

The combination of feedback for rule-following and task performance seemed to be a logical step. In research on rule-governance, antecedents rules are usually pitted against the direct task performance contingencies. This second type of verbal consequence looks at both of these dimensions in verbal consequential form. The subject is given feedback on rule-following as well as the programmed consequences associated with rule-following.

Task performance feedback has not previously been studied in this way. Verbal task performance consequences can be immediate or delayed.

The points used in this study are an example of immediate feedback. They can also be conceptualized as verbal consequences given the fact that there reinforcing value is verbally established by orienting instructions. In fact these points are often nothing but words and are exchangeable for nothing. Even when the task consequences are not directly established by verbal behavior, verbal accompaniments seem highly likely. For example, a child shooting down a plane in a video game may see the plane explode, but may say to himself "I shot him." It would be difficult to devise task performance feedback for adults that would be completely non-verbal. In this sense, most human operant studies involve verbal task performance feedback to the extent that they employ consequences whose value is established by verbal description. However, as stated above, this feedback has been immediate as opposed to delayed summative feedback. While both seem important, the present study focused more on delayed, summative forms of task performance feedback.

The verbal summative type of feedback seems more relevant to how feedback is used in applied settings. What is traditionally called feedback in applied behavioral research conducted in industrial settings (see Rapp, Carstensen, & Prue, 1983 for a review of this literature), amounts to a verbal summation of behavior or behavior products administered well after the behavior has occurred. For example, feedback has taken the form of oral and written tallies of safety violations. Such feedback in conjunction with suggestions for remediation has been shown to significantly reduce safety violations (Sulzer-Azaroff & de Santamaria, 1980). Another example is provided by feedback that summarizes the consequences of production, in this case, the number of rosin bags that were made by factory workers. This feedback was shown to increase the amount of time that machines were running during the day (Frost, Hopkins, & Conrad, 1981).

These examples indicate the applied relevance of verbal consequences that provide a summation of performance. What is missing in the applied literature is a more precise analysis of the relationships among rules, rule-following feedback, and feedback on task performance. The human operant laboratory provides a precise setting for the study of this phenomenon as compared to industrial settings which are fraught with social complexities and other types of competing contingencies.

## The Accuracy of Verbal Consequences

Both of the types of feedback described above can involve a dependent or contingent relationship between the consequence and the subjects' behavior. Positive or negative feedback can be based on the subjects' behavior with respect to the rule. However, it is not clear whether verbal consequences truly function as consequences, or as a special type of antecedent. Recall that verbal antecedents often induce insensitivity regardless of their accuracy. The mere presence of verbal consequences for rule-following may enhance rule-following regardless of accuracy. The necessity of accuracy was studied in the following manner. Some of the subjects receiving the types of feedback discussed above were always told that they were following the rule regardless of their actual behavior. If the actual contingency between rule-following and rule-following feedback is not important, then there should be no difference in the effect of the messages when they are dependent or nondependent -- accurate or inaccurate. Examining this dependency factor helps to explore how verbal feedback actually works.

## Control Conditions

Two control conditions were also included in the experiment. Some subjects received no rule and no feedback, and others received a rule without feedback. These control groups established a baseline of rule-induced insensitivity to changing contingencies as well as contingency control in the absence of a specific rule.

Possible Effects of the Two Types of Feedback

It seems likely that rule-following feedback alone may increase insensitivity to changes in programmed contingencies in situations where the rule is incongruent with maximum effectiveness or efficiency with respect to the programmed contingency. Such an effect could be easily interpreted by appealing to the notion of competing collateral contingencies. Programmed contingencies support behavior that meets the requirement for delivery of the programmed consequence. In my procedure, rule-following ultimately led to decreased effectiveness or decreased response efficiency with respect to the programmed consequences. Positive feedback for rule-following and negative feedback for rule-breaking could further support behavior that is not effective in terms of the programmed contingencies. Given that rules alone often effectively compete with programmed contingencies, the addition of rule-following feedback is likely to further enhance rule-following.

The possible effect of the combination of feedback on rule-following and task performance is more difficult to predict than the effects of feedback on rule-following alone. On the one hand, task performance feedback in the context of rule-following feedback could reduce any increase in rule-following produced by rule-following feedback. Subjects may better note the relation between following or not following the rule and increased or decreased point delivery. Because in my procedure rule-following ultimately led to decreased points or decreased response efficiency, such a relation could reduce rule-following. Essentially, it may alter the nature of rule-following from a socially-mediated end in itself to a means to an end in the natural world.

From the standpoint of a competing contingency analysis, this manipulation may increase the effectiveness of the programmed consequences by specifying that rules no longer lead to effective action. Such a finding would be of interest in that it would point to ways that rules could be used to establish effective responding that would be sensitive to any subsequent changes in effectiveness.

However, task performance feedback in the context of rule-following feedback could increase rule-induced insensitivity still further, if the points are taken to be indications of following or not following the rule. That is, rule-following feedback plus task performance feedback could alter the functions of points from desirable consequences to indications of rule-breakage. Such an effect would be difficult to account for in terms of a simple competing contingency model because it would involve a change in the function of points.

# CHAPTER II

## Method

### Subjects

Subjects were undergraduate and graduate students at the University of Nevada-Reno. They were recruited using three procedures: 1) students in introductory psychology classes signed up for the experiment as a means of fulfilling course requirements or obtaining extra credit; 2) signs were posted on campus to solicit volunteers who were interested in participating in a psychology experiment concerned with human learning; and 3) the principal investigator visited psychology classes to solicit volunteers.

Ninety-nine subjects completed the experiment. The data from 60 subjects met the criteria for inclusion in the study, making for a total of ten subjects in each experimental group. Of these 60 subjects, 39 were female and 21 were male. Their ages ranged from 15 to 50 with a mean age of 23. Subjects were randomly assigned to the experimental groups as a means of controlling for bias due to age, gender, or other factors.

### Setting and Apparatus

The experiment was conducted in a small laboratory room containing a chair, table, and the experimental apparatus. The apparatus included a microcomputer with a CGA monitor. Two telegraph keys mounted on a wooden platform were wired to the joystick port at the rear of the computer.

## Experimental Task

A five-by-five matrix with a circle in the upper left-hand corner appeared on the monitor. The matrix comprised 25, 4-cm by 3.5-cm squares. Below the grid, either a blue or red 4.5-cm by 1.5 cm rectangle was illuminated. The blue rectangle appeared below the left half of the matrix and the red rectangle appeared below the right half of the matrix. Only one rectangle was presented at any given time. A wooden platform with two telegraph keys was located directly in front of the monitor.

According to a programmed schedule, presses on the left button moved the circle down one square, while presses on the right button moved the circle one square to the right. If the circle was moved more than five squares down or five squares to the right, it reset to the upper-left hand corner. If the circle reached the lower right-hand corner, a message on the screen instructed the subject to press either button in order to receive a point. The screen then displayed the total number of points that had been earned for that session and the circle was reset to the upper left hand corner.

## Procedure

At the beginning of the experiment, the subject was read the following instructions:

> Please read these instructions with me as I read them out loud. 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 experiment, you will be alone in this room for approximately 96 minutes. The experiment will begin when a five by five grid appears on the monitor. When the experiment is over, the monitor will say so.

> When the grid appears, there will be a circle in the upper left-hand corner. To make points, move the circle to the lower right-hand corner; then when the monitor says to, push either button to receive your point. Try to see how many points you can get. Each point is worth a chance at two $20.00 prizes to be given at the end of the semester.
>
> Moving the circle to the lower right-hand corner involves the buttons and the lights.
>
> When the blue rectangle is lit, the best way to push the buttons is slowly with several seconds between each push. When the red rectangle is lit, the best way to push the buttons is rapidly.
>
> Please do not push both buttons at the same time during the task. If you have any questions, ask them now, because during the experiment the experimenter will not be able to answer any questions.

The subject was then asked to sign the consent form (see Appendix A). Any questions were answered by rereading the relevant portion of the instructions. The experimenter then left the room and the experiment began.

Subjects worked individually for one 96-minute session. Movement of the circle was programmed according to two different multiple schedules of reinforcement. One multiple schedule was in effect during the first 32 minutes of the experiment and a second multiple schedule was in effect for the final 64 minutes of the experiment. The change from one schedule to another was not signalled.

First Multiple Schedule

During the first 32 minutes of the experiment (Phase 1), movement of the circle using the telegraph keys was programmed according to a multiple differential reinforcement of low rate 6 seconds (DRL 6)/fixed ratio 18 (FR 18) schedule of reinforcement. When the blue rectangle appeared at the bottom of the matrix, presses on the buttons moved the circle in accordance with a DRL 6 schedule of reinforcement: each press following a six-second period without a press resulted in a movement. A press following a pause of less than six seconds resulted in the timer being reset. Very low rates of responding maximized point delivery in this schedule. When the red rectangle appeared, presses on the button moved the circle in accordance with a FR 18 schedule of reinforcement. A movement occurred following the 18th response on either button. The direction of movement was determined by the particular button pressed. High rates of responding maximized point delivery in this schedule. The color of the light and thus the schedule of reinforcement switched every two minutes.

Inclusion Criteria. Of particular interest in this study was the interaction between control by antecedent rules and control by verbal consequences. Therefore it was critical that each subject showed behavior consistent with the rule during acquisition and before feedback on rule-following began. Only subjects who earned at least one point in each of the two initial schedules during the first 20 minutes of the experiment were included in the study. Verbal feedback began after 20 minutes. Thirty nine subjects who began the experiment did not meet the criteria for inclusion.

Second Multiple Schedule

Following 32 minutes of exposure to the first multiple schedule, the schedule was switched to a multiple fixed ratio 1 (FR 1)/fixed interval yoked (FI Yoked) schedule of reinforcement that remained in effect for the final 64 minutes of the experiment. The change in schedules was not announced or signalled in any way.

When the blue rectangle previously associated with the DRL 6 schedule was present, presses on the buttons moved the circle in accordance with a FR 1 schedule of reinforcement. Each press on the button resulted in a movement of the circle. High rates of responding maximized point delivery in this schedule.

When the red rectangle previously associated with the FR 18 schedule appeared, the circle moved according to a FI yoked schedule, which was individualized for each subject. The interval value was calculated by determining the average number of seconds that it took the subject to respond 18 times and move the circle in the last two-minute phase of the FR 18. For example, if a subject responded 432 times in the last two-minute FR 18 component, his or her interval value would be five seconds. In a FI 5 schedule, the first press on the button after five seconds elapsed resulted in a movement of the circle. Presses occurring in the interval before five seconds elapsed produced no effect. In this schedule, lower rates of responding than that previously seen in the FR 18 schedule would generate the same number of points.

If the subject showed no response rate changes under the two schedules in the last 64 minutes as compared to the first 32 minutes, the circle would move in almost exactly the same way and earn the same amount of points. However, following the switch from the DRL 6 to the FR 1, an increase in response rate resulted in a substantial increase in movement of the circle and the delivery of points. Thus a large increase in the <u>effectiveness</u> of responding was possible.

When the schedule switched from the FR 18 to the FI Yoked, the subject could show a substantial decrease in response rate without reducing the number of movements of the circle or the number of points delivered. In addition, the number of movements or points could not be increased. Thus an increase in efficiency but not effectiveness was possible.

Rule Messages

During the first 20 minutes of the experiment, each switch between components of the multiple schedule was marked by a four second pause during which the screen went blank. For the next 44 minutes, switches between the components of the multiple schedule were marked by a four second message which gave feedback on rule-following. The form of the message was different for each experimental group, with two groups receiving no messages throughout the entire experiment. The groups who received no messages continued to receive the four seconds of blank screen between components. In the final 32 minutes of the experiment (Phase 3), no messages were presented between components of the multiple schedule. All subjects received a blank screen for four seconds in the time period between alternating components of the multiple schedule. The 32 minute period of time beginning with the schedule transition and ending with the cessation of rule-messages was referred to as Phase 2.

Types of Rule-Messages. The first type of rule-message was referred to as rule-following feedback because it stated whether or not the subject was emitting behavior that was in correspondence with the original rule (fast response rates when the red rectangle was present and slow response rates when the blue rectangle was present). This message took the form: "You are (not) following the rule that you were given at the beginning of the session".

The second type of message was referred to as rule-following point feedback as it gave feedback on the number of the specified consequences (points) that the subject had earned, within the context of rule-following feedback. This type of message took the form: "You are (not) following the rule that your were given at the beginning of the session. You earned X point(s) in the last two minutes."

Dependence of Rule-Messages. Both types of rule-messages presented feedback as to whether or not the subjects' behavior was in correspondence to the behavior that was specified in the rule. This feedback was either dependent or independent of the subjects' actual performance on the task.

In the dependent condition, the rule-following feedback was dependent on the subjects' actual behavior. If subjects responded 30 times or less in two minutes when the blue rectangle was present (DRL 6 and FR 1 schedules), they were told that they were following the rule that was given at the beginning of the experiment. If subjects responded more than 30 times in two minutes when the blue rectangle was present, they were told that they were not following the rule. When the red rectangle was present (FR 18 or FI yoked schedules), subjects who responded more than 100 times in two minutes were told that they were following the rule and subjects who responded 100 times or less were told that they were not following the rules.

In the nondependent condition, the subjects were always told that they were following the rules regardless of their performance. Nondependence specifically refers to a consistent delivery of positive feedback as opposed to the delivery of positive and negative feedback based on a random schedule independent of performance.

Presentation of Rule Messages. Rule messages were introduced 20 minutes after the experiment began. This allowed all subjects to acquire the response under the influence of the rule alone. The messages were introduced 12 minutes before the unannounced change in schedules. Staggering these changes avoided associating the schedule change with a salient change such as the addition of rule messages. Pairing these two manipulations may have inadvertently called attention to the schedule change and made it easier to detect.

Control Conditions

There were two control conditions in this experiment. These groups received no rule messages. A blank screen was always displayed for four seconds between the two-minute schedule components.

The Rule Alone Group received the standard rule at the beginning of the experiment but received no rule-following feedback during the course of the experiment.

The Minimal Rule Group received minimal instructions as opposed to the more specific instructions received by the preceding groups. No rule messages were presented. The instructions were the same as those given to the other subjects with the exception of the omission of the following section:

> When the blue rectangle is lit, the best way to push the buttons is slowly with several seconds between each push. When the red rectangle is lit the best way to push the buttons is rapidly.

## Debriefing

Following the experiment, the subjects were given a debriefing statement (Appendix B) and the experimenter answered any questions that were raised.

### Experimental Design

The experimental design can be represented as a 2 (rule-message) by 2 (dependence) factorial design with two control groups. In one control group the subjects received the standard antecedent rule but did not receive rule-following feedback messages of any kind. This allows for the evaluation of the effects of verbal consequences on rule-following, above and beyond the effects of rules alone. The other control group received minimal instructions. A comparison between the groups receiving rules alone and the groups receiving minimal instructions would reveal the effects of rules alone. By crossing the two types of rule messages and two types of correspondence, and adding appropriate control groups, six experimental groups are formed. These groups also be represented as a single-factor design. The six groups are as follows:

1. Rule-Following Dependent (n=10).
2. Rule-Following Nondependent (n=10).
3. Rule-Following Point Dependent (n=10).
4. Rule-Following Point Nondependent (n=10).
5. Rule Alone (n=10).
6. Minimal Rule (n=10).

# CHAPTER III

## Results

Of primary interest in this study were changes in subjects' behavior in response to transitions from the first multiple schedule to the second multiple schedule and the withdrawal of the feedback on rule-following. At the onset of Phase 2, the schedules of reinforcement were changed from a FR 18 to a FI Yoked and from a DRL 6 to a FR 1.

The two basic schedule transitions seem to involve different consequential dimensions. Sensitivity to the change from the FR 18 to the FI Yoked is a matter of increased efficiency of responding. A subject who is responding at a high rate in the FR 18 schedule and earning a substantial number of points can greatly decrease her rate of responding and still earn the same number of points in the FI Yoked schedule. High and low response rates earn the same number of points in a two-minute period. However, the low response rate is more efficient in terms of the number of responses it takes to receive a point.

Sensitivity to the change from a DRL 6 to the FR 1 is a matter of increased effectiveness of responding. A subject who is responding with low rates in the DRL 6 and earning the maximum number of points can increase her rate of responding and earn many more points in the FR 1. Continued low response rates result in no change in the number of points earned while a change to a higher response rate results in a much higher number of points earned. The high response rate is more effective in terms of earning points.

Sensitivity to schedule changes that permit greater efficiency of responding and sensitivity to schedule changes which permit greater response effectiveness may be affected by different variables. For this reason, the findings for the efficiency-based transition and the effectiveness-based transition were analyzed separately.

## Data Analysis

The number of responses and points earned per two-minute component was the principal dependent measure. Of particular interest is the average number of responses and points per two-minute component in each phase across the six experimental groups. Recall that for the first 32 minutes (Phase 1) the initial schedules of reinforcement were in effect. In the groups that received rule messages, the messages began after 20 minutes had elapsed in Phase 1. For the second 32 minutes (Phase 2) the schedules were changed and remained the same for the remainder of the experiment. Rule messages continued to be presented throughout all of Phase 2. For the final 32 minutes of the experiment (Phase 3), the rule messages, in groups that received them were withdrawn. The second multiple schedule remained in effect in Phase 3.

The mean number of responses and points per two-minute component was computed for Phase 1 (using the three components of each schedule prior to the schedule change), Phase 2 (using the eight components in each schedule after the schedule change), and Phase 3 (using the eight components in each schedule following the withdrawal of the rule-messages). The final three components were used in Phase 1 to help insure relatively stable responding and point earning, since the first few components showed highly variable responding due to task acquisition.

The experimental design was conceptualized in two different ways. One conceptualization consisted of a series of single-factor designs. There were six groups that were each exposed to three phases. Three separate one-way analyses of variance (ANOVAs) were computed to examine differences in group performance during each experimental phase. A repeated-measures design could not be used because of the violation of the assumption of homogeneity of variance across the three phases. Thus a set of analyses were also computed using difference scores to examine changes between phases.

The design was also conceptualized as a two (rule message type) by two (dependence) factorial design. Conceptualized in this fashion, the Minimal Rule Group and the Rule Alone Group were external control groups not included in the main analysis. The two-way ANOVA was used to determine the effects of rule message and dependence and the interaction of these variables. A separate analysis was conducted for each phase. Once again, the two-way analyses were conducted both on mean number of responses and points per component in each phase and on differences scores from phase to phase.

These two conceptualizations explored both differences between groups and effects of variables common to more than one group, during task acquisition (Phase 1), following a schedule change (Phase 2) and following withdrawal of rule-messages (Phase 3). Performance in each phase and changes from one phase to another (difference score analyses) were examined. In all inferential statistical analyses a $p$ value of 0.05 was considered to be statistically significant.

## Efficiency-Based Transition

### Parametric Analysis of Response Rate Data

The efficiency-based transition began with a FR 18 schedule of reinforcement in Phase 1. A one-way (group) ANOVA (See Table 1; Table 1 and all subsequent tables are located in Appendix C) was computed to compare mean number of responses per component across the six groups in Phase 1. No significant differences ($F(5,54) = 0.39$, $p$ = ns) were found among the six groups in Phase 1. The mean number of responses per two minutes in Phase 1, across the six groups, was 488.6. These findings indicated that there were no major differences in schedule acquisition across the six groups.

The second phase marked the introductions of the FI Yoked schedule of reinforcement. A one-way (group) ANOVA (See Table 1) was computed to compare mean number of responses per component across the six groups in Phase 2. No significant difference ($F(5,54) = 0.47$, $p$ = ns) was found between the six groups in Phase 2. The mean number of responses per two minutes in Phase 2 across the six groups was 333.8, about 155 responses fewer than in Phase 1. Thus, subjects in the six groups responded uniformly to the change to the FI Yoked schedule of reinforcement in Phase 2. The different types of feedback did not produce a differential response to an efficiency-based change in the schedule of reinforcement.

The third phase marked the withdrawal of the rule messages and a continuance of the FI Yoked schedule of reinforcement. A one-way (group) ANOVA (See Table 1) was computed to compare mean number of responses per component across the six groups in Phase 3. Once again, no significant differences ($\underline{F}(5,54) = 0.32$, $\underline{p}$ = ns) were found between the six groups in Phase 3. Responding showed a further decline, with the mean number of responses per two minutes in Phase 3, across the six groups, being 250.5. The withdrawal of the rule messages did not have a differential effect on response rate across the six groups.

Two-way (rule message x dependence) ANOVAs were computed to assess differential influence of the type of rule message and whether or not the rule messages were dependent on actual responding. The Minimal Rule Group and the Rule Alone Group were excluded from these analyses. A separate analysis was computed for each of the three phases. As might be expected, given the results of the one-way analyses, there were no significant differences in the mean number of responses per component between the two types of rule-following feedback, the two types of feedback dependencies, or their interaction in any of the three phases (see Table 2). Thus, either alone or in combination, neither the rule messages nor the type of dependency had any effect on acquisition, post schedule transition responding, or post rule message withdrawal responding when the schedule change afforded only increased response efficiency.

In addition to examining the differences in mean number of responses per group per phase, difference scores were computed for each group. The difference in the mean number of response per component between phases was computed for each subject. This gave rise to three difference scores: the difference between Phase 2 and Phase 1 (D21), the difference between Phase 3 and Phase 2 (D32), and the difference between Phase 3 and Phase 1 (D31). These scores enabled the study of possible divergence in the mean difference in the number of responses from phase to phase across groups. None of the one-way or two-way ANOVAs was statistically significant for any of the three difference score measures (see Tables 3 & 4).

Nonparametric Analyses

The data were also analyzed in a nonparametric fashion. Pilot work suggested that two specific patterns indicated insensitivity to change from the FR 18 to the FI Yoked schedule of reinforcement. One pattern was typified as a steady continuation of the previous pattern or a failure to show dramatic change. Operationally, this was defined as a failure to go below 100 responses in any of the eight components in Phase 2. A second pattern was typified as a decrease in response rate below the criterion followed by a return to above criterion response rate. Operationally this was defined as a decrease below 100 and return to above 100 in any of the eight components in Phase 2. A cutoff of 100 responses was chosen because it was also the cutoff between receiving a positive versus a negative rule-following message in the dependent groups. In none of the groups were fewer than eight out of ten subjects insensitive to the efficiency-based transition based on the criteria described above. The number of subjects in each of the six groups showing insensitivity and sensitivity formed the basis for a Chi-square table (see Table 5). No significant difference was found (Chi-Square =2.39 $\underline{p}$ = ns). A similar table was constructed for the number of subjects showing the defined insensitivity patterns versus subjects showing the defined sensitivity pattern in Phase 3 (See Table 5). No significant difference was found (Chi-Square =1.41 $\underline{p}$ = ns). These results suggest that subjects, regardless of group, were uniformly insensitive to the efficiency-based transition.

The results of from the nonparametric analysis are consistent with those of the parametric analyses. Overall, the independent variables showed no differential effects on the response to the transition from a FR 18 to a FI Yoked schedule of reinforcement or to the subsequent withdrawal of rule messages.

## Parametric Analysis of Point Data

In addition to the response rate data, the mean number of points earned per component was calculated for each phase. Identical analyses were computed for the point data as were done for the response rate data. No significant effects were found (see Tables 6, 7, 8, & 9).

## Point of Contact With the Schedule Change

Sensitivity to programmed contingencies can be assessed in more than one way. Response rate is one global measure of schedule sensitivity. Looking at response rate alone does not indicate if contact with the contingencies was actually made at a more molecular level. For example, a subject still showing 300 responses per two-minute component following the shift from the FR 18 to the FI Yoked schedule of reinforcement may have some instances of long interresponse times in a given component, thus showing evidence of having contacted the schedule change. However, looking only at the number of responses per component would suggest that this subject did not contact the change. Contact with a change in contingencies can also be operationally defined in terms of the amount of time between responses. Interresponse times are a more precise indicant of contact with the contingencies.

Recall that the FI value was individually determined for each subject in that it was yoked to response rates in the latter part of Phase 1. The mean FI Yoked value across the six groups was 4.61 seconds. A one-way (group) ANOVA showed no significant differences ($F(5,54) = .31$, $p$ = ns) in the mean FI Yoked values across the six groups (See Table 10).

For the FR 18/FI Yoked schedule of reinforcement, the computer recorded each time the interresponse time was more than four seconds. Four seconds was chosen because it approximated the average interval value across subjects for the FI Yoked and provided a more precise indicator of when subjects showed evidence of schedule control. There were 24 components in the FR 18/FI Yoked schedule. After the eighth component, the schedule was changed. Response times of greater than four seconds during the two-minute components following the change from the first to the second multiple schedule were of particular interest. The first component after the change in multiple schedules change in which the subject showed one, four, and eight IRT's of greater than four seconds were recorded for each subject. The values of one, four, and eight were chosen because they indicated when the first point of contact occurred (one time), when the subject had contacted the change enough times to possibly move the circle through half of the grid (four times), and through the entire grid, thus earning a point (eight times).

A one-way ANOVA (group) was computed to analyze between-group differences in the mean component during which one, four, or eight IRT's of more than four seconds were shown. There were no significant differences between groups in terms of these dependent measures (See Table 11). On average, the subjects showed one IRT of greater than four seconds during the 13th component (13.3), four IRT's during the 16th component (15.6), and eight IRT's during the 18th component (18.4). This indicates that subjects showed the first evidence of contact five components after the schedule change and with little evidence of stronger contact until after the end of the second phase.

IRTs are a more precise measure of point of contact than observation of average response rate change following the schedule change. Failure to show sensitivity to contingencies can be due to the fact that response variability is often restricted by instructions (Joyce & Chase, 1990). Thus contact with the contingencies is not made until variable responding occurs. Failure to show sensitivity may also be due to other contingencies in addition to the programmed contingencies. Instructed subjects who have actually made contact with contingencies can still appear insensitive to these contingencies (Hayes et al., 1986b). It is conceivable that a subject can show contact based on IRTs and still appear insensitive in terms of response rate (see results for the effectiveness-based transition as an examples of this effect).

The relationship between the two measures of sensitivity warrants some empirical scrutiny. To further assess how these two measures of sensitivity relate to each other, correlations were computed between the three point of contact measures (one, four, and eight IRT's) and the average mean number of responses per component during the second and third phase.

There was a consistent significant positive correlation between the mean number of responses in Phase 2 and the component number in Phase 2 or 3, at which the subject accumulated one ($r = 0.63$, $p = 0.0001$), four ($r = 0.64$, $p = 0.0001$), and eight ($r = 0.58$, $p = 0.0001$) interresponse times of more than four seconds. This suggests that the higher the observed response rate in Phase 2, the later the point of contact was made. Overall, response rate and point of contact were two measures of insensitivity that were correlated with each other. It would be difficult to tell if any possible differences in response rate were due to differences in point of contact or to differences in the maintenance of response patterns once the changed contingencies had been contacted. It would therefore be of interest to look specifically at maintenance effects separately from point of contact effects.

To study this issue further, the analyses conducted with respect to response rate were also conducted with point of contact as the covariate. Analyses of covariance (ANACOVAR) were conducted to assess differences across groups in terms of average number of responses in Phases 2 and 3 (after the schedule change), and difference scores from Phase 1 to 2, from Phase 2 to 3, and from Phase 1 to 3. There were no significant differences between groups in terms of these dependent measures (see Tables 12 & 14). In addition there were no significant differences when two-way ANACOVARs (rule message type x dependence) were conducted with response rate and difference scores as the dependent measures (see Tables 13 & 15).

These results suggest that the results of the parametric analyses on response rate -- when controlling for point of contact as a covariate -- are no different than the results of the analyses that do not control for point of contact as a covariate. This conclusion is specific for a schedule change that enabled a possible increase in efficiency.

