ZUKERMAN, Alan Girard, 1947-
EFFECTS OF A MULTIPLE SCHEDULE ON INTERACTIONS OF MULTIPLE RESPONSES WITH CHILDREN.

The University of North Carolina at Greensboro, Ph.D., 1974
Psychology, experimental

EFFECTS OF A MULTIPLE SCHEDULE ON INTERACTIONS OF MULTIPLE RESPONSES WITH CHILDREN

by

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A Dissertation Submitted to
the Faculty of the Graduate School at
The University of North Carolina at Greensboro
in Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy

Greensboro
1974

Approved by

Dissertation Adviser

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ZUKERMAN, ALAN G. Effects of a Multiple Schedule on Interactions of Multiple Responses with Children. (1974) Directed by: Dr. P. Scott Lawrence. Pp. 149.

Although most past work on the understanding and control of behavior has concentrated on stimuli and responses in isolation from the behavioral stream, trends in research incorporating study of multiple responses and temporally distal stimulus input are evident. Studies combining the use of humans, "natural," everyday responses, and momentary analyses of response interactions have not been conducted. This investigation sought to systematically investigate and extend the behavioral stream approach in experimental, theoretical, and applied areas. Specific areas of interest were the effects of noncontiguous stimulus input on immediate responding, interactions of multiple responses, and symptom-response substitution.

A group contingency was applied to the desirable response of conjoint in-seat and attending. The undesirable responses monitored were out-of-seat, aggressive and/or complaining behavior, and non-task related talking. Stereotyped responding was also monitored, as was the response of looking at cue lights accompanying a multiple schedule. The multiple schedule was used to assess effects of immediate and distal stimulus input on responding and response interactions. The first experimental phase consisted of a baseline of an equal MULT VI VI. The second

phase was a shift to MULT VI EXT. A recovery of baseline, with an equal MULT VI VI, was attempted in the third phase.

A correlational analysis between response density and level of interobserver agreement yielded a linear relationship with a high correlation. Evaluation of data from contingent responding revealed definite discriminative control of the schedule over responding in latter sessions of the second phase, and possible discriminative control earlier. In the second phase, undesirable responses increased in density in not only the extinction components of the schedule, but also the reward components. Inverse relationships within sessions and subjects were found between the contingent desirable response and the undesirable responses. The conditional probability-momentary analyses yielded several types of interactions between responses. In general, undesirable responses were bi-directionally compatible and facilitatory. Undesirable responses were generally either strongly inversely related to the contingent response of attending and in-seat, or were incompatible with its occurrence. Stereotyped responding tended to be compatible with other responding, and independent of other ongoing responding and stimulus events. Behavioral contrast was not obtained, nor was symptom-response substitution. Highly compartmentalized responding was found, possibly controlled by noncontiguous inputs.

The results were discussed in regard to implications for experimental research on and the understanding of the behavior stream. It was suggested that further consideration be given to the factors of ongoing, interacting multiple responding and noncontiguous stimulus input in future research and analysis. Similar suggestions were made to practitioners and researchers in behavior therapy, in order to improve assessment, and maximize generalization and maintenance of behavior change. Advantages to compiling tables of response interactions, and conducting studies on the effects of changing a response on selected other responses, were noted.

ACKNOWLEDGMENTS

I wish to express my gratitude to Dr. P. Scott Lawrence, who, by serving as my dissertation chairman and doctoral program adviser, made my graduate program both challenging and rewarding. To Drs. Marilyn Erickson, Robert Jones, Walter Salinger, and Michael Weiner, I express thanks for their encouragement, support and patience as members of my doctoral committee. To Dr. Richard Shull, also a committee member, I convey special thanks for his support, time, and direction in every phase of this project. To Thomas Rowan, M.A., and Jeff Kapust, B.A., I wish to express gratitude for technical assistance, without which this project could not have been completed. I thank Elaine Talbert, M.A., Deborah Alexander, and Jackie Anglin for serving as observers. The Staff at St. Pius X School and Convent deserves commendation for cooperation and endurance that were well beyond what would ordinarily be expected. Special gratitude is expressed to Drs. Martin Covington, Berkeley; W. C. Sheppard, Oregon; Jack Michael, Western Michigan University; and E. W. Hitzing, Western Michigan University, whose varied influences were invaluable in bringing me to this goal. Finally, to my parents, I say thanks for your unceasing support and faith.

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CHAPTER I

INTRODUCTION

The works of pioneering conditioning theorists such as Skinner (1938) and Pavlov (1927) are concerned primarily with investigations of the single response in relation to experimenter-programmed stimuli. The salivary response of the dog (Pavlov, 1927), the key peck of the pigeon, and the bar press of the rat (Skinner, 1938) were the major dependent variables investigated in relation to manipulated stimulus parameters.

A trend towards investigations of multiple responses, including those not previously seen as under the control of experimentally programmed stimuli, can be documented. Psychology in its early stages of development tended to study phenomena in isolation under carefully controlled conditions. Early attempts at studying the behavior stream of continuous stimulus input and response output (Schoenfeld and Farmer, 1970) were generally molar and observational, without rigorous experimental methodology (Barker and Wright, 1951; Barker, Wright, Barker, and Schoggen, 1961; Brunswik, 1956). More recent work has involved the study of dual concurrent responses under rigorous experimental control (Catania, 1966). Finally, multiple responses have recently been studied employing some of the observational and classification techniques currently available (e.g., Ferritor, Buckholdt, Hamlin, and Smith, 1972; Sajwaj, Twardosz, and Burke, 1972; Schoenfeld and Farmer, 1970; Staddon and Simmelhag, 1971; Rand, 1974; Terrace, 1974). It should be possible at the current stage of knowledge and technology to extend the study of multiple responses in interaction to humans, using "natural" responses and looking at momentary response interactions and relations between responding and stimulus events.

Relationships between responding and stimulus events have tended to emphasize single or dual manipulanda-defined responses in relation to immediately prevailing stimulus events (e.g., Catania, 1966; Skinner, 1938). Studies using humans as subjects and "natural" responses have concentrated on temporally proximal stimulus events and situations to reach the conclusion that "behavior is controlled by antecedents and consequences" (Mischel, 1969; Bandura and Walters, 1963). Distal, or non-temporally proximal stimulus input has been studied by using multiple schedules (Terrace, 1966; Terrace, 1974; Waite and Osborne, 1972). The multiple schedule is an experimentally controlled procedure, consisting of two or more schedules, each with a different associated stimulus (Morse, 1966). A component in a multiple schedule consists of a period in which one schedule and its associated stimulus are prevailing. The effects of the temporally removed components of a multiple schedule can be monitored in the other components of the multiple schedule. The multiple schedule will be used in this study to investigate the influence of distal stimulus input upon the interactions of multiple "natural" responses of humans. The purpose is to show that antecedent and consequent conditions that control complex behavior are often temporally located prior to and following the onset of an immediate situation.

A specific area in which both multiple responses and distal stimulus input are involved is that of symptom substitution. Practitioners of and investigators in behavior therapy have historically rejected the existence of phenomena that have been labelled symptom substitution (Bandura and Walters, 1963; Mischel, 1969). When viewed operationally as an inverse covariance between two or more responses, the phenomenon clearly becomes one of interaction between responses. If symptom substitution is so viewed, then recent investigations in the area of interactions of responses where inverse covariance was obtained (Ferritor et al., 1972; Sajwaj et al., 1972) become relevant. Additionally, an argument will be developed and supported that studies of changed responding in constant and changed components of multiple schedules (i.e., behavioral contrast and interacting responses in EXT components) might be relevant to the area of response substitution when defined as inverse covariance. The contention is that symptom-response substitution is related definitionally to interaction of responses and procedurally to multiple schedules.

Yates (1970), Bandura and Walters (1963), and Mischel (1969) all recognized in reviews on the subject that elimination of one response or response pattern would theoretically result in the next most dominant set of responses tending to occur. When the newly occurring responses are considered maladjustive, symptom substitution might be said to have occurred (Caheen, 1969). It might be added, parenthetically, that when the response substitution is considered adaptive, intervention would probably be labeled successful. Notwithstanding the theoretical rationale for the occurrence of response substitution, reviewers including Yates (1959), Bandura and Walters (1963), and Mischel (1968) have concluded that response substitution rarely, if ever, occurs with behavior therapy. The conclusion may well be warranted based on thorough reviews of the literature. However, factors such as journals demanding successful outcomes and investigators tending not to look for interacting responses could well explain the lack of reports of undesired response substitution. The current investigation will explicitly explore various response interactions that could be labelled undesired response substitution.

To summarize, recent work indicates increased interest in the study of responses in interaction and of relatively distal stimulus conditions as controlling immediate responding. Symptom substitution is a kind of response interaction. The multiple schedule is a procedure approximating the complexity of ongoing behavior and the controlling variables. Its appropriateness as the procedure of choice in investigating general response interactions, distal stimulus input, and symptom-response substitution will become clear in the subsequent reviews of the three areas.

General Modes of Response Interactions

William James (1890) stated that "thought is always changing" and that within each individual "thought is sensibly continuous." If "behavior" is substituted for "thought," the forerunner of Schoenfeld's "behavior stream" (Schoenfeld and Farmer, 1970) is seen. The basic perspective is one of ongoing behavior in time, controlled by previous responding and by environmental stimulus control. In an experiment, when an organism is not performing the experimenter-defined response (R), it must be doing something else (not R, or $\not R$). Schoenfeld and Farmer (1970) present data to show that $\not R$ comes under schedule control as does R. Several points are germane to the analysis of response interactions. First, in a basic, if not trivial sense, there is always inverse covariance between some responses. If an organism is not engaged in R, it must be doing $\not{R}$, and vice versa. Second, the range of an experimenter-defined R-class is selected and thus arbitrary, with wider ranges in fact being performed by the organism. Third, Schoenfeld and Farmer (1970) state that extinction increases response variability, a conclusion that will be subsequently documented, employed theoretically, and extended experimentally in this investigation.

In a stream analysis, the role of reinforcement is to change relative response densities (Schoenfeld and Farmer, 1970). The term density replaces frequency to emphasize that responding occurs in time and is relative to time and other ongoing responding. Since a continuous stream in time analysis leads to the conclusion that reinforcement operations vary only the relative density in time of one response relative to the occurrence of all others (Schoenfeld and Farmer, 1970), covariance relations are logical necessities.

The thrust of the present analysis of response interactions is to deal with covariances that are both reliable and of intrinsic interest in themselves. In other words, the primary interest is in interactions of responses that have potential theoretical import, such as response substitution, and/or applied relevance. The experiments reported by Schoenfeld and Farmer (1970) demonstrating control of $\not{R}$ and interactions of R and $\not{R}$

used a duration-defined $\not{R}$ that combined any responding other than R into one category. The present interest is to deal with specific, topographically definable (other than by reference to duration alone) $\not{R}$'s. It is admitted that this approach represents a return to a fractionization of the behavior stream. However, it is a compromise between isolation of the single response from all others versus considering the whole stream as two dichotomized parts, with one, $\not{R}$, totally unfractionalized. The compromise approach is designed to investigate the occurrence and controlling factors of "naturally occurring" multiple responses in interaction.

When responding is measured by frequency, one response can affect another or others in only three ways. A response can increase, decrease, or leave unchanged the occurrence of other responses in time, given its occurrence. However, the mechanisms underlying these three relative frequency changes are often unclear. Response-produced proprioceptive feedback is possible (Schoenfeld and Farmer, 1970). Yelton (1974) points out that in the area of social responses the occurrence of one response could result in a shift in attention, thereby changing stimulus control and altering response-reinforcer relations for other R's. While undoubtedly true, and sometimes empirically validated, the attentional hypothesis for interacting response relations is often general, circular, and untestable, and thus is often of little value (Hinde, 1970).

An obvious way for the occurrence of one response to result in a decrease in the relative density in time of another is for the responses to be incompatible, i.e., not capable of being performed at the same time. To take a trivial example, an organism cannot locomote and remain stationary at the same time. Other examples of incompatible, or mutually exclusive, R's may not always be as obviously definitionally determined, and therefore must be demonstrated to be incompatible empirically. The continuum ranges from mutually exclusive, or incompatible responses, to inextricably linked responses that occur or nearly always occur in temporal proximity. A major interest of the current investigation will be to ascertain empirically where several responses of interest should be placed on the continuum.

One possible form of response interaction is for one response to be precurrent to another and/or greatly increase the probability that the second response will follow (Stadden and Simmelhag, 1971). The mechanisms underlying tight, direct linkages seem to be poorly understood at present. Fixed action patterns are examples of extremely tight linkage, since they consist of series of movements that are invariant in form and independent of environmental stimuli once elicited (Hinde, 1970). Parenthetically, it should be noted that distinct responses are susceptible to functional control, by definition, and would thus not be inextricably linked, i.e., could be separately manipulable. Therefore, using the functional criterion for defining responses, there might be some problems in referring to FAP's as patterns of inextricably linked responses. However, FAP's are series of movements reliably occurring as patterns, invariant within a genus, species, or merely one individual. Hinde (1970) mentions motivational systems, effectors, and the nature of the nervous system as delimiting and constraining factors.

Examples of tightly linked, direct relations of "true" responses into what could be labelled as patterns have been noted by Stadden and Simmelhag (1971) and Rand (1974). While replicating Skinner's (1948) superstition experiment, it was found that birds within certain early parts of FI's developed characteristic sequences of behavior. The sequencing was "very rigid, so that although a given behavior might fail to occur during a particular interval, it never occurred out of sequence" (Stadden and Simmelhag, 1971). In other words, once a particular response occurred early, certain subsequent responses were likely, although not certain, to occur. The controlling factor in the onset and offset of these sequential activities, known as interim behaviors, was seen to be postfood time. Interim behaviors, consisting of tightly linked sequences of responses, tended to occur shortly after the delivery of food, which could be viewed as initiating a period of extinction. Terminal responding tended to occur in a temporally proximal position to the ends of intervals (Staddon and Simmelhag, 1971).

Rand (1974), using a successive discrimination task, also looked at patterns of responding other than the instrumental response (R). It was found that in S- (extinction) periods birds developed individual patterns of responding that served to remove the visual stimulus from view. It was concluded that the individual response patterns functioned as escape from an aversive stimulus (Rand, 1974). The foregoing study is an instance of studying behaviors in the stream other than R in a multiple scheduling paradigm. The present study will also employ a multiple schedule to investigate interacting responses other than the experimenter-defined and manipulated R.

Both Rand (1974) and Staddon and Simmelhag (1971) found what will be herein defined as inverse covariance. In periods correlated with extinction, birds decreased time spent performing instrumental responses to experimenter-defined reinforcement and increased various interim responses ($\not{R}$'s). The interim responses tended to be highly specific within individual organisms. An abundance of animal and human literature exists to suggest that inverse covariance in extinction periods is no anomaly (Terrace, 1972). Azrin and Lindsley (1956) found that children who were previously reinforced for cooperative social responses, when extinguished, decreased cooperative social responses while verbalizing and response variability increased. Azrin, Hutchinson, and Hake (1966) found extinction-induced aggressive behaviors. Azrin and Hutchinson (1967) found that in periods correlated with extinction in fixed interval schedules, pigeons spent increased periods of time performing aggressive responses. Terrace (1966) noted that in periods of S- following successive discrimination training, responses including wing flapping and turning away from the key occurred. Terrace (1966) labelled these behaviors emotional responses, and viewed them as byproducts of discrimination learning (Terrace, 1972).

Several interpretations have been offered to explain inverse covariance in extinction, and deciding among the validity of some of them may largely involve choices of at what levels one prefers to operate. As mentioned, Staddon and Simmelhag (1971) found postfood time to be the controlling factor in onset and offset of interim behaviors. Periods following food delivery have the highest density of interim behaviors, and are essentially periods of extinction. Two predictions might follow. In a multiple schedule where one component is extinction, the highest density of interim behaviors should occur in early intervals of the extinction component. Also, where food delivery does not predict a period of relatively low density, such as in a random VI schedule, interim behaviors, if any, should occur only briefly following reinforcement delivery. Both of these predictions will be empirically tested.

Inverse covariance in extinction has also been explicated by the possibility that extinction is "painful" in and of itself, and the pain "induces" emotional responses. Ulrich, Wolff, and Azrin (1964) found that shock administered to pairs of rats reliably produced fighting behavior. However, Miller (1948) found that fighting in rats could function as an instrumental escape response to shock. Induction of responses through aversive characteristics of extinction thus may not provide a complete picture; i.e., both "elicited" and instrumental components may be involved. The present study will not directly investigate induction mechanisms in extinction, but will monitor possible occurrences of inductive phenomena following the introduction of an extinction component in a multiple schedule. Careful attention will be paid to possible occurrences of responses "induced" in the constant reward component after introduction of an extinction component into the situation. "Induced," when used in this context, is a descriptive term. Variables controlling the phenomena may or may not include the aversive characteristics of extinction.

Terrace's interpretation that the signal of extinction, the S- itself, is aversive was supported by a study in which it was found that pigeons would peck a key whose only consequence was to turn off the S- for brief time periods (Terrace, 1971). Birds in an errorless learning paradigm did not when placed in the procedure learn the escape response; thus it was concluded that the S- was an aversive stimulus that could maintain escape responding and induce "emotional" behaviors. Rand (1974), as previously cited, found that sequences of responses that functioned to remove the bird from the view of the S- regularly occurred during periods of extinction. Extension of these results to organisms other than birds has not been made; this investigation will look for differential viewing of signals accompanying different components of a multiple schedule. Aggressive and/or complaining behavior might also indicate "aversiveness" of S- or extinction.

Schoenfeld and Farmer (1970) and Staddon and Simmelhag (1971) noted the frequent finding of increased response variability in extinction. Schoenfeld's perspective leads obviously to the view that responding in periods of low reinforcement density is an increase of density of $\not{R}$'s over R's. Staddon and Simmelhag's (1971) and Hinde's (1970) analyses, encompassing ethological perspectives, emphasize the evolutionary and individual adaptiveness of interim activities. Combining a stream analysis with ethology, one could deduce that the increase of $\not{R}$'s over R's in extinction is both necessary logically and eminently adaptive for an organism, since increased response --

variability in the wild (e.g., foraging, reorienting, defense reactions, etc.) in periods of low reinforcement density would increase the probability of increasing or maximizing reinforcement density. Again, as Hinde (1970) has pointed out, inferring adaptiveness from behavior is often a circular and nontestable proposition.

Control of R's by various stimulus and temporal parameters is susceptible to experimental investigation (Staddon and Simmelhag, 1971; Schoenfeld and Farmer, 1970; Rand, 1974). Whether or not S- actively inhibits responding, as Spence (1937) maintained and Skinner (1938) attempted to refute, is beyond the scope of this investigation. However, the correlation of various responses with S- periods, including those to the signal itself, will be investigated. Interim and terminal responding in reward components, or contingent and noncontingent responding, could be controlled by relative proximity to extinction components. The current investigation will explore this.