## Effectiveness-Based Transition

In the effectiveness-based transition a DRL 6 schedule of reinforcement was in effect for the first 32 minutes of the experiment (Phase 1). Following this phase, the schedule was changed to a FR 1 schedule of reinforcement which remained in effect for the remainder of the experiment. In the final 32 minutes, the rule-messages were withdrawn.

### Parametric Analysis of Response Rate Data

The data analysis procedures for the effectiveness-based transition were identical to those conducted with the efficiency-based transition. Group differences in mean number of responses per component were examined for each phase.

A one-way (group) ANOVA was computed to compare mean number of responses per component across the six groups in Phase 1 (see Table 16). A significant difference ($F(5,54) = 3.36$, $p < 0.02$) was found between the six groups in Phase 1. A Tukey test was computed to determine if there were significant differences between the individual groups. There was no significant difference among the Rule-Following Dependent Group (24.6), the Rule Alone Group (20.2), the Rule-Following Point Dependent Group (17.3), the Rule-Following Point Nondependent Group (17.0), and the Rule-Following Nondependent Group (16.5). The Minimal Rule Group showed the highest mean number of responses per component at 31.3 and was significantly higher than the Rule Alone Group, the Rule-Following Point Dependent Group, the Rule-Following Point Nondependent Group, and the Rule-Following Nondependent Group. There was no significant difference between the Minimal Rule group and the Rule-Following Dependent Group. This analysis reflects between-group differences in acquisition prior to the schedule change. Subjects in the Minimal Rule Group, with no rule to specify effective performance, tended to respond at a higher rate than necessary for the schedule requirements. The data also suggest a similar but less pronounced trend in the Rule-Following Dependent Group. However, analyses presented in a later section indicate that all groups earned a similar amount of points in Phase 1. These differences in response rate do not represent significant functional differences.

Phase 2 began with the introduction of the FR 1 schedule of reinforcement. A one-way (group) ANOVA was computed to compare mean number of responses per component across the six groups in Phase 2 (see Table 16). A significant difference ($F(5,54) = 2.55$, $p < 0.05$) was found between the six groups in Phase 2. A Tukey test was computed to determine if there were significant differences between the pairs of individual groups. The Minimal Rule Group (202.1) was not significantly different from the Rule-Following Nondependent Group (178.6), the Rule Alone Group (173.9), the Rule-Following Point Nondependent (154.2) or the Rule-Following Dependent Group (147.7). The Rule-Following Point Dependent Group (87.7) was not significantly different from the Rule-Following Nondependent Group, the Rule Alone Group, the Rule-Following Point Nondependent and the Rule-Following Dependent Group. The Rule-Following Point Dependent Group was the only group to differ significantly from the Minimal Rule Group. The Rule-Following Point Dependent Group had a lower mean number of responses per component than the other five groups. The Rule-Following Point Dependent manipulation seemed to induce somewhat higher degrees of insensitivity to the effectiveness-based schedule change than the other five groups.

Phase 3 marks the withdrawal of the rule messages with a continued FR 1 schedule of reinforcement. A one-way (group) ANOVA was computed to compare mean number of responses per component across the six groups in Phase 3 (see Table 16). A significant difference ($F(5,54) = 3.35$, $p = 0.02$) was found between the six groups in Phase 3. A Tukey test was computed to determine significant differences between the pairs of individual groups. The Minimal Rule Group (253.1) was not significantly different from the Rule Alone Group (215.8), Rule-Following Point Nondependent Group (211.2), the Rule-Following Nondependent Group (210.6) or the Rule-Following Dependent Group (203.9). The Rule-Following Point Dependent Group (123.7) was not significantly different from the Rule Alone Group, Rule-Following Point Nondependent Group, the Rule-Following Nondependent Group and the Rule-Following Dependent Group. The Rule-Following Point Dependent Group was the only group to be significantly different from the Minimal Rule Group. The Rule-Following Point Dependent Group had the lowest mean number of responses per component. The Rule-Following Point Dependent manipulation seemed to induce somewhat higher degrees of insensitivity to the FR1 schedule of reinforcement even after the rule messages had been withdrawn.

A separate two-way (rule message x dependence) ANOVA was computed on data from each phase to assess differential influence of the type of rule message and rule message dependency. There were no significant differences in any of these analyses (see Table 17). Taken together, these results suggest that rule message type and dependence do not have differential effects on the subjects' adaptation to the effectiveness-based transition or response to rule message withdrawal when compared to each other, but certain combinations of these variables produce results that differ from the control condition.

As in the efficiency-based transition, a set of analyses was conducted on the difference scores from phase to phase. Three difference scores were examined: the difference between Phase 2 and Phase 1 (D21), the difference between Phase 3 and Phase 2 (D32), and the difference between Phase 3 and Phase 1 (D31).

A one-way (group) ANOVA was computed with D21 as the dependent variable (see Table 18). A significant difference was found between the six groups ($F(5,54) = 2.35$, $p < 0.05$). A Tukey test was computed to further determine significant differences between the pairs of individual groups. The Minimal Rule Group (170.8) was not significantly different from the Rule-Following Nondependent Group, (162.2) the Rule Alone Group (153.8), the Rule-Following Point Nondependent (137.2) or the Rule-Following Dependent Group (123.1). The Rule-Following Point Dependent Group (70.41) was not significantly different from the Rule-following Nondependent Group, the Rule Alone Group, the Rule-Following Point Nondependent Group and the Rule-Following Dependent Group. The Rule-Following Point Dependent Group was the only group to be significantly different from the Minimal Rule Group. The Rule-Following Point Dependent Group had a the lowest D21 score. The Rule-Following Point Dependent manipulation seems to induce higher degrees of insensitivity to the effectiveness based transition as measured by difference scores.

A one-way (group) ANOVA was computed with D32 as the dependent variable (see Table 18). No significant differences were found between the six groups ($F(5,54) = 0.36$, $p$ = ns). This suggests little appreciable effect of withdrawing the rule message.

A one-way (group) ANOVA was computed with D31 as the dependent variable (see Table 18). A significant difference was found between the six groups ($F(5,54) = 2.96$, $p < .05$). A Tukey test was computed to further determine significant differences between the pairs of individual groups. The Minimal Rule Group (221.8) was not significantly different from the Rule Alone Group (195.6), Rule-Following Nondependent Group (194.2), the Rule-Following Point Nondependent Group (194.1) or the Rule-Following Dependent Group

(179.3). The Rule-Following Point Dependent Group (106.40) was not significantly different from the Rule-following Dependent Group, the Rule-Following Point Nondependent Group, the Rule-Following Dependent Group, and the Rule Alone Group. The Rule-Following Point Dependent Group was the only group to be significantly different from the Minimal Rule Group. The Rule-Following Point Dependent Group had a the lowest D31 score. These results indicate that the Rule-Following Point Dependent manipulation induced higher degrees of insensitivity to the change from the DRL 6 to the FR 1 schedule of reinforcement as measured by difference scores.

A separate two-way (rule message x dependence) ANOVA was computed for the difference score data to assess differential influence of the type of rule message and rule message dependency on the three difference scores (see Table 19). In the analysis for the D21 scores the results for dependence were significant ($F(1,36) = 4.85$, $p < .0.05$). The mean difference score for the subjects in groups that were given dependent messages (96.7) was found to be significantly different from the mean difference score for the subjects in the groups that received messages that were not dependent (149.7) based on a Tukey test. There was no significant effect for the rule message factor or the rule message x dependence interaction.

There were no significant findings for the D32 and the D31 scores. Overall these results suggest that rule message type and dependence do not have differential effects on the subjects' adaptation (as measured by difference score) to the effectiveness-based transition or response to rule message withdrawal, but certain combinations (namely the Rule-Following Point Dependent Group) of these variables produce results that differ from the control condition. There also may be some slight effect of dependence, suggesting that messages that are dependent may be more effective at inducing rule control than messages that are not dependent. However, this effect is weak at best.

Non Parametric Analysis of Response Rate Data

The data were also analyzed in a nonparametric fashion. Pilot work suggested that two specific patterns could indicate insensitivity to change from the DRL 6 to the FR 1 schedule of reinforcement. One pattern can be typified as a steady continuation of the previous pattern or a failure to show dramatic change. Operationally this was defined as a failure to show more than 30 responses in any of the 8 components in Phase 2. A second pattern is typified as a major change in response rate followed by a return to the original response rate shown prior to the transition. Operationally this was defined as a increase above 30 responses and a return to below 30 responses in any of the 8 components in Phase 2. Thirty responses was chosen because it was also the cutoff for receiving a positive versus a negative rule-following message in the dependent groups. In the Rule-Following Point Dependent group, 7 of 10 subjects were identified as being insensitive to the change. The next highest number of insensitive subjects per group is the Rule-Following Dependent Group with two of ten subjects identified as showing insensitivity. Differences between the number of subjects in each of the six groups showing insensitivity versus sensitivity was examined via a Chi-square test (see Table 20). A significant difference was found (Chi-Square = 23.30, $p$ <

.001). In order to guard against the possibility of error due to a high number of the expected values below 5, the data were collapsed to compare the number of sensitive versus insensitive subject in the rule-following point dependent group to the combined figures for all of the remaining groups (see Table 20). This test also revealed a significant difference (Chi-Square = 17.45, $p < .001$).

The subjects who never show an increase above thirty do not contact the negative rule message. This insensitivity may have a different quality from the insensitivity that results from exposure to the negative rule message. When only those subjects who showed an increase above 30 with a subsequent return to below 30 are defined as insensitive (as opposed to those who never increased responding and thus may not have contacted the new point contingency), the resulting Chi-Square test (see Table 20) is significant as well (Chi-Square = 17.51, $p < .01$). When the rule-following point dependent subjects who were exposed to negative rule-message are compared to the remaining subjects (see Table 20), significance is also obtained (Chi-Square = 10.41, $p < .01$).

The same criteria for defining insensitivity were used to characterize the subjects' behavior in Phase 3. A Chi-Square table was constructed for the number of subjects showing the defined insensitivity patterns and subjects showing the defined sensitivity pattern in Phase 3 (See Table 20). No significant difference was found (Chi-Square = 7.451 $p > 0.20$). The nonparametric analyses provide additional evidence that the rule-following point dependent feedback leads to more insensitivity to the programmed contingencies than the other types of feedback.

Parametric Analysis of Point Data

In addition to the response rate data, the mean number of points earned per two-minute component was calculated for each phase. The identical analyses were computed for the point data as with the mean number of responses per component. A one-way (group) ANOVA was computed to compare mean number of points earned per component across the six groups in Phase 1 (see Table 21). No significant differences ($F(5,54) = 0.43$, $p$ = ns) were found between the six groups in Phase 1. Uniform point earnings were observed in response to the DRL 6 schedule of reinforcement in effect during the last three components of Phase 1. The point earnings were uniform in spite of the differences in actual response rate among the six groups.

The second phase marked the introduction of the FR 1 schedule of reinforcement. A one-way (group) ANOVA was computed to compare mean number of points earned per component across the six groups in Phase 2 (see Table 21). A significant difference ($F(5,54) = 2.54$, $p = 0.05$) was found between the six groups in Phase 2. A Tukey test was computed to determine significant differences between the pairs of individual groups. The Minimal Rule Group (23.1) was not significantly different from the Rule-Following Nondependent Group (20.9), the Rule Alone Group (19.7), the Rule-Following Dependent (18.4) or the Rule-Following Point Nondependent Group (18.0). The Rule-Following Point Dependent Group (10.1) was not significantly different from the Rule-Following Nondependent Group, the Rule Alone Group, the Rule-Following Point Nondependent Group or the Rule-Following Dependent Group. The Rule-

Following Point Dependent Group was the only group to be significantly different from the Minimal Rule Group. The Rule-Following Point Dependent Group had the lowest mean number of points earned per component than the other five groups. These results support the view that the lower response rates seen by the Rule-Following Point Dependent group affected the effectiveness of responding as defined by the number of points earned.

Phase 3 marked the withdrawal of the rule messages. A one-way (group) ANOVA was computed to compare mean number of points earned per component across the six groups in Phase 3 (see Table 21). A significant difference ($F(5,54) = 3.87$, $p < 0.01$) was found between the six groups in Phase 3. A Tukey test was computed to determine significant differences between the pairs of individual groups. The Minimal Rule Group (29.2) was not significantly different from the Rule-Following Dependent Group (26.5), the Rule Alone Group (25.8), the Rule-Following Point Nondependent Group (25.4), or the Rule-Following Nondependent Group (24.9). The Rule-Following Nondependent Group was not significantly differently from the Rule-Following Point Dependent Group (14.3). However, the Rule-Following Point Dependent Group earned significantly less points than the Rule-Following Point Nondependent Group, the Rule Alone Group, the Rule-Following Dependent Group or the Minimal Rule Group. Thus, the Rule-Following Point Dependent Group persisted in ineffective responding even when the rule-messages were withdrawn.

A separate two-way (rule message x dependence) ANOVA was computed on the point data from each phase to assess differential influence of the type of rule message and rule message dependency. There were no significant differences in the analyses for Phases 1 and 2 (see Tables 22). The results for Phase 3 (see Table 22) indicate that the effects for rule-messages and dependence were not significant. The interaction between rule-messages and dependence was significant ($F(1,36) = 4.58$, $p < 0.05$). This significant interaction is consistent with the finding that the Rule-Following Point Dependent Group seems to enhance rule-following as measured by point earnings. Taken together these results suggest that rule message type and dependence do not have differential effects on the subjects' adaptation to the effectiveness-based transition or response to rule message withdrawal when compared to each other, but certain combinations of these variables produce results that differ from the control condition.

As with the response rate data, a set of analyses were conducted on the difference scores for points from phase to phase. Three differences scores were examined: the difference between Phase 2 and Phase 1 (D21), the difference between Phase 3 and Phase 2 (D32), and the difference between Phase 3 and Phase 1 (D31).

A one-way (group) ANOVA was computed with D21 as the dependent variable (see Table 23). A significant difference was found between the six groups ($F(5,54) = 2.54$, $p < 0.05$). A Tukey test was computed to determine significant differences between the pairs of individual groups. The Minimal Rule Group (21.9) was not significantly different from the Rule-Following Nondependent Group (20), the Rule Alone Group (18.6), Rule-Following

Dependent Group (17.3), or the Rule-Following Point Nondependent Group (17.0). The Rule-Following Point Dependent Group (9.0) was not significantly different from the Rule-following Nondependent Group, the Rule Alone Group, the Rule-Following Dependent Group, or the Rule-Following Point Nondependent Group. The Rule-Following Point Dependent Group was the only group to be significantly different from the Minimal Rule Group. The Rule-Following Point Dependent Group had a the lowest D21 score. The Rule-Following Point Dependent manipulation seems to induce higher degrees of insensitivity to the effectiveness- based transition.

A one-way (group) ANOVA was computed with D32 as the dependent variable (see Table 23). No significant differences were found between the six groups ($\underline{F}(5,54) = 0.67$, $\underline{p}$ = ns).

A one-way (group) ANOVA was computed with D31 as the dependent variable (See Table 23). A significant difference was found between the six groups ($\underline{F}(5,54) = 3.89$, $\underline{p} < 0.05$). A Tukey test was computed to determine significant differences between the pairs of individual groups. The Minimal Rule Group (28.1) was not significantly different from the Rule-Following Dependent Group (25.4), the Rule Alone Group (24.7), the Rule-Following Point Nondependent Group (24.4), or the Rule-Following Nondependent Group (23.9). The Rule-Following Point Dependent Group (13.2) was not significantly different from the Rule-following Dependent Group yet was significantly different from the Rule-Following Dependent Group, the Rule Alone Group, and the Rule-Following Point Nondependent Group. The Rule-Following Point Dependent

Group was the only group to be significantly different from the Minimal Rule Group. The Rule-Following Point Dependent Group had the lowest D31 score. These results indicate that the Rule-Following Point Dependent manipulation induced higher degrees of insensitivity to the change from the DRL 6 to the FR 1 schedule of reinforcement.

A separate two-way (rule message x dependence) analysis of variance was computed for the difference score data to assess differential influence of the type of rule message and dependency. There were no statistically significant differences in these analyses for D21 and D32 (See Table 24). The two-way analysis for D31 (see Table 24) revealed no significant effects for the rule message factor or the dependence factor. However, the results for the rule message x dependence interaction was significant ($F(1,36) = 4.57$, $p < .05$). This significant interaction is consistent with the differences between groups detected in the one-way analyses. These two analyses taken together suggest that the Rule-Following Point Dependent Group may have been the only group to enhance rule-following.

Overall these results suggest that rule message type and dependence did not have differential effects on the subjects' adaptation (as measured by difference score) to the effectiveness-based transition. In addition, these factors do not appear to impact subjects' response to rule message withdrawal in terms of calculated difference scores. However, certain combinations of these variables produced results that differ from the control condition.

Point of Contact With the Schedule Change

As with the efficiency-based transition, interresponse times were used to indicate the component in which a rather precise contact was made with the schedule transition. For example, a subject exposed to the shift from the DRL 6 to the FR 1 may show the same low number of responses per component leading to the conclusion that responding is still occurring once every six seconds. In reality such a subject could have responded rapidly for short periods within the component, made contact with the changed contingency, and then slowed down again.

The computer recorded each time a interresponse time was less than two seconds. The two-second value was chosen because a two-second IRT would represent a rapid series of responding. There were 24 components during the DRL 6/FR 1 schedules. After the eighth component, the schedule was changed. Of interest were interresponse times less than two seconds during the two-minute components after the schedule was changed. The first component during which the subject accumulated one, four, and eight IRT's of less than two seconds were recorded for each subject. The point-of-contact data are precise indicators of when subjects showed very strong evidence of schedule control.

A one-way (group) ANOVA was computed to analyze for between group differences in the mean component during which one, four, or eight IRT's of less than two seconds were shown (see Table 25). There were no significant differences between groups in terms of these dependent measures. On average, the subjects showed one IRT of less than two seconds during the 10th component

(9.7), four IRT's during the 10th component (10.5), and eight IRT's during the 10th component (10.7). This indicates that subjects showed the first evidence as well as relatively strong evidence of contact approximately two components after the schedule change.

As with the efficiency-based transition, correlations were computed to further assess the relationship between point of contact and response rate. With data on the effectiveness-based transition, there was a consistent significant negative correlation between the subjects' mean number of responses in Phase 2 and the component number (in Phase 2 or 3, at which the subject accumulated one ($r = -0.45366$, $p = 0.0003$), four ($r = -0.58294$, $p = 0.0001$), and eight ($r = -0.59619$, $p = 0.0001$) interresponse times of less that two seconds. This suggests that the higher the observed response rate in Phase 2, the earlier the point of contact with the changed contingency.

As with the efficiency-based transition, the response rate analyses were also conducted with point of contact as a covariate. These analyses examined the effects of verbal feedback on the maintenance of rule-following after the changed contingency had been contacted. The first component in which the subject showed eight IRTs of less than two seconds was used for the covariate. The analyses were only conducted for the mean number of responses in Phases 2 and 3, as these were the two phases after the schedule change.

A one-way (group) ANACOVAR was computed to compare mean number of responses per component across the six groups in Phase 2 (see Table 26). The first component in which the subject showed eight IRTs of less than two seconds was used for the covariate. A significant difference ($F(5,53) = 2.59$, $p < 0.05$) was found between the six groups in Phase 2. Post hoc analyses were computed to determine if there were significant differences between the pairs of individual groups. The Rule-Following Point Dependent Group (101.8) had a significantly lower mean number of responses per component than each of the other five groups with the exception of the Rule-Following Point Nondependent Group (149.0). There were no additional significant differences between the remaining groups. This effect is represented graphically in Figure 1 (Figure 1 and all subsequent figures are located in Appendix D).

The Rule-Following Point Dependent manipulation seemed to induce somewhat higher degrees of insensitivity in Phase 2 of the effectiveness-based transition, than four of the remaining five groups when point of contact was used as a covariate.

Phase 3 begins with the withdrawal of the rule messages with a continued FR 1 schedule of reinforcement. A one-way (group) ANACOVAR was computed to compare mean number of responses per component across the six groups in Phase 3 (see Table 26). The first component in which the subject showed eight IRTs of less than two seconds was used for the covariate. A significant difference ($F(5,53) = 3.15$, $p = < .05$) was found between the six groups in Phase 3. Post hoc analyses were computed to determine if there were significant differences between the individual groups. The Rule-Following Point Dependent Group ($x$ = 131.8) showed a significantly lower mean number of responses than the other five groups. There were no other significant differences between the remaining five groups. This effect is represented graphically in Figure 1.

The Rule-Following Point Dependent manipulation seemed to induce somewhat higher degrees of insensitivity to the FR1 schedule of reinforcement even after the rule messages had been withdrawn when point of contact was taken into account.

A separate two-way (rule message x dependence) ANACOVAR was computed on data from each phase to assess differential influence of the type of rule message and dependence. The first component in which the subject showed eight IRTs of less than two seconds was used for the covariate. The analyses for Phase 2 (see Table 27) indicate significant effects for rule message type ($F(1,35) = 3.94$, $p = .055$). Post hoc analyses indicated that rule-following point feedback (121.6) produced lower mean number of responses than rule-following feedback (162.5). The interaction between rule-message type and dependence was not significant. The same test conducted with data from Phase 3 revealed no significant results (see Table 27).

A set of ANACOVARs were also conducted on the difference scores from phase to phase. Three differences scores were examined: the difference between Phase 2 and Phase 1 (D21), the difference between Phase 3 and Phase 2 (D32), and the difference between Phase 3 and Phase 1 (D31).

A one-way (group) ANACOVAR was computed with D21 as the dependent variable (see Table 28). A marginally significant difference was found between the six groups ($F(5,53) = 2.14$, $p = 0.075$). Post hoc analyses were computed to determine significant differences between the individual groups. The Rule-Following Point Dependent Group ($x$ = 84.2) had a significantly lower mean difference score than four of the other five groups. There were no additional significant differences between the remaining groups. These results are represented graphically in Figure 2.

The Rule-Following Point Dependent manipulation seemed to induce somewhat higher degrees of insensitivity in Phase 2 of the effectiveness-based transition, than four of the other five groups when point of contact was used as a covariate.

A one-way (group) ANACOVAR was computed with D32 as the dependent variable (see Table 28). No significant differences were found between the six groups ($F(5,53) = 0.40$, $p$ = ns).

A one-way (group) ANACOVAR was computed with D31 as the dependent variable (see Table 28). A significant difference was found between the six groups ($F(5,53) = 2.65$, $p < 0.05$). Post hoc analyses were computed to determine significant differences between the pairs of individual groups. The Rule-Following Point Dependent Group (114.1) had a significantly lower mean difference score than each of the other five groups. There were no additional significant differences between the remaining groups. These results are represented graphically in Figure 2.

The Rule-Following Point Dependent manipulation seemed to induce somewhat higher degrees of insensitivity in Phase 3 of the effectiveness-based transition than the other five groups when point of contact was used as a covariate.

A series of two-way (rule message x dependence) ANACOVARs was computed for the difference score data to assess differential influence of the type of rule message and rule message dependence on the three difference scores. The analysis for D21 (see Table 29) indicate no significant effects for the type of rule-message, dependence or their interaction.

The two-way (rule message x dependence) ANACOVAR for D32 (see Table 29) indicated no significant effects for rule message type, dependence, and the interaction.

The analyses for D31 (see Table 29) indicated significant effects for dependence ($F(1,35) =$ , $p < .06$). Post hoc analyses indicated that dependent feedback produced lower mean number of responses (146.6) than nondependent feedback (190.4). The interaction between these two factors was not significant. The dependence of the rule messages appears to be an influential variable for this individual test and dependent variable. The fact that it has not been a consistently significant factor in other test does indicate that any effect is probably weak at best.

Taken together, a general conclusion is that these results provided strong support for the conclusion that rule-following feedback plus task-performance feedback produced considerably more insensitivity to programmed contingencies than the other types of feedback. These effects are over and above individual differences in when the subjects come into contact with the contingencies. In fact, if point of contact is examined as a covariate the effects of rule-following feedback plus task performance feedback are more evident.

# CHAPTER IV

## Discussion

The purpose of the present study was to explore empirically how verbal consequences related to rule-following affect control by rules. Rule-following feedback alone and rule-following feedback plus task performance feedback were the specific types of verbal consequences studied. The former involved feedback on the correspondence between the subject's behavior and a rule given at the beginning of the session. The latter involved this same feedback plus feedback on task performance or points earned. In other words, this second type of feedback was based on the rule-behavior correspondence as well as other programmed consequences affiliated with this correspondence.

The dependence of rule-following feedback on the subject's behavior was also manipulated as a means of discerning if the effects of verbal stimuli as consequences were due to form alone or the form in a contingent relationship with behavior.

Because rules and feedback could interact differently with different types of programmed schedules of reinforcement, two specific types of schedule transitions were employed. One transition enabled a possible increase in the efficiency of responding while a second involved a possible increase in the effectiveness of responding.

In the introduction, three issues were abstracted from the review of empirical and conceptual issues related to control by verbal stimuli: The degree to which verbal stimuli override control by programmed contingencies, possible contingency analyses of observed effects, and the utility of function-altering in describing the effects of verbal stimuli. Each may be reexamined now in light of the findings of the present study.

## Do Verbal Consequences Override Control by Other Types of Consequences?

The preceding review of the literature on verbal antecedents indicate that they often override control by programmed contingencies. In the present study, rule-following feedback alone, either dependent or not dependent on rule-compliance, did not appreciably affect the subjects' response to the efficiency or effectiveness-based transitions. Rule-following feedback plus task performance feedback, however, significantly overrode control by the programmed contingencies provided a) the schedule transition involved a possible increase in effectiveness and b) the rule-following messages were dependent on the subjects' behavior.

These conclusions are based on three types of data: (a). Parametric analysis of mean number of responses and points earned per component in Phases 2 and 3 (and difference scores for these values); (b). Similar analyses on the mean number of responses per component using point of contact with the changed contingency as a covariate, and (c). Non-parametric analyses of the number of subjects in each group showing insensitivity to programmed contingencies. In the first set of analyses, the Rule-Following Point Dependent Group was the only group to show lower mean number of responses, point earnings, and corresponding difference scores than the Minimal Rule Group in both Phases 2 and 3. The Rule-Following Point Dependent Group was not significantly different from the other groups when examined without point of contact as a covariate, though the trends were consistent across both Phases 2 and 3 and across several dependent measures. When point of contact with the schedule was used as a covariate, the rule-following point dependent group showed strong differences from the other five groups on the number of responses in Phase 2 and 3, and the associated difference scores. This increased effect seen in the analysis of covariance indicates that the insensitivity shown by the Rule-Following Point Dependent Group was primarily an issue of the differential maintenance of rule-following in the face of contingency contact. In the non-parametric analyses, more subjects in the Rule-Following Point Dependent Group were operationally defined as showing insensitivity in Phase 2 than in any other group. Taken together, these analyses indicate that rule-following feedback plus task performance feedback was the only type of feedback to override control by the programmed contingencies and produce significant evidence of rule-following.

The fact that the addition of concurrent feedback on task performance only overrode control by programmed contingencies when rule-following feedback was dependent on the subject's actual compliance with the rule suggests that the contingent relationship between feedback and behavior rather than the form of the feedback alone was important. If both the dependent and nondependent groups had shown equal effects and more insensitivity than the Rule Alone Group, the antecedent functions of the verbal feedback would have been implicated. However, since the Rule-Following Point Dependent Group produced a greater degree of insensitivity than the Rule-Following Point Nondependent Group, the consequential nature of the message is suggested.

Differences in the Efficiency Versus Effectiveness-Based Transitions

The data were analyzed separately for the efficiency-based and the effectiveness-based transition. The utility of analyzing the data from these transitions separately appeared to be validated by different results for the two types of schedule transitions. The differential effect of feedback form and dependency on response to the effectiveness-based transition were discussed above.