A recent study of interest showing both direct and inverse covariance of responses used an extinction paradigm, where a retarded child was ignored by his teacher when he initiated conversations (Sajwaj et al., 1972). Initiated conversation decreased, as did use of girls' toys during free play and appropriate behavior in class. Social behavior relative to the other children increased, as did disruptions. Several points are evident. First, direct and inverse covariance of responses occurred. Second, from a functional point of view, all the responses listed above are interrelated, since a single programmed contingency resulted in reliable changes among these responses when applied only to one of the responses. However, it should be emphasized that the functional relations were not identical; i.e., some were direct and some inverse. Finally, what comprises or will comprise a response class may not be intuitively obvious, *a priori*. "Common sense" probably would not have predicted initiated conversation and playing with girls' toys as covarying directly. Causal determinants of such idiosyncratic response covariations will probably continue to be puzzling until systematic attention is paid to covarying responses. Until investigation of covarying responses and their controlling relations are made, conflicting findings such as whether or not manipulating attending behavior affects arithmetic skills (Ferritor et al., 1972; Kirby and Shields, 1972) will remain puzzling.

The complexity of interacting multiple responses can exceed that of inversely covarying responses in extinction and interim periods (Staddon and Simmelhag, 1971; Sajwaj et al., 1972). A study by Gibson (1974) found that in adult retardates training verbalizations increased recreational responding but left cooperative behavior unchanged. Training recreational responding resulted in direct covariance with cooperative behavior. Training cooperative behavior resulted in increased verbal responding and no significant effects on recreational responding.

Various possibilities and instances of response interactions have been discussed. Linkage has ranged from relatively invariant (Staddon and Simmelhag, 1971) to complex and problematical (Ferritor et al., 1972; Kirby and Shields, 1972; Gibson, 1974). Periods in which interactions are particularly likely to occur are those correlated with low reinforcement density (Staddon and Simmelhag, 1971; Schoenfeld and Farmer, 1970). Delivery of reinforcement, aversiveness of cues, and control of $\not{R}$'s by the stimulus suppressing R, were among mechanisms discussed as possible controlling factors in addition to constraining motivational and morphological systems. The use of a multiple schedule to study response interactions and potential controlling mechanisms is related to past work involving extinction and periods of high and low reinforcement density. One component of a multiple schedule could be of high reinforcement density, while the other was an extinction component. The utility and relevance of the multiple schedule to the study of distal stimulus input on current responding will now be discussed.

Multiple Schedules and Behavioral Contrast

Studies of behavioral contrast by definition involve changed responding in a constant component of a multiple schedule. Positive contrast is defined by increases in response rate in the constant component; negative contrast occurs when responding decreases in the negative component. A transient contrast effect is found where rate changes are monitored within a constant component and are greatest when the component's onset occurs. A sustained contrast effect is obtained when a rate change in the constant component of a multiple schedule is in the opposite direction of the other component (Nevin and Shettleworth, 1968). Rate changes referred to in either component involve only the response under contingency. This investigation will seek to monitor the effects, if any, of the distal stimulus input of components upon multiple responding in immediate components.

Contrast is usually thought of as changes in a single operant in different components of a multiple schedule (Nevin and Shettleworth, 1968). Rachlin (1973), using an approach resembling Staddon and Simmelhag's (1971), found that the "operant" analyzed into what were actually two discrete responses. Positive contrast (increase in response rates in the constant component) was due to the summating interaction of instrumental and "elicited" responses. Negative contrast was seen as owing its effects to subtraction of inhibited responses from instrumental responses. The two types of responses referred to are keypecks of pigeons instrumental in meeting schedule requirements and those found in autoshaping studies. Transitions from low to high reinforcement periods resulted in usually brief increases in excited responses; conversely, transitions from high to low values of reinforcement "inhibit" (quotes mine) these same responses (Rachlin, 1973). The findings suggest that contrast is often a combination of the results produced by a stimulus-reinforcer relationship (e.g., the signal followed by the keypeck of the pigeon, and food), rather than by changes in the strength of the operant alone. The current investigation will attempt to produce contrast using a response and a reinforcer which would not be expected to result in "elicited" responses, analogous to elicited keypecks, producing a contrast effect. An additional focus, using Rachlin's (1973) and Staddon and Simmelhag's type of analysis, which is moment-to-moment, as well as between components, will be to monitor the occurrence of the antagonistic $\not{R}$'s found in extinction in a constant reinforcement component as well. The aim is to pinpoint various functional relationships between different $\not{R}$'s in different temporal compartments of components and stimulus events.

To date, only three published studies showing contrast effects with humans exist in the literature (O'Brien, 1968; Waite and Osborne, 1972; Terrace, 1974). The paucity of positive findings for human contrast may result from an extrapolation of Rachlin's thesis, i.e., that contrast is due to increases and decreases of "elicited" responses in relation to reinforcer presentation and absence. Lever-pressing or button-pressing by humans would not be expected to yield elicited responses analogous to keypecks of birds when in the food situation. Another possible reason for the lack of positive studies showing changed responding in a constant component as a function of changes in another component could be the difficulty in obtaining schedule control with humans. In turn, this difficulty could be due to failure to employ "natural" responses, to provide tasks that were not boring, to validate the reinforcing power of nominal "reinforcers," etc. The current investigation will attempt to produce contrast using "natural" responses with no obvious response-reinforcer relations of the type discussed by Rachlin (1973). An additional primary thrust will be to monitor R's in both components and in phases after shifts to evaluate both short- and long-term effects of distal stimulus changes on collateral responses.

O'Brien's (1968) study purporting to show contrast effects with humans contains a procedural weakness, and therefore does not conclusively demonstrate contrast in humans. This study showed transient contrast effects, where rate changes are monitored within the constant component of a multiple schedule and are greatest when the component's onset occurs. O'Brien's (1968) study did not establish responding on a baseline and then impose a shift in one component, and therefore labelling increased responding in VI components is problematical. Nevertheless, it was found that increased responding was most pronounced in VI components preceded by several extinction components.

Waite and Osborne's (1972) study with children was the first study with humans to find a sustained contrast effect, which refers to a rate change in the constant component in the opposite direction of the other component (Nevin and Shettleworth, 1968). Stability was obtained on an equal MULT VI VI and then switched to MULT EXT VI. A recovery of baseline was made. It was found that responding increased over sessions in the VI component while decreasing in the EXT component, thus demonstrating sustained behavioral contrast in children. Since the response used, pressing, and the reinforcer, centavo pieces, had no obvious "natural" relation with "elicited" elements within the response, Rachlin's (1973) analysis of contrast effects would not seem to apply to the findings (Waite and Osborne, 1972).

Both studies (O'Brien, 1968; Waite and Osborne, 1972) used schedules that made contact with children using individual, as opposed to group, contingencies. This investigation will employ a group contingency in order to study the interactions of potentially interesting social R's with each other and the response under direct contingency. Numerous applied investigations have used group classroom contingencies to control responding (O'Leary and O'Leary, 1972).

Symptom-Response Substitution: A Response Interaction in a Multiple Schedule

Suppose that both the natural environment and a therapist's office are viewed as presenting different schedules of reinforcement. Further, suppose that extinguishing a response in the therapist's office results in a rise in that response and/or appearance of new undesirable responses in the natural environment. In the first instance, that of a rise in the rate of an undesirable response following extinction in therapy, it could be said that a contrast effect was obtained in an analogue of a multiple schedule. In the second example, where reduction of a response in the office results in the appearance of new, undesirable responses in the natural environment, response substitution would have occurred. In either hypothetical instance, the influence of an antecedent situation results in interactions of rates of the same and/or different responses.

Perhaps the most controversial area of response interactions, and one often dismissed (Bandura and Walters, 1963; Mischel, 1968), involves this type of symptom or response substitution in applied behavioral analysis. The medical definition of symptom substitution is roughly that of a new symptom replacing an eliminated symptom when the cause of the eliminated symptom is not removed (Yates, 1958; Cahoon, 1969). Theoreticians of divergent biases differ as to what constitutes a cause. However, if response substitution is defined as inverse covariance that is undesired or maladaptive, then there are instances in which it may be expected to occur using contemporary therapeutic procedures (Cahoon, 1969). Procedures utilizing extinction and/or punishment are explicitly mentioned as likely candidates, particularly if alternative responses that are desired are not programmed (Cahoon, 1969). If an S- can indeed control the onset and subsequent occurrence of certain kinds of behavior, it would not be surprising to find that its application on an R would at times result in undesired R's increasing in density. Additionally, removing the most probable member of a response class would often result in the next most probable member supplanting it in a given stimulus situation (Bandura and Walters, 1963). In some instances an analysis of S-, inhibition, and excitation might be most profitable. In others, there might be reason to organize the data around tightly linked motivational systems with hierarchies of stereotypic responses in certain situations. As previously cited, the literature on symptom substitution that is labelled as such cites its incidence as very low or nonextant with behavior therapy (Bandura and Walters, 1963; Mischel, 1968; Yates, 1970). However, if inverse covariance of an undesirable nature is the definition, then the studies by Ferritor et al. (1972) and

Sajwaj et al. (1972) are instances and may be the proverbial "tips of the iceberg."

To reiterate, lack of generalization from the office to the natural environment, when accompanied by a rise in the undesirable R's in relative density and/or new undesirable R's, becomes redefined as analogous to a multiple scheduling contrast effect or undesirable response substitution. On the other hand, generalization wherein covariance is labelled desirable may be seen as response substitution, if inverse, and direct covariance if positively correlated. (Further discussion of possible mechanisms, including those already referred to, as well as the possible relevance of displacement phenomena, are found in Miller, 1948, and Hinde, 1970).

Scope and Overview of the Investigation

The thrust of the foregoing review and discussion is fourfold:

(1) Antecedent and consequent situations can have effects on responding in immediate, constant situations. The multiple schedule has been used to produce and investigate certain noncontiguous effects (e.g., Terrace, 1966; Waite and Osborne, 1972). Little attention has been paid in this connection to interacting multiple responses.

(2) Behavior is essentially continuous, and responses interact inversely and directly in terms of relative density

in time. Scheduling parameters and dimensions underlying compatibility-incompatibility are implicated in control. The study of multiple responses in interaction in a moment-by-moment analysis has been illuminating with infrahuman organisms (Rachlin, 1973; Staddon and Simmelhag, 1971) and should be of interest with humans.

(3) Many of the effects discussed, found in extinction, multiple scheduling, and natural situations are due to the onset and offset of various stimulus events and can include proprioceptive feedback as well. Decreases in certain responses are often accompanied by increased variability in responding, especially in low density periods.

(4) The three points above need to be considered logically and empirically in the understanding and control of behavior. The task of further research is to identify response interactions of potential import, to monitor distal situations of influence in stable situations, and to attempt to specify controlling relations when possible.

In order to investigate the influence of temporally removed situations on responding in a constant component, and at the same time study interactions of multiple responses and possible response substitution, a multiple scheduling paradigm and a moment-by-moment analysis will be used. Using human subjects, a baseline of an equal MULT VI VI will be established, with a number of responses in addition to the response under direct contingency monitored. A second phase of MULT VI EXT will then be instituted. Interactions in EXT will be observed, as will any influence of the shift on responding in the constant component and overall levels of responding. A recovery of baseline phase will terminate the study.

Specific Areas of Investigation

(1) Does change in one condition of a multiple schedule result in changed responding in another constant condition, other than the R's in the experimenter-programmed contingency? In other words, does the relative density of $\not{R}$'s change between components? Terrace (1971) and Rand (1974) demonstrated in pigeons that various $\not{R}$'s occurred in EXT. This investigation will attempt to replicate the effects using humans. Another question is whether $\not{R}$'s will increase or decrease in relative density in the constant reinforcement component. As a possibility, suppose that R is being in seat and attending in the classroom. Various $\not{R}$'s could increase, decrease, or remain stable in density in the constant and shifted components; directional changes could be different as a function of the component. As an example, the shift to VI EXT could increase aggressive responding in the shifted component (EXT), and conversely decrease or perhaps "induce" concommitant increases of aggressive behavior in the constant VI.

(2) Are the changes direct or inverse? For instance, one would surely expect that decrease in standing would

result in an increase in being in seat, by virtue of the incompatibility of the responses and the fact that together they comprise a universe. In other instances, it might be that some responses would be independent or inconsistent in their dependence-independence relations. For example, there might not be a systematic relation between verbalizing and aggressing across children, or any consistency might be limited to particular children. There may or may not be a relation between stereotyped activity and verbalizing, or stereotyped activity and aggressive responding, etc.

(3) Are there lawful temporal relations, consistent with orderly relations found between the timing of the density of various responses and scheduling parameters with animals? For example, Rachlin (1973) found that contrast effects tended to occur soon after transitions. Azrin et al. (1966) found that aggressive responding in extinction tended to decrease over time. Staddon and Simmelhag (1971) found that interim periods, correlated with low reinforcement density, had highest density of interim behaviors. An EXT component therefore should have high density of R̸'s, whereas a random VI in which an organism cannot predict low density periods from reinforcement delivery or response-produced cues should have a stable pattern of interim behaviors, unless proximal to a controlling extinction component. These effects have yet to be demonstrated in humans using the multiple schedule,

moment-by-moment procedure and analysis.

(4) Can any response interactions be conceptualized as analogous to response substitution or displacement? Conceptually, inverse response covariance, if obtained, would constitute response substitution. Inverse response covariance of an undesirable nature would constitute the response substitution commonly referred to as "symptom" substitution (Cahoon, 1969). As an example, suppose that inverse covariance of in-seat and locomoting were found in the constant VI component following a shift to MULT VI EXT. Further, the decrease in locomoting resulted in increased stereotyped behavior while in-seat, an instance of undesirable response substitution. Displacement might be occurring if the onset of EXT coincided with increased incidence of aggression.

(5) Many potentially important interactions are predicated upon the availability of social responses. For this and practical considerations a group of subjects will be employed in the study. A central question will involve investigating the feasibility of producing good schedule control in humans using a group contingency on the experimenter-defined response. Given that schedule control can be demonstrated using a group contingency, can contrast be produced with this procedure? To date, all contrast studies using infra-human organisms (Dunham, 1968; Rachlin,

1973) and the studies employing humans as subjects (O'Brien, 1968; Waite and Osborne, 1972; Terrace, 1974) have used individual contingencies to produce contrast effects. This investigation will utilize a method in which subjects will meet the requirement for VI reinforcement by fulfilling a group contingency, but in which data are taken on each subject. The primary rationale for this procedure is to increase the probability that interesting R's and interactions might occur; i.e., many responses that are "natural" to the human organism are social in context.

(6) Terrace (1971) and Rand (1974) found that the S- signal was aversive, since it controlled escape responding. This investigation will attempt to find any evidence for the S- signal or the extinction period being aversive for humans in a MULT VI EXT phase. Such evidence could include looking away from the signal (Rand, 1974), emotional behaviors (Terrace, 1966) or aggression (Azrin et al., 1966) in extinction.

CHAPTER II

METHOD

Subjects

A total of ten children currently enrolled in the third and fourth grades of the St. Pius Church Diocese's Day School served as subjects in the pilot and experimental phases of the study. Five subjects selected from a morning language studies class served in the pilot phases; these subjects were not used again in the study. Five other subjects, described by the teacher as "the most active and troublesome" boys in her class, served as subjects throughout the experimental phases of investigation. Two experimental subjects were at one reading level while the other three experimental subjects were at a lower level.

Apparatus and Scheduling of the VI

The general characteristics of the experimental setting are described below (see description under Setting). A console flashed and blipped simultaneously every 20" with input from a 20" recycling timer. These signalled an observer to switch from observing one child to another. In the middle of the console were two buttons: one controlled the onset and offset of a VI 2' tape and two sets of cue lights that operated simultaneously. Each set of cue lights were household 100 watt light bulbs with painted glass. The other button in the middle vertical plane of the console was pressed by the O concurrently with the 20" spaced light flashes and blips and fed to one pen of an Esterline-Angus 20 channel multiple event recorder. Six buttons placed horizontally in the lower region of the console were connected to separate pens of the event recorder, and were used for monitoring the dependent response measures in the study. Each of these buttons had a label affixed proximally identifying a particular response. The console body was wood, measured approximately 2' by 2', and rested on a card table. The VI 2' tape also fed to one pen of the event recorder, such that onset and offset of intervals was recorded. A buttonpress device was carried by the experimenter, who functioned as the teacher. He will be referred to as the E-teacher. It fed into the event recorder and a 20" timer. The 20" timer, activated when E-teacher pressed the device he carried for 20" consecutively, was conjoined to the VI 2' tape so that conjoint occurrence of the stopping of the tape when availability of reinforcement occurred and timing-out of the 20" timer hooked to the E-teacher's buttonpress apparatus operated a sound-alert device. Operation of this device automatically restarted the VI 2' tape and also was recorded as a single event on the event recorder. Its operation also functioned to signal the E-teacher that the children had satisfied a group response criterion during a period of reinforcement availability, and therefore reinforcement should occur. Standard relay circuitry was employed to regulate timed events. The console is depicted in Figure 1.

The intervals within the VI were thus controlled by a combination of a punched tape, a buttonpress held by the E-teacher, and relay equipment. The response criterion for the E-teacher to press the portable button is described under the heading Response Definitions and Functions of the Observer. When the button had been pressed for 20" consecutively *after* the tape had stopped (i.e., a period of reinforcement availability had started), a sound-alert device operated, thereby signalling the E-teacher to reinforce the subjects and automatically starting the VI tape again.

Non-social reinforcers consisted of M and M's. A backup system involved the dispensing of store-bought toys, such as model airplane kits, balls, games, etc. on a weekly basis. X number of reinforcements that varied from week to week allowed each child to select a toy of his choice from a menu.