In the efficiency-based transition, the six experimental groups did not produce differential effects. The type of feedback as well as the dependence of the feedback did not account for a significant amount of the variance for any of the dependent measures: the mean number of responses per phase, mean number of points per phase, the mean difference between phases in mean number of responses and points, and the number of subjects showing response patterns operationally defined as sensitive or insensitive. This basic effect also held true when point of contact with the schedule was used as a covariate.

In the efficiency-based transition, the "cost" of insensitivity is expending higher amount of effort without a change in the delivery of reinforcement. High amounts of effort may not necessarily be aversive in a relatively nonengaging task.

In other words it is better to do something than to do nothing. Given this analysis, it is conceivable that subjects who contact the efficiency-based transition may continue to show high rates of responding. This appears to actually be the case. Subjects on average showed contact with the schedule change within 32 minutes of the transition yet on average did not fall much below a 50% decrease in responding from baseline or 250 responses per two minutes.

### Summary

In summary, rule-following feedback plus task performance feedback was the only type of feedback in the context of the current study that appreciably led to correspondence between the subject's behavior and the rule. An increased correspondence between rule and behavior was observed in this feedback condition only with the effectiveness-based transition and when the feedback was dependent on the subject's actual rate of responding. The question remains as to why this particular feedback showed such an effect. Subsequent discussion will analyze this effect in terms of the theoretical points as described in Chapter I.

## Accounts of the Observed Effects of Verbal Consequences

The present experiment proved to be a difficult context in which to examine differences between various types of verbal feedback. The Rule Alone Group did not show appreciable insensitivity to the effectiveness or efficiency-based transition. With other types of schedule transitions, these same rules have been shown to produce insensitivity in and of themselves (Hayes et al., 1986 a,b). Rule-following feedback alone did not have an appreciable effect on subsequent adherence to the rules. This was true in both the effectiveness and efficiency-based transitions. Thus, the current experiment looked at differences between types of verbal consequences in the context of both an impotent rule and generally ineffective rule-following feedback. Simple additive effects of different variables would be difficult to detect in such a context.

Against that background, the clear insensitivity produced by the Rule-Following Point Dependent condition deserves special attention. What might account for it? We will consider several alternatives.

Specificity

Specific rules have been shown to produce more control than general rules (Olson & Hayes, 1984). Specificity refers to the degree to which environmental or behavioral aspects of contingencies are described with precision. For example, the statement "Go Slow" specifies that the speed of response is at issue, but is imprecise beyond that. Individual members of the verbal community may have widely different histories with regard to the word "slow." Does the word have to do with the rate of response repetition, or the speed of each response considered individually? If it has to do with the rate of response repetition, how slow is "slow?" A more specific rule such as "press 30 times in two minutes" would evoke more consistent behavior by the verbal community. Similarly, more specific feedback messages may exert stronger control over behavior. When the verbal community responds consistently to behavior or verbal specifications, it can in turn consistently reinforce rule-following or punish rule-breaking with a greater degree of precision.

In the current study, the presentation of positive versus negative feedback was based on a set response criterion. When the subjects pressed 30 times or less during the two-minute component, they were told that they were following the rule and when they pressed more than 30 times they were told that they were not following the rule. However, these criteria were not specifically made available to the subject in verbal form.

In addition to reliance on qualitative or quantitative aspects of response topography, the verbal community can also make use of response products, incorporating them into instructions or feedback involving the behavior. For example, the feedback "You smoke too much" may be based not on actual observation of smoking but on the number of cigarette butts observed in an ashtray. Verbal feedback can explicitly refer to these products: "You smoke too much! I found ten cigarette butts in your room!" The addition of task performance feedback to rule-following feedback in the current study can be thought of this way. Points are response products. Incorporating these response products into feedback may increase the specificity of the feedback. Points could be taken to be a verifiable metric by which the verbal community metes out reinforcement or punishment for rule-following or rule-breaking.

In the current study, positive feedback was provided for rule-following when subjects responded fewer than 30 times and earned approximately two points per two minutes and negative feedback was provided when subjects responded more than 30 times and earned more than two points per two minutes. This may have had the effect of establishing the sum total of points earned per two minutes as a response product that was the basis for reinforcement or punishment meted out by the verbal community. The increase in specificity may directly effect the strength and consistency of rule-following feedback as a consequence that reinforces and punishes rule-following.

However, there may be additional effects of incorporating response products in the form of points into feedback on rule-following. At the onset of the experiment, the subjects were told: "Try and earn as many points as you can." This statement along with the mention of points being exchangeable for chances at a prize presumably established points as a reinforcer. The specificity analysis describes how combining feedback on point earning with feedback on rule-following can establish point earnings as a criteria for punishment meted out by the verbal community. Such an operation may act directly on the reinforcing value of points. In addition to enhancing the consistency of rule-following feedback, incorporating points as response products into feedback on rule-following may change the function of points from reinforcing to punishing. Concepts derived from the theory and research on function-altering may point to additional contingencies which contribute to the observed effect and consequently improve the precision of the specificity account.

## Function-Altering as a Descriptive Account of the Effectiveness of Verbal Consequences

The specificity analysis argued that incorporating response products into feedback on rule-following might allow the verbal community to reinforce rule-following and punish rule-breaking more consistently. Note, however, that points now serve a different function. In the absence of feedback, they are delivered as consequences for task-performance and appear to reinforce this behavior. With the addition of feedback, they may be specified as indicators of rule-breaking. They are given in the context of aversive feedback and may come to have punishing functions once more than two points are earned in a two-minute period.

The data can be construed as supporting a change in the function of points. That points can function as reinforcers in this experimental situation is supported by several observations. Subjects given minimal rules and accurate rules worked readily to earn points, both pressing slow on the DRL 6 schedule and pressing many times per minute on the FR 18 schedule. There were no gross differences in response rate and especially points earned across all groups in the first phase of the experiment. Following the effectiveness-based transition, subjects in the Minimal Rule Group and the four other ruled groups showed marked increases in response rate soon after making contact with the transition. These observations indicate that points exerted strong control over behavior except when dependent rule-following feedback plus task performance feedback was given. Perhaps this effect was not solely due to some other contingency overriding the reinforcing function of points, but to a change in that function directly.

The effects of rule-following feedback plus task performance feedback lasted into the third phase, well after the feedback messages were withdrawn. When antecedent rules are presented and subsequently withdrawn, compliance with the rule rapidly desists if non-compliance is known to be more effective in terms of point earnings (Hayes et al., 1986b). The removal of the rule-following plus task performance feedback did not result in such a return to effective responding, even though the changed contingency had been contacted. The feedback was withdrawn but the delivery of points continued but did not seem to reinforce behavior in the same way as before. If feedback established points as aversive, their continuance would continue to punish rule-breaking, possibly for some time after the feedback was removed. Thus it may be that presenting task performance feedback in the context of rule-following feedback altered the reinforcing function of points.

The previous discussion of function-altering could shed light on the behavioral processes possibly involved in this change in function. At the onset of the experiment, the subject was given a verbal rule. The actual rule in this case instructed the subject to "Press slowly with several seconds between each push." The elements of this verbal rule could be seen as participating in equivalence classes with the actual behavior of pressing, and the behavioral quality of slowness defined in terms of temporal delay. The form of the verbal feedback was this: "You are (not) following the rule given at the beginning of the session. You earned x points in the last two minutes." The words "You are not following the rule" may participate in an equivalence class with the actual event of the subject pressing the button at a certain rate with respect to a rule. Presumably these words may also have some aversive qualities. This statement is generally paired with the statement "You earned x points," provided the value of x is above 2 (that is, provided the response rate is in violation of the rule). The pairing may establish "x points" as aversive, where x > 2. The aversive function of the words "x points" may transfer to the actual points via equivalence.

There is one difficulty with these analyses. Rule-following feedback is not effective in punishing behavior in and of itself. How then does it acquire this function when paired with task performance feedback? There are two ready possibilities. First, rule-following feedback may be aversive but ineffective as a punisher because it is too long delayed. Since the pairing of rule-following feedback and the points is immediate and the points themselves are much less delayed throughout the task, the function-altering effect might enable a mildly aversive but consequentially ineffective stimulus to establish another stimulus as consequentially effective. Second, task performance and rule-following feedback may together cue possible social consequences in a fashion unlike either alone. As described earlier, points as response products are readily identifiable and quantifiable. In the past, the verbal community may have been more likely to administer aversive consequences for breaking a rule when the behavior of interest or its products are readily identifiable. Thus, the presence of verifiable task performance feedback may alter the effects of rule-following feedback.

The differential results with the efficiency versus effectiveness-based transitions further supports a function-altering interpretation. Rule-following feedback plus task-performance feedback increased rule-following only in the effectiveness-based transition. These results are expected given a function-altering account. In the effectiveness-based transition, positive feedback was paired with the delivery of < 2 points and negative feedback was paired with the delivery of

> 2 points. It was argued that this pairing changed the function of points. This pairing did not occur in the efficiency-based transition. Because this transition did not lead to a possible increase in point delivery, the point delivery remained the same regardless if the rule was being followed or not. The subjects could earn the same amount of points by pressing more than 100 times or by pressing once following the given interval. Therefore the amount of points earned was not associated with positive or negative feedback. Given the account presented above, a change in function would not be expected to occur. Rule-following feedback plus task performance feedback could therefore be functionally equivalent to rule-following feedback alone in the efficiency-based transition.

## Summary

The preceding discussion merges elements of the specificity and function-altering account. The specificity account deals more with the contingency arrangements that enhance rule-following. The function-altering account describes how a rather complex message that incorporates feedback on response products with rule-following feedback may alter the function of the response products and augment control by contingencies for rule-following. These two interpretations are quite compatible and together comprise a reasonable formulation. The formulation requires additional empirical support. The limitations of the current study suggest some additional experiments that would continue to explore the contingency and function-altering effects of rule-following feedback.

## Limitations of the Present Study and Future Research

The exploratory nature of this study is a strength as well as a weakness. Its strength is in bringing empirical methods to bear on a largely unstudied area. A natural implication of such exploratory research is that it often raises more empirical questions than it answers. Such is the case in this study. The strategy in this section is to explore some of the issues suggested by this study and to build a description of a future research program around them.

The actual mechanism underlying the effectiveness of rule-following feedback plus task performance feedback requires empirical attention. I described a function-altering account which dealt with the combined effects of these two types of feedback and their impact on the reinforcing function of points. This feedback was given every two minutes and was in addition the ongoing feedback regarding total point earnings given at the actual time of point delivery. The function-altering account described how the verbal pairing of rule-following feedback (presumably an aversive verbal stimulus in the context of rule breakage) and task performance feedback (a reinforcing verbal stimulus) changes the function of task performance feedback. The change in function for the verbal stimuli transfers to its "referents", actual points. A way to model such a change would be to deliver rule-following feedback concurrently with the actual delivery of points. Each time a point was delivered, feedback on rule-following could be given as well. If the effect of this manipulation were similar to the effect seen in the present study, the function-altering account would be more credible.

Additional groups would help refine the analysis. Giving rule-following feedback along with point delivery also has the effect of giving rule-following feedback more frequently. Recall that rule-following feedback alone was not effective in inducing insensitivity in either schedule transition. If increasing the frequency of rule-following feedback makes it effective, whether or not it is paired with points, it would rule out the possibility that task performance and rule-following feedback may together cue possible social consequences in a fashion unlike either alone. It would make more plausible the view that the linkage between points and rule-following overcame the problems with delayed rule-following feedback.

Other conditions might help examine the specificity interpretation of the effectiveness of verbal feedback. The argument was made that rule-following plus task performance feedback might enhance the specificity and thus the effectiveness of the feedback because it incorporates response products into the feedback. Perhaps the rule-following feedback itself could be made more "specific" by stating the specific criteria for the feedback. This might take the form of "You are following the rule you were given at the beginning of the session. You responded more than thirty times in the last two minutes." If this feedback was more effective at inducing rule-following, the importance of specificity in general would be highlighted. If such an effect deteriorated when rule-following feedback was withdrawn, the role of the points in maintaining rule-following in Phase 3 would be implicated. If no deterioration occurred, specificity per se, with no appeal to function-altering, would be strengthened as an explanation for the present results.

The preceding research ideas empirically address some of the issues suggested by the theoretical analysis of the effects of the feedback studied here. Some general modifications might improve on the empirical soundness of the current methodology as well.

The effects of rule-following feedback on efficiency-based transitions was not fully tested in this experiment. The results indicate that the efficiency-based transition was a difficult one for human subjects to detect. The mean number of responses across all subjects decreased by 50% between Phase 1 and 3. However, in Phase 3 the subjects were still responding an average of 250 times per component. This is a relatively high response rate in view of the fact that 40 response per two minutes would satisfy an FI 4 (the average FI Yoked value) schedule of reinforcement. Even though subjects on average had one IRT of greater than four seconds, they did not show evidence of stronger contact until after 32 minutes of responding. In comparison, subjects showed strong contact as evidenced by IRT's on average after 22 minutes of responding in response to the effectiveness-based transition.

The overall tendency for the subjects not to show a decrease beyond 50% has implications for the interpretations of the effects of rule-following feedback. Human behavior in response to programmed schedules of reinforcement is notoriously variable. If the average decrease is about 50%, then a group that varies from this mean must show either extremely consistent high or low response rates for a statistically significant difference to be detected. A ceiling or floor effect may be occurring here.

There are also some aspects of the efficiency-based transition that may have contributed to the ineffectiveness of rule-following feedback. In Phase 2, the average rate of 334 response per component on the FI Yoked schedule of reinforcement would result in very limited contact with the negative rule message which was given if subjects went below 100 response in a component. These effects of rule-following feedback may not have been adequately tested for the efficiency-based transition. Perhaps future research on this schedule might involve a more stringent criterion for negative feedback (e.g. 300 responses).

The difficulty detecting the change might also be attributed to the specific multiple schedule used in this study. The effectiveness based transition might indirectly affect performance on the efficiency-based transition. The effectiveness-based transition was contacted very early in the second phase and resulted in higher response rates and much higher point earnings. This might result in a contrast effect that indirectly influenced higher response rates on the FI yoked. Future study of the efficiency-based transition might be conducted with single-subject design.

A final issue involves the interaction of antecedent rules with the schedules discussed here. The effects of feedback on rule-produced insensitivity were given a strong test in this experiment. Rules were not shown to produce insensitivity to either schedule when compared to minimal rule situations. It would be of interest to examine the feedback studied here in situations where rules have proven to be more effective. A transition to extinction has been used in previous experiments when accurate rules have been shown to induce insensitivity (Hayes et al., 1986). In addition, the rule used here might be modified to be more powerful. Perhaps eliminating phrases such as "try and earn as many points as you can" and "the best way to earn points" will put the emphasis more on compliance. In addition, response criteria could be made more specific: "Presses must be followed by a six second pause" and "Press at least 200 times." could be substituted for "Press slowly with several seconds between each push." and "Press rapidly."

In summary, these limitations and suggestions for future research take two forms. One is to further explore the mechanism behind the qualitative effect of rule-following plus task performance feedback in light of the effect that both types of feedback alone are impotent. The second involves general changes that may enhance rule compliance and the effectiveness of rule-following feedback. Together, these ideas imbed the current study in a research program that will begin to address the issues raised by verbal feedback. The current study is exploratory in nature and its generalizability cannot be taken for granted, however. Future replication and study will allow for increased generalizability and external validity.

## Implications of the Present Study

As an initial exploratory study of verbal consequences and their relation to rule-following, this study indicates that verbal consequences can enhance rule-following in spite of a schedule transition that pits programmed contingencies against rules. Given that there has been little human operant research on the effects of verbal consequences, this finding indicates the value of continued research on verbal consequences and their interaction with rules. An example of such a research program was described above.

This study also has implications for the literature on rule-governed behavior in general. While there have been many studies demonstrating that rules often override control by programmed contingencies of reinforcement, there has been comparatively little research on the factors leading to this effect. Behavior-analytic theory has long held that rule-following can be a result of collateral contingencies specifically supporting rule-following and often times competing against the very contingencies specified in the rule (Catania et al., 1989; Cerutti, 1989; Skinner, 1969; Zettle & Hayes, 1982). Theoretically, rule-induced insensitivity to programmed contingencies under certain conditions is predicted. However, direct empirical study of this phenomena has been limited. The present study directly addresses this issue and in addition brings empirical methods to bear on the role that verbal consequences may play in establishing such contingencies.

The results also suggest that a comprehensive analysis of the impact of the verbal consequence studied here requires the incorporation of function-altering in addition to consequential sources of control. This point is based on observations of how a relatively complex stimuli such as rule-following feedback plus task performance feedback appeared to impact the function of programmed consequences. An important implication of the current study is that it highlights how observations in a more naturalistic yet controlled setting suggests further research at this level as well as at a more basic level.

The present study suggests two levels of analysis for the study of function-altering. One strategy would be to further study changes in stimulus functions resulting from verbal stimulation. Research to date has studied instructions in terms of their evocative effects on behavior. The function-altering effects have been neglected or obscured. This literature could be reevaluated in terms of how specific instructions might have also altered the function of the stimuli employed in specific experiments. In addition, there is a need for studies that specifically look at how rules impact the function of stimuli. An example of this, is the research on repeated acquisition that has begun to address how rules impact the formation of complex stimulus sequences via function-altering (e.g. Danforth, Chase, Dolan, & Joyce, 1990).

A second focus would be to further study the relationship between the observed function-altering effects of verbal stimuli and the function-altering effect that has been observed in the equivalence preparation. Research on equivalence has the advantage of being more controlled. We know that equivalence as a phenomena has so far only been demonstrated in verbal humans (Devany, Hayes & Nelson, 1986). This implies a possible relationship between equivalence and the type of function-altering that results from verbal stimulation. If words acquire functions via an equivalence like phenomena, then understanding equivalence might lead to a better understanding of the effects of words when combined into a rule form.

The discussion of the relationship between function-altering and equivalence presented here, highlights how little is known about these two phenomena. They seem related but in a sense represent parallel types of analyses. They both are descriptions of effects. What is missing is precise knowledge of how these effects are established in humans. Does equivalence underlie verbal function-altering or are the two processes essentially the same thing? Such analyses have been slow to develop even in the controlled study of matching to sample preparations.

The current study points to the need for such an analysis. The apparent function-altering effects of the rule-following feedback plus task performance feedback highlights how little is really known about both function-altering as an effect and equivalence as a possible analytic preparation that might help understand this effect. Therefore an implication of the current study is the fact that it points to important basic research on verbal stimuli. This work would be crucial in developing more precise analytic concepts which appear necessary to help explain the effects of such complex verbal stimuli.

The current study is both naturalistic and exploratory. The stimuli used here are complex and novel. It is naturalistic in the sense that there is much room for intrusion by the vast social verbal histories that subjects bring to the experimental situation. It is novel in the sense that verbal consequences for rule-following have not been extensively studied in the human operant laboratory.

The value of exploratory and naturalistic research on the effects of verbal stimuli is to be seen in the implications discussed above. The rather involved and perhaps imprecise interpretations of what might be happening in the current setting point to difficult questions and reveal areas of imprecision in terms of the behavioral principles that have been brought to bear on rule-following. For example, accounts of rules as contingency-specifying discriminative stimuli have lead to interesting developments in theory (Skinner, 1969; Zettle & Hayes, 1982) and research (Baron & Galizio, 1983) that have helped predict and control this difficult phenomena as well as explain it in terms of observable and manipulatable events. However, the concept of a contingency-specifying stimulus and how it acts on behavior have not been precisely explained. The arguments for function-altering point to the precision gap and suggest the beginnings of research that will bring a more precise understanding of rules and the exact ways that they impact behavior.

The exploratory nature of this study has some additional values. This experiment started with the well-researched situation of the human operant laboratory and incorporated a variable that has applied relevance, has not before been studied in this context, and addresses an important issue with respect to collateral contingencies for rule-following. Due to the novelty of the variable and the imprecision of current theory on verbal stimuli, the study did not follow a strict hypothesis-testing model. However, the outcome did suggest some lines of research that could become progressively more precise in terms of the actual issues that are examined.

The naturalistic quality of the current study was referred to abov` It is in fact on a continuum in terms of experimental control. The basic implications discussed above are at one end, the applied arena at another, and human operant research and this study in the middle. The implication of this middle ground is that it provides a bridge between the precise experimentation of the basic lab and the rather vague yet socially important research in the clinical laboratory. Its further value is in providing an empirical preparation to foster the use of basic principles in predicting and controlling human behavior in the applied arena.

Rules and feedback are important aspects of teaching in a verbal community. Laboratory research and resultant theoretical interpretation of rule-governance have formed the basis for applied interventions and interpretations of existing clinical procedures. For example, the findings and theory of rule-governance have been applied to the interpretation of the effectiveness of cognitive-behavioral therapies (Zettle & Hayes, 1982). Clinical research has demonstrated that the social contingencies engaged by instructions are a critical component of the effect of some verbal therapies (Hayes et al., 1985; Hayes & Wolf, 1984; Rosenfarb & Hayes, 1984; Zettle & Hayes, 1983). The prevailing theory behind these therapies posits that changing thoughts or self instructions is an integral aspect of their effectiveness. An account based on social contingencies leads to somewhat different interventions than one based on this assumption. In addition, factors resulting in social control can be more directly targeted.

The current study suggests how rules and verbal consequences might be brought to bear on clinically significant behavior. Take for example the clinical lore surrounding effective parenting. Clinicians in applied settings often talk about the importance of highlighting the natural consequences for rule-following.

Such a rule might take the form of "Clean your room because it makes it easier to find your toys." The implication is that such a rule might bring the behavior of room cleaning under the control of the natural consequence of access to toys. This is presumed to be healthier than rules focusing solely on social control (e.g. Clean your room or you lose your TV).

This analysis may be called into question if the role of feedback in such a setting is examined. Take for example the following feedback given when a child complains of not being able to find a toy. Successful feedback might take the form: "See! if you had done what I asked and cleaned your room you would have been able to find your toys." At first, such feedback would presumably help to bring room cleaning under the control of the natural consequence. An analysis based on the results presented here might draw a different conclusion. It is apparent that finding toys is not a strong enough reinforcer to override the contingencies leading to a dirty room. The feedback in fact might work because it ties feedback on task performance to feedback on rule adherence. The effect might be to change the relatively ineffectual reinforcing function of finding toys to more aversive functions established by the use of observed toy finding as a metric for rule-following. What was thought to be more naturalistic feedback may indeed be coercive social feedback.

This analysis is an example of how the effects of the current study may be extended, in theory, to clinical phenomena. Actual practical extension should be done with caution and only after further replication. The example does serve to highlight implications for the understanding of clinical phenomena.

In conclusion, the present work suggests the efficacy of rule-following feedback in conjunction with task performance feedback in enhancing compliance with rules, even when the rules directly compete with a programmed contingency. This finding points to one type of collateral contingency (Cerutti, 1989) that may enhance compliance in and of itself. The effectiveness of this specific type of feedback suggests that in addition to providing competing collateral consequences for rule-following, the feedback may work to alter the function of consequences for task performance - thus leading to an even stronger effect than reinforcing rule-following or punishing rule breakage. These results and their interpretation have implications for the development of further basic research on function-altering and equivalence as well as the development of instructional and feedback based therapies.

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## Appendix A

## Consent Form

I agree to participate in the present study being conducted under the supervision of Dr. Steven C. Hayes, a faculty member of the Psychology Department at the University of Nevada-Reno. I have been informed in writing and orally about the procedures to be followed and about any discomforts or risks which may be involved. The investigator has offered to answer further questions that I have regarding the procedures of this study. I understand that I am free to withdraw from the study at any time without penalty or prejudice. The information gained from this study will be presented in such a way that my identity will remain confidential. I also understand that when my participation is over I will be thoroughly debriefed about the study.

If I have any concerns or questions, I understand that I can contact Dr. Steven C. Hayes, Department of Psychology (784-6668), or the UNR Biomedical/Social Behavioral Human Subjects Review Committee (784-4040).

Name:____________________ Signature:______________________________

Date:____________________

## Appendix B

## Debriefing Statement

This experiment was conducted in a sub-field of psychology called operant psychology. In operant psychology, we find it useful to distinguish between two types of behavior: Contingency- shaped behavior and a subset of contingency-shaped behavior called rule-governed behavior. Contingency-shaped behavior is controlled by its consequences while rule-governed behavior is under the control of a verbal antecedent or rule. An example of contingency-shaped behavior would be a child who carries her umbrella to school because she walked out the door that morning and was rained on. An example of rule- governed behavior would be a child who carried an umbrella because her mother told her to do so.

The research in our lab is concerned with the interaction between control by rules and consequences. In previous experiments, we have examined how the presence of rules interact with actual consequences in the control of human behavior. We have found that when a person's behavior is controlled by rules, it is often insensitive to a change in consequences. For example, if a mother was overprotective, a child may carry an umbrella to school every day even if it rarely rained.

It may be the case that rule-produced insensitivity is a result of the way that we are taught to follow rules. One method of teaching might stress that rules are always to be followed while another might teach that rule are only to be followed if they lead to effective actions or beneficial consequences. In this experiment, we examined two different strategies for establishing rule-governed behavior. One strategy involved giving feedback which encouraged rule following. Subjects exposed to this strategy might be expected to follow a rule about task performance even after the task changed. This would might be due to the emphasis on following rules for the sake of following rules.

A second strategy might emphasize following rules because they lead to more effective behavior or to desirable consequences. We might expect subjects trained with this procedure to stop following rules if these rules were found to no longer be effective. This is because an emphasis is placed on the consequences of rule-following as opposed to rule following in and of itself.

All groups were exposed to approximately the same task, but were given different feedback messages. The feedback messages were intended to reflect the two strategies that were discussed above. One consisted of feedback on rule-following alone and another consisted of feedback on rule-following and point earnings. Sometimes the feedback was accurate and sometimes the feedback was inaccurate in that the subjects were always told that they were following the rule, regardless of their performance. Some subjects did not receive feedback messages at all. The feedback messages were only presented in the middle of the experiment so that we could examine differences in behavior when the messages were both present and absent.

In both sessions, presses on the left button moved the circle down, and presses on the right button moved the circle to the right. For the first 32 minutes, the movement of the circle was programmed as follows. When the blue light was on, each press had to be followed by a six second pause in order to make the circle move. If a response occurred before the six seconds were over, the timer was reset and the circle would not move. When the red light was on, the circle moved after every 18th press on either button.

After the first 32 minutes the way to move the circle was changed. This is the most critical phase of the experiment. In the first 32 minutes, we could not be sure if your button pressing was controlled by the instructions that we gave you or the points that you received. Therefore we changed the way to get points. When the blue light was on, every press resulted in the circle moving. When the red light was on, the first press after a certain time interval resulted in the circle moving. The interval was based on the number of times that you pressed the button in the last red phase before the change occurred. If subjects changed their responding when the task changed, then we could say that their behavior was controlled by the points (contingency-shaped). If subjects did not change their responding, their behavior was most likely rule-governed. In this way, we were able to determine how the different feedback strategies effect the control exerted by rules and consequences.

This study has implications for learning how human behavior is controlled and how feedback interacts with rules. In addition, these types of studies have implications for clinical psychology. For instance, certain clinical problems may be marked by extremely rigid rule following regardless of the consequences of such behavior. For example, a depressed person may operate under the rule "No matter what I do nothing ever works." and be totally insensitive to actual successes in her life. This is an example of an extension of laboratory results to every day life and much more research is required before we can fully understand control by rules and the role of rules in clinical phenomena.

Thank you very much for participating in the experiment today. We will give away the prize money at the end of the semester and will call you if you are a winner. The number of points that you earned will be adjusted to control for any advantages that may have resulted only from the task or instruction that you received. Please do not talk about the experiment to other students who might be participating in it in the future. In addition, please feel free to call Dr. Hayes if you are interested in the results of the study after we have completed it.