Specific Characteristics of the Experimental Setting

Figure 2 illustrates the setting in which the pilot and experimental phases of the study were conducted. An

FIGURE 1

Drawing of Observer's Recording and Control Console

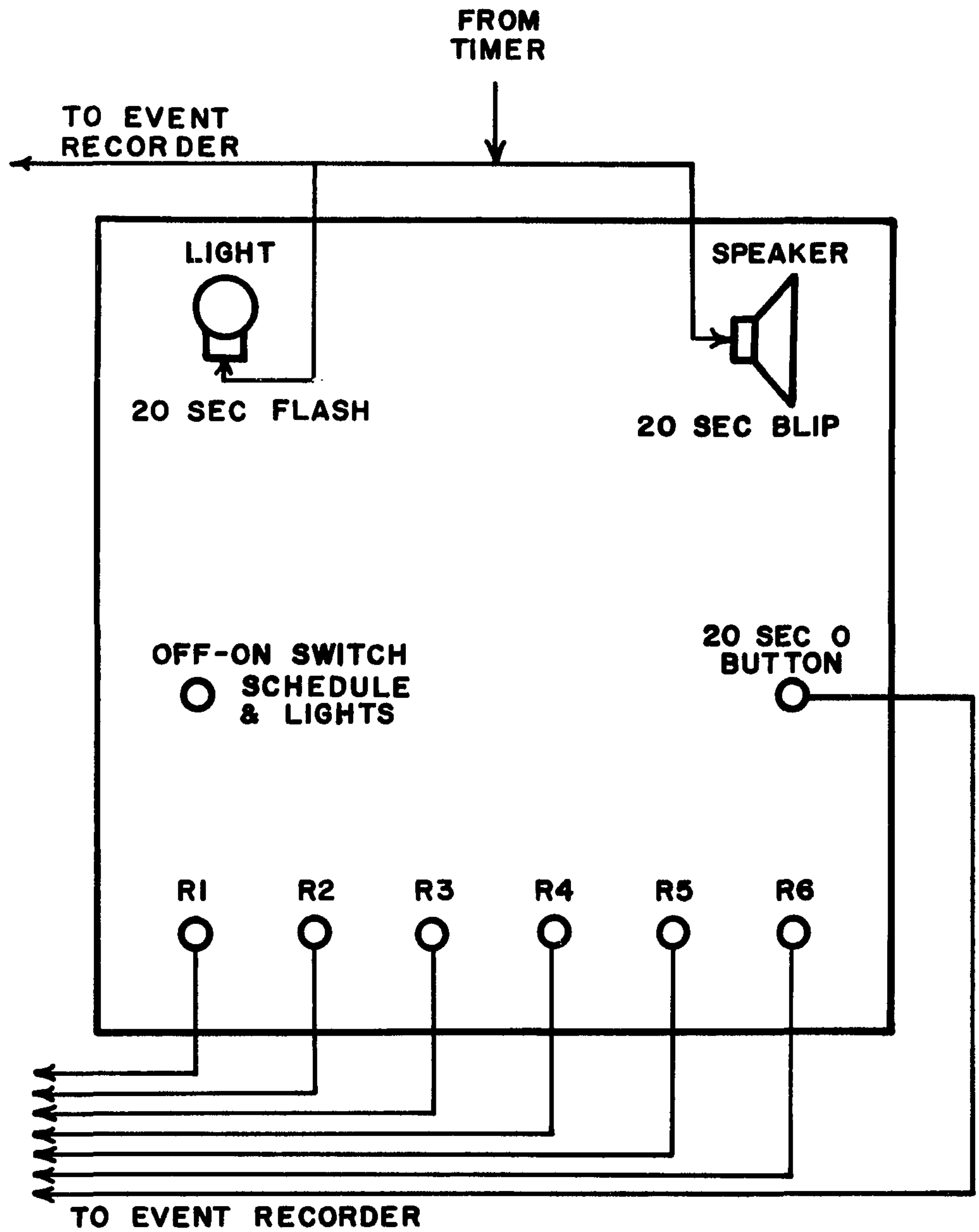
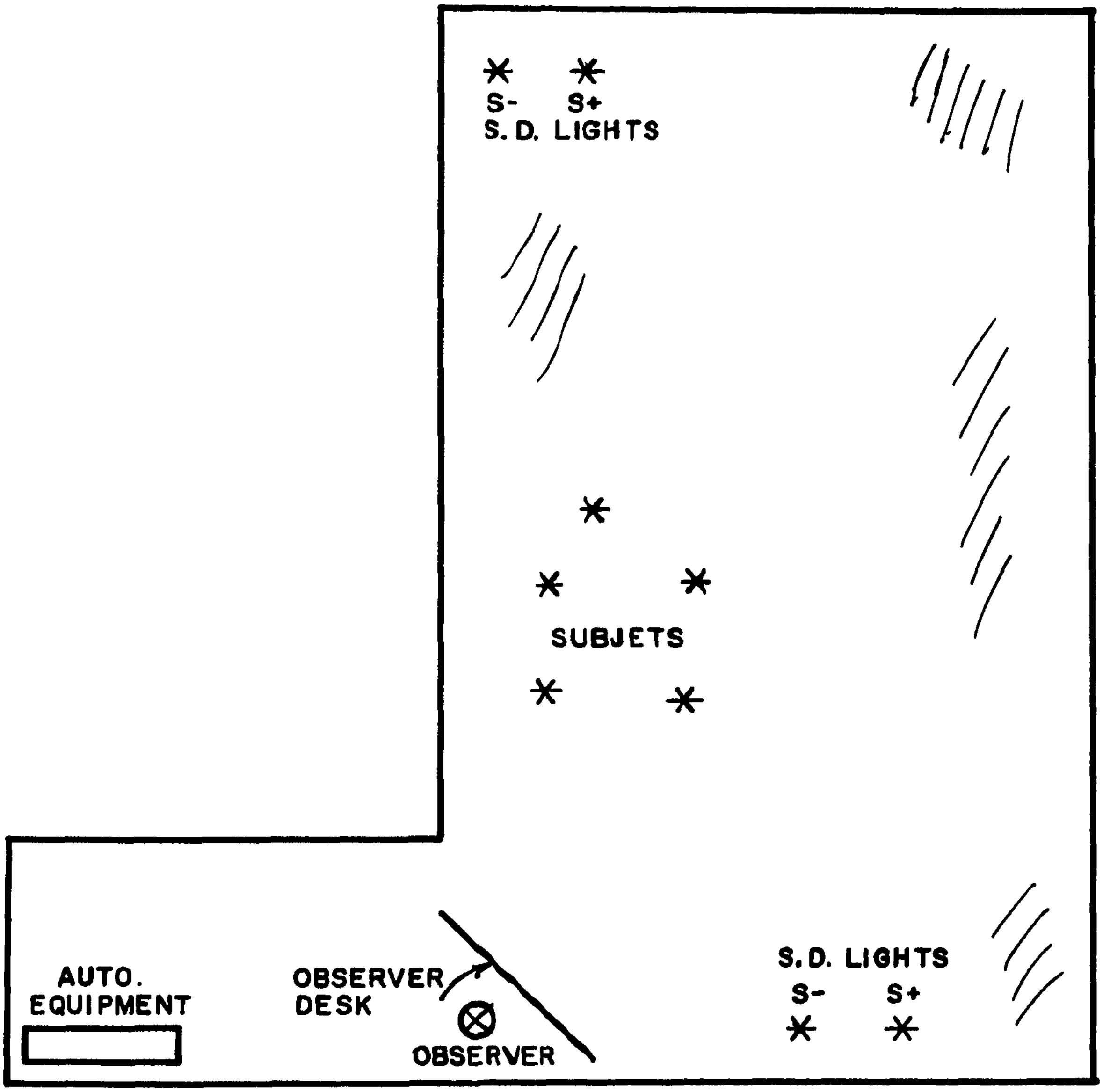

FROM
TIMER
TO EVENT
RECORDER
LIGHT
SPEAKER
20 SEC FLASH
20 SEC BLIP
OFF-ON SWITCH
SCHEDULE
& LIGHTS
20 SEC O
BUTTON
R1
R2
R3
R4
R5
R6
TO EVENT RECORDER

FIGURE 2

Depiction of Experimental Chambers and the Placements of Apparatus, Subjects, and the Observer

(Note that the observer had an unobstructed view of all subjects)


S- S+
S.D. LIGHTS
SUBJETS
AUTO.
EQUIPMENT
OBSERVER
DESK
OBSERVER
S.D. LIGHTS
S- S+

L-shaped area was employed. The large room had a coffee table and chairs set towards the right wall. The room was shag carpeted. The subjects sat on the carpet towards the left side of the large room. Their seating was elliptical. On opposite sides of the large room, represented at the top and bottom of Figure 2, were the cue lights, signalling components. Cue lights were placed on bookshelves near the ceiling. The observer was seated behind a card table at the lower intersection of the two rooms forming the L. The console rested on top of the card table. The stationary automated equipment was in the small room, behind and to one side of the observer.

Response Definitions and Functions of the Observer

The observer monitored six responses. They were:

R1: Sitting and attending to task. Topographically, both buttocks or both forelegs in contact with carpet and facial orientation to material or teacher (if teacher was also interacting with the subject). The duration was the entire 20" interval to be coded as a response.

R2: Out of seating area. Not within 3' of any other subject. Standing, fully erect, regardless of location in the room unless to talk to teacher. Did not include E-approved trips to the bathroom. Any occurrence in an interval was the criterion.

R3: Stereotyped activity while in the seating area. When sitting or kneeling in the elliptical area, if a subject engaged in stereotyped activity of limbs, head, extremities, or mouth, R3 was scored. Included repetitive face-tapping, finger-snapping, knuckle-rapping, lip-smacking, forehead-wrinkling, foot-tapping, rocking, head-turning, etc.

R4: Aggressive physical behavior and complaining verbal behavior. Hitting at another child, whether or not contact is made; pushing-shoving, and grabbing another child's person or property (rapid movements) were exemplars of aggressive physical behavior. Complaining verbal behavior occurred if the voice tone changed to that of a "whine" and/or dissatisfaction with the prevailing schedule conditions was explicitly verbalized.

R5: Looking at the cue lights. Scored if a child during an observation period appeared to look at either set of lights signalling the schedule component. Since the lights were in view of the children without turning the body or neck, mounting of the lights was sufficiently high such that looking at the cue lights was likely to be accompanied by upward movements of the head in space. If the face was oriented to either set of lights, and the head tilted up, then looking at the cue lights was scored.

R6: Non-task, or disruptive, talking. Scored if during an interval a subject was observed to emit verbalizations that were not related to the ongoing task.

R2 to R6 could hypothetically occur several times in a 20" scoring interval. However, in any one scoring-observing interval, each response was scored but once. In other words, two distinct occurrences of R6 by a child nevertheless resulted, if occurring in the same scoring interval, in one press of button R6 by the observer. R1 could be scored only once at the end of a 20" scoring interval because part of its definition included a 20" duration.

Because of limitations impinging on any human observer, a time-sampling procedure was employed. The 20" light flashes and simultaneous blips on the O console signalled the observer to switch from observing one child to another in a preset order. The order of observing subjects was invariant throughout the experimental phases; each component started with the same subject being observed. Absences were noted by the observer on the event record of that day.

End of a ten minute component was signalled to the observer by a windup timer on her desk. The observer then dimmed the cue lights. During 1' timeouts between components the observer continued to take data. Start of a new component occurred when the observer switched on the cue lights and tape by use of a button on her console (see Figure 1). End of a session occurred when the observer shut down all equipment. E-teacher then announced recess or time to go back to the ordinary classroom.

Observer reliability was assessed for dependent responses by calculating per cent agreement with independent reliability checkers. The observer's accuracy in button-pressing to note the start of observing a different subject every 20" was checked by comparing the automatic recording of the passage of 20" on the event record with the observer's manual buttonpressing.

Functions of the E-Teacher

The E-teacher picked up and returned the subjects from their regular classroom. He taught the daily material, which was provided by the regular classroom teacher and covered language and reading skills areas. E-teacher monitored R1, in seat and attending, by pressing the portable button device whenever R1 occurred for all five subjects simultaneously; the button was released whenever one or more subjects was not engaged in R1. When a sound-alert device operated, due to the conjunction of the stopping of the VI tape and R1 having occurred for 20" consecutively, the E-teacher administered potential reinforcers, such as M and M's to all five subjects. He accompanied these with social praise, such as "good job," "you all are doing very well," "you are being nice and studying hard," etc. The E-teacher also dispensed toys rewarded through earning enough M and M's during the week on Friday. E-teacher also gave all verbal instructions concerning the experiment. Any emergencies, such as potentially dangerous aggressive behavior or accident, were handled by E-teacher; the experiment and data-taking ceased for the duration of emergencies.

The observer and E-teacher provided partial reliability checks on each other for response R1. Looking within a 20" scoring interval on the event record, E-teacher's button pressing, if occurring for the entire interval, meant that all five subjects were engaged in R1 during that interval, and should have been matched by the observer's press on button R1 showing that she saw one particular child do R1, and thus pressed at the end of the interval.

Procedure

The basic design of the study was baseline, followed by a change in schedule conditions, followed by a recovery of baseline attempt. The baseline experimental phase was MULT VI VI; the second phase was MULT VI EXT. Recovery was MULT VI VI.

Experimental Phase 1--MULT VI VI

Four mornings weekly, Tuesday through Friday, the five children comprising the group of subjects used throughout the experimental phases were taken from their homeroom class at 8:55 A.M. They were taken to the experimental setting, which was in a house adjoining their school. From 9:00 A.M. to 10:00 A.M., Tuesday through Friday, they were exposed to a MULT VI 2' VI 2' schedule, with one minute timeout between components of ten minutes' duration. Recess occurred daily from 10:00 to 10:15. On Tuesdays and Thursdays recess was followed by continued exposure to the MULT VI VI until about 11:00 A.M. On Wednesdays and Fridays recess was followed by return to their ordinary classroom. On Tuesdays and Thursdays return to the home classroom transpired shortly after 11:00 A.M. The schedule of experimental sessions and recess time was dictated by constraints imposed by the school administration and availability of the observer-research assistant.

During this phase the observer and E-teacher performed their previously described functions. The observer monitored the multiple responses, switching from one subject to another every 20" in a preset order, and turned the VI tape and houselights on and off. E-teacher taught, monitored R1 for the group as a whole, and dispensed potential reinforcers. Meeting contact with the VI requirements occurred when an interval in the tape had timed out, stopping the tape, and 20" consecutively of the group as a whole engaging in R1, in seat area and attending, had occurred.

Instructions to the subjects were given by E-teacher concerning the experimental conditions. They were told that they were covering the same material as the other children still in the classroom. The subjects were told that they could earn M and M's, and toys and prizes, etc. E-teacher said: "All of you must be in the seating area and attending to your work to get the M and M's. Part of the time being good like this will get you M and M's, and part of the time I will not give them out. If the group has earned X M and M's by the end of each week, each one of you will get your choice of a toy, game, etc." Handing out of M and M's was accompanied by putting checks on a piece of paper, signalling progress towards the checks required to earn toys. The number of checks required to obtain toys varied.

Phase 2 began when data from each component of the MULT VI 2' VI 2' stabilized according to the following criteria: 1) approximately equal numbers of reinforcers were being dispensed in the two components, assessed on a mean basis for a session; 2) most of the monitored responses showed no more than 15% discrepancies between the two components for two consecutive sessions; 3) number of times reinforcement occurred in the constant VI component remained stable within and between sessions. On the average, there were five opportunities for reinforcement in a VI component, and a particular component was run twice on two days and four times on other days weekly. Given these figures, the margin for variation was small between occurrences of a component daily.

Experimental Phase 2--MULT VI EXT

Experimental Phase 2 was identical to Phase 1, with the exception of the following changes:

(1) A particular component of the VI 2' VI 2' multiple schedule described above was changed to an extinction component, making the schedule in this phase MULT EXT VI 2'. During the EXT component the E-teacher dispensed no potential reinforcers, primary or social, for group fulfillment of the contingency involving R1 previously described. Instead, occurrences of the group reaching criterion were not reinforced or signalled during EXT, since the VI tape was not operative during this component. The subjects were instructed prior to the start of Phase 2 that "soon there will be a change about when you can get M and M's and checks counting for toys." After several sessions in Phase 2 clear differences between VI and EXT responding had not occurred, and the subjects were told that "when the pink light is on you can't get M and M's or checks. However, I don't expect the new rules to mean that you can go wild; Sister doesn't give M and M's but she wouldn't stand for you going wild." This last instruction minimized the possibility that telling subjects that during EXT reinforcement would no longer occur put demand on the subjects to misbehave.

(2) EXT was accomplished programatically by shutting off the VI 2' VI 2' tape. However, all variables of interest were monitored, including E-teacher's monitoring of R1 for the group as a whole.

Experimental Phase 2 was run until reliable patterns of potential intrinsic and/or theoretical interest were found.

Phase 3--Recovery--MULT VI VI

A recovery of baseline was attempted. Phase 2 was followed by a shift to MULT VI VI, as in Phase 1. Conditions prevailing were identical to those in Phase 1, except that the shift to VI VI was announced to the subjects by stating that "you can now get M and M's and checks when either the yellow or pink lights are on."

CHAPTER III

RESULTS

Reliability

Spot checks on interobserver agreement were made throughout the course of the study. Reliability data were taken on a total of seven occasions, including twice in the baseline condition, Phase 1; four times in the MULT VI EXT experimental condition, Phase 2; and once in the recovery condition, Phase 3. Comparisons were made between the observer that functioned throughout the study and two independent reliability checkers. One spot checker, to be referred to as Spot Checker A, served on four occasions; the other spot checker, to be referred to as Spot Checker B, served on three occasions other than Spot Checker A.

Interobserver agreement was calculated using the formula agreements/ agreements plus disagreements, excluding intervals in which neither observer scored the response as occurring (two absences). Calculations were made comparing data taken from an event record that received input from the daily observer with data from scoring sheets used by the spot checkers (see Appendix A). Given that the data were dichotomous within an interval in that either a response was scored once or not at all by an observer, and multiple responses were being scored, the use of the above formula is appropriate. Excluding intervals in which both observers do not score a response produces lower percentages than including such intervals (Repp, Deitz, Boles, Deitz, and Repp, 1974).

Generally, agreement levels obtained for most of the responses monitored were lower than those usually acceptable. However, a relationship found between response density and interobserver agreement is depicted graphically in Figures 3 and 4. In these figures, response density is plotted on one axis, while obtained interrater agreement figures are plotted against the other axis. The curvilinear function depicted in Figures 3 and 4 was generated by calculating the chance expectations of two observers reaching agreement at given response densities, and will be further explicated shortly.

Figure 3 presents reliability data obtained between the regular observer and Spot Checker A. Response numbers are listed. For R1, In-seat and Attending, average interobserver agreement was 80%; for R2, Out-of-seat, agreement was 47% across occasions; for R3, Stereotyped Behavior, reliability was 52% across the four occasions monitored; for R4, Aggressive and/or Complaining Behavior, 38%; R5, Looking at the Cue Light, 50%; and for R6, Non-task Related Talking, 56%. Using all 17 data points depicted in Figure 3, the Pearson product-moment correlation between response density, or frequency of occurrence in per cent

FIGURE 3

Reliability Data Between the Regular Observer and Spot Checker A Presented as a Relationship Between Response Density and Interobserver Agreement

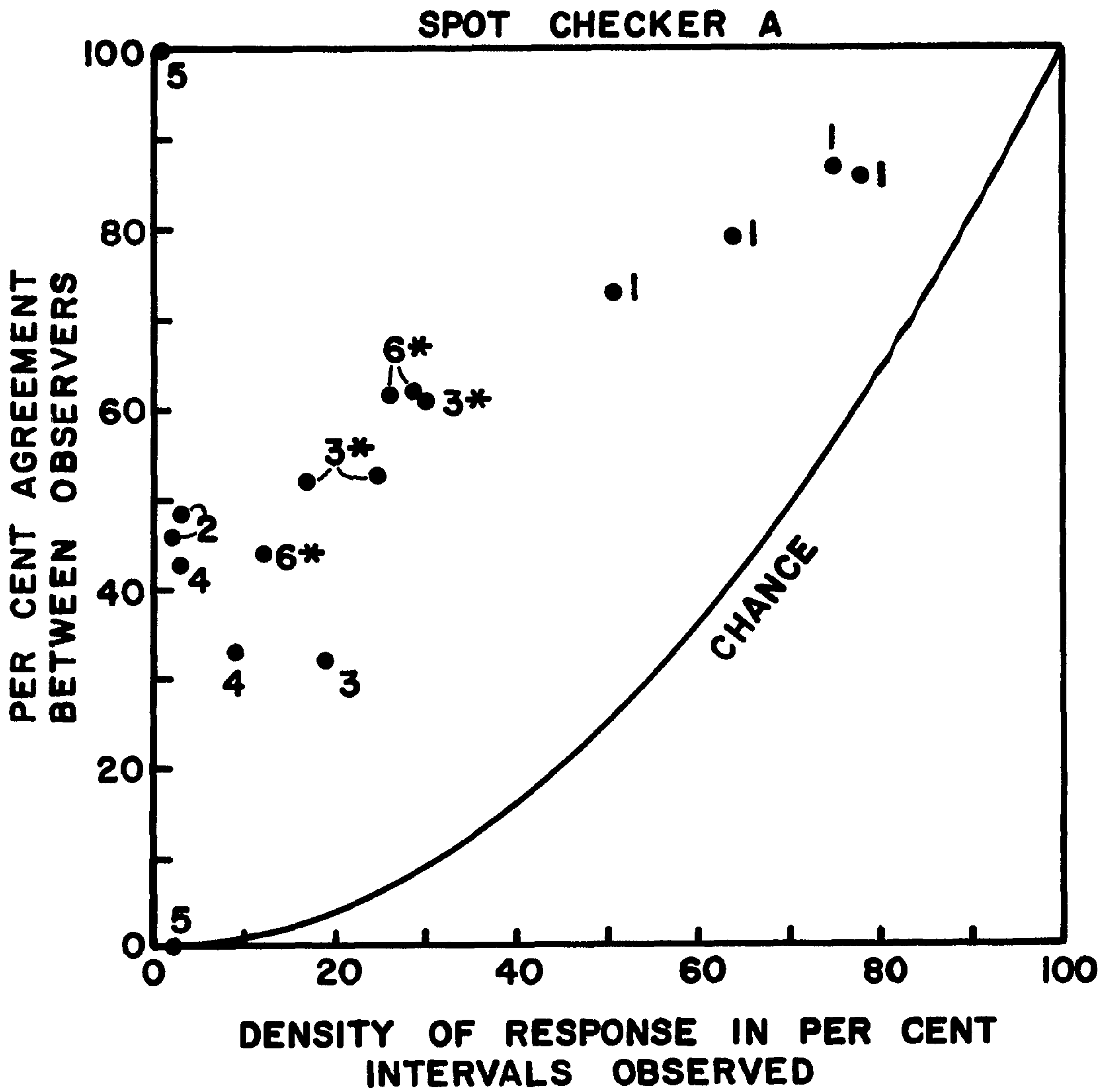
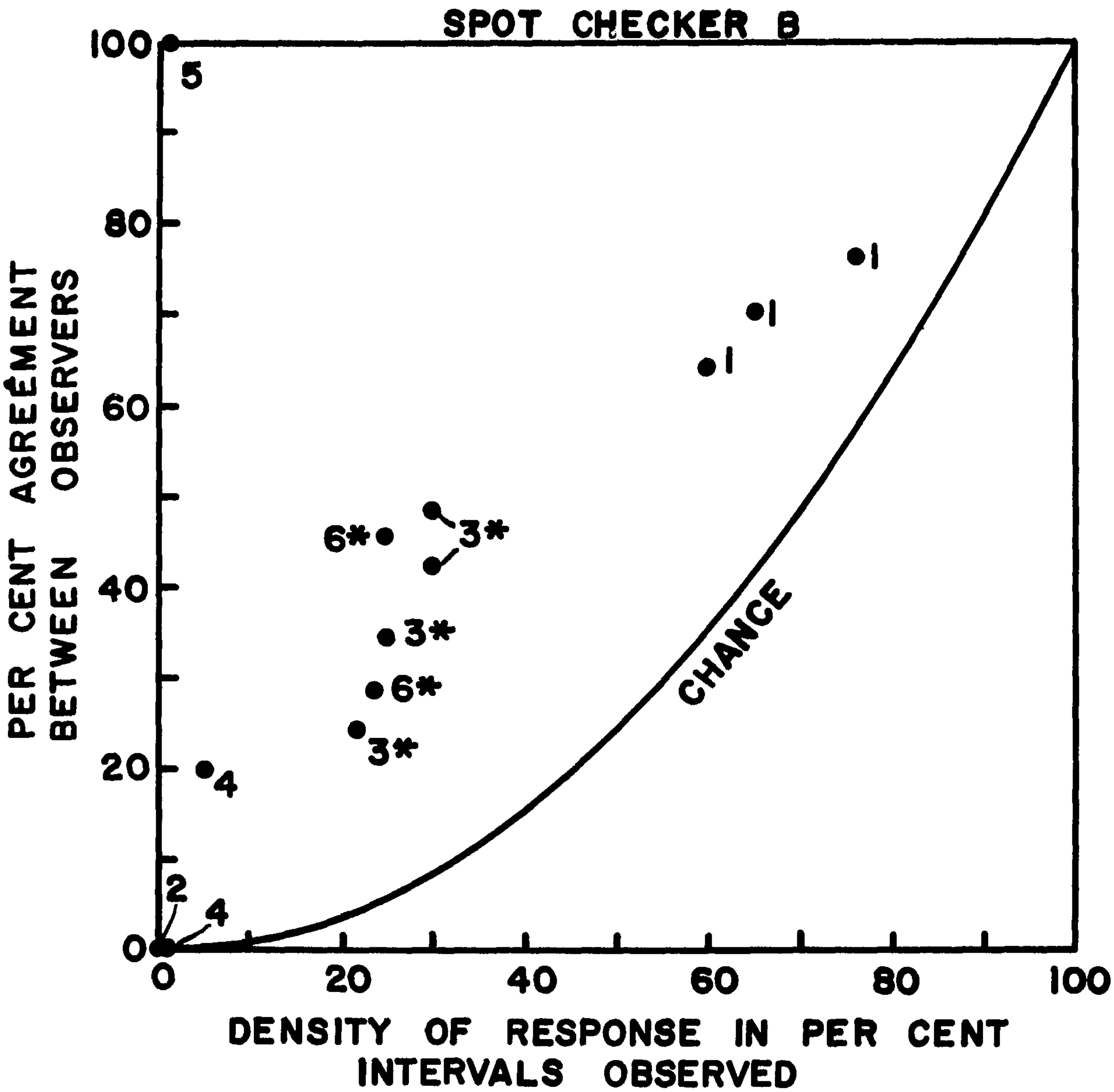

SPOT CHECKER A
PER CENT AGREEMENT BETWEEN OBSERVERS
DENSITY OF RESPONSE IN PER CENT INTERVALS OBSERVED
CHANCE
0
20
40
60
80
100
5
1
2
3
4
6*
3*

FIGURE 4

Reliability Data Between the Regular Observer and Spot Checker B Presented as a Relationship Between Response Density and Interobserver Agreement


SPOT CHECKER B
PER CENT AGREEMENT BETWEEN OBSERVERS
DENSITY OF RESPONSE IN PER CENT INTERVALS OBSERVED
CHANCE
0
20
40
60
80
100
5
1
1
1
6*
3*
3*
6*
3*
4
2
4

intervals, and interobserver agreement, was found to be .61. Excluding points with response densities of two percent or less, and using 14 of the points in Figure 3, the product-moment correlation between density of the response and interobserver agreement was .92 for Checker A and the regular observer.

Figure 4 presents reliability data obtained between the regular observer and Spot Checker B. Again, response numbers are listed and the points represent response density plotted against interobserver agreement. Agreement percentages were lower for corresponding responses between Spot Checker B and the regular observer, as compared to Spot Checker A and the regular observer. For example, reliability for R1 summed across occasions and averaged was 71% for rater B as compared to rater A's 80%; for R3, summed across occasions and averaged, the obtained agreement was 38% for rater B versus 52% for rater A. Using all thirteen data points obtained from comparing checker B's coding with the regular observer's, the correlation between response density and interobserver agreement was found to be .55. Again, excluding data points with response densities of two per cent or less, the correlation between response rate and interobserver agreement was found to be .96.

For data points obtained using either spot checker, only R5, looking at the cue light, yielded points with extremely low response density and higher interobserver agreement. Excluding R5, and occurrences of R1 and R2 when their densities were two per cent or less, the relationship between response density and interobserver agreement was strong. When R4 or R2 occurred at percentages of greater than two per cent, these responses also fit the pattern. When R6 and R3 reversed positions in response density, interobserver agreement percentages were likewise reversed. The starred points in Figures 3 and 4 illustrate this point.

Although high correlations were found between response density and interobserver agreement using both spot checkers, the y-intersect of the "best-fit" lines through the points in Figures 3 and 4 differs for the two spot checkers. In other words, interobserver agreement for given response densities was higher generally between Spot-checker A and the regular observer than between Spot-checker B and the regular observer. The curvilinear line, identical in Figures 3 and 4, is a function generated by calculating the chance expectations of two observers reaching agreement at given response densities. If a response occurred in 90% of the intervals, and each observer pressed randomly with a probability of .90 of a press in a given interval, then the probability that two observers would agree would be .90 times .90, or .81. With a probability of both observers pressing at .50, the probability of agreement by chance would be .25. The function generated using chance expectations, depicted in Figures 3 and 4, would differ if a different formula for calculating interobserver agreement had been used. For instance, if absences were not excluded, then a chance function of interobserver agreement would be U-shaped.

There is no formula available devised specifically for comparing obtained levels of interrater agreement with expected or chance levels of agreement. However, Edwards (1973) describes a method for testing the significance of the difference between two correlation coefficients. The formula involves transforming the correlation coefficients to Z values, and calculating the standard error of the difference between the two coefficients. One Z value is subtracted from the other, and the difference is divided by the standard error of the difference, yielding a Z value. This final Z value is evaluated in terms of the standard normal curve to test for significance (Edwards, 1973). Obtained levels of interobserver agreement and chance levels of agreement were treated as correlation coefficients in order to test for significance in differences. It was found that all obtained figures of interobserver agreement were significantly different from chance at the .01 level, except for obtained levels of interobserver agreement of zero per cent.

No direct measures of reliability were taken on the E-teacher's monitoring of the group-contingent response. Anecdotally, monitoring all five children concurrently and teaching at the same time was difficult. However, there is no reason to suspect that agreement on this group response would not have followed the same function found for the other responses. When group attending was high, inter-observer agreement would be expected to be high. Two indirect measures of the E-teacher's monitoring of the group-contingent response, all five subjects attending to task concurrently, are available from Figures 18 and 19. Given that the E-teacher scored all five children as attending for an interval, as monitored by the button-press feeding into the event record, the regular observer should have scored the one child she was observing as attending during that same interval. A strong positive relationship was found between the individual and the group attending responses. Looking at Figure 18 at bar graphs showing percentages of the occurrence of R1, individual, given that R8, the group response, was scored, it was found that 92% of the occasions that the group response was scored throughout the study, the individual child observed was also scored as attending. In the B or EXT component in sessions 25-28, agreement was 100%. As direct measures of the reliability of the monitoring of the group-contingent response, these measures are probably inflated and invalid. Agreement between the observer and the E-teacher, comparing the observation of one child with the group, does not guarantee that the E-teacher was reliably observing the other four children.

R2, out-of-seat, and R8, the five subjects on-task and attending were defined to be incompatible. Therefore, given that R8 was scored as occurring by the E-teacher, out-of-seat, R2, should not have occurred in the same intervals. Figure 19 yields this indirect measure of the monitoring of the group-contingent response, R8. It was found that given that R2 was scored, R8 was scored at a near-zero rate.

In summary, the reliability findings presented depict varying levels of agreement between observers for the different multiple responses. Levels of agreement obtained were functions of response density across observers, occasions, and responses. Agreement levels did differ across observers; for one checker, agreement was higher between her and the regular observer than between the other checker and the regular observer. Obtained levels of agreement differed significantly from chance. No direct measures of reliability were taken of the monitoring of the group-contingent response, R8. Two indirect measures showed appropriate relations between the scoring of R8 and themselves.

Schedule Control, Contrast, and R's

Separations of response rates between components cannot be results of differing reinforcement densities between components in Phase 1, nor of increased reinforcement in the A component of Phase 2, relative to the A component of Phase 1. This can be seen by inspecting the figures presented in Table 1, which lists the percentages of intervals that reinforcement occurred in the VI components in the three phases of the study. A and B components in Phase 1 did not differ significantly in their reinforcement densities using a Chi-square test (Alder and Roessler, 1964); ($df = 1$, $p > .05$). The difference between A and B components was also nonsignificant at the .05 level in Phase 3. Reinforcement was only delivered in the A component in Phase 2. The eight percent figure for the A components, phase 2, is lower than either percentage in A or B, Phase 1.

Clearest evidence for schedule control is shown when group responding under contingency and the individual responding show separation between components in response densities in the second phase, MULT VI EXT. If the schedule was effective, response densities of the individually monitored response of conjoint attending to task and in-seat (R1) and the group response of all five subjects simultaneously attending to task and in-seat (R8) should have been higher in the "A," or VI components, than in the "B," or EXT components, in Phase 2.

TABLE 1

Percentages of Intervals in Which Reinforcement Occurred in VI Components

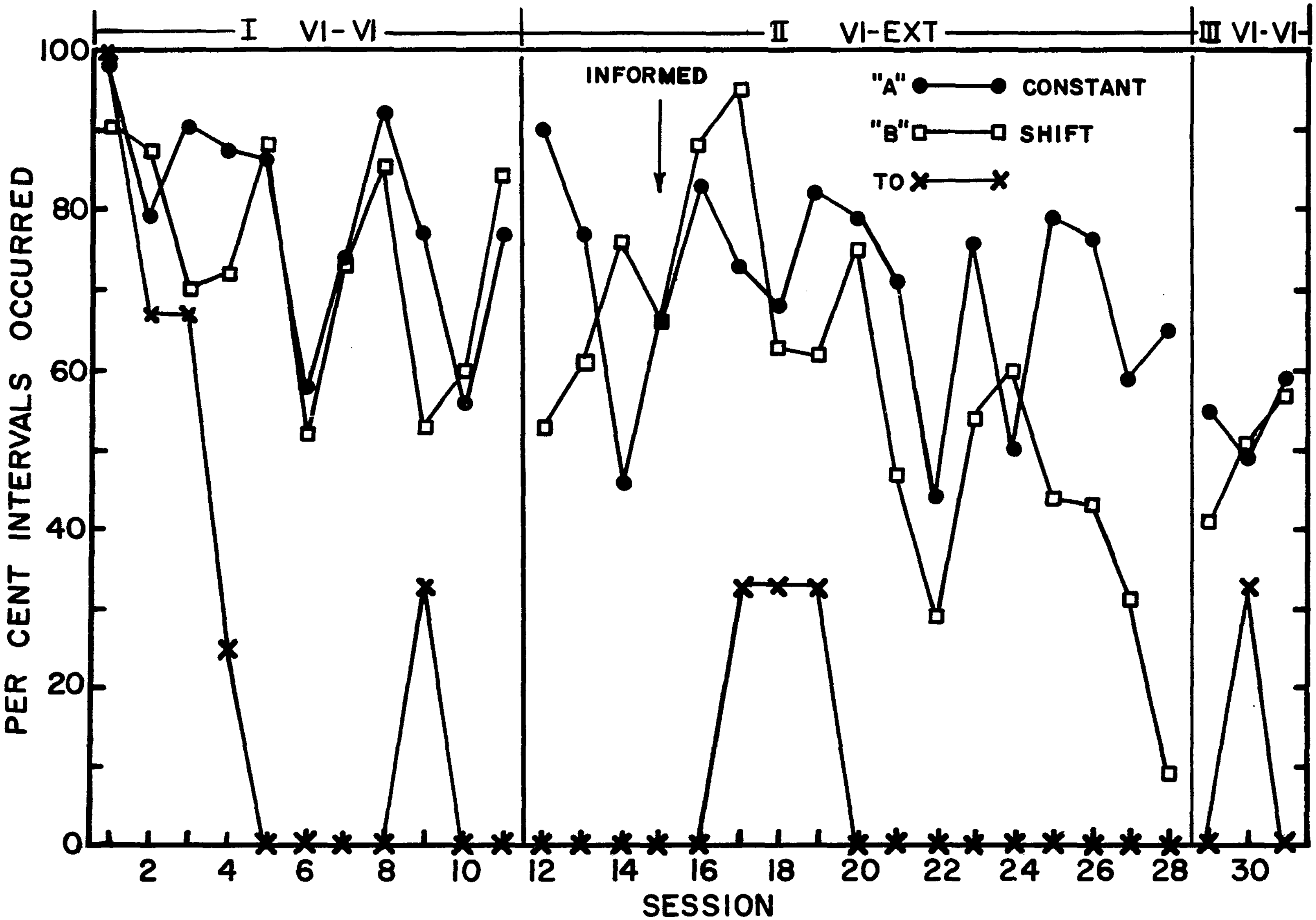
Phase	A & B, or Expected	Component A	Component B
1	10.5%	9.5%	10.5%
2	8.0%	8.0%	-
3	6.1%	5.3%	6.9%

Figures 5 and 6 present these two responses, individually monitored attending to task and in-seat (R1), and group attending to task and in-seat (R8) on a session by session basis. In Figure 5, data from the individual subjects are collapsed across subjects, and grouped within components and sessions. In both Figures 5 and 6, separate functions are depicted for A (constant) and B (shifted) components. Data are presented for responding during the one minute Time-out (TO) periods in Figure 5, the individually monitored response of attending to task and in-seat. TO data were not taken for the group contingent response (R8); thus none is presented in Figure 6.