# Appendix C

## Tables

Table 1

Mean Number of Responses Per Component in Phase 1 for the FR 18 Schedule of Reinforcement: Group (6) One-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 5197.13 | 0.39 |
| Error | 54 | 13399.37 | |

Mean Number of Responses Per Component in Phase 2 for the FI Yoked Schedule of Reinforcement: Group (6) One-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 13873.17 | 0.47 |
| Error | 54 | 29213.44 | |

Mean Number of Responses Per Component in Phase 3 for the FI Yoked Schedule of Reinforcement: Group (6) One-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 9829.57 | 0.32 |
| Error | 54 | 31153.19 | |

Table 2

Mean Number of Responses Per Component in Phase 1 for the FR18 Schedule of Reinforcement: Rule Message (2) x Dependence (2) Two-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Rule Message | 1 | 777.22 | 0.05 |
| Dependence | 1 | 14965.30 | 1.04 |
| Rule Message x Dependene | 1 | 686.08 | 0.05 |
| Error | 36 | 14321.65 | |

Mean Number of Responses Per Component in Phase 2 for the FI Yoked Schedule of Reinforcement: Rule Message (2) x Dependence (2) Two-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Rule Message | 1 | 43232.60 | 1.88 |
| Dependence | 1 | 65.72 | 0.00 |
| Rule Message x Dependence | 1 | 25150.73 | 1.09 |
| Error | 36 | 23050.46 | |

Table 2 (continued)

Mean Number of Responses Per Component in Phase 3 for the FI Yoked Schedule of Reinforcement: Rule Message (2) x Dependence (2) Two-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Rule Message | 1 | 229.73 | 0.01 |
| Dependence | 1 | 9997.00 | 0.33 |
| Rule Message x Dependence | 1 | 4892.06 | 0.16 |
| Error | 36 | 30377.76 | |

Table 3

Mean Number of Responses Per Component Difference Scores Between Phase 2 and 1 for the FR 18/FI Yoked Schedule of Reinforcement: Group (6) One-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 21165.01 | 0.89 |
| Error | 54 | 23798.71 | |

Mean Number of Responses Per Component Difference Scores Between Phase 3 and 2 for the FR 18/FI Yoked Schedule of Reinforcement: Group (6) One-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 29042.53 | 1.48 |
| Error | 54 | 19677.77 | |

Table 3 (continued

Mean Number of Responses Per Component Difference Scores Between Phase 3 and 1 for the FR 18/FI Yoked Schedule of Reinforcement: Group (6) One-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 3863.75 | 0.14 |
| Error | 54 | 28489.63 | |

Table 4

Mean Number of Responses Per Component Difference Scores Between Phase 2 and 1 for the FR 18/FI Yoked Schedule of Reinforcement: Rule Message (2) x Dependence (2) Two-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Rule Message | 1 | 55603.12 | 2.30 |
| Dependence | 1 | 17014.39 | 0.70 |
| Rule Message x Dependence | 1 | 17528.88 | 0.73 |
| Error | 36 | 24159.19 | |

Mean Number of Responses Per Component Difference Scores Between Phase 3 and 2 for the FR 18/FI Yoked Schedule of Reinforcement: Rule Message (2) x Dependence (2) Two-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Rule Message | 1 | 37159.39 | 1.96 |
| Dependence | 1 | 11683.75 | 0.62 |
| Rule Message x Dependence | 1 | 52227.36 | 2.75 |
| Error | 36 | 18986.92 | |

Table 4 (continued)

Mean Number of Responses Per Component Difference Scores Between Phase 3 and 1 for the FR 18/FI Yoked Schedule of Reinforcement: Rule Message (2) x Dependence (2) Two-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Rule Message | 1 | 1852.05 | 0.07 |
| Dependence | 1 | 499.43 | 0.02 |
| Rule Message x Dependence | 1 | 9242.21 | 0.33 |
| Error | 36 | 27906.22 | |

Table 5

Chi-Square Table for Subjects Who Showed Sensitive Versus Insensitive Behavior Patterns in Phase 2 of the FR 18/FI Yoked Schedule of Reinforcement.

| Group | Sensitive | Insensitive |
|---|---|---|
| Rule-Following Dependent | 1 (1.67) | 9 (8.33) |
| Rule-Following Nondependent | 1 (1.67) | 9 (8.33) |
| Rule-Following Point Dependent | 1 (1.67) | 9 (8.33) |
| Rule-Following Point Nondependent | 2 (1.67) | 8 (8.33) |
| Rule Alone | 2 (1.67) | 8 (8.33) |
| Minimal Instructions | 3 (1.67) | 7 (8.33) |

D.F = 5, Chi-Square =2.39, p = ns

Table 5 (Continued)

Chi-Square Table for Subjects Who Showed Sensitive Versus Insensitive Behavior Patterns in Phase 3 of the FR 18/FI Yoked Schedule of Reinforcement.

| Group | Sensitive | Insensitive |
|---|---|---|
| Rule-Following Dependent | 3<br>(2.83) | 7<br>(7.17) |
| Rule-Following Nondependent | 2<br>(2.83) | 8<br>(7.17) |
| Rule-Following Point Dependent | 4<br>(2.83) | 6<br>(7.17) |
| Rule-Following Point Nondependent | 3<br>(2.83) | 7<br>(7.17) |
| Rule Alone | 2<br>(2.83) | 8<br>(7.17) |
| Minimal Instructions | 3<br>(2.83) | 7<br>(7.17) |

D.F = 5, Chi-Square = 1.41, p = ns

Table 6

Mean Number of Points Per Component in Phase 1 for the FR 18 Schedule of Reinforcement: Group (6) One-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 0.19 | 0.27 |
| Error | 54 | 0.71 | |

Mean Number of Points Per Component in Phase 2 for the FI Yoked Schedule of Reinforcement: Group (6) One-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 0.21 | 0.38 |
| Error | 54 | 0.53 | |

Mean Number of Points Per Component in Phase 3 for the FI Yoked Schedule of Reinforcement: Group (6) One-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 0.20 | 0.36 |
| Error | 54 | 0.56 | |

Table 7

Mean Number of Points Per Component in Phase 1 for the FR 18 Schedule of Reinforcement: Rule Message (2) x Dependence (2) Two-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Rule Message | 1 | 0.36 | 0.46 |
| Dependence | 1 | 0.21 | 0.27 |
| Rule Message x Dependence | 1 | 0.01 | 0.01 |
| Error | 36 | 0.79 | |

Mean Number of Points Per Component in Phase 2 for the FI Yoked Schedule of Reinforcement: Rule Message (2) x Dependence (2) Two-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Rule Message | 1 | 0.00 | 0.00 |
| Dependence | 1 | 0.71 | 1.33 |
| Rule Message x Dependence | 1 | 0.07 | 0.12 |
| Error | 36 | 0.54 | |

Table 7 (continued)

Mean Number of Points Per Component in Phase 3 for the FI Yoked Schedule of Reinforcement: Rule Message (2) x Dependence (2) Two-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Rule Message | 1 | 0.01 | 0.02 |
| Dependence | 1 | 0.51 | 0.88 |
| Rule Message x Dependence | 1 | 0.08 | 0.13 |
| Error | 36 | 0.58 | |

Table 8

Mean Number of Points Per Component Difference Scores Between Phase 2 and 1 for the FR 18/FI Yoked Schedule of Reinforcement: Group (6) One-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 0.13 | 0.62 |
| Error | 54 | 0.21 | |

Mean Number of Points Per Component Difference Scores Between Phase 3 and 2 for the FR 18/FI Yoked Schedule of Reinforcement: Group (6) One-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 0.01 | 0.13 |
| Error | 54 | 0.09 | |

Table 8 (continued)

Mean Number of Points Per Component Difference Scores Between Phase 3 and 1 for the FR 18/FI Yoked Schedule of Reinforcement: Group (6) One-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 0.10 | 0.40 |
| Error | 54 | 0.26 | |

Table 9

Mean Number of Points Per Component Difference Scores Between Phases 2 and 1 for the FR 18/FI Yoked Schedule of Reinforcement: Rule Message (2) x Dependence (2) Two-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Rule Message | 1 | 0.34 | 1.57 |
| Dependence | 1 | 0.15 | 0.70 |
| Rule Message x Dependence | 1 | 0.03 | 0.16 |
| Error | 36 | 0.21 | |

Mean Number of Points Per Component Difference Scores Between Phases 3 and 2 for the FR 18/FI Yoked Schedule of Reinforcement: Rule Message (2) x Dependence (2) Two-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Rule Message | 1 | 0.01 | 0.13 |
| Dependence | 1 | 0.02 | 0.23 |
| Rule Message x Dependence | 1 | 0.00 | 0.00 |
| Error | 36 | 0.08 | |

Table 9 (continued)

Mean Number of Points Per Component Difference Scores Between Phases 3 and 1 for the FR 18/FI Yoked Schedule of Reinforcement: Rule Message (2) x Dependence (2) Two-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Rule Message | 1 | 0.23 | 0.78 |
| Dependence | 1 | 0.07 | 0.22 |
| Rule Message x Dependence | 1 | 0.04 | 0.14 |
| Error | 36 | 0.30 | |

Table 10

Mean Fixed Interval Value for the FI Yoked Schedule of Reinforcement: Group (6) One-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 0.40 | 0.31 |
| Error | 54 | 1.30 | |

Table 11

Mean Component in Phase 2 or 3 in which Subjects Showed One IRT of Greater than Four Seconds for the FI Yoked Schedule of Reinforcement: Group (6) One-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 23.59 | 0.84 |
| Error | 54 | 28.10 | |

Mean Component in Phase 2 or 3 in which Subjects Showed Four IRTs of Greater than Four Seconds for the FI Yoked Schedule of Reinforcement: Group (6) One-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 39.18 | 0.92 |
| Error | 54 | 42.50 | |

Table 11 (continued)

Mean Component in Phase 2 or 3 in which Subjects Showed Eight IRTs of Greater than Four Seconds for the FI Yoked Schedule of Reinforcement: Group (6) One-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 20.50 | 0.43 |
| Error | 54 | 47.56 | |

Table 12

Mean Number of Responses Per Component in Phase 2 for the FI Yoked Schedule of Reinforcement: Group (6) One-Way ANACOVAR with Mean Component in Phase 2 or 3 in which Subjects Showed Eight IRTs of Greater than Four Seconds for the FI Yoked Schedule of Reinforcement as the Covariate

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 112023.55 | 0.62 |
| Error | 53 | 19469.87 | |

Mean Number of Responses Per Component in Phase 3 for the FI Yoked Schedule of Reinforcement: Group (6) One-Way ANACOVAR with Mean Component in Phase 2 or 3 in which Subjects Showed Eight IRTs of Greater than Four Seconds for the FI Yoked Schedule of Reinforcement as the Covariate

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 5700.20 | 0.25 |
| Error | 53 | 22677.00 | |

Table 13

Mean Number of Responses Per Component in Phase 2 for the FI Yoked Schedule of Reinforcement: Rule Message (2) x Dependence (2) Two-Way ANACOVAR with Mean Component in Phase 2 or 3 in which Subjects Showed Eight IRTs of Greater than Four Seconds for the FI Yoked Schedule of Reinforcement as the Covariate

| Source | df | MS | F |
|---|---|---|---|
| Rule Message | 1 | 15016.65 | 0.91 |
| Dependence | 1 | 2772.49 | 0.17 |
| Rule Message x Dependence | 1 | 28320.87 | 1.71 |
| Error | 35 | 16562.25 | |

Table 13 (continued)

Mean Number of Responses Per Component in Phase 3 for the FI Yoked Schedule of Reinforcement: Rule Message (2) x Dependence (2) Two-Way ANACOVAR with Mean Component in Phase 2 or 3 in which Subjects Showed Eight IRTs of Greater than Four Seconds for the FI Yoked Schedule of Reinforcement as the Covariate

| Source | df | MS | F |
|---|---|---|---|
| Rule Message | 1 | 6268.05 | 0.29 |
| Dependence | 1 | 2376.27 | 0.11 |
| Rule Message x Dependence | 1 | 3461.66 | 0.16 |
| Error | 35 | 21951.00 | |

Table 14

Mean Number of Responses Per Component Difference Scores Between Phases 2 and 1 for the FR 18/FI Yoked Schedule of Reinforcement: Group (6) One-Way ANACOVAR with Mean Component in Phase 2 or 3 in which Subjects Showed Eight IRTs of Greater than Four Seconds for the FI Yoked Schedule of Reinforcement as the Covariate

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 21902.57 | 1.11 |
| Error | 53 | 19758.78 | |

Mean Number of Responses Per Component Difference Scores Between Phases 3 and 2 for the FR 18/FI Yoked Schedule of Reinforcement: Group (6) One-Way ANACOVAR with Mean Component in Phase 2 or 3 in which Subjects Showed Eight IRTs of Greater than Four Seconds for the FI Yoked Schedule of Reinforcement as the Covariate

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 29183.04 | 1.46 |
| Error | 53 | 20009.89 | |

Table 14 (continued)

Mean Number of Responses Per Component Difference Scores Between Phases 3 and 1 for the FR 18/FI Yoked Schedule of Reinforcement: Group (6) One-Way ANACOVAR with Mean Component in Phase 2 or 3 in which Subjects Showed Eight IRTs of Greater than Four Seconds for the FI Yoked Schedule of Reinforcement as the Covariate

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 3026.37 | 0.12 |
| Error | 53 | 25337.64 | |

Table 15

Mean Number of Responses Per Component Difference Scores Between Phases 2 and 1 FR18 /FI Yoked Schedule of Reinforcement: Rule Message (2) x Dependence (2) Two-Way ANACOVAR with Mean Component in Phase 2 or 3 in which Subjects Showed Eight IRTs of Greater than Four Seconds for the FI Yoked Schedule of Reinforcement as the Covariate

| Source | df | MS | F |
|---|---|---|---|
| Rule Message | 1 | 52620.66 | 2.69 |
| Dependence | 1 | 53710.08 | 2.75 |
| Rule Message x Dependence | 1 | 24857.84 | 1.27 |
| Error | 35 | 19547.93 | |

Table 15 (continued)

Mean Number of Responses Per Component Difference Scores Between Phases 3 and 2 for the FR 18/FI Yoked Schedule of Reinforcement: Rule Message (2) x Dependence (2) Two-Way ANACOVAR with Mean Component in Phase 2 or 3 in which Subjects Showed Eight IRTs of Greater than Four Seconds for the FI Yoked Schedule of Reinforcement as the Covariate

| Source | df | MS | F |
|---|---|---|---|
| Rule Message | 1 | 37059.83 | 1.90 |
| Dependence | 1 | 11821.15 | 0.61 |
| Rule Message x Dependence | 1 | 52477.51 | 2.69 |
| Error | 35 | 19522.08 | |

Table 15 (continued)

Mean Number of Responses Per Component Difference Scores Between Phases 3 and 1 for the FR 18/FI Yoked Schedule of Reinforcement: Rule Message (2) x Dependence (2) Two-Way ANACOVAR with Mean Component in Phase 2 or 3 in which Subjects Showed Eight IRTs of Greater than Four Seconds for the FI Yoked Schedule of Reinforcement as the Covariate

| Source | df | MS | F |
|---|---|---|---|
| Rule Message | 1 | 1394.09 | 0.06 |
| Dependence | 1 | 4271.20 | 0.19 |
| Rule Message x Dependence | 1 | 7519.31 | 0.34 |
| Error | 35 | 22024.84 | |

Table 16

Mean Number of Responses Per Component in Phase 1 for the DRL 6 Schedule of Reinforcement: Group (6) One-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 339.55 | 3.36* |
| Error | 54 | 101.20 | |

Mean Number of Responses Per Component in Phase 2 for the FR 1 Schedule of Reinforcement: Group (6) One-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 15363.46 | 2.55* |
| Error | 54 | 6018.15 | |

Table 16 (continued)

Mean Number of Responses Per Component in Phase 3 for the FR 1 Schedule of Reinforcement: Group (6) One-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 18162.49 | 3.35* |
| Error | 54 | 5421.70 | |

* $p < .05$

Table 17

Mean Number of Responses Per Component in Phase 1 for the DRL 6 Schedule of Reinforcement: Rule Message (2) x Dependence (2) Two-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Rule Message | 1 | 114.45 | 1.92 |
| Dependence | 1 | 177.75 | 2.98 |
| Rule Message x Dependence | 1 | 153.43 | 2.58 |
| Error | 36 | 59.58 | |

Mean Number of Responses Per Component in Phase 2 for the FR 1 Schedule of Reinforcement: Rule Message (2) x Dependence (2) Two-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Rule Message | 1 | 17807.98 | 2.89 |
| Dependence | 1 | 23730.05 | 3.85 |
| Rule Message x Dependence | 1 | 3150.45 | 0.51 |
| Error | 36 | 6163.35 | |

Table 17 (continued)

Mean Number of Responses Per Component in Phase 3 for the FR 1 Schedule of Reinforcement: Rule Message (2) x Dependence (2) Two-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Rule Message | 1 | 15875.84 | 2.25 |
| Dependence | 1 | 22155.38 | 3.15 |
| Rule Message x Dependence | 1 | 16275.98 | 2.31 |
| Error | 36 | 7044.22 | |

Table 18

Mean Number of Responses Per Component Difference Scores Between Phases 2 and 1 for the DRL 6/FR 1 Schedule of Reinforcement: Group (6) One-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 13356.99 | 2.35* |
| Error | 54 | 5677.42 | |

Mean Number of Responses Per Component Difference Scores Between Phases 3 and 2 for the DRL 6/FR 1 Schedule of Reinforcement: Group (6) One-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 1123.95 | 0.36 |
| Error | 54 | 3090.53 | |

Table 18 (continued)

Mean Number of Responses Per Component Difference Scores Between Phase 3 and 1 for the DRL 6/FR 1 Schedule of Reinforcement: Group (6) One-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 15571.12 | 2.96* |
| Error | 54 | 5257.14 | |

* $p < .05$

Table 19

Mean Number of Responses Per Component Difference Scores Between Phase 2 and 1 for the DRL 6/FR 1 Schedule of Reinforcement: Rule Message (2) x Dependence (2) Two-Way ANOVA

| Source | df | MS | F |
| --- | --- | --- | --- |
| Rule Message | 1 | 15067.21 | 2.61 |
| Dependence | 1 | 28015.32 | 4.85* |
| Rule Message x Dependence | 1 | 1913.39 | 0.33 |
| Error | 36 | 5779.44 | |

Mean Number of Responses Per Component Difference Scores Between Phase 3 and 2 for the DRL 6/FR 1 Schedule of Reinforcement: Rule Message (2) x Dependence (2) Two-Way ANOVA

| Source | df | MS | F |
| --- | --- | --- | --- |
| Rule Message | 1 | 55.46 | 0.02 |
| Dependence | 1 | 27.03 | 0.01 |
| Rule Message x Dependence | 1 | 5104.89 | 1.80 |
| Error | 36 | 2830.08 | |

Table 19 (continued)

Mean Number of Responses Per Component Difference Scores Between Phase 3 and 1 for the DRL 6/FR 1 Schedule of Reinforcement: Rule Message (2) x Dependence (2) Two-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Rule Message | 1 | 13294.41 | 1.95 |
| Dependence | 1 | 26302.03 | 3.85 |
| Rule Message x Dependence | 1 | 13268.90 | 1.94 |
| Error | 36 | 6827.14 | |

Table 20

Chi-Square Table for Subjects Who Showed Sensitive Versus Insensitive Behavior Patterns in Phase 2 of the DRL 6/FR 1 Schedule of Reinforcement

| Group | Sensitive | Insensitive |
|---|---|---|
| Rule-Following Dependent | 8 (8.17) | 2 (1.83) |
| Rule-Following Nondependent | 9 (8.17) | 1 (1.83) |
| Rule-Following Point Dependent | 3 (8.17) | 7 (1.83) |
| Rule-Following Point Nondependent | 10 (8.17) | 0 (1.83) |
| Rule Alone | 9 (8.17) | 1 (1.83) |
| Minimal Instructions | 10 (8.17) | 0 (1.83) |

D.F = 5, Chi-Square =23.30, $p < .001$

Table 20 (continued)

Chi-Square Table for Subjects Who Showed Sensitive Versus Insensitive Behavior Patterns in Phase 2 of the DRL 6/FR 1 Schedule of Reinforcement

| Group | Sensitive | Insensitive |
|---|---|---|
| Rule-Following Point Dependent | 3 (8.17) | 7 (1.83) |
| Remaining Groups | 46 (40.83) | 4 (9.17) |

(d.f. = 1, Chi-Square = 17.45, $p < .001$).

Table 20 (continued)

Chi-Square Table for Subjects Who Showed Sensitive Versus Insensitive (Insensitivity that Contacts Negative Rule Messages) Behavior Patterns in Phase 2 of the DRL 6/FR 1 Schedule of Reinforcement

| Group | Sensitive | Insensitive |
|---|---|---|
| Rule-Following Dependent | 8<br>(8.67) | 2<br>(1.33) |
| Rule-Following Nondependent | 10<br>(8.67) | 0<br>(1.33) |
| Rule-Following Point Dependent | 5<br>(8.67) | 5<br>(1.33) |
| Rule-Following Point Nondependent | 10<br>(8.67) | 0<br>(1.33) |
| Rule Alone | 9<br>(8.67) | 1<br>(1.33) |
| Minimal Instructions | 10<br>(8.67) | 0<br>(1.33) |

D.F = 5, Chi-Square = 17.510, $p < .01$

Table 20 (continued)

Chi-Square Table for Subjects Who Showed Sensitive Versus Insensitive (Insensitivity That Contacts Negative Rule Messages) Behavior Patterns in Phase 2 of the DRL 6/FR 1 Schedule of Reinforcement.

| Group | Sensitive | Insensitive |
|---|---|---|
| Rule-Following Point Dependent | 5<br>(8.67) | 5<br>(1.33) |
| Remaining Groups | 47<br>(55.32) | 3<br>(6.67) |

(d.f. = 1, Chi-Square = 10.41, $p < .01$).

Table 20 (continued)

Chi-Square Table for Subjects Who Showed Sensitive Versus Insensitive Behavior Patterns in Phase 3 of the DRL 6/FR 1 Schedule of Reinforcement

| Group | Sensitive | Insensitive |
|---|---|---|
| Rule-Following Dependent | 8 (8.5) | 2 (1.5) |
| Rule-Following Nondependent | 9 (8.5) | 1 (1.5) |
| Rule-Following Point Dependent | 6 (8.5) | 4 (1.5) |
| Rule-Following Point Nondependent | 9 (8.5) | 1 (1.5) |
| Rule Alone | 9 (8.5) | 1 (1.5) |
| Minimal Instructions | 10 (8.5) | 0 (1.5) |

D.F = 5, (Chi-Square = 7.451, $p > 0.20$

Table 21

Mean Number of Points Per Component in Phase 1 for the DRL 6 Schedule of Reinforcement: Group (6) One-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 0.042 | 0.43 |
| Error | 54 | 0.10 | |

Mean Number of Points Per Component in Phase 2 for the FR 1 Schedule of Reinforcement: Group (6) One-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 198.48 | 2.54* |
| Error | 54 | 78.03 | |

Table 21 (continued)

Mean Number of Points Per Component in Phase 3 for the FR 1 Schedule of Reinforcement: Group (6) One-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 266.35 | 3.87* |
| Error | 54 | 68.78 | |

* $p$ < .05

Table 22

Mean Number of Points Per Component in Phase 1 for the DRL 6 Schedule of Reinforcement: Rule Message (2) x Dependence (2) Two-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Rule Message | 1 | 0.00 | 0.00 |
| Dependence | 1 | 0.10 | 1.57 |
| Rule Message x Dependence | 1 | 0.01 | 0.17 |
| Error | 36 | 0.06 | |

Mean Number of Points Per Component in Phase 2 for the FR 1 Schedule of Reinforcement: Rule Message (2) x Dependence (2) Two-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Rule Message | 1 | 319.28 | 3.91 |
| Dependence | 1 | 271.70 | 3.33 |
| Rule Message x Dependence | 1 | 72.93 | 0.89 |
| Error | 36 | 81.70 | |

Table 22 (continued)

Mean Number of Points Per Component in Phase 3 for the FR 1 Schedule of Reinforcement: Rule Message (2) x Dependence (2) Two-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Rule Message | 1 | 340.82 | 3.81 |
| Dependence | 1 | 223.45 | 2.50 |
| Rule Message x Dependence | 1 | 409.73 | 4.58* |
| Error | 36 | 89.54 | |

* $p < .05$

Table 23

Mean Number of Points Per Component Difference Scores Between Phase 2 and 1 for the DRL 6/FR 1 Schedule of Reinforcement: Group (6) One-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 198.02 | 2.54* |
| Error | 54 | | |

Mean Number of Points Per Component Difference Scores Between Phase 3 and 2 for the DRL 6/FR 1 Schedule of Reinforcement: Group (6) One-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 28.08 | 0.67 |
| Error | 54 | 41.83 | |

Table 23 (continued)

Mean Number of Points Per Component Difference Scores Between Phase 3 and 1 for the DRL 6/FR 1 Schedule of Reinforcement: Group (6) One-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 265.09 | 3.89* |
| Error | 54 | 68.21 | |

* $p < .05$

Table 24

Mean Number of Points Per Component Difference Scores Between Phases 2 and 1 with the DRL 6/FR 1 Schedule of Reinforcement: Rule Message (2) x Dependence (2) Two-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Rule Message | 1 | 319.28 | 3.94 |
| Dependence | 1 | 282.23 | 3.48 |
| Rule Message x Dependence | 1 | 71.16 | 0.88 |
| Error | 36 | 81.09 | |

Mean Number of Points Per Component Difference Scores Between Phases 3 and 2 for the DRL 6/FR 1 Schedule of Reinforcement: Rule Message (2) x Dependence (2) Two-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Rule Message | 1 | 0.35 | 0.01 |
| Dependence | 1 | 2.36 | 0.06 |
| Rule Message x Dependence | 1 | 136.94 | 3.53 |
| Error | 36 | 38.80 | |

Table 24 (continued)

Mean Number of Points Per Component Difference Scores Between Phases 3 and 1 with the DRL 6/FR 1 Schedule of Reinforcement: Rule Message (2) x Dependence (2) Two-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Rule Message | 1 | 340.82 | 3.84 |
| Dependence | 1 | 234.00 | 2.63 |
| Rule Message x Dependence | 1 | 405.51 | 4.57* |
| Error | 36 | 88.67 | |

Table 25

Mean Component in Phase 2 or 3 in which Subjects Showed One IRT of Less than Two Seconds for the FR 1 Schedule of Reinforcement: Group (6) One-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 1.99 | 1.28 |
| Error | 54 | 1.55 | |

Mean Component in Phase 2 or 3 in which Subjects Showed Four IRTs of Less than Two Seconds for the FR 1 Schedule of Reinforcement: Group (6) One-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 9.22 | 1.02 |
| Error | 54 | 9.05 | |

Table 25 (continued)

Mean Component in Phase 2 or 3 in which Subjects Showed Eight IRTs of Less than Two Seconds for the FR 1 Schedule of Reinforcement: Group (6) One-Way ANOVA

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 8.11 | 0.82 |
| Error | 54 | 9.84 | |

Table 26

Mean Number of Responses Per Component in Phase 2 for the FR 1 Schedule of Reinforcement: Group (6) One-Way ANACOVAR with Mean Component in Phase 2 or 3 in which Subjects Showed Eight IRTs of Less than Two Seconds for the FR 1 Schedule of Reinforcement as the Covariate

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 10155.41 | 2.59* |
| Error | 53 | 3928.44 | |