To demonstrate schedule control, response densities in Figure 5, the individually monitored conjoint response of attending and in-seat, collapsed across subjects, should have been approximately equal in the equal MULT VI VI conditions of Phases 1 and 3; response rates should have been higher in the VI or "A" components of Phase 2, relative to the EXT or "B" components of that phase. Using the Wilcoxon Signed Ranks Test for matched pairs of points (Alder and Roessler, 1964), it was found that response densities for the two components, combining Phases 1 and 3, were not significantly different at the .05 level. In Phase 2, MULT VI EXT, the Wilcoxon Test yielded differences between VI and EXT components on the response rates of individual in-seat and attending (R1) at the .05 level of

FIGURE 5

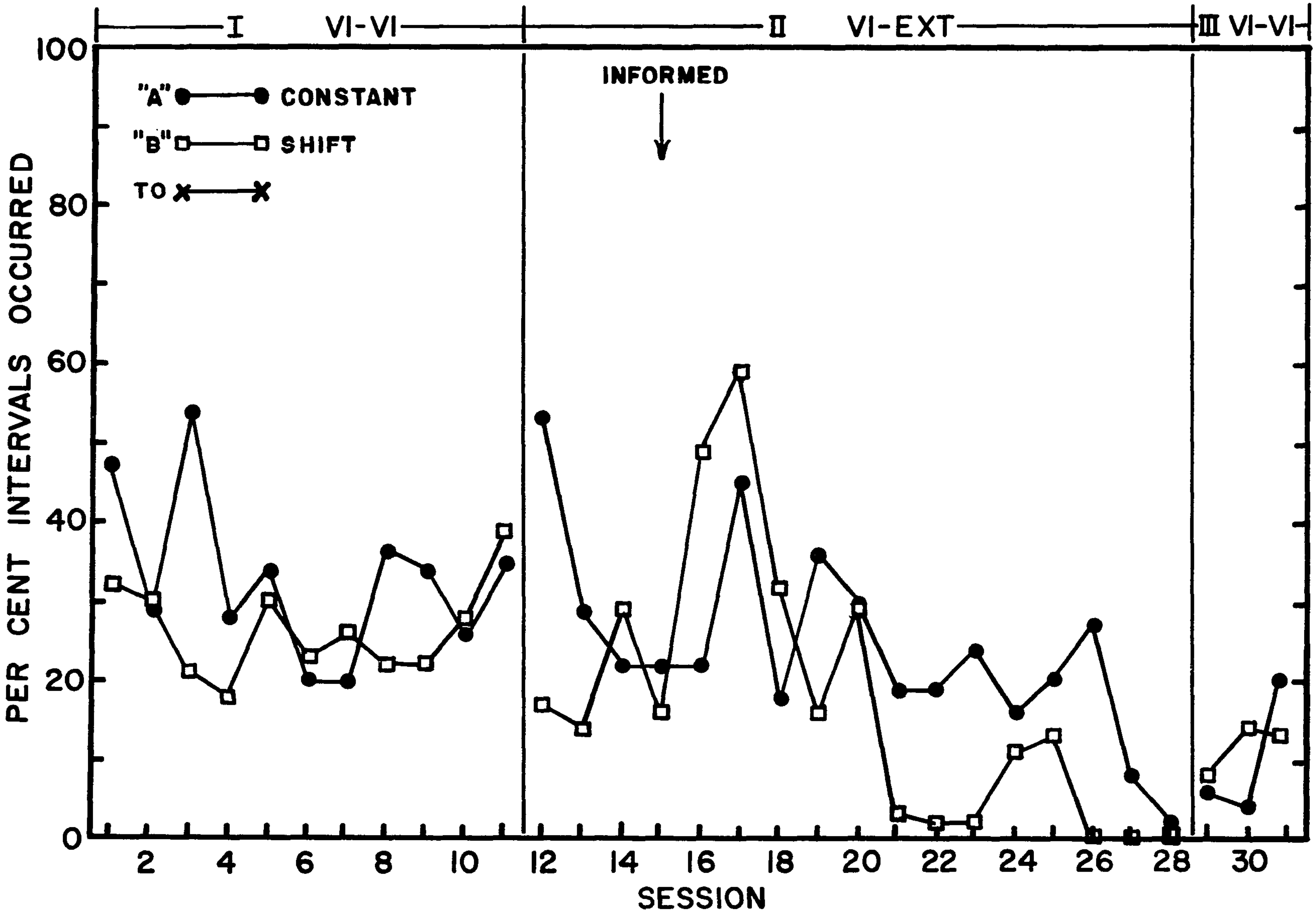
Response Rates Within Sessions of R1, Individual Conjoint In-Seat and Attending, Separated According to Components and Phases (Grouped Data)



I VI-VI
II VI-EXT
III VI-VI
100
80
60
40
20
0
PER CENT INTERVALS OCCURRED
INFORMED
"A" CONSTANT
"B" SHIFT
TO
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
SESSION

FIGURE 6

Response Rates Within Sessions of R8, the Group-Contingent Response, All Subjects In-Seat and Attending to Task Concurrently


I VI-VI
II VI-EXT
III VI-VI
INFORMED
"A" CONSTANT
"B" SHIFT
TO
PER CENT INTERVALS OCCURRED
0
20
40
60
80
100
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
SESSION

significance (Wl = 40, n = 17). Discriminative control of the schedule over attending behavior becomes even more apparent when one inspects the data in Sessions 25 through 28 in Figure 5. Attending behavior showed a steady decline in these sessions and in extinction differences between VI and EXT responding were greatest in these sessions. Time-out responding depicted in Figure 5 showed low rates of conjoint in-seat and attending following the first several sessions of the investigation. Time-out periods can be thought of as periods of signalled extinction, where no primary and little social consequation occurred.

The data presented in Figure 6, depicting responding of the group as a unit on the group-contingent response of attending and in-seat (R8), are consistent with the findings of the individually monitored conjoint response of attending to task and in-seat, shown in Figure 5. Differences in response densities between A and B components for the group as a unit on the group-contingent response were clear, large, and consistent, for Sessions 21 to 28 of Phase 2, with the exception of Session 24. In Session 24, one subject was expelled from the experimental session immediately prior to the start of an extinction component. During that succeeding extinction component the remaining subjects attended at a near 100%

rate. In Session 25, it appeared that the effects of expelling a subject from the previous session carried over to the first extinction component of that session.

Verbalizations anecdotally recorded during the course of the study offer support for the establishment of schedule control and help to explain some anomalies in the data. Subjects were informed during Session 15 that reinforcers could be earned by attending only in the yellow, or the "A," component. Inspecting Figure 5, grouped data of the individually monitored response of conjoint in-seat and attending to task, one finds clear differences in responding between the two components in the first two sessions of Phase 2, Sessions 12 and 13. Session 14, however, resulted in a large difference in response rate in favor of the "B," or extinction, components. In Session 14, several times subjects verbalized during an extinction component that checks had not been received for some time period. One or more subjects then instructed the others that they, the group, should be quiet and get to work so that checks could be earned. Attending at high density would then follow, thus explaining higher density of attending in extinction than VI in Session 14. Prior to the start of Session 15, subjects were asked if they could tell how and when they could earn checks and M and M's. No subject verbalized a correct contingency hypothesis, and the subjects were then informed. Subsequent R1 responding (individual conjoint in-seat and attending) throughout Phase 2, with the exceptions of Sessions 16, 17, and 24, showed higher response rates for R1 in VI compared to EXT components. In Session 24, the disruption of the pattern was probably due to the ejection of a subject prior to onset of an EXT component, which resulted in near 100% attending in that component. Frequently during Phase 2, following Session 15, when the subjects were informed, the onset of the yellow cue light was followed by one or more subjects telling the group that checks and M and M's could be earned. Frequently when reinforcements had not occurred for varying periods in a yellow, or "A" component, one or more subjects would instruct the others to be quiet and attend so that reinforcement could occur.

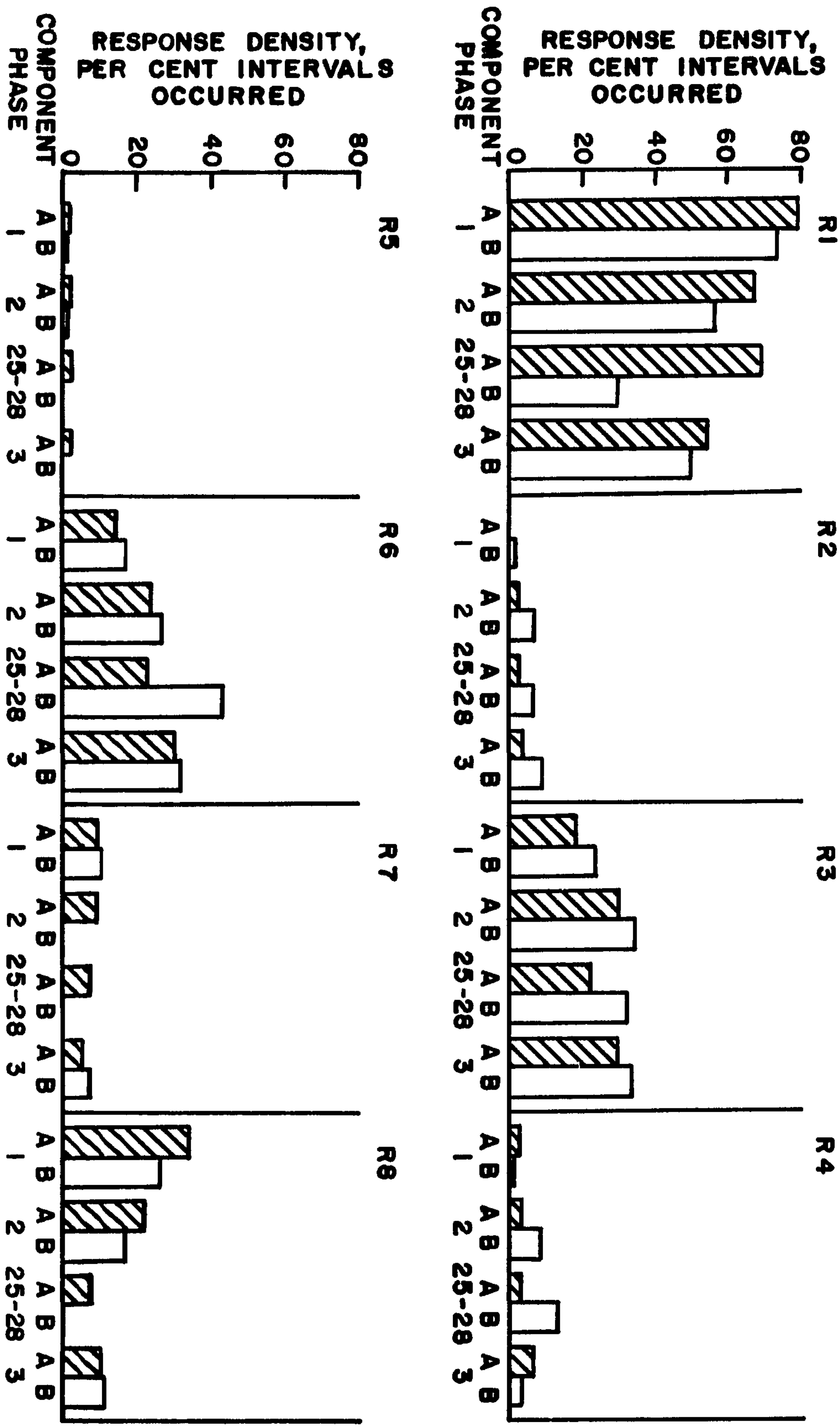
Behavioral contrast did not occur in either the individually monitored response of conjoint in-seat and attending (R1) or the contingent response of the group as a unit conjointly attending to task and in-seat (R8). Looking at Figures 5 and 6, responding in extinction components did show drops in Phase 2 relative to Phase 1. However, a defining characteristic of stable contrast, a rise over time in the rate of the contingent response in the other component, did not result. Instead, the rate of contingent responding, individually monitored and for the group as a unit, declined in the second phase, relative to the first. Transient contrast effects were precluded from occurring in Phase 2 relative to Phase 1, since initial responding at onset of A, or the constant VI component, was so high in Phase 1 that a ceiling effect resulted. Although a ceiling effect in regard to the possibility of stable contrast effects might also be argued, the results showed drops in contingent responding in the constant VI across sessions, which a ceiling effect would not require.

Figure 7 graphically summarizes the data presented thus far on the individually monitored response of in-seat and attending to task (R1) and the group-contingent response of all subjects as a unit attending and in-seat (R8). It also depicts by phases and components the response densities of the undesirable responses of out-of-seat (R2), aggressive and/or complaining (R4), and non-task related talking (R6). Also portrayed are densities by phases and components of stereotyped responding (R3) and of reinforcement occurrence (R7).

Changes in response densities by phases of the undesirable responses can be evaluated by inspecting Figure 7. Out-of-seat responding (R2) showed larger separations between A and B components in Phase 2 and Sessions 25-28 as a block, relative to Phase 1. However, baseline was not recovered, since separations in favor of relatively higher rates in B components persisted into Phase 3. The clear differences seen in Figure 7 between

FIGURE 7

Grouped Responding on Multiple Responses by Phases and Components, with Sessions 25-28 as a Block


RESPONSE DENSITY, PER CENT INTERVALS OCCURRED
COMPONENT
PHASE
0
20
40
60
80
R1
R2
R3
R4
R5
R6
R7
R8
A B
1
2
25-28
3

VI and EXT components (A and B, respectively) in Phase 2 for R4, aggressive and/or complaining responding, are supported by significance obtained at the .01 level (W1 = 18, n = 17), using the Wilcoxon Test. Differences between A and B components in baseline and recovery combined for analysis were nonsignificant at .05. The most dramatic separations between A and B components in aggressive and/or complaining responding, R4, occurred in Sessions 25-28, arguing further that discriminative control of the schedule over responding was first acquired or was enhanced in these sessions. The third undesirable behavior, non-task related talking, R6, also showed clearest differences between components in response densities in Sessions 25-28. The separation in Phase 2, with non-task related talking occurring at a higher density in B or extinction components, relative to VI components, was significant using the Wilcoxon (W1 = 39, n = 17; $p < .05$). Differences between A and B components, both VI, in Phases 1 and 3, combining the data points for analysis, were nonsignificant (W1 = 34, n = 14).

No definitive conclusions can be drawn from inspecting the data on R3, stereotyped responses, as summarized in Figure 7, since differences between A and B components were significant at the .01 level, in favor of the rates in B, for Phases 1 and 3 combined (W1 = 15, n = 14), as well as in Phase 2 (W1 = 19) n = 17), using the Wilcoxon Signed Ranks Test.

Figures 8, 9, and 10 present response densities on a sessions basis for the undesirable responses of out-of-seat (R2), aggressive and/or complaining (R6), and non-task related talking. Response densities are depicted according to percentage of intervals of occurrence in A (constant) and B (shifted) components, as well as in Time-out (TO) periods. In summary, the undesirable responses of out-of-seat (R2), aggressive and/or complaining, and non-task related talking occurred at highest densities in latter sessions of Phase 2. Separations in densities according to component type, EXT or VI, were clearest in the latter sessions of Phase 2. Generally high densities of these undesirable responses also occurred during periods of time-out, a form of signalled extinction for both primary and social consequation.

Figure 11 presents response densities of R3, stereotyped responding on a session-by-session basis, for A and B components and Time-out periods. Since stereotyped responding was highly variable and generally occurred at higher densities in B components throughout the study, no definitive conclusions can be reached regarding this response. However, inspecting Figure 11, highest densities of stereotyped responding occurred throughout the study in time-out periods.

The response of looking at the cue light (R5) yielded no significant statistical results. If the cue

FIGURE 8

Response Rates Within Sessions of R2, Individual Out-of-Seat Behavior, Separated According to Components and Phases (Grouped Data)

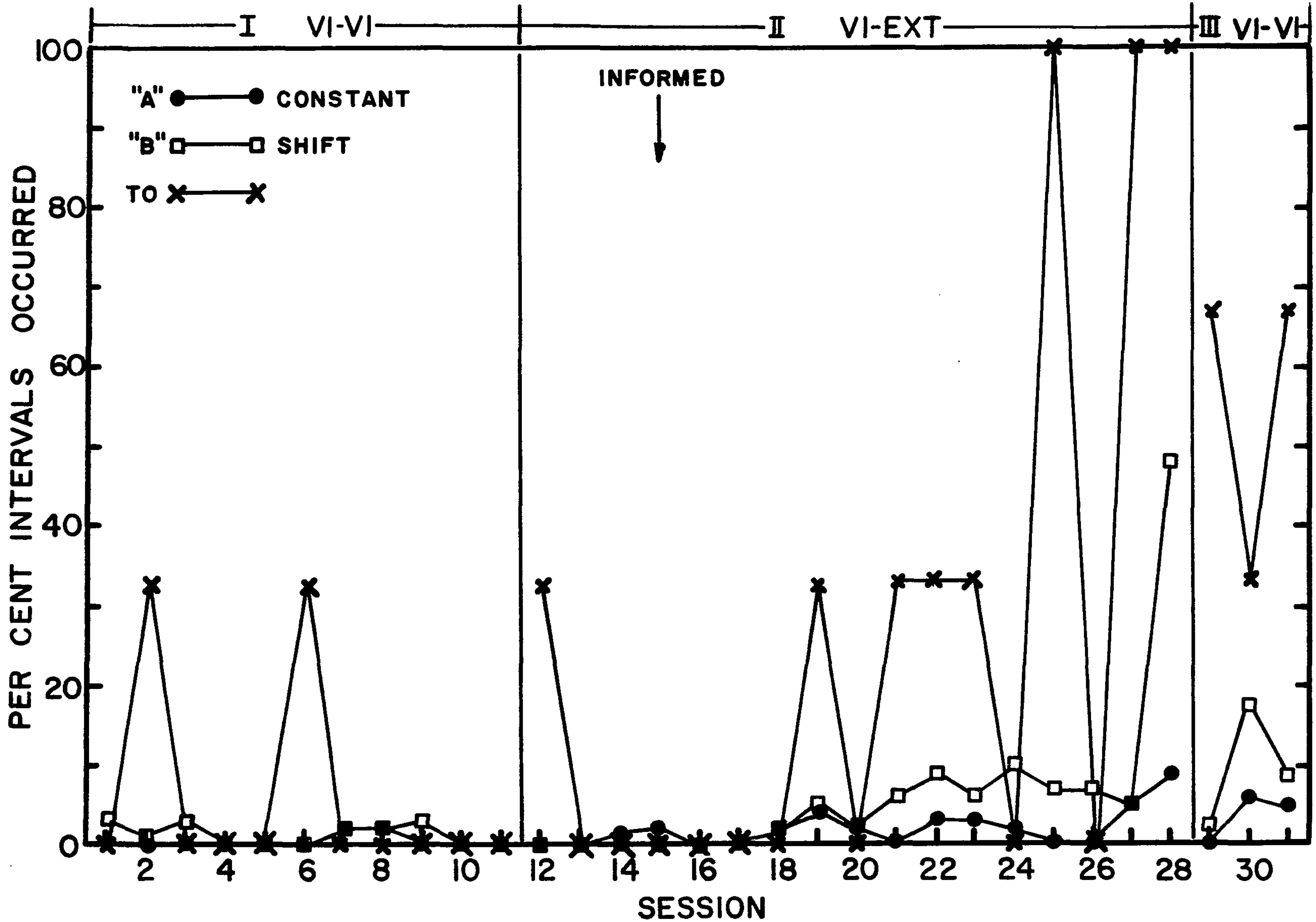

I VI-VI
II VI-EXT
III VI-VI
INFORMED
"A" CONSTANT
"B" SHIFT
TO
PER CENT INTERVALS OCCURRED
SESSION
0
20
40
60
80
100
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30

FIGURE 9

Response Rates Within Sessions of R4, Aggressive and/or Complaining Behavior of Individual Subjects, Separated According to Phases and Components (Grouped Data)

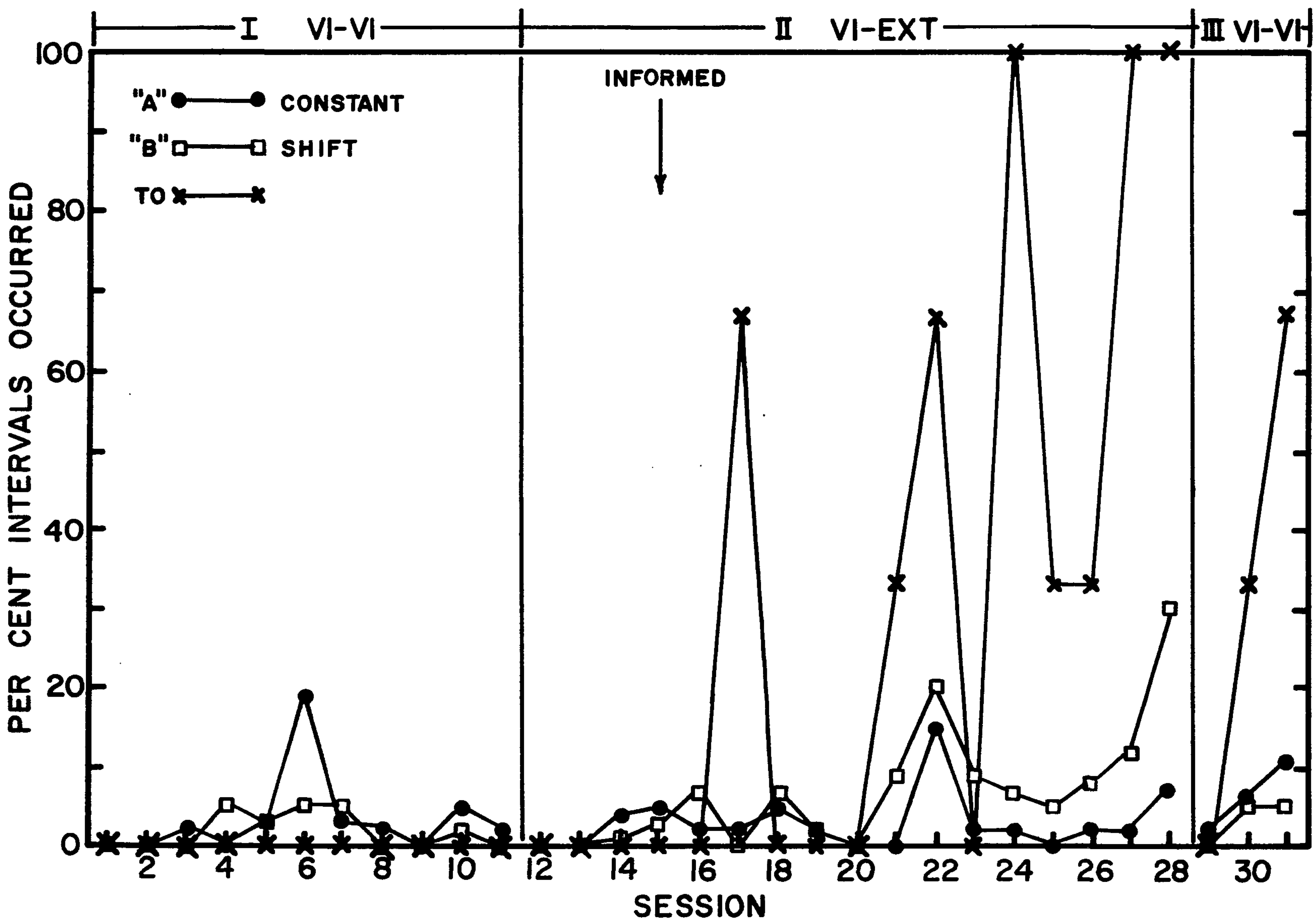

I VI-VI
II VI-EXT
III VI-VI
INFORMED
"A" CONSTANT
"B" SHIFT
TO
PER CENT INTERVALS OCCURRED
100
80
60
40
20
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
SESSION

FIGURE 10

Response Rates Within Sessions of R6, Individual Non-Task Related Talking, Separated According to Phases and Components (Grouped Data)

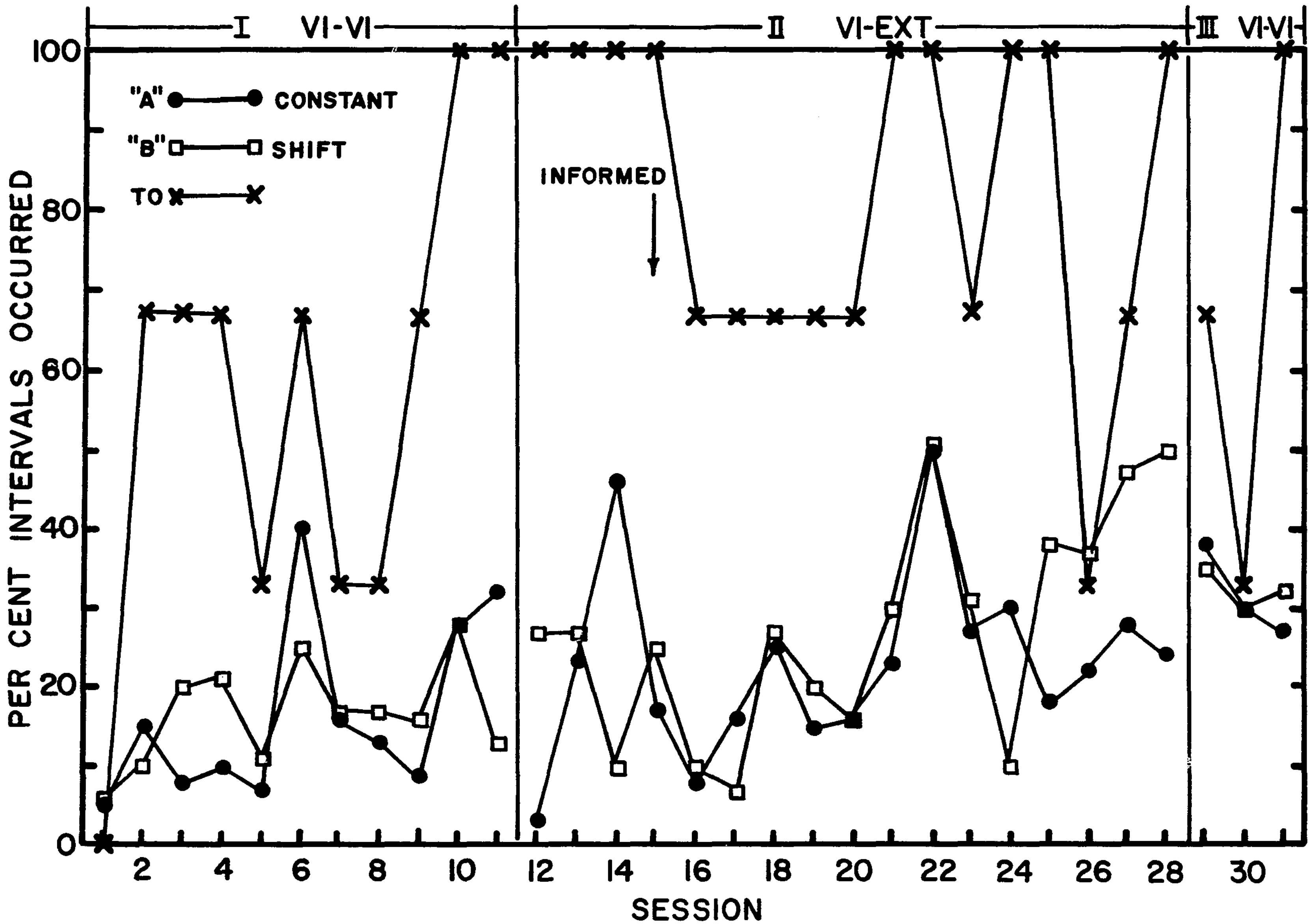
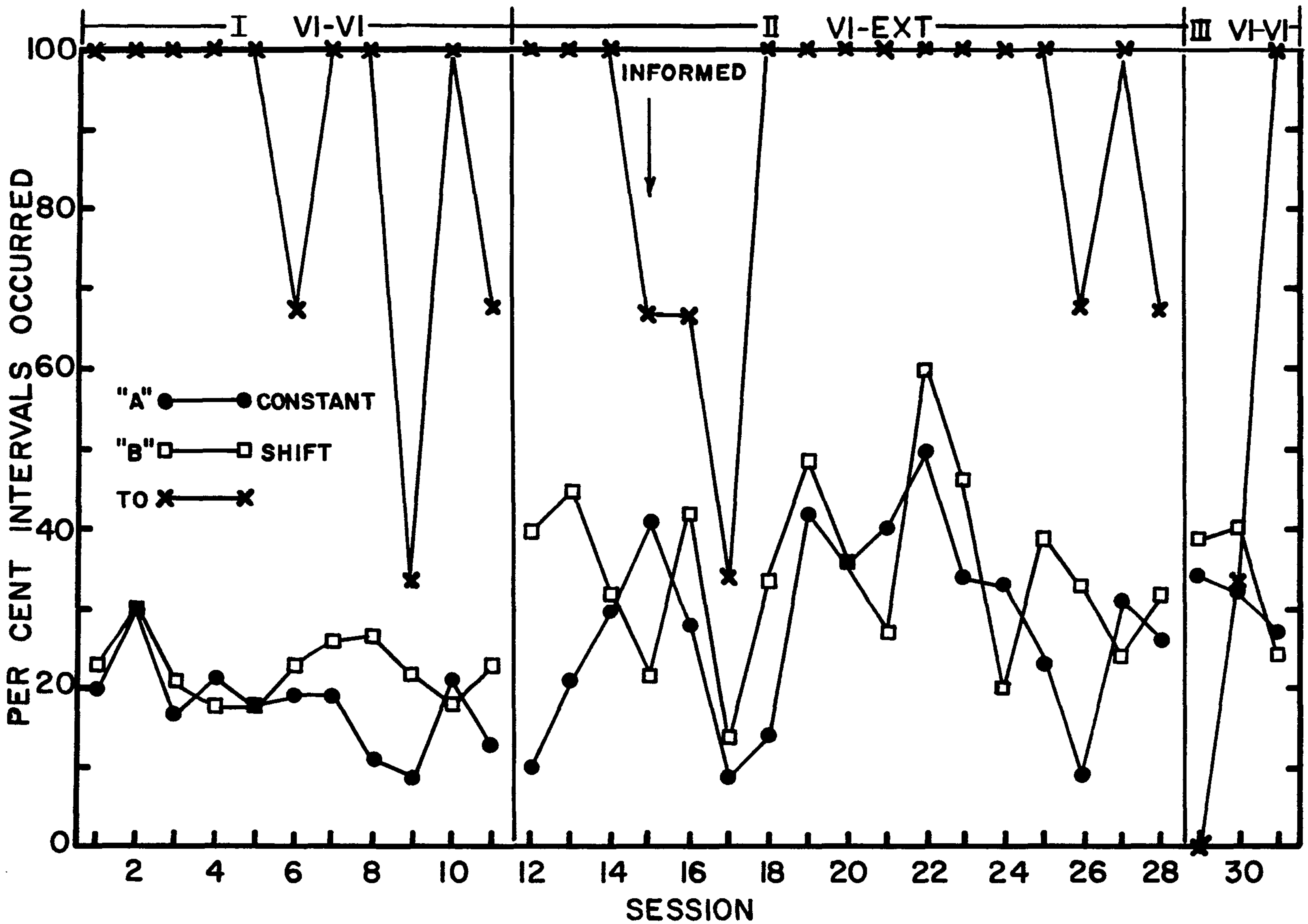

I VI-VI
II VI-EXT
III VI-VI
100
80
60
40
20
0
PER CENT INTERVALS OCCURRED
"A" CONSTANT
"B" SHIFT
TO
INFORMED
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
SESSION

FIGURE 11

Response Rates Within Sessions of R3, Stereotyped Responding of Individual Subjects, Separated According to Phases and Components (Grouped Data)


I VI-VI
II VI-EXT
III VI-VI
INFORMED
"A" CONSTANT
"B" SHIFT
TO
PER CENT INTERVALS OCCURRED
0
20
40
60
80
100
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
SESSION

light itself were indeed aversive in EXT components, subjects should have looked at it more frequently in VI components than in EXT components. Inspecting Figure 12, in the last seven sessions of Phase 2, MULT VI EXT, with the exception of Session 24, the response occurred slightly but consistently at a higher rate in VI components as opposed to EXT components. No time-out data were taken since the cue lights were dimmed in these periods.

Figures 13, 14, and 15 present response densities for the six responses scored by the observer for individual subjects. The data are not averaged; three subjects' data are presented separately. The three subjects were selected on the basis of availability of individual analysis via computer; for technical reasons, not all of the other two subjects' data was retrievable on an individual basis. For S2 (Figure 13), clear differences in response densities during Phase 2, contrasting A and B components, are found only for out-of-seat, R2, and aggressive and/or complaining, R4, when compared to differences in Phases 1 and 3. For S4 (Figure 14), clear differences were obtained for conjoint attending and in-seat (R1), aggressive and/or complaining responding (R4), and looking at the cue light (R5) in Phase 2, when contrasted with differences in Phases 1 and 3. For S4, the differences found in rates between A and B components in Phase 2 for stereotyped responding (R3) and non-task

FIGURE 12

Response Rates Within Sessions of R5, Individual Looking at the Cue Lights, Separated According to Phases and Components (Grouped Data)

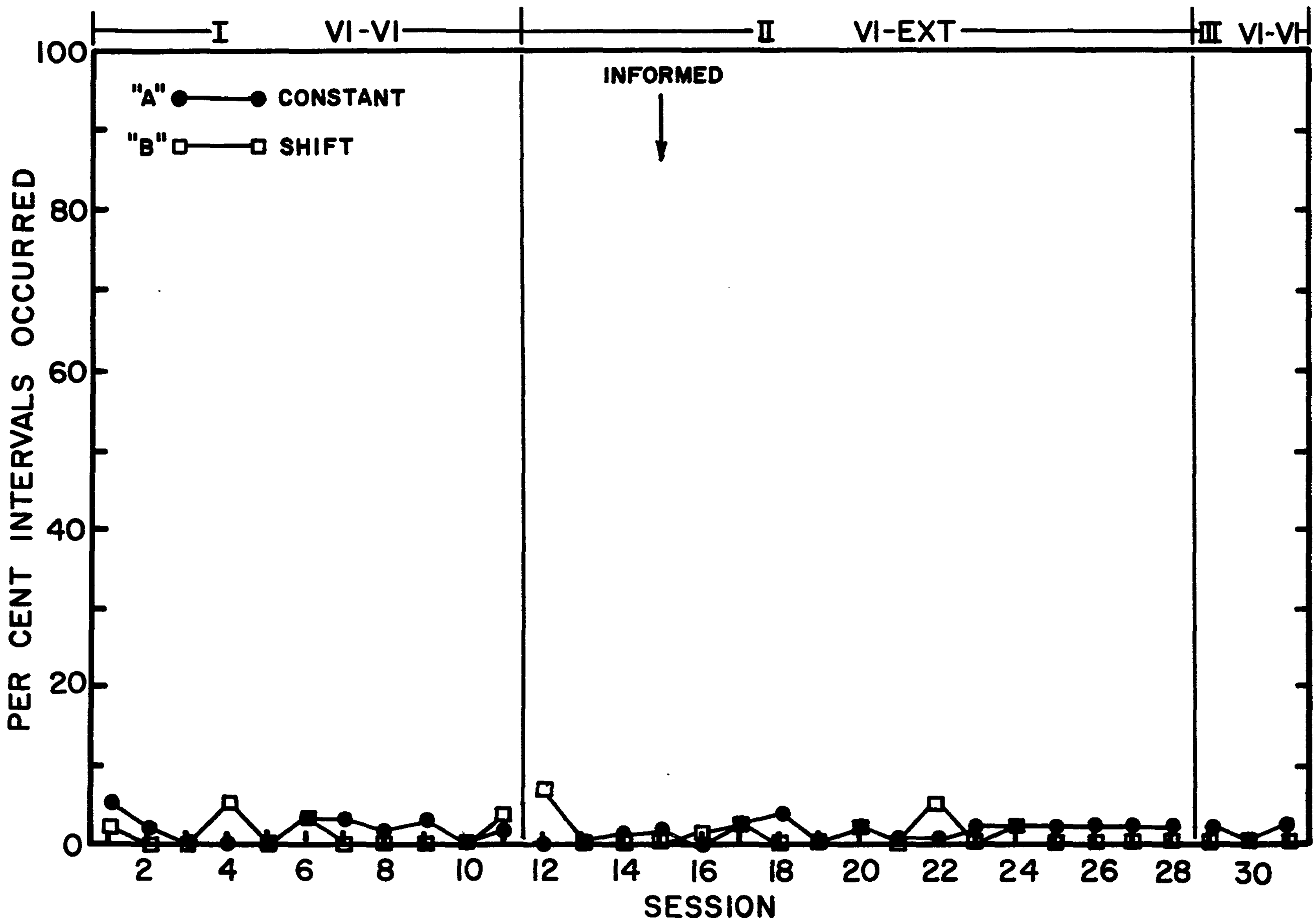

I VI-VI
II VI-EXT
III VI-VI
INFORMED
"A" CONSTANT
"B" SHIFT
PER CENT INTERVALS OCCURRED
100
80
60
40
20
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
SESSION