Mean Number of Responses Per Component in Phase 3 for the FR 1 Schedule of Reinforcement: Group (6) One-Way ANACOVAR with Mean Component in Phase 2 or 3 in which Subjects Showed Eight IRTs of Less than Two Seconds for the FR 1 Schedule of Reinforcement as the Covariate

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 15134.60 | 3.15* |
| Error | 53 | 4800.97 | |

*$p < .05$

Table 27

Mean Number of Responses Per Component in Phase 2 for the FR 1 Schedule of Reinforcement: Rule Message (2) x Dependence (2) Two-Way ANACOVAR with Mean Component in Phase 2 or 3 in which Subjects Showed Eight IRTs of Less than Two Seconds for the FR 1 Schedule of Reinforcement as the Covariate

| Source | df | MS | F |
|---|---|---|---|
| Rule Message | 1 | 16750.70 | 3.94* |
| Dependence | 1 | 6940.20 | 1.63 |
| Rule Message x Dependence | 1 | 5188.83 | 1.22 |
| Error | 35 | 4251.31 | |

Table 27 (continued)

Mean Number of Responses Per Component in Phase 3 for the FR 1 Schedule of Reinforcement: Rule Message (2) x Dependence (2) Two-Way ANACOVAR with Mean Component in Phase 2 or 3 in which Subjects Showed Eight IRTs of Less than Two Seconds for the FR 1 Schedule of Reinforcement as the Covariate

| Source | df | MS | F |
|---|---|---|---|
| Rule Message | 1 | 15148.59 | 2.46 |
| Dependence | 1 | 9297.81 | 1.51 |
| Rule Message x Dependence | 1 | 19309.41 | 3.14 |
| Error | 35 | 6147.45 | |

*$\underline{p}$ = .055

Table 28

Mean Number of Responses Per Component Difference Scores Between Phases 2 and 1 for the DRL 6/FR 1 Schedule of Reinforcement: Group (6) One-Way ANACOVAR with Mean Component in Phase 2 or 3 in which Subjects Showed Eight IRTs of Less than Two Seconds for the FR 1 Schedule of Reinforcement as the Covariate

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 7889.14 | 2.14* |
| Error | 53 | 3684.47 | |

Mean Number of Responses Per Component Difference Scores Between Phases 3 and 2 for the DRL 6/FR 1 Schedule of Reinforcement: Group (6) One-Way ANACOVAR with Mean Component in Phase 2 or 3 in which Subjects Showed Eight IRTs of Less than Two Seconds for the FR 1 Schedule of Reinforcement as the Covariate

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 1087.69 | 0.40 |
| Error | 53 | 2746.84 | |

Table 28 (continued)

Mean Number of Responses Per Component Difference Scores Between Phases 3 and 1 for the DRL 6/FR 1 Schedule of Reinforcement: Group (6) One-Way ANACOVAR with Mean Component in Phase 2 or 3 in which Subjects Showed Eight IRTs of Less than Two Seconds for the FR 1 Schedule of Reinforcement as the Covariate

| Source | df | MS | F |
|---|---|---|---|
| Group | 5 | 12420.36 | 2.65** |
| Error | 53 | 4691.90 | |

*$p$ = .075, **$p$ < .05

Table 29

Mean Number of Responses Per Component Difference Scores Between Phases 2 and 1 for the DRL 6/FR 1 Schedule of Reinforcement: Rule Message (2) x Dependence (2) Two-Way ANACOVAR with Mean Component in Phase 2 or 3 in which Subjects Showed Eight IRTs of Less than Two Seconds for the FR 1 Schedule of Reinforcement as the Covariate

| Source | df | MS | F |
|---|---|---|---|
| Rule Message | 1 | 14130.38 | 3.53 |
| Dependence | 1 | 9722.49 | 2.43 |
| Rule Message x Depend | 1 | 3492.25 | 0.87 |
| Error | 35 | 4003.38 | |

Table 29 (continued)

Mean Number of Responses Per Component Difference Scores Between Phases 3 and 2 for the DRL 6/FR 1 Schedule of Reinforcement: Rule Message (2) x Dependence (2) Two-Way ANACOVAR with Mean Component in Phase 2 or 3 in which Subjects Showed Eight IRTs of Less than Two Seconds for the FR 1 Schedule of Reinforcement as the Covariate

| Source | df | MS | F |
|---|---|---|---|
| Rule Message | 1 | 40.26 | 0.01 |
| Dependence | 1 | 172.06 | 0.06 |
| Rule Message x Dependence | 1 | 4478.92 | 1.63 |
| Error | 35 | 2753.20 | |

Table 29 (continued)

Mean Number of Responses Per Component Difference Scores Between Phases 3 and 1 for the DRL 6/FR 1 Schedule of Reinforcement: Rule Message (2) x Dependence (2) Two-Way ANACOVAR with Mean Component in Phase 2 or 3 in which Subjects Showed Eight IRTs of Less than Two Seconds for the FR 1 Schedule of Reinforcement as the Covariate

| Source | df | MS | F |
|---|---|---|---|
| Rule Message | 1 | 4930.19 | 0.98 |
| Dependence | 1 | 19053.27 | 3.78* |
| Rule Message x Dependence | 1 | 14471.38 | 2.87 |
| Error | 35 | 5036.30 | |

*$p < .06$

# Appendix D

## Figures

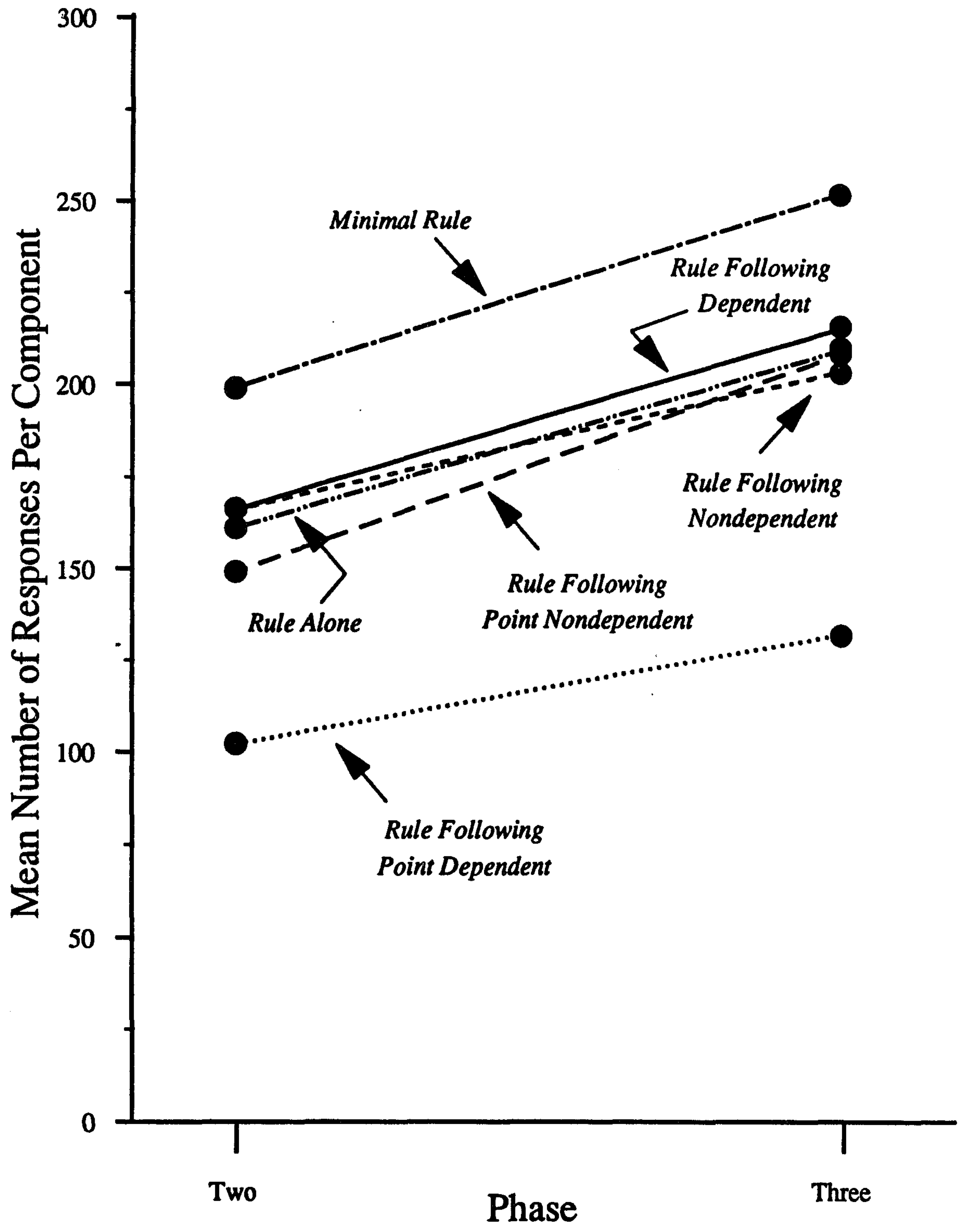



Figure 1: Mean Number of Responses Per Phase Per Component, FR 1 Schedule of Reinforcement (After DRL 6), Point of Contact Used as Covariate

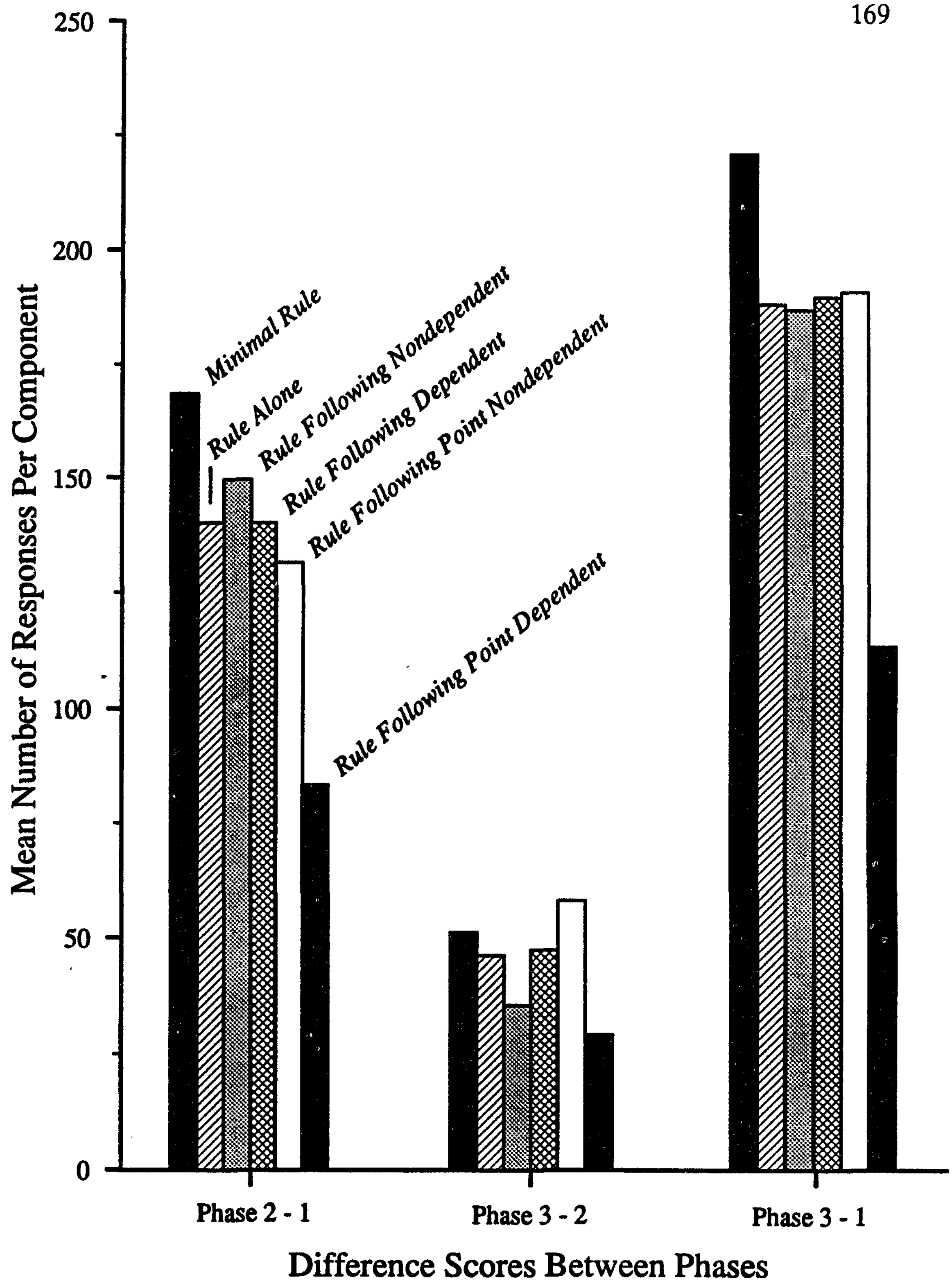



Figure 2: Mean Difference in Number of Responses Per Component, DRL 6 / FR 1 Schedule of Reinforcement Point of Contact Used as Covariate

# Appendix E

## Raw Data

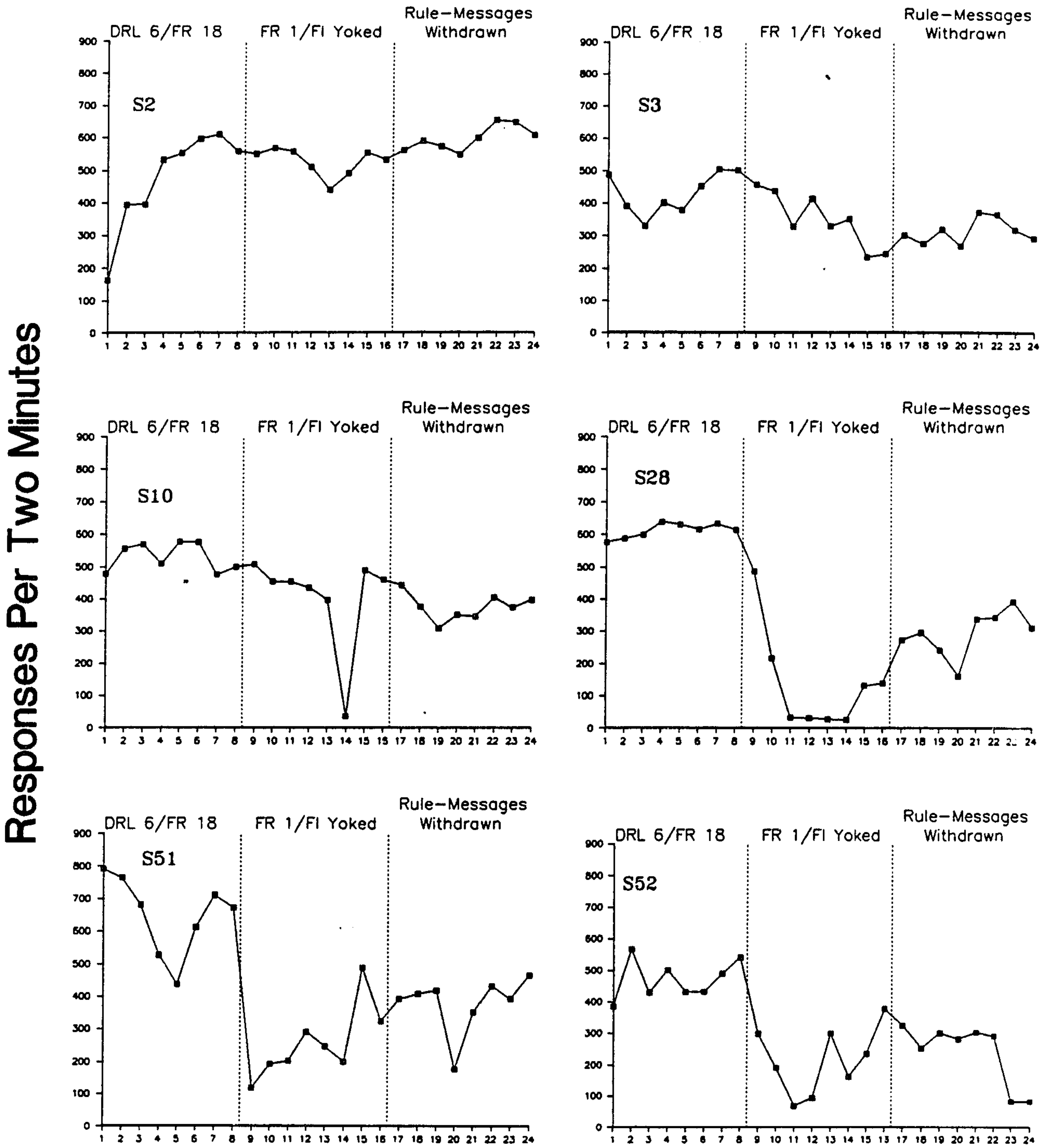
### Mean Number of Responses Per phase

| | | | | Responses DRL6/FR1 | | | Response FR18/FI Yoked | | |
|---|---|---|---|---|---|---|---|---|---|
| ID | GR | RM | DE | Ph 1 | Ph2 | Ph3 | Ph 1 | Ph 2 | Ph 3 |
| 2 | 1 | 1 | 1 | 18.00 | 32.75 | 269.88 | 588.67 | 526.50 | 599.63 |
| 3 | 1 | 1 | 1 | 14.67 | 38.25 | 30.00 | 486.33 | 350.63 | 316.25 |
| 10 | 1 | 1 | 1 | 18.67 | 137.25 | 250.13 | 518.00 | 405.00 | 375.88 |
| 28 | 1 | 1 | 1 | 17.00 | 283.13 | 281.38 | 622.00 | 136.75 | 295.13 |
| 51 | 1 | 1 | 1 | 34.33 | 268.88 | 301.00 | 666.33 | 259.00 | 380.75 |
| 52 | 1 | 1 | 1 | 64.67 | 233.00 | 245.25 | 488.33 | 216.50 | 240.88 |
| 62 | 1 | 1 | 1 | 21.00 | 26.88 | 31.88 | 318.67 | 375.00 | 404.00 |
| 75 | 1 | 1 | 1 | 18.00 | 40.25 | 103.75 | 349.67 | 265.13 | 140.75 |
| 76 | 1 | 1 | 1 | 16.67 | 192.50 | 269.00 | 442.67 | 84.63 | 20.50 |
| 85 | 1 | 1 | 1 | 23.00 | 223.75 | 256.63 | 642.67 | 127.50 | 68.38 |
| 11 | 2 | 1 | 2 | 16.67 | 197.88 | 280.13 | 631.00 | 628.88 | 458.50 |
| 23 | 2 | 1 | 2 | 14.67 | 221.13 | 213.25 | 320.33 | 349.13 | 238.88 |
| 27 | 2 | 1 | 2 | 15.67 | 17.13 | 11.50 | 582.00 | 530.25 | 504.13 |
| 33 | 2 | 1 | 2 | 18.67 | 238.13 | 262.13 | 315.33 | 133.63 | 92.88 |
| 39 | 2 | 1 | 2 | 16.33 | 196.13 | 228.13 | 349.67 | 99.50 | 95.25 |
| 64 | 2 | 1 | 2 | 17.33 | 195.50 | 256.88 | 612.33 | 101.13 | 29.63 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 68 | 2 | 1 | 2 | 17.67 | 247.25 | 296.63 | 538.33 | 227.00 | 166.13 |
| 73 | 2 | 1 | 2 | 16.67 | 221.38 | 234.50 | 439.00 | 308.63 | 275.63 |
| 79 | 2 | 1 | 2 | 17.00 | 161.25 | 194.38 | 566.33 | 493.63 | 95.38 |
| 89 | 2 | 1 | 2 | 14.00 | 90.50 | 128.63 | 465.00 | 402.00 | 348.38 |
| 5 | 3 | 2 | 1 | 20.67 | 133.25 | 143.50 | 517.33 | 342.00 | 220.63 |
| 13 | 3 | 2 | 1 | 14.67 | 33.75 | 38.50 | 527.67 | 542.13 | 452.63 |
| 17 | 3 | 2 | 1 | 17.00 | 156.13 | 202.88 | 364.33 | 270.38 | 31.50 |
| 22 | 3 | 2 | 1 | 15.67 | 135.63 | 198.13 | 623.67 | 391.38 | 254.75 |
| 25 | 3 | 2 | 1 | 14.67 | 18.38 | 34.50 | 386.67 | 255.63 | 273.88 |
| 31 | 3 | 2 | 1 | 21.00 | 215.38 | 236.75 | 415.67 | 316.38 | 393.88 |
| 43 | 3 | 2 | 1 | 17.00 | 67.63 | 117.25 | 539.67 | 437.38 | 238.75 |
| 44 | 3 | 2 | 1 | 19.33 | 64.75 | 31.88 | 472.00 | 257.50 | 310.00 |
| 45 | 3 | 2 | 1 | 15.33 | 14.50 | 202.25 | 412.33 | 547.63 | 27.38 |
| 50 | 3 | 2 | 1 | 17.67 | 37.75 | 31.38 | 858.67 | 545.25 | 465.50 |
| 4 | 4 | 2 | 2 | 15.67 | 62.88 | 156.88 | 585.00 | 576.38 | 597.00 |
| 14 | 4 | 2 | 2 | 18.00 | 210.88 | 215.00 | 373.33 | 29.38 | 22.38 |
| 15 | 4 | 2 | 2 | 19.67 | 230.38 | 244.00 | 453.33 | 401.88 | 388.75 |
| 26 | 4 | 2 | 2 | 18.67 | 110.25 | 200.38 | 478.00 | 321.50 | 387.63 |
| 36 | 4 | 2 | 2 | 16.67 | 209.88 | 237.25 | 473.33 | 203.13 | 67.75 |
| 48 | 4 | 2 | 2 | 14.67 | 79.75 | 116.50 | 455.00 | 366.38 | 236.25 |
| 55 | 4 | 2 | 2 | 17.67 | 140.50 | 185.63 | 475.67 | 454.63 | 340.63 |
| 57 | 4 | 2 | 2 | 16.33 | 202.00 | 264.75 | 505.67 | 452.13 | 29.75 |
| 65 | 4 | 2 | 2 | 16.00 | 186.38 | 297.88 | 554.00 | 335.88 | 441.13 |

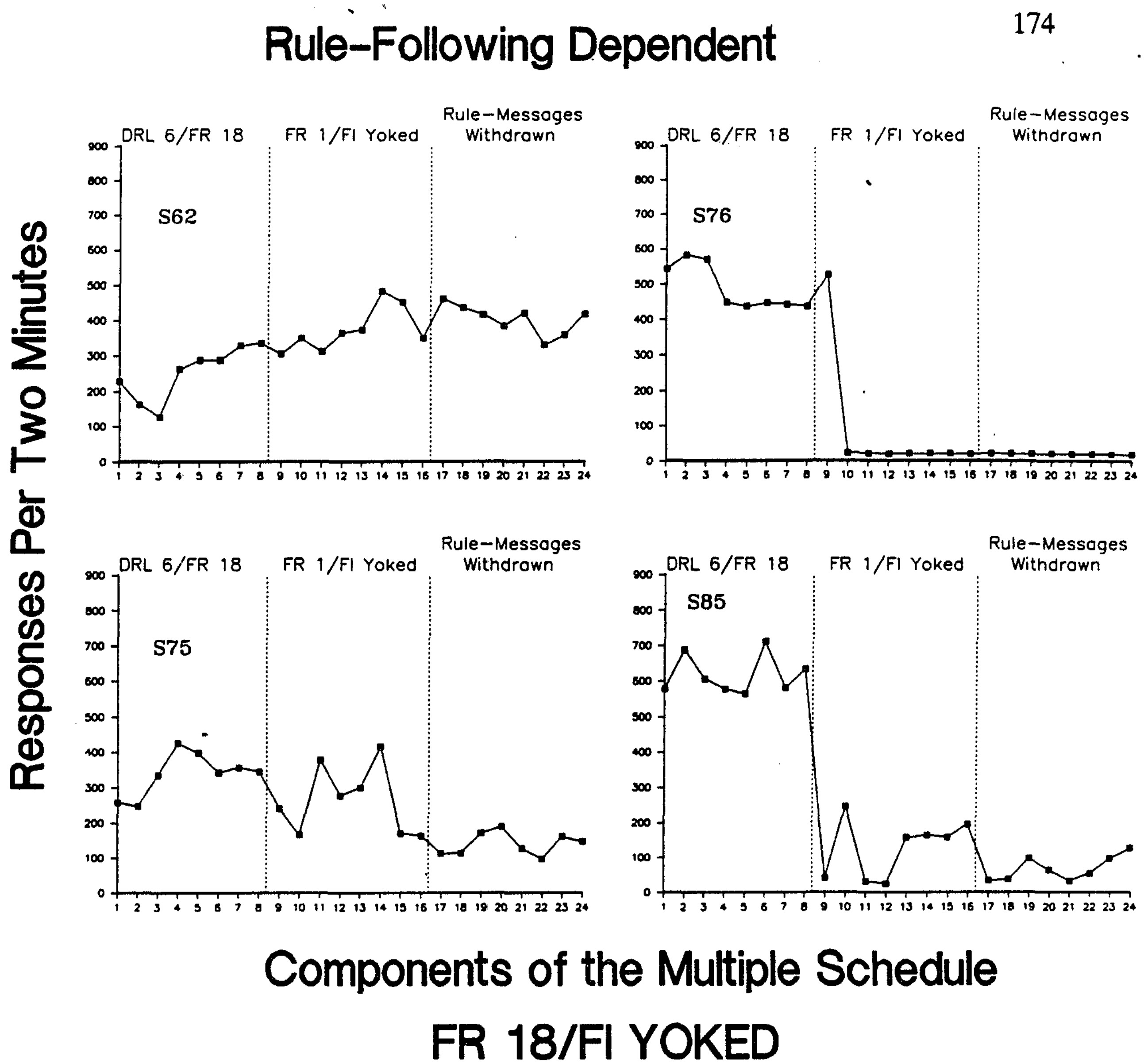
| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 82 | 4 | 2 | 2 | 16.67 | 108.88 | 192.88 | 295.00 | 288.50 | 62.63 |
| 9 | 5 | | | 20.67 | 265.00 | 202.63 | 579.00 | 330.75 | 239.75 |
| 19 | 5 | | | 19.00 | 139.75 | 208.63 | 357.67 | 157.88 | 120.25 |
| 20 | 5 | | | 22.67 | 202.00 | 196.38 | 355.00 | 47.88 | 55.88 |
| 29 | 5 | | | 31.33 | 233.38 | 261.75 | 470.67 | 128.13 | 159.00 |
| 30 | 5 | | | 16.67 | 188.88 | 253.00 | 619.33 | 638.25 | 584.38 |
| 32 | 5 | | | 16.00 | 163.63 | 259.25 | 566.67 | 559.13 | 291.88 |
| 69 | 5 | | | 13.33 | 36.88 | 88.50 | 527.67 | 545.63 | 526.00 |
| 70 | 5 | | | 19.67 | 96.25 | 213.13 | 568.67 | 474.63 | 390.00 |
| 72 | 5 | | | 24.33 | 185.75 | 248.75 | 413.33 | 110.75 | 189.25 |
| 80 | 5 | | | 18.33 | 227.63 | 226.13 | 541.00 | 276.50 | 107.50 |
| 1 | 6 | | | 17.00 | 133.63 | 262.63 | 453.33 | 557.50 | 44.75 |
| 7 | 6 | | | 71.33 | 285.50 | 291.88 | 527.33 | 298.13 | 49.63 |
| 8 | 6 | | | 17.67 | 127.38 | 194.88 | 363.67 | 225.38 | 38.75 |
| 12 | 6 | | | 23.67 | 250.38 | 265.50 | 470.67 | 31.50 | 30.88 |
| 41 | 6 | | | 46.67 | 24.38 | 213.13 | 329.67 | 376.88 | 471.50 |
| 53 | 6 | | | 28.00 | 240.75 | 271.13 | 515.33 | 525.38 | 482.63 |
| 58 | 6 | | | 25.33 | 274.00 | 332.88 | 719.00 | 630.13 | 332.00 |
| 83 | 6 | | | 16.33 | 228.75 | 211.63 | 357.33 | 112.75 | 69.63 |
| 95 | 6 | | | 49.67 | 253.38 | 228.38 | 354.67 | 288.13 | 274.13 |
| 97 | 6 | | | 17.33 | 202.75 | 258.88 | 519.33 | 359.13 | 181.13 |