FIGURE 13

Responding by Phases and Components, Subject 2

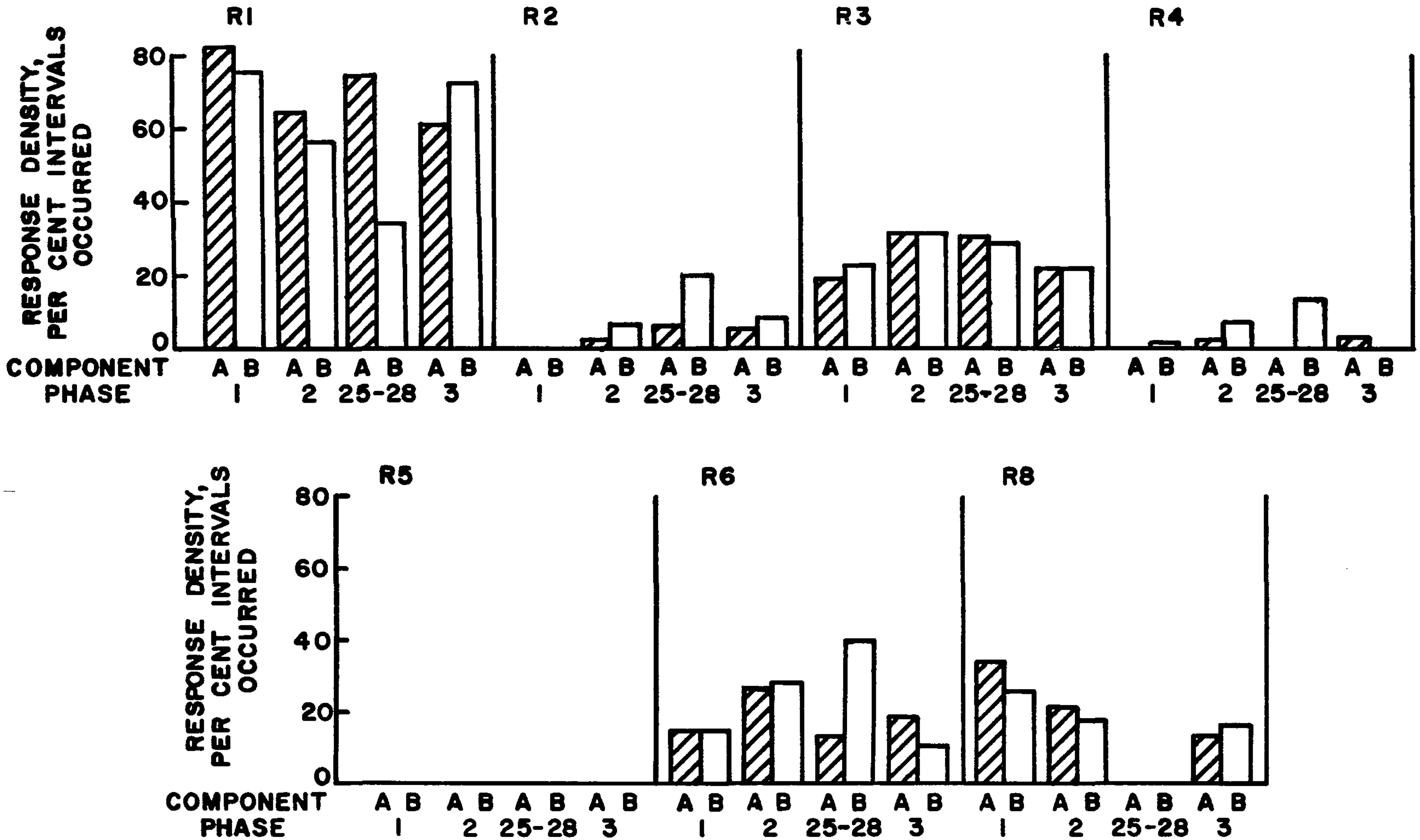
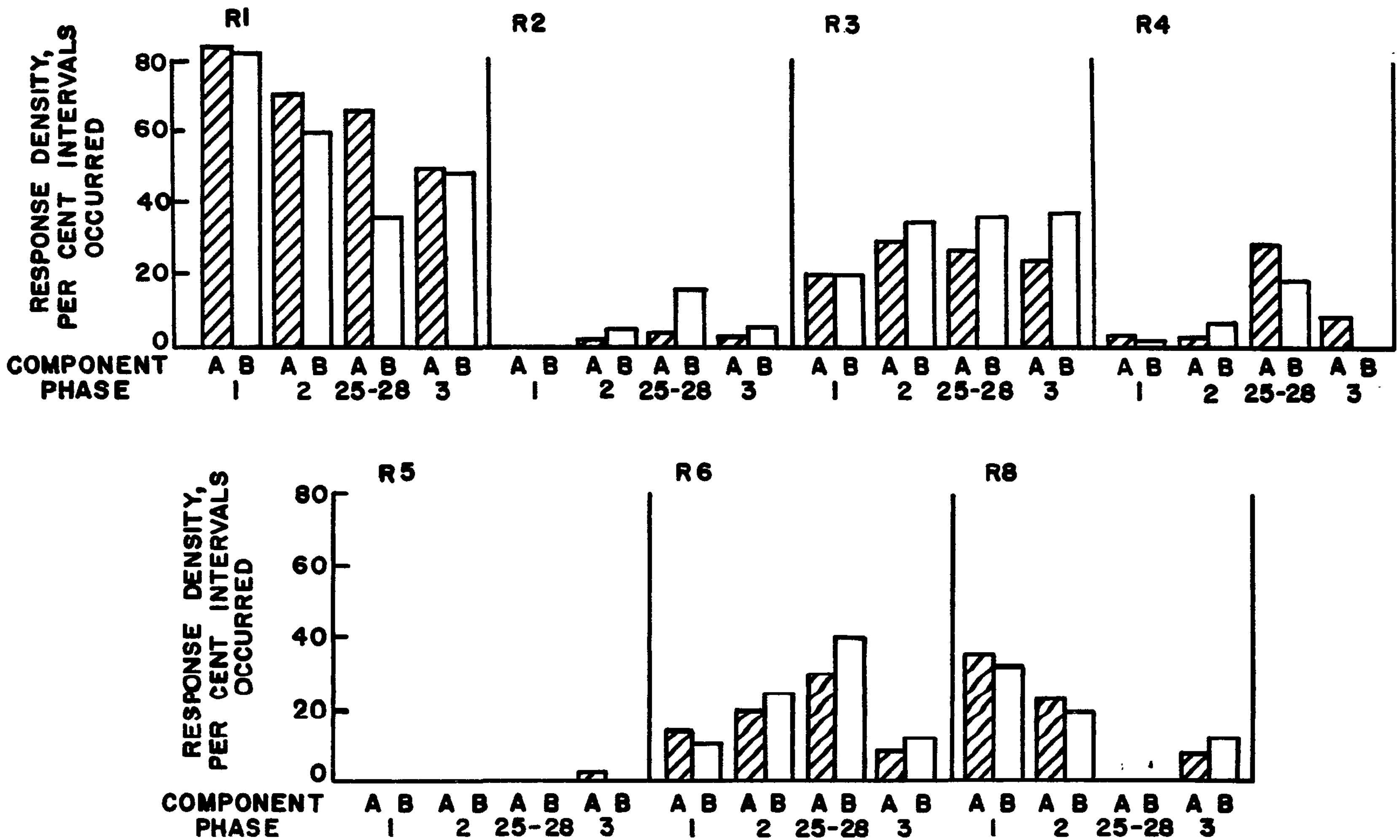

R1
R2
R3
R4
RESPONSE DENSITY, PER CENT INTERVALS OCCURRED
80
60
40
20
0
COMPONENT A B A B A B A B A B A B A B A B A B A B A B A B A B A B A B A B
PHASE 1 2 25-28 3 1 2 25-28 3 1 2 25-28 3 1 2 25-28 3
R5
R6
R8
RESPONSE DENSITY, PER CENT INTERVALS OCCURRED
80
60
40
20
0
COMPONENT A B A B A B A B A B A B A B A B A B A B A B A B
PHASE 1 2 25-28 3 1 2 25-28 3 1 2 25-28 3

FIGURE 14

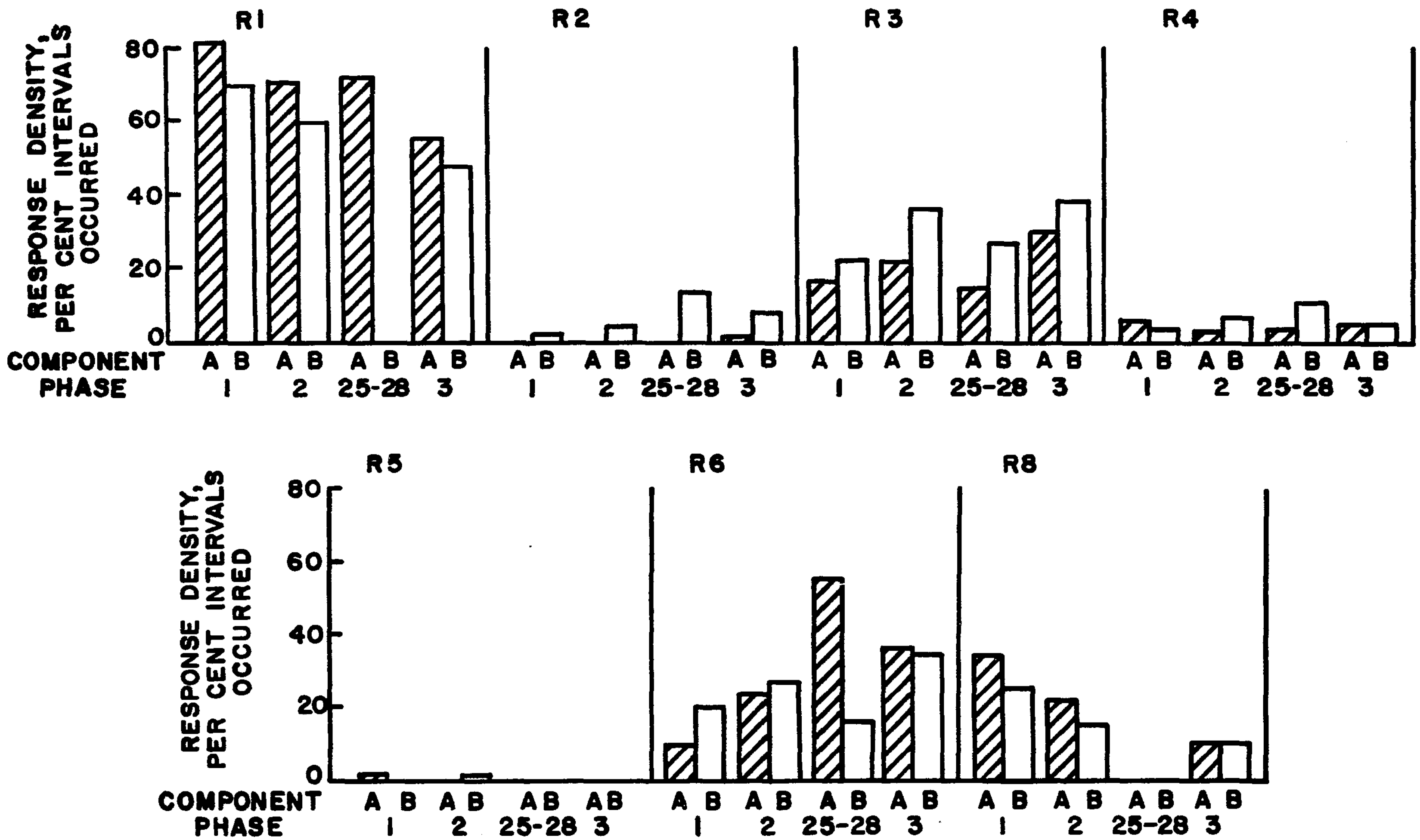
Responding by Phases and Components, Subject 4



R1
R2
R3
R4
RESPONSE DENSITY, PER CENT INTERVALS OCCURRED
0
20
40
60
80
COMPONENT
PHASE
A B A B A B A B
1 2 25-28 3
R5
R6
R8

FIGURE 15

Responding by Phases and Components, Subject 5


R1
R2
R3
R4
RESPONSE DENSITY, PER CENT INTERVALS OCCURRED
80
60
40
20
0
COMPONENT A B A B A B A B A B A B A B A B A B A B A B A B A B A B A B A B
PHASE 1 2 25-28 3 1 2 25-28 3 1 2 25-28 3 1 2 25-28 3
R5
R6
R8
RESPONSE DENSITY, PER CENT INTERVALS OCCURRED
80
60
40
20
0
COMPONENT A B A B AB AB A B A B A B A B A B A B A B A B
PHASE 1 2 25-28 3 1 2 25-28 3 1 2 25-28 3

related talking (R6) are problematical, since the differences persisted in Phase 3, a baseline recovery attempt. Individual patterns for S5, presented in Figure 15, when collapsed within phases, showed clear differences between only aggressive and/or complaining responding, R4, A and B components that did not persist into Phase 3. However, apparent differences between components occurred with S5 in Phase 2 for out-of-seat and stereotyped responding that persisted into the next phase. Data on the individual subjects for Sessions 25-28 yielded the clearest, largest differences in responding between the two component types (Figures 13, 14, and 15). In these sessions, the multiple responses under study showed differences in density as a function of whether the component was extinction or VI.

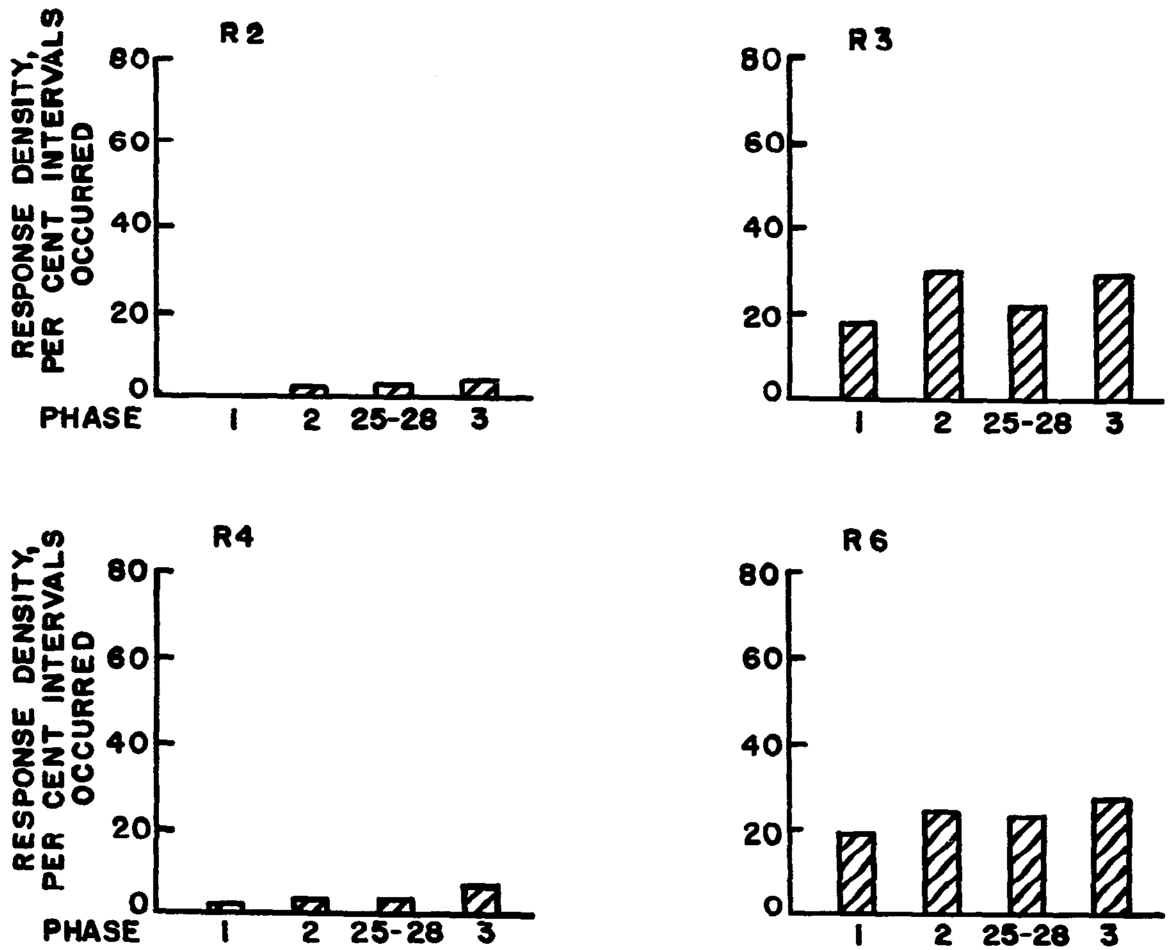
In summary, schedule control was demonstrated through differing densities, according to component type, in Phase 2 and particularly in Sessions 25-28, of the individually and the group-monitored contingent response of conjoint in-seat and attending to task. Undesirable responses of out-of-seat, aggressive and/or complaining, and non-task related talking yielded clearly higher densities in extinction components, relative to VI components, in latter sessions of Phase 2, MULT VI EXT. Stereotyped responding showed no clear pattern. Looking at the cue light occurred at a slightly higher density in VI components than EXT components once a discrimination was clearly acquired. Contrast did not occur.

Response Induction

Increases in the rates of occurrence of several responses other than the contingent response, or several R's, can be noted by inspecting Figure 12. Responses 2, out-of-seat; 3, stereotyped; 4, aggressive and/or complaining; and 6, non-task related talking, all showed increases in rates of occurrence in Phase 2 relative to Phase 1. The increases were maintained in the short recovery of baseline attempt, Phase 3, although differences between components tended to decrease. Combining both A and B components for analysis, R2 showed a 3.5% density increase in Phase 2 relative to Phase 1. R3 showed a 12% density increase in Phase 2. R4 showed a five percent increase in overall response rate in Phase 2 relative to 1, while the increase in R6 was approximately nine percent. Although inspection of Figure 12 reveals that the increases in rates in Phase 2 relative to Phase 1 on the various R's were due largely to increased responding in "B" components, Figure 16 shows that portions of the increases were results of increased responding in the "A," or constant VI components. Looking at the constant VI components alone, R2, out-of-seat, increased from 0% in Phase 1 to two percent in Phase 2 and three percent in Sessions 25-28. The rate of occurrence

FIGURE 16

Responding in the Constant VI Component, by Phases


R2
R3
R4
R6
RESPONSE DENSITY, PER CENT INTERVALS OCCURRED
0
20
40
60
80
PHASE
1
2
25-28
3

in the observation intervals was 18% in Phase 1, 29% in Phase 2, and 22% in Sessions 25-28 for R3, stereotyped responding. For R4, aggressive and/or complaining behavior, slight increases from two percent in Phase 1 to three percent in Phase 2 and Sessions 25-28 were found in the constant VI components. R6, non-task related talking, showed increases from 19% in Phase 1 to 24% and 23% respectively in Phase 2 and Sessions 25-28.