## Rule-Following Dependent

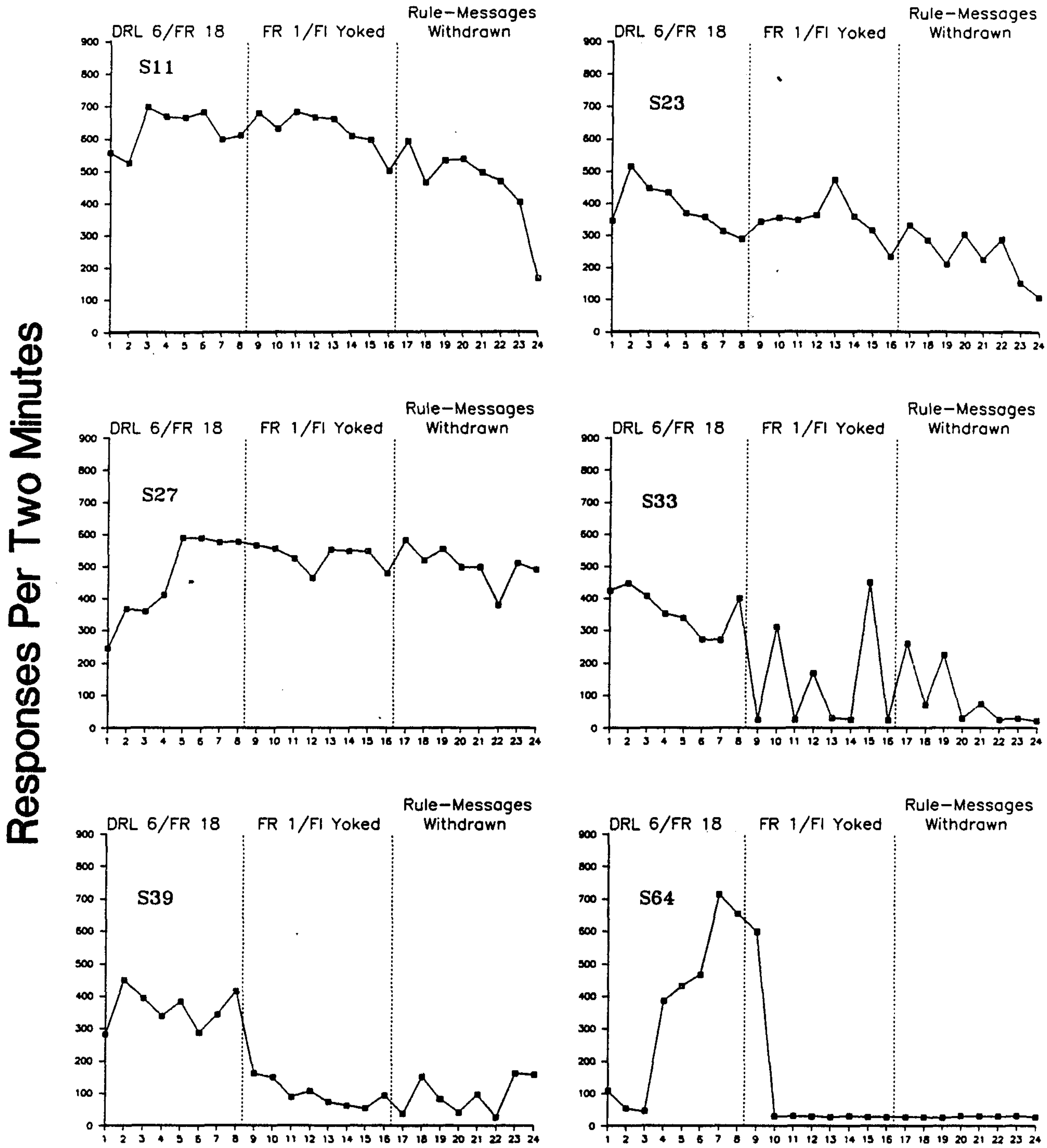



Components of the Multiple Schedule

FR 18/FI YOKED

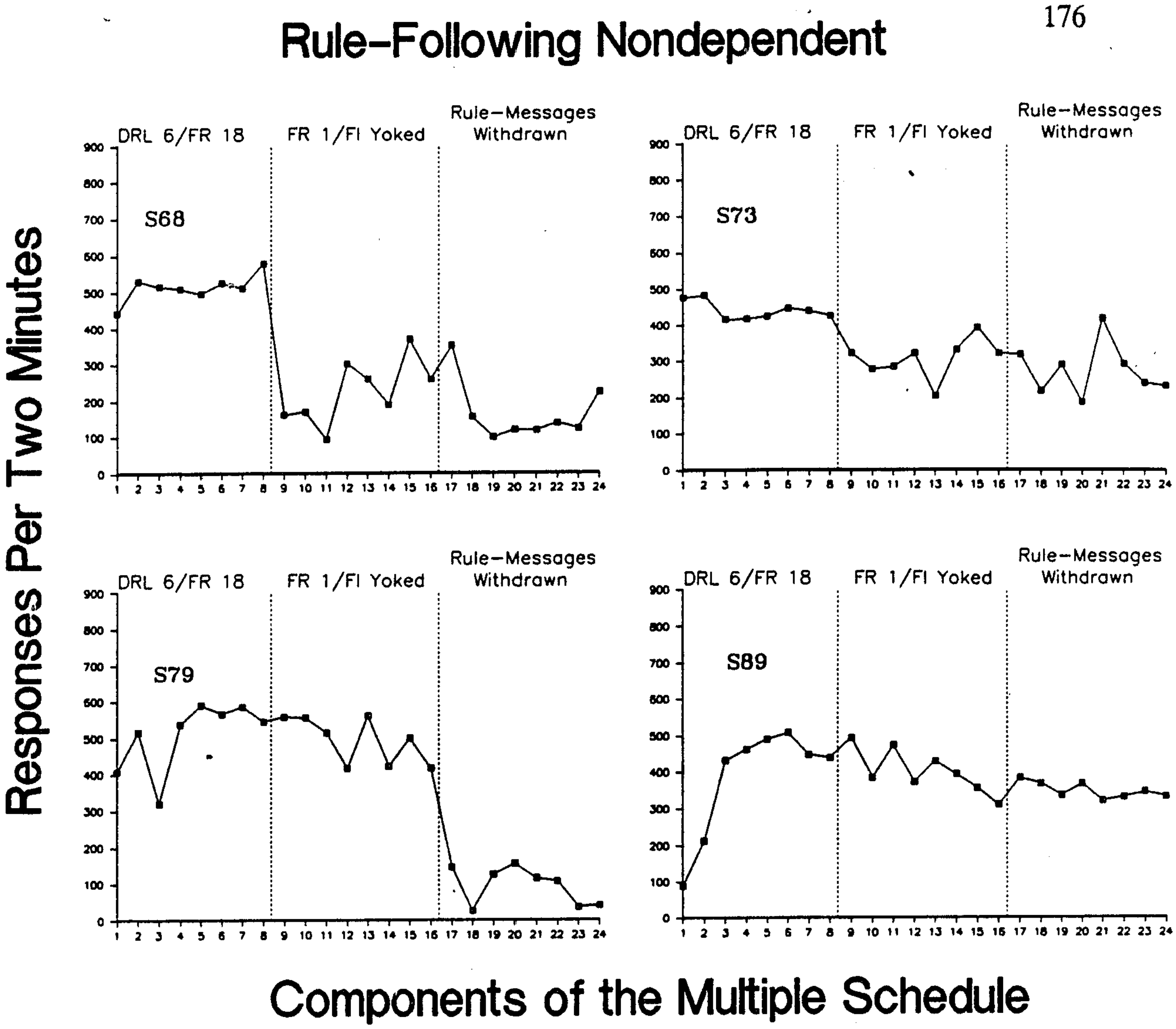

Rule-Following Dependent
Responses Per Two Minutes
DRL 6/FR 18
FR 1/FI Yoked
Rule-Messages Withdrawn
S62
S76
S75
S85
Components of the Multiple Schedule
FR 18/FI YOKED

## Rule-Following Nondependent

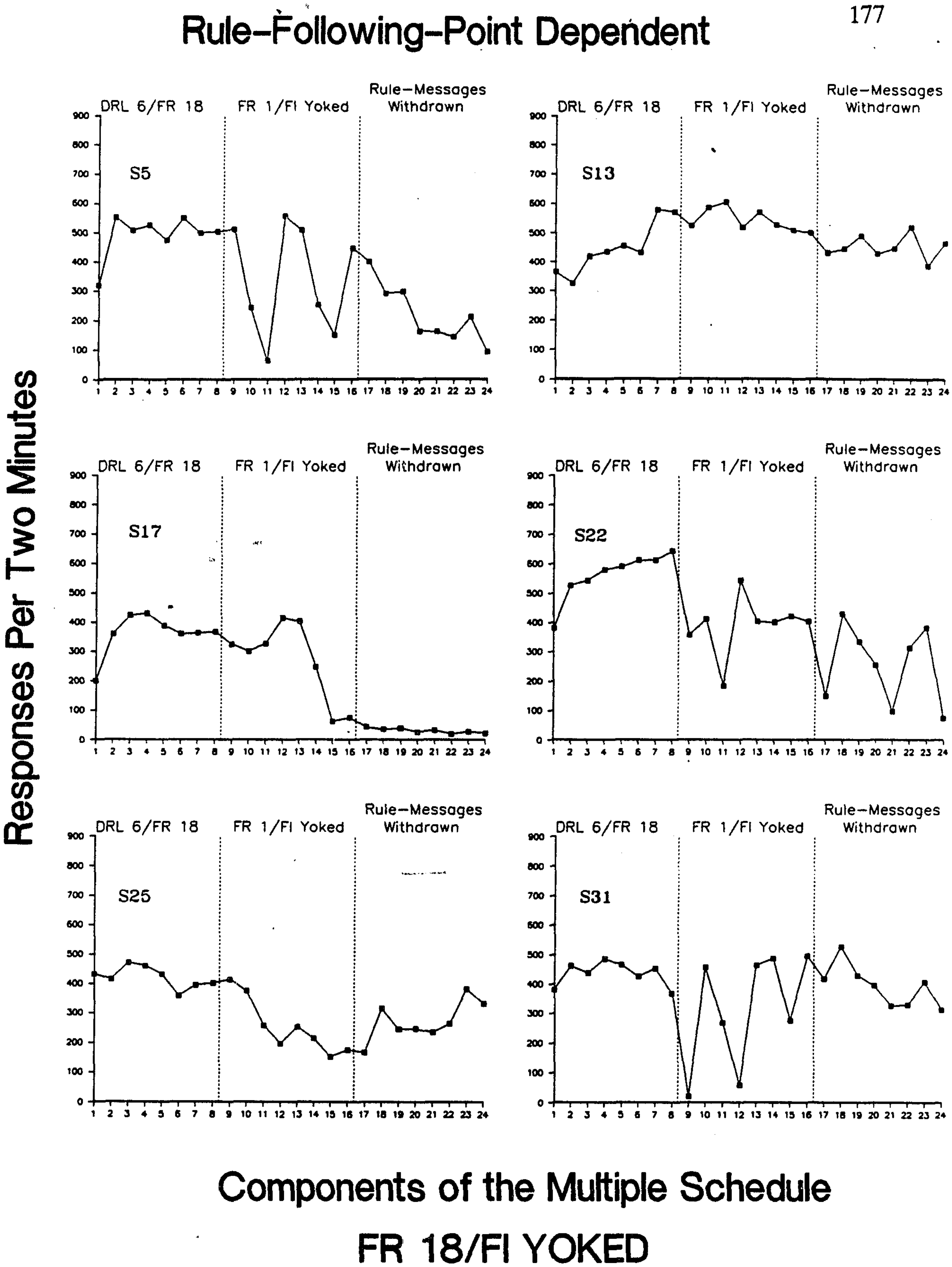


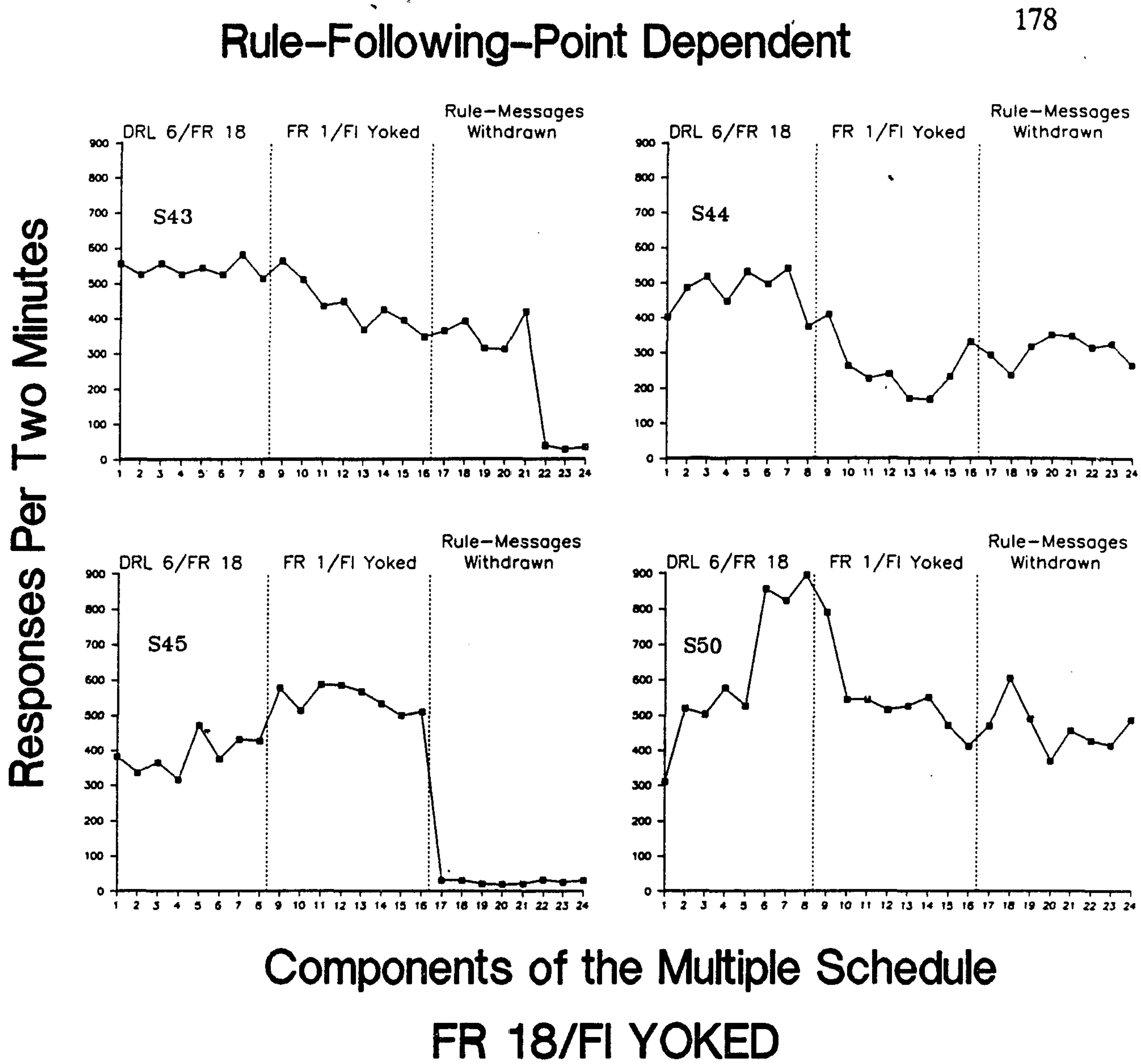

Components of the Multiple Schedule

FR 18/FI YOKED

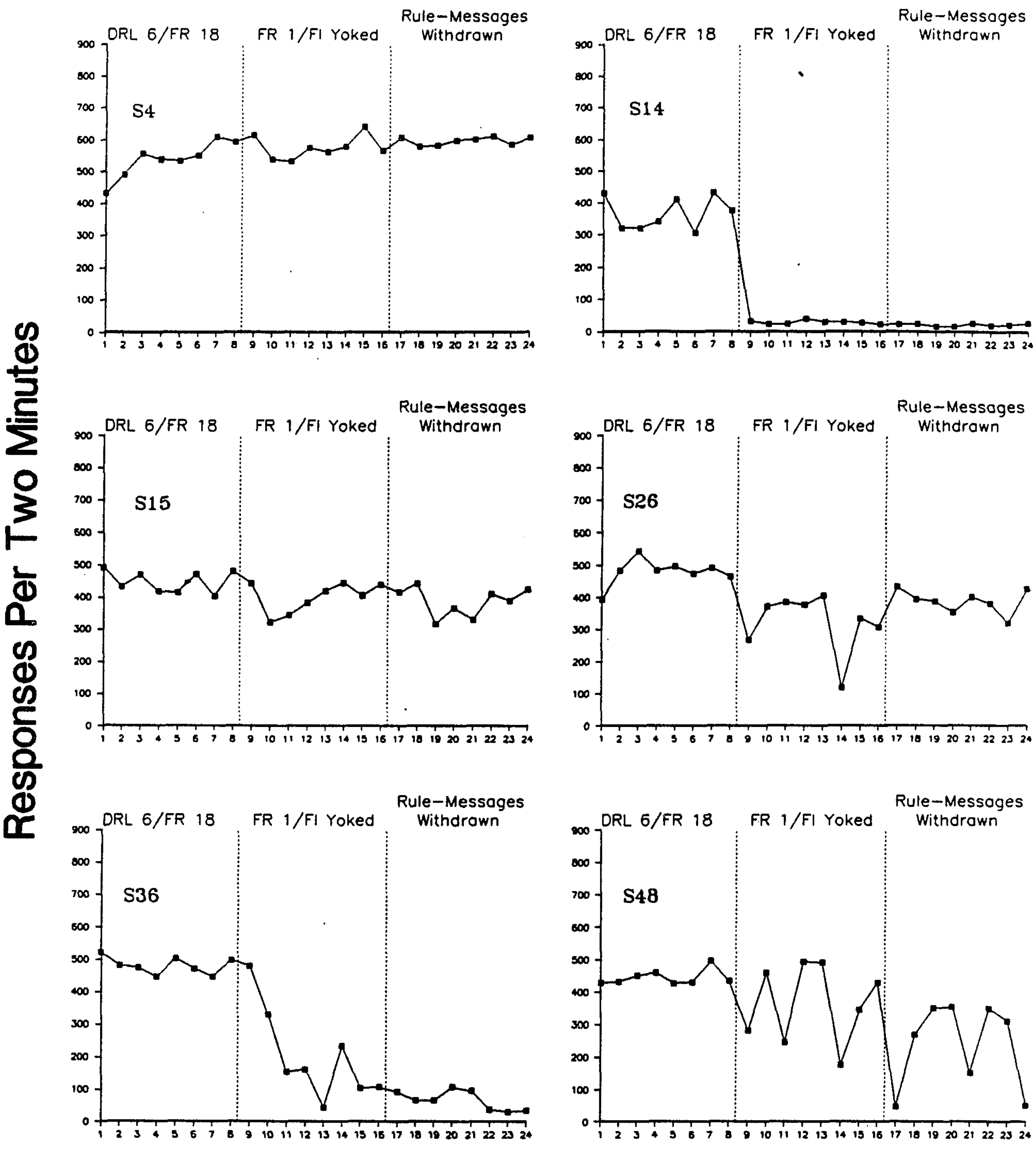



FR 18/FI YOKED


Rule-Following-Point Dependent
Responses Per Two Minutes
DRL 6/FR 18
FR 1/FI Yoked
Rule-Messages Withdrawn
S5
S13
S17
S22
S25
S31
0
100
200
300
400
500
600
700
800
900
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Components of the Multiple Schedule
FR 18/FI YOKED


Rule-Following-Point Dependent
Responses Per Two Minutes
DRL 6/FR 18
FR 1/FI Yoked
Rule-Messages Withdrawn
S43
S44
S45
S50
Components of the Multiple Schedule
FR 18/FI YOKED

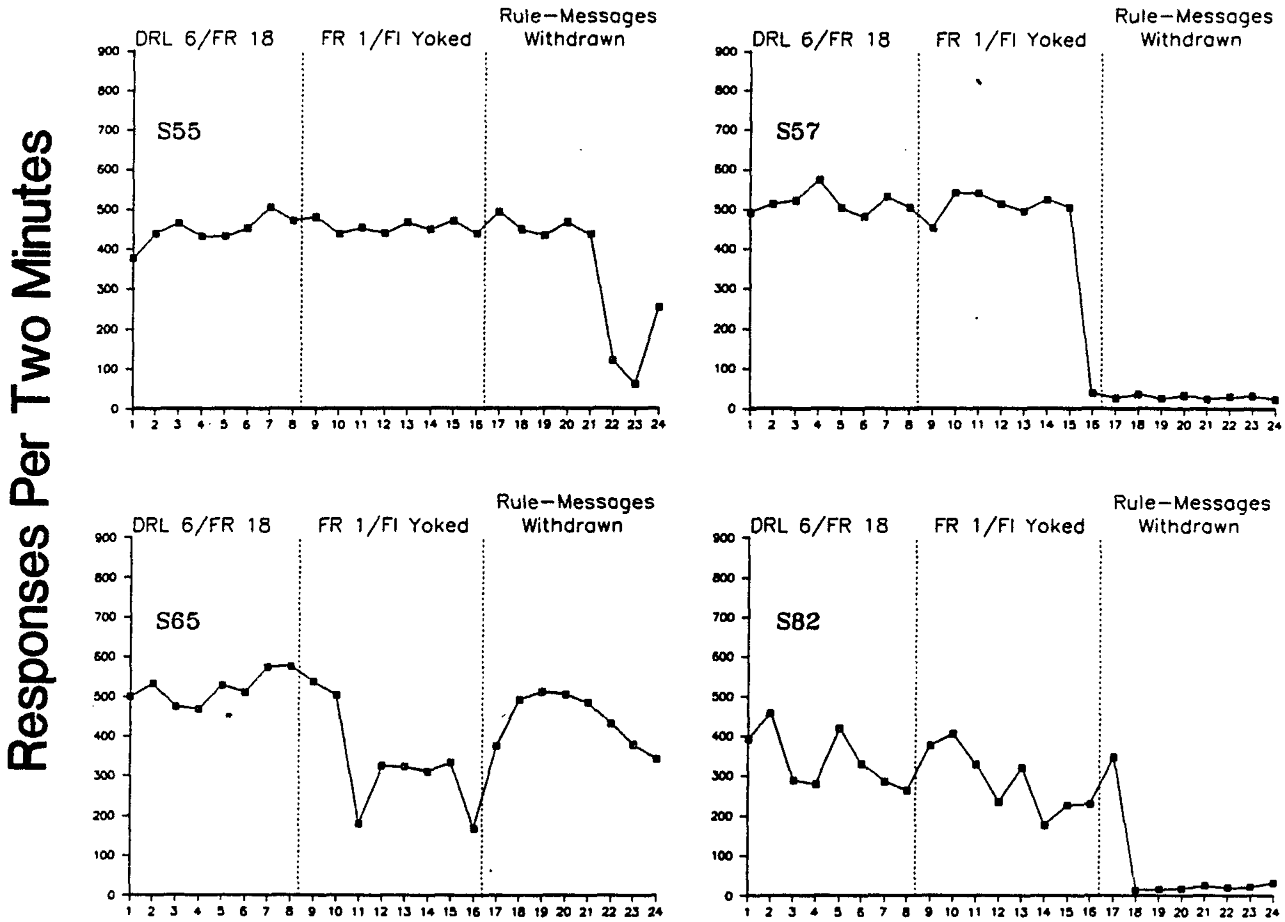
# Rule-Following-Point Nondependent




Components of the Multiple Schedule

FR 18/FI YOKED

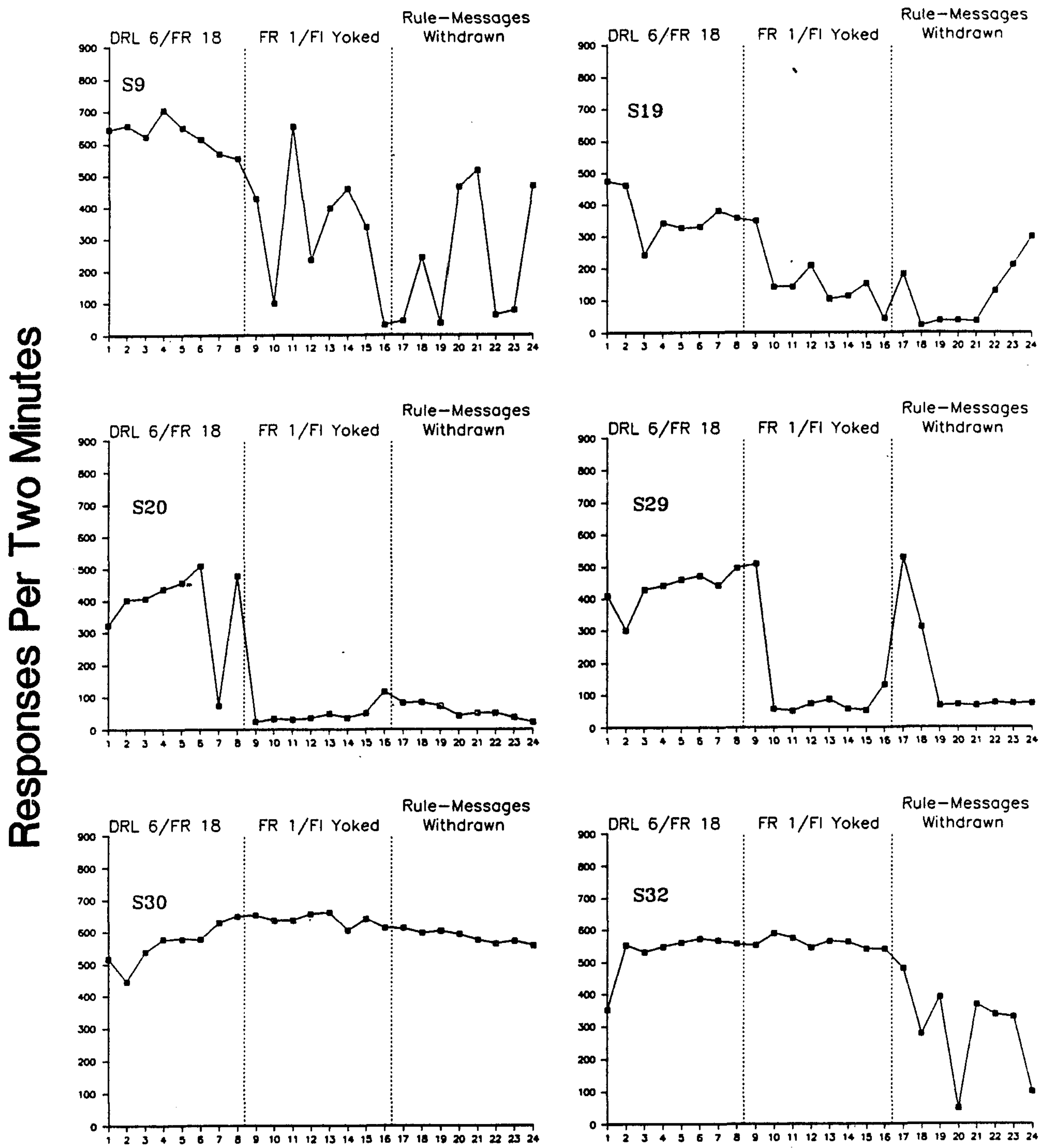
# Rule-Following-Point Nondependent




Components of the Multiple Schedule

FR 18/FI YOKED

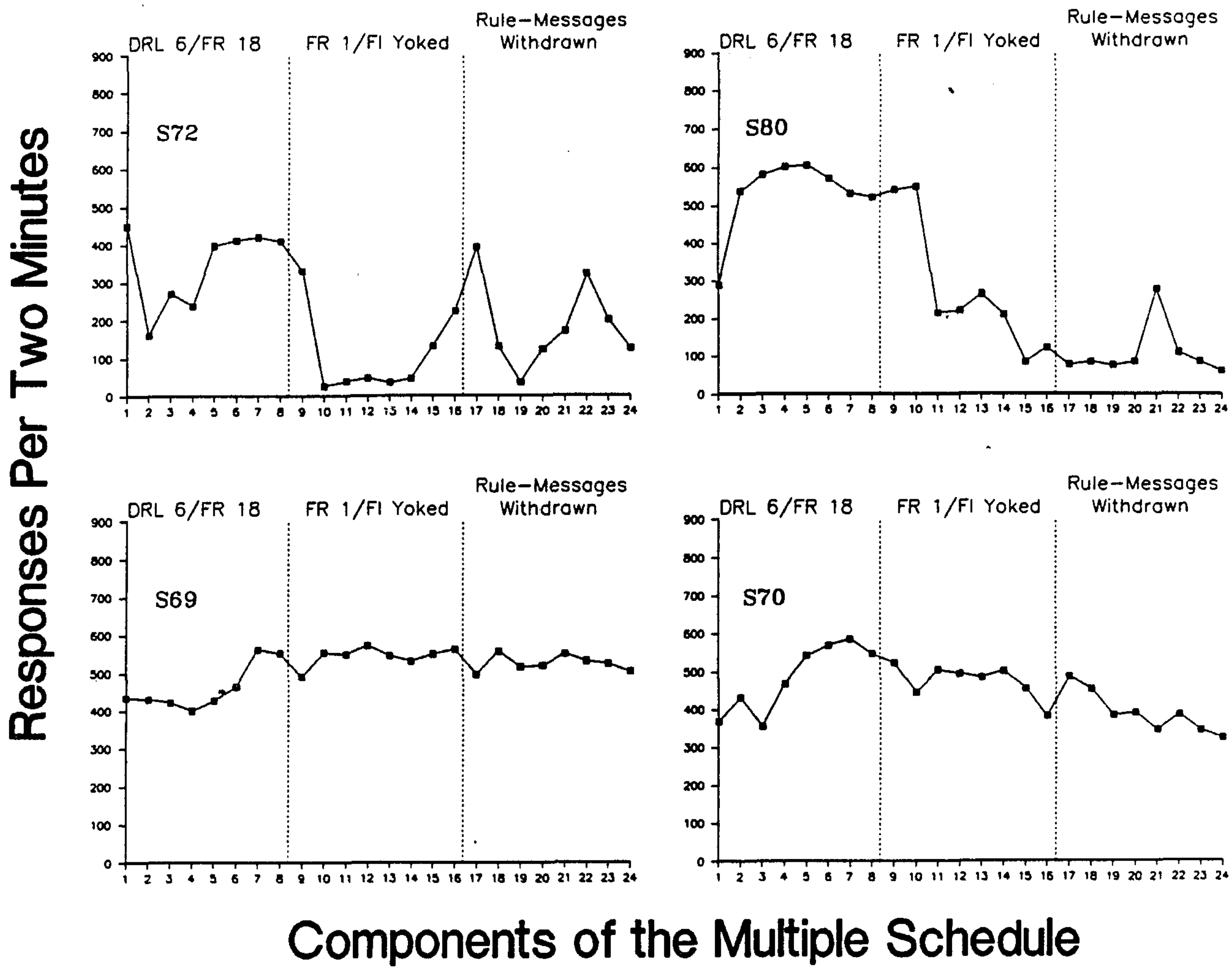
# Rule Alone




**Components of the Multiple Schedule**

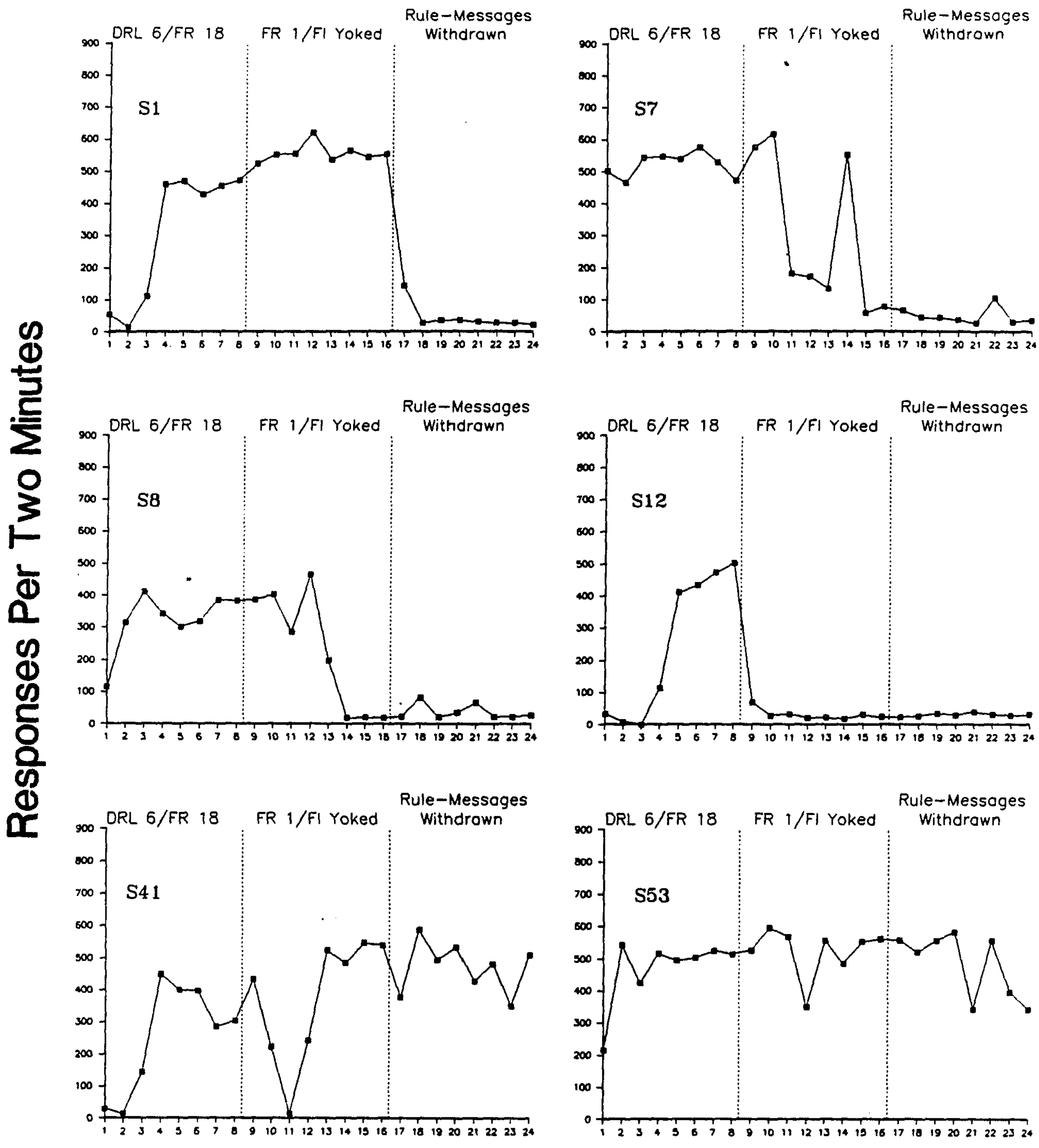
**FR 18/FI YOKED**

# Rule Alone



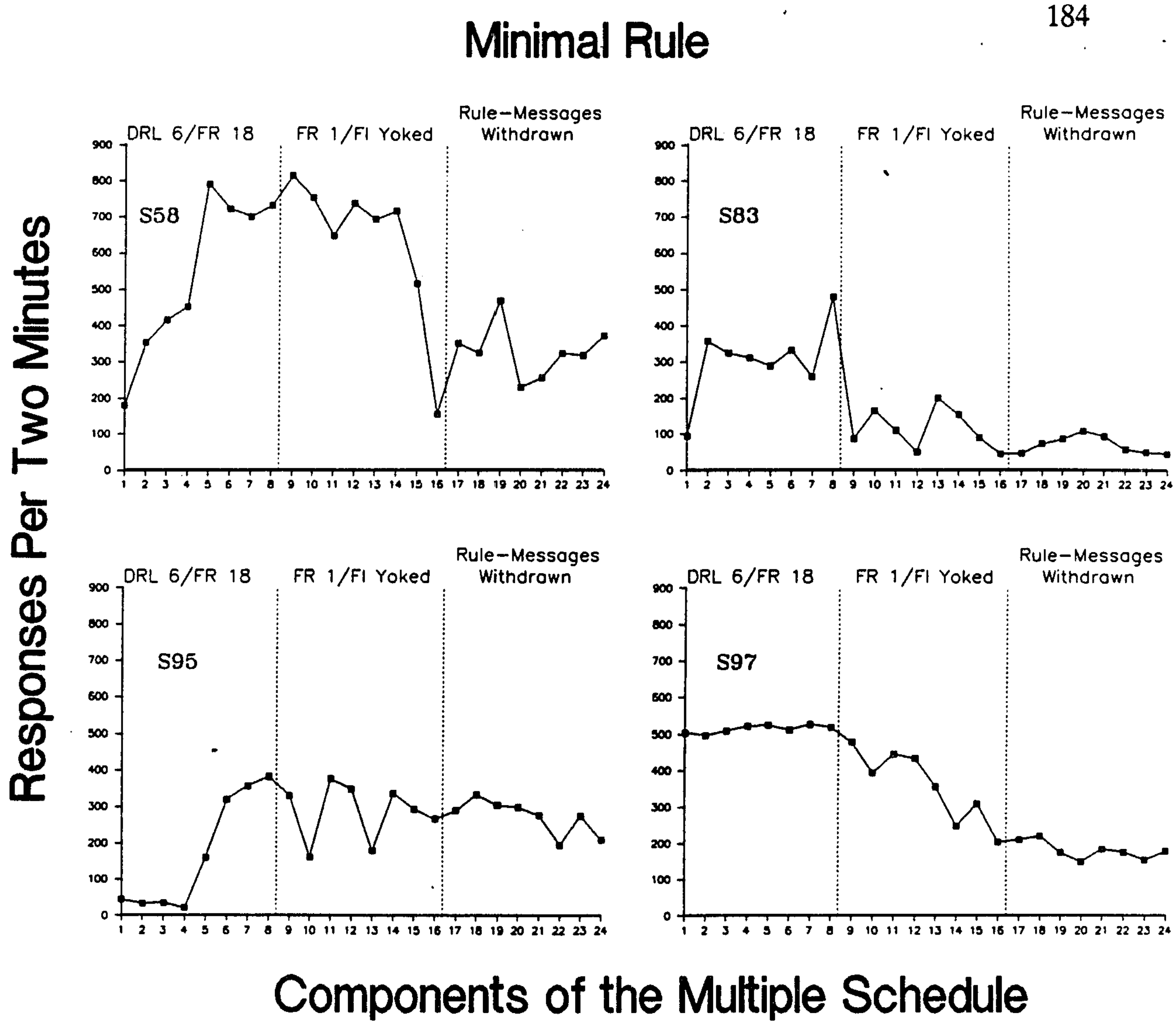

FR 18/FI YOKED

# Minimal Rule

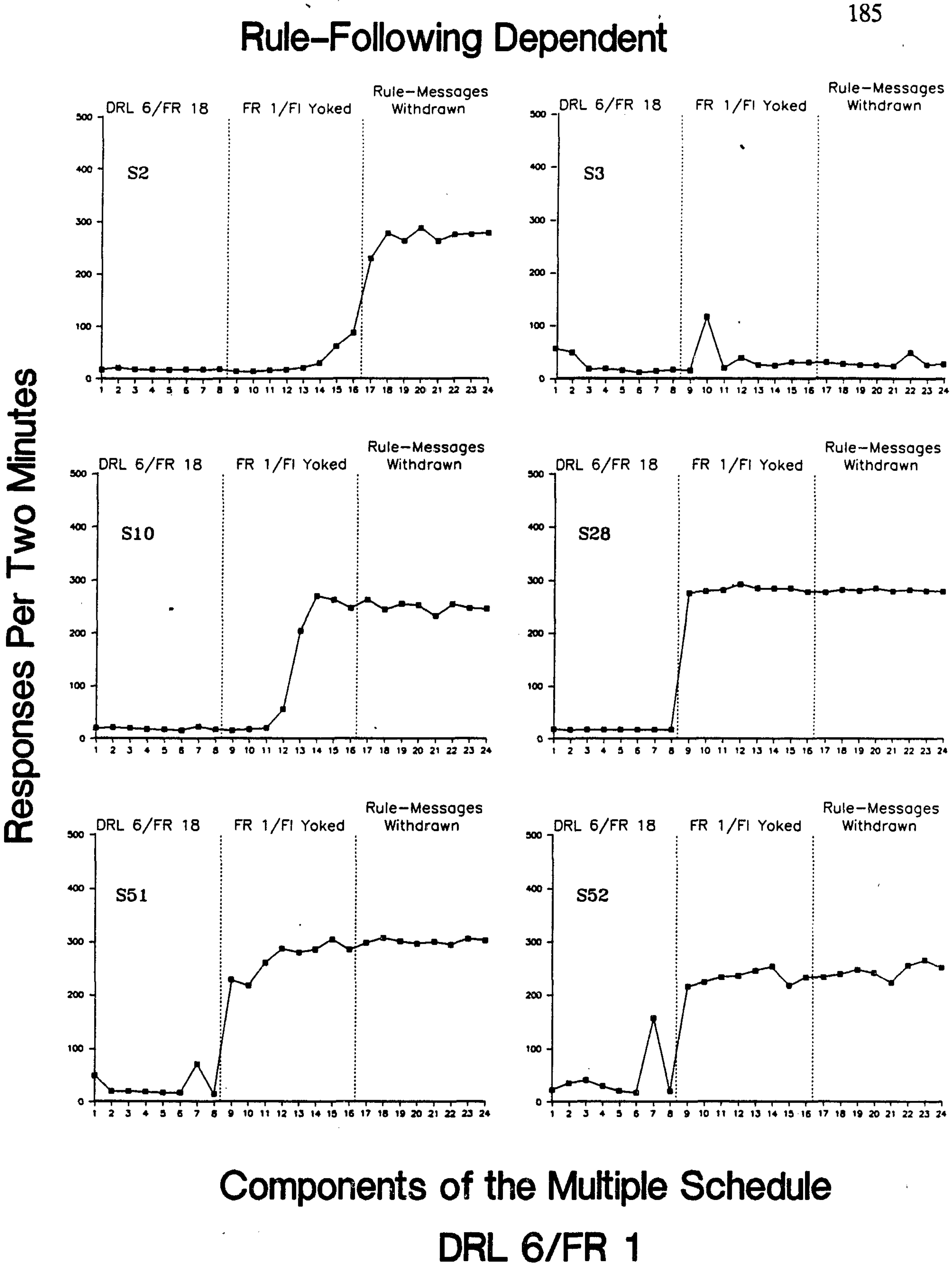


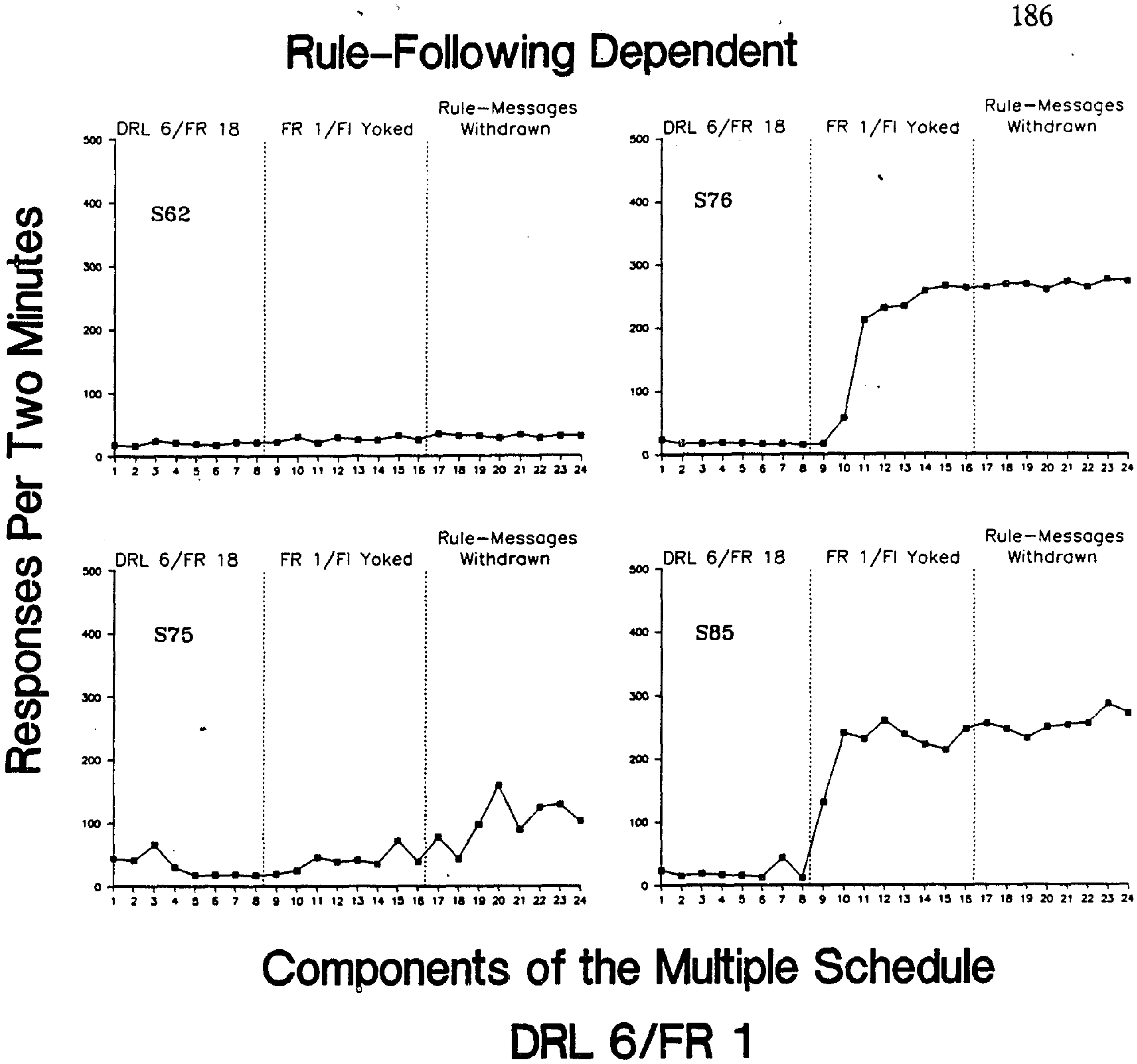

Components of the Multiple Schedule

FR 18/FI YOKED

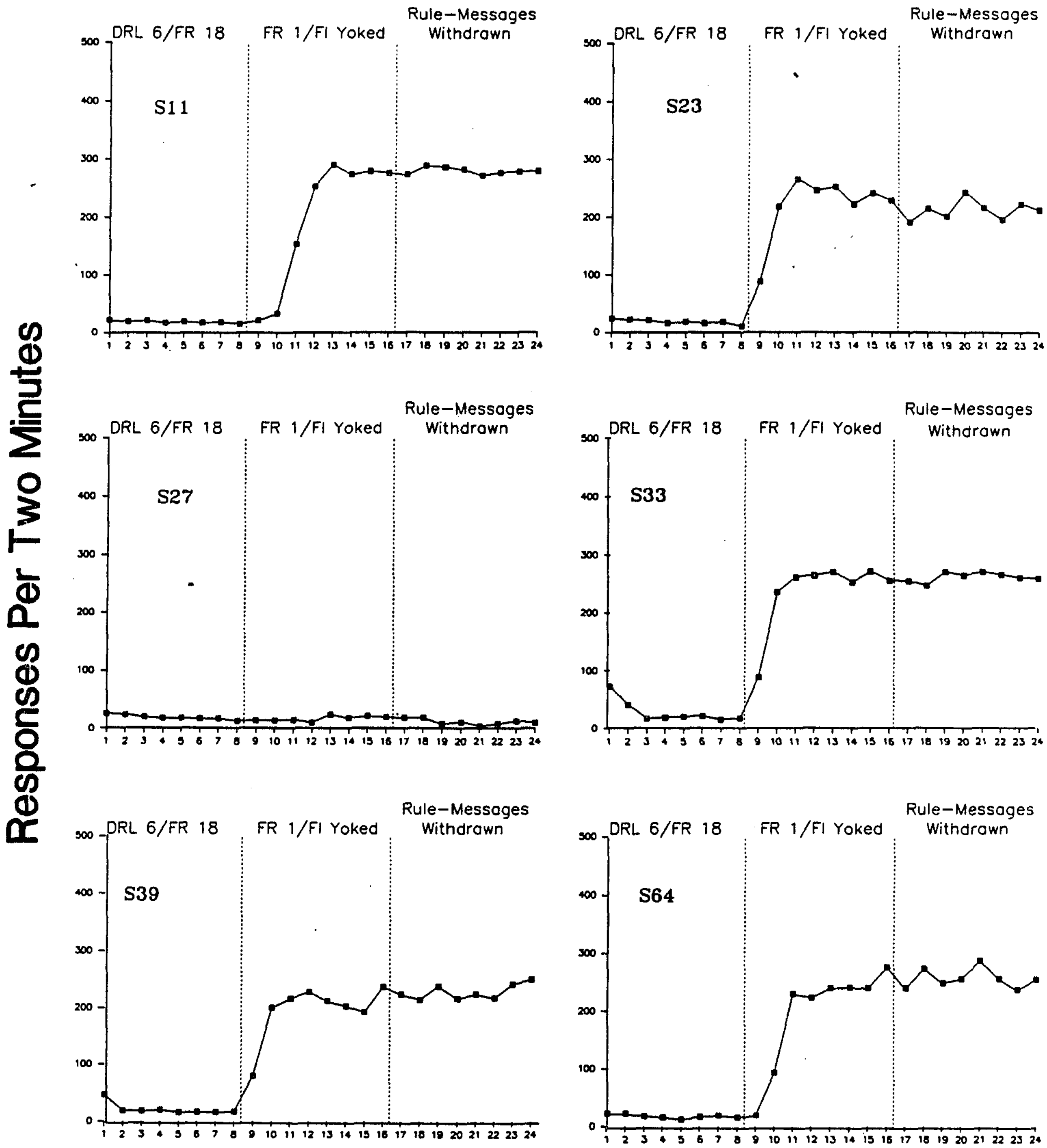



FR 18/FI YOKED


Rule-Following Dependent
Responses Per Two Minutes
DRL 6/FR 18
FR 1/FI Yoked
Rule-Messages Withdrawn
S2
S3
S10
S28
S51
S52
Components of the Multiple Schedule
DRL 6/FR 1

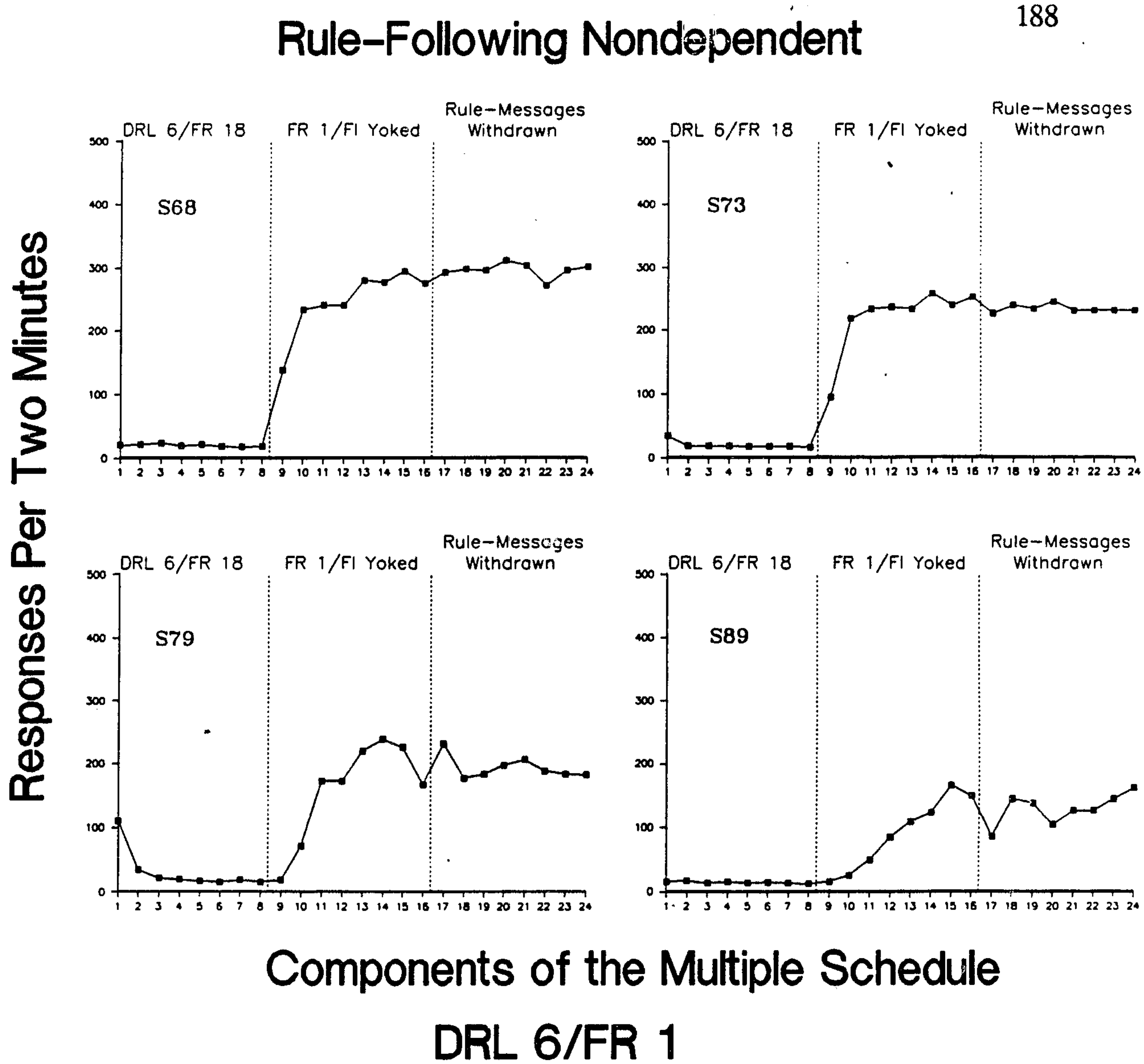

Rule-Following Dependent
Responses Per Two Minutes
DRL 6/FR 18
FR 1/FI Yoked
Rule-Messages Withdrawn
S62
S76
S75
S85
0
100
200
300
400
500
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Components of the Multiple Schedule
DRL 6/FR 1

# Rule-Following Nondependent

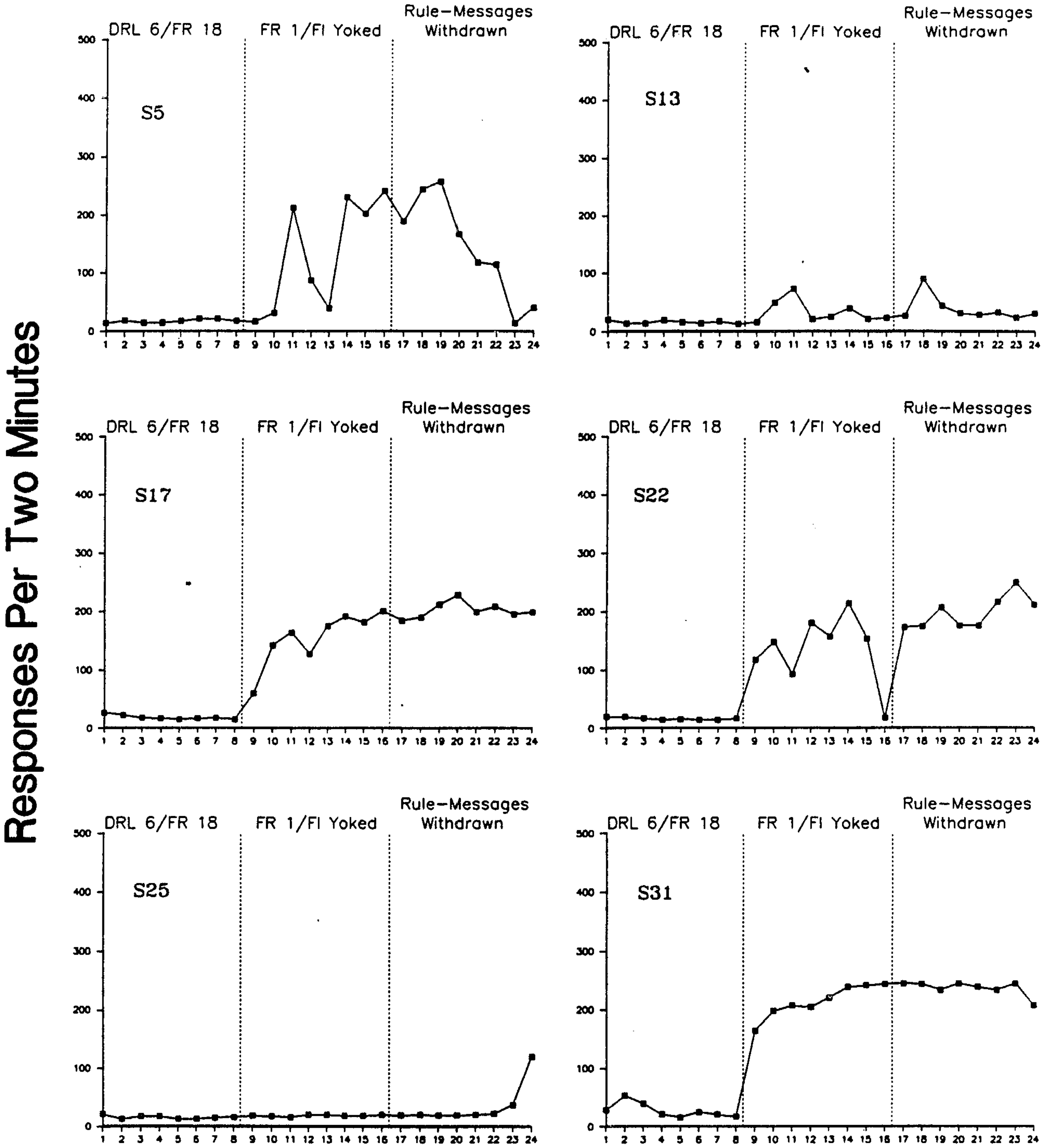



Components of the Multiple Schedule

DRL 6/FR 1


Rule-Following Nondependent
Responses Per Two Minutes
DRL 6/FR 18
FR 1/FI Yoked
Rule-Messages Withdrawn
S68
S73
S79
S89
0
100
200
300
400
500
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Components of the Multiple Schedule
DRL 6/FR 1

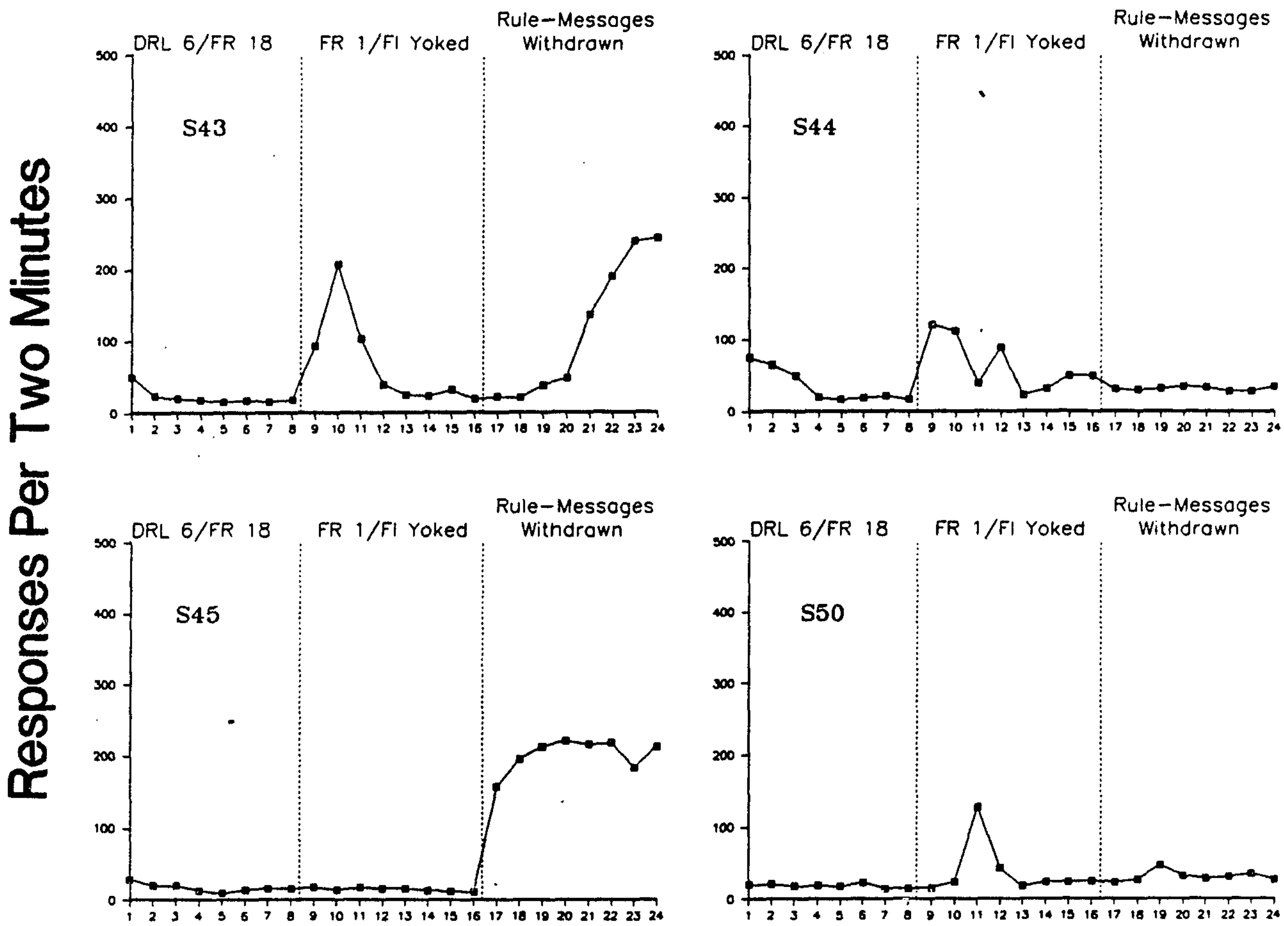
# Rule-Following-Point Dependent




Components of the Multiple Schedule

DRL 6/FR 1

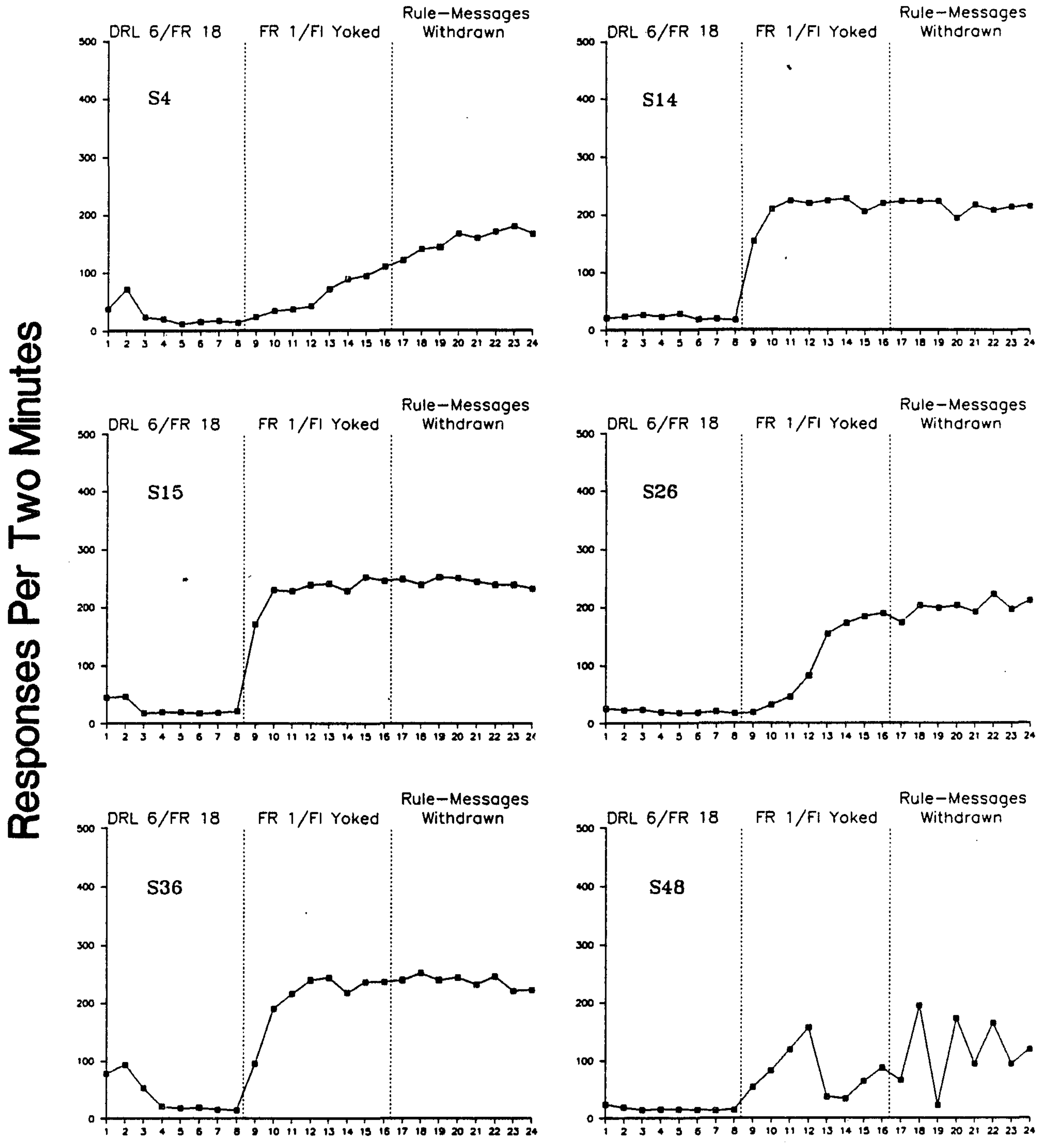
# Rule-Following-Point Dependent




Components of the Multiple Schedule

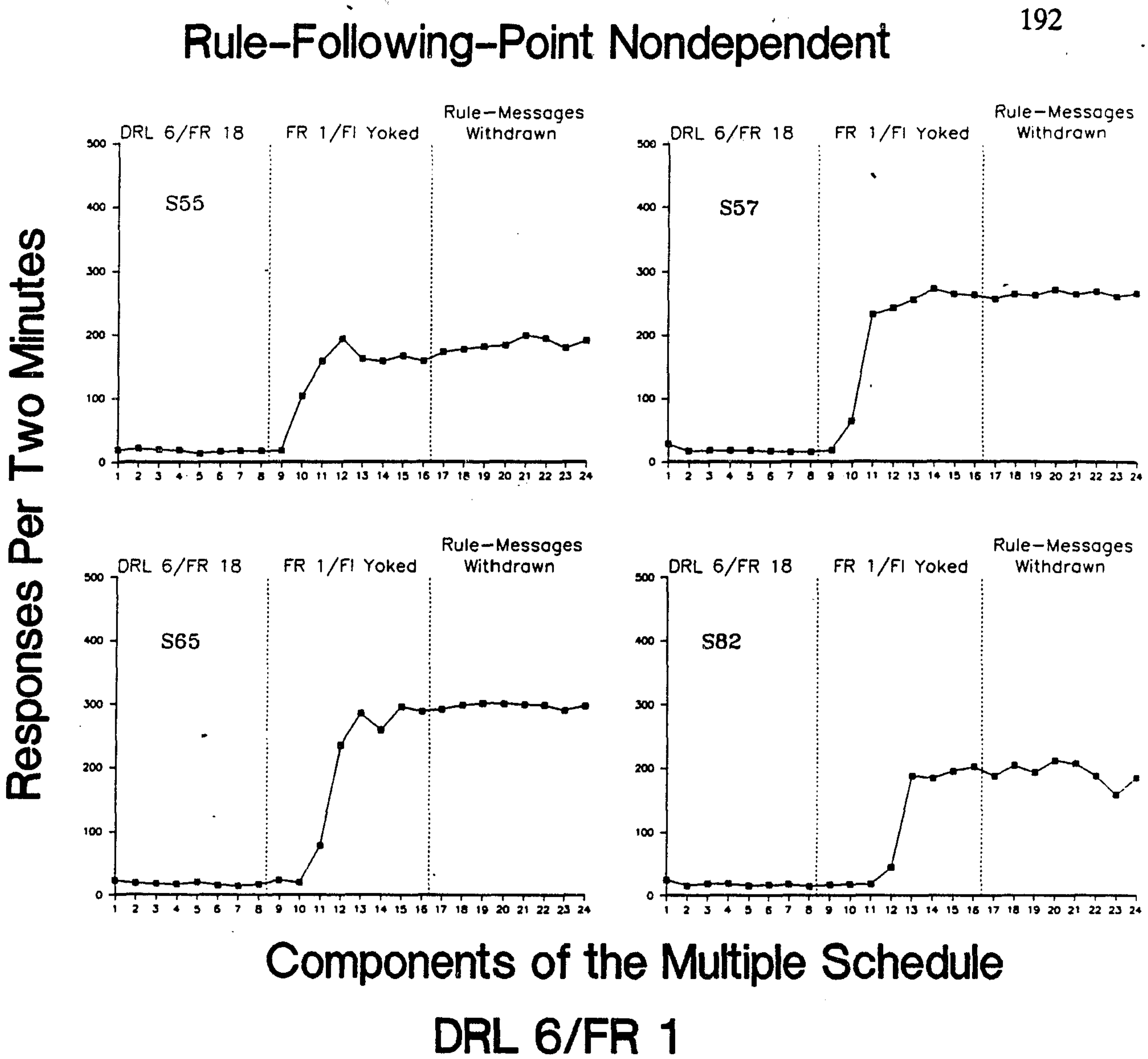
DRL 6/FR 1

# Rule-Following-Point Nondependent

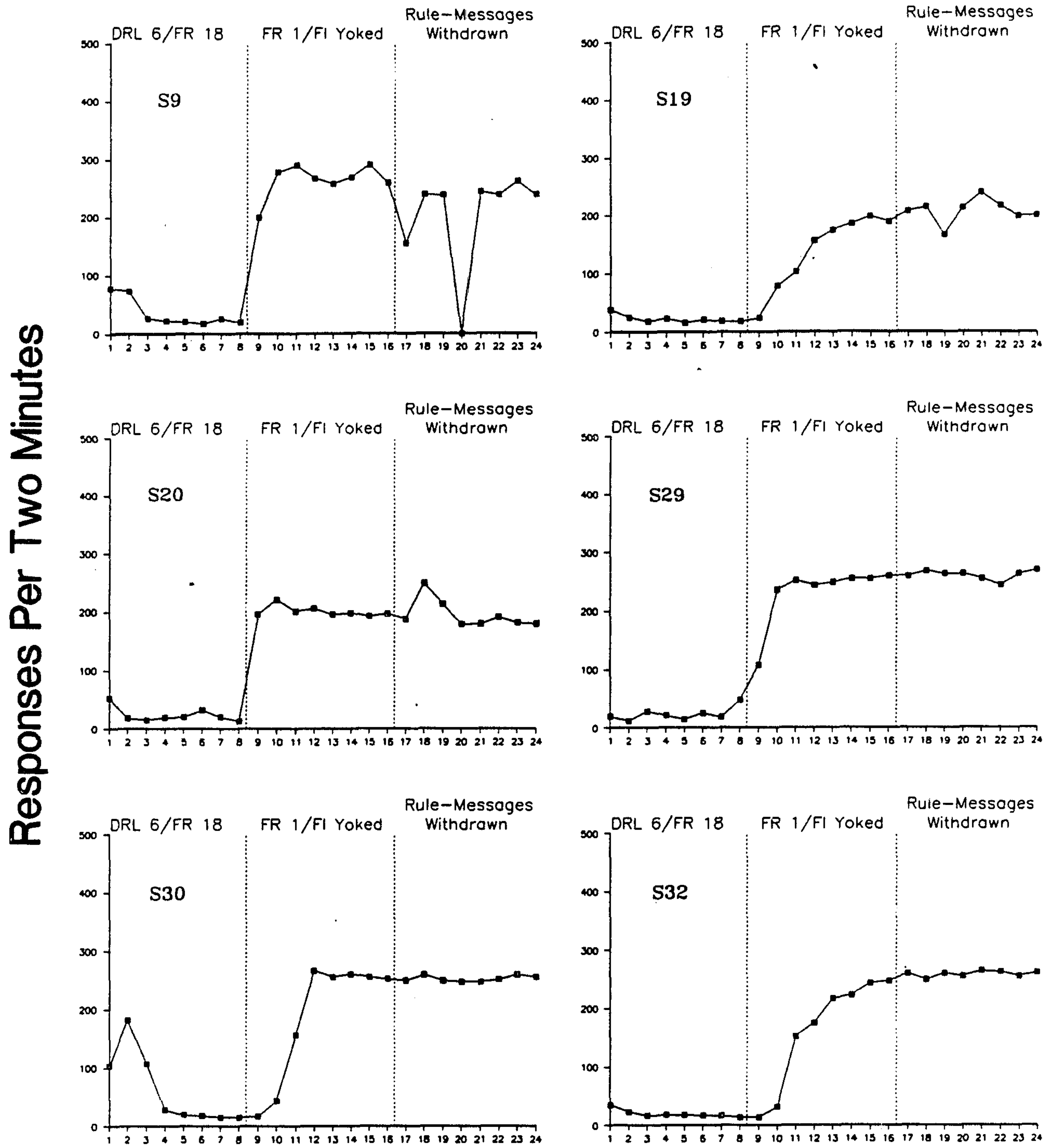



Components of the Multiple Schedule

DRL 6/FR 1


Rule-Following-Point Nondependent
Responses Per Two Minutes
DRL 6/FR 18
FR 1/FI Yoked
Rule-Messages Withdrawn
S55
S57
S65
S82
0
100
200
300
400
500
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Components of the Multiple Schedule
DRL 6/FR 1

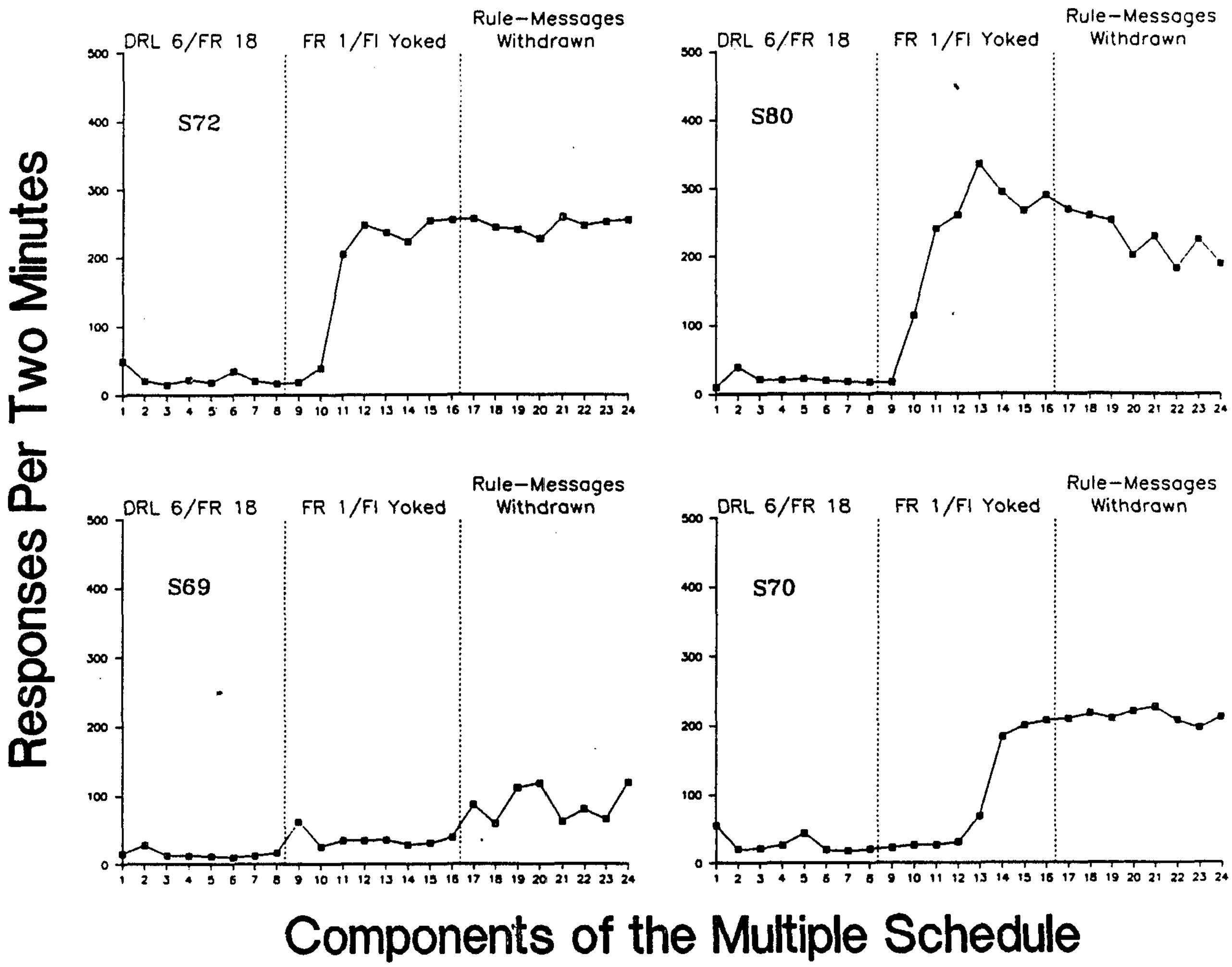
## Rule Alone




Components of the Multiple Schedule

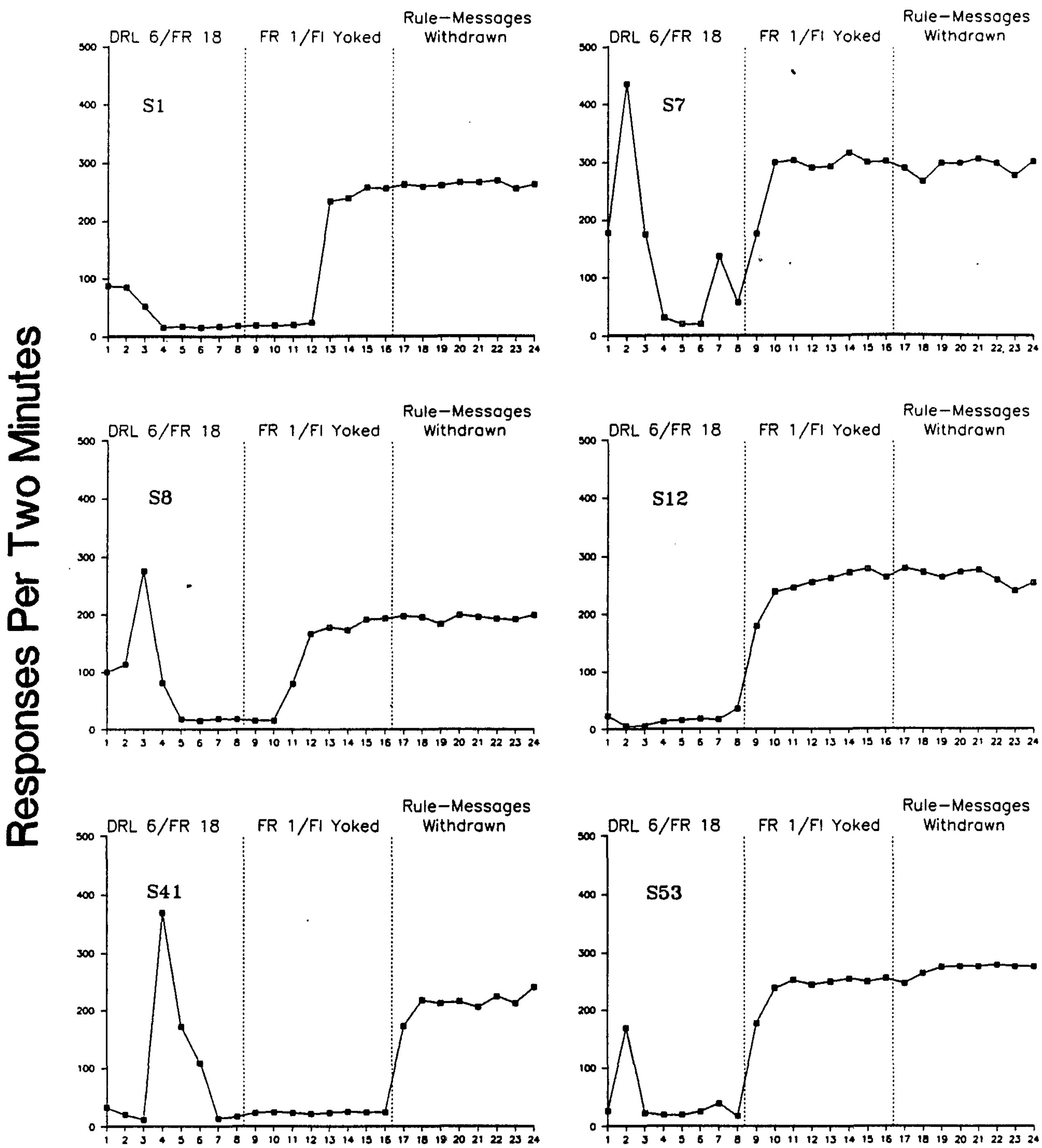
DRL 6/FR 1

# Rule Alone




DRL 6/FR 1

# Minimal Rule




Components of the Multiple Schedule

DRL 6/FR 1

# Minimal Rule