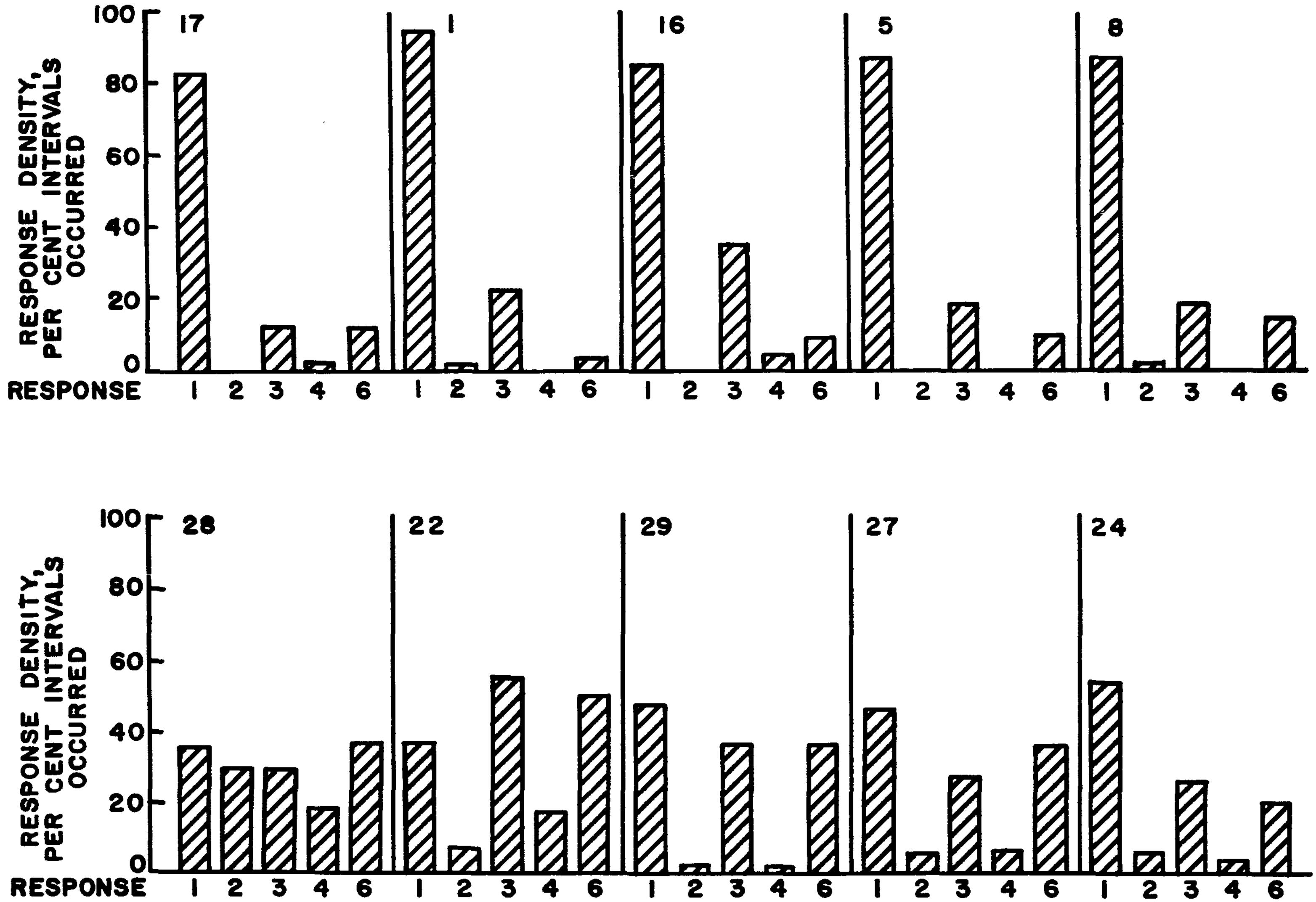
General Interactions of Responses

Figure 17 presents data showing inverse relations between R1, conjoint in-seat and attending, and the R's of out-of-seat, stereotypy, aggression and/or complaining, and non-task related talking. The data are presented within sessions. The upper portion of Figure 17 presents the five sessions in the study with the highest density of occurrence of R1. These sessions had relatively low rates of the undesirable R's 2, 4, and 6. Thus, in sessions with high rates of conjoint in-seat and attending, low rates of out-of-seat, aggression and/or complaining, and non-task related talking occurred. Conversely, looking at the bottom portion of Figure 17, relatively low rates of the desirable responses in a session were accompanied by relatively high rates of the undesirable responses.

In order to evaluate interactions of responses in regards to compatibility and incompatibility, a momentary

FIGURE 17

Interactions of the Individually Monitored Contingent Response (R1) with R's, Grouped Data on a Sessions Basis


RESPONSE DENSITY, PER CENT INTERVALS OCCURRED
RESPONSE
0
20
40
60
80
100
17
1
16
5
8
28
22
29
27
24
1 2 3 4 6

analysis was used in the calculations of conditional probabilities of the occurrence of Response X, given the occurrence of Response Y. Each observation interval was scanned by computer; given that Response Y occurred in an interval, the computer noted if Response X also occurred in that interval. Total conditional probabilities of Response X given the occurrence of Response Y were then tabulated by phases and component types.

Several types of interactions were possible, using the conditional probability model. Unidirectional compatibility and facilitation were obtained if the conditional probability of RX/RY was greater than the unconditional probability of occurrence of RX, <u>or</u> if the conditional probability of RY/RX was greater than the unconditional probability of RY's occurrence, but not both. Bidirectional compatibility and facilitation between RX and RY resulted if the conditional probability of RX/RY was greater than the unconditional probability of RX occurrence, <u>and</u> the conditional probability of RY/RX was greater than the unconditional probability of occurrence of RY. Compatibility without facilitation was yielded when the unconditional probability of RX was approximately equal to the conditional probability of RX/RY. Incompatibility between RX and RY was obtained when the probability of RX/RY was substantially lower, or near-zero, compared to the unconditional probability of occurrence of RX, and the probability of RY/RX was near-zero, compared to a higher probability of occurrence of RY, obtained unconditionally. Strong inverse relations were obtained between RX and RY when the conditional probability of one of the two responses was substantially lower than the unconditional probability of that response's occurrence.

The findings regarding interactions of responses on a momentary basis may be summarized as follows: The individually monitored desirable response of conjoint in-seat and attending, R1, showed bidirectional incompatibility with out-of-seat responding, R2; slight inverse relations bidirectionally with stereotyped responding, indicating compatibility with no facilitation; strong inverse relations with aggressive and/or complaining responding, R4, bidirectionally indicating incompatibility, but not reaching mutual exclusiveness; strong inverse relations with looking at the cue light, R5; and strong bidirectional inverse relations with non-task related talking, R6. The desirable response, in summary, showed strong inverse relations with undesirable responses, and compatibility with stereotyped responding.

Out-of-seat responding, R2, showed bidirectional compatibility and facilitation with aggressive and/or complaining behavior, R4. Out-of-seat responding also was bidirectionally compatible with non-task related talking, although strength of relations and presence or absence of facilitation differed across components and phases.

Stereotyped responding, R3, showed inconsistent relations across responses, phases, and components. However, it was bidirectionally compatible with the contingent attending response, and the three undesirable responses, out-of-seat, aggressive and/or complaining, and non-task related talking.

Aggressive and/or complaining behavior was bidirectionally compatible and yielded facilitation with non-task related talking, as well as with out-of-seat behavior. Taken as a group, the three undesirable responses were found generally to be compatible and facilitatory with one another.

Figures 18 through 23 illustrate various response interactions, using an analysis fully described above. The bars in Figures 18 through 23 with numbers at the top represent densities of the response without reference to a conditional relationship. For example, in Figure 18, under the heading R1/R2, the first bar to the very left of the graph has a 1 on its top. This density represents the percentage of occurrence of R1 in all intervals scanned in the study. The small bar to the right of this bar, without a number at its top, represents a conditional density, which is the density of occurrence of R1 given that R2 occurred in the interval. Unconditional and conditional densities of the various responses in Figures 18 through 23 are presented in the foregoing manner by components and phases.

FIGURE 18

Conditional Interactions of R1, Conjoint In-Seat and Attending, with Other Responses, Moment-by-Moment Analyses

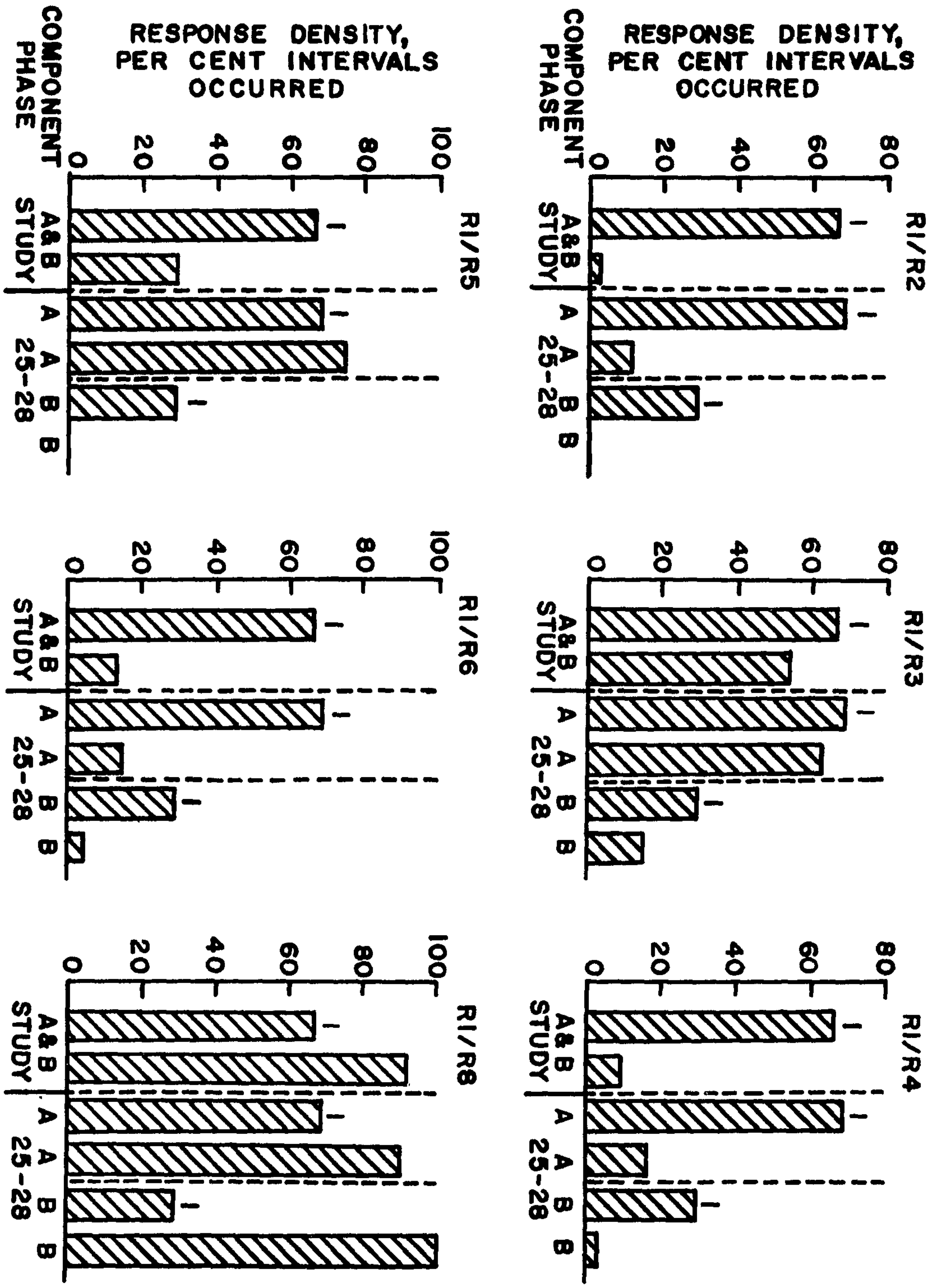

RESPONSE DENSITY, PER CENT INTERVALS OCCURRED
COMPONENT
PHASE
RI/R2
RI/R3
RI/R4
RI/R5
RI/R6
RI/R8
A&B
STUDY
A
A
25-28
B
B
0
20
40
60
80
100

FIGURE 19

Conditional Interactions of Out-of-Seat Behavior, R2, with Other Responses, Moment-by-Moment Analyses

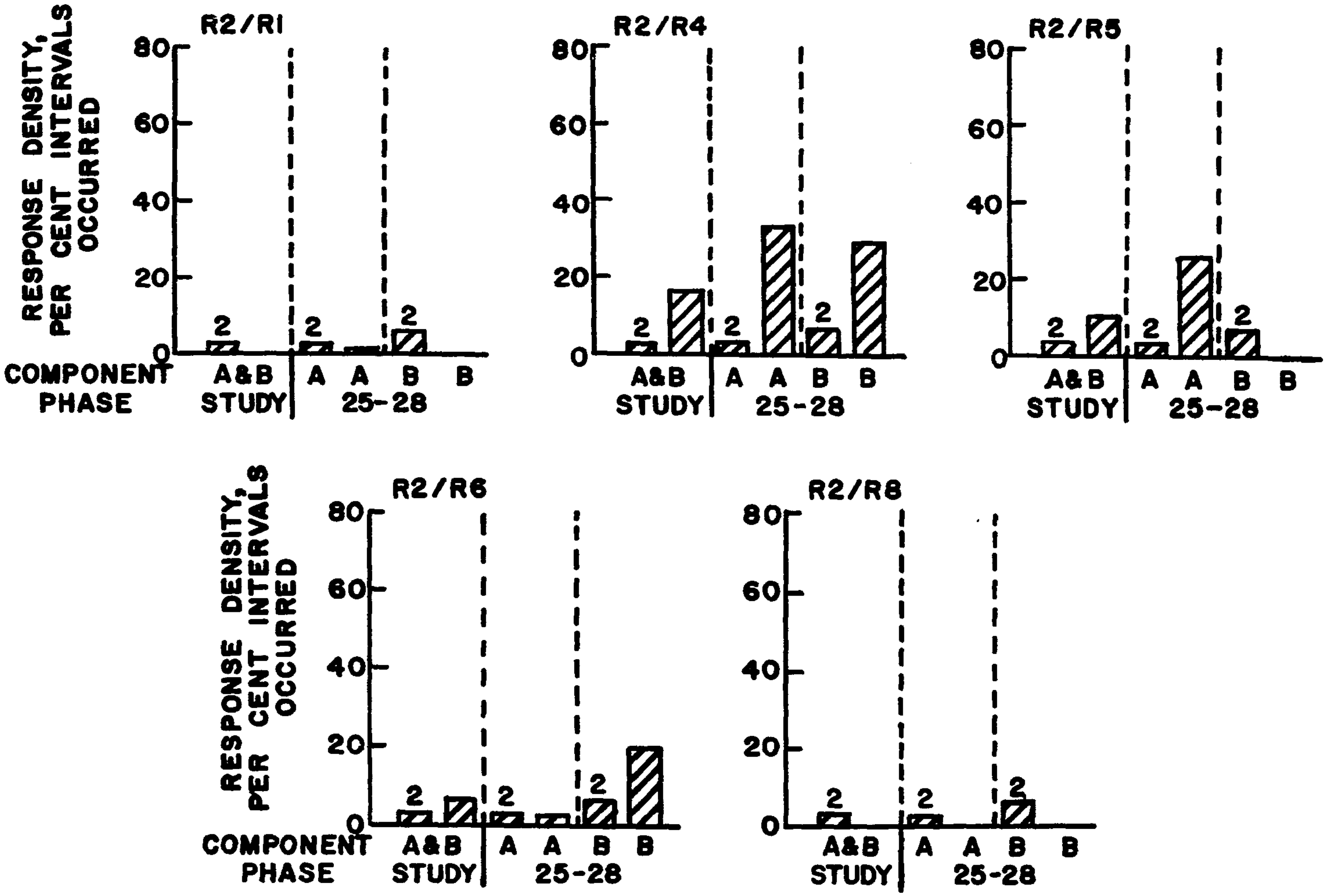

RESPONSE DENSITY, PER CENT INTERVALS OCCURRED
R2/R1
R2/R4
R2/R5
R2/R6
R2/R8
0
20
40
60
80
2
COMPONENT
PHASE
A&B
STUDY
A A B B
25-28

FIGURE 20

Conditional Interactions of R3, Stereotyped Behavior, with Other Responses, Moment-by-Moment Analyses

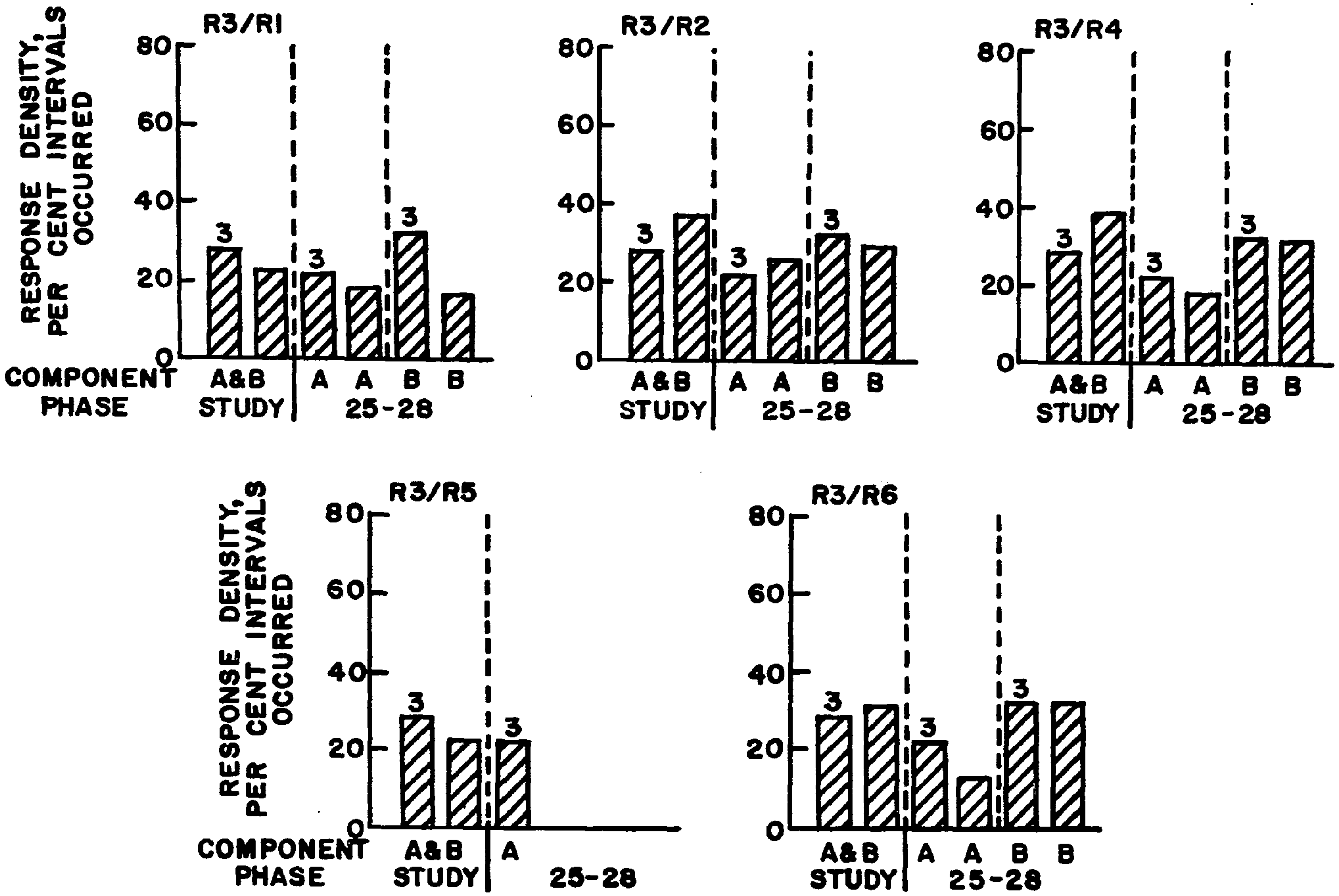

RESPONSE DENSITY, PER CENT INTERVALS OCCURRED
COMPONENT
PHASE
R3/R1
R3/R2
R3/R4
R3/R5
R3/R6
0
20
40
60
80
A&B
STUDY
A
B
25-28
3

FIGURE 21

Conditional Interactions of R4, Aggressive and/or Complaining Behavior, with Other Responses, Moment-by-Moment Analyses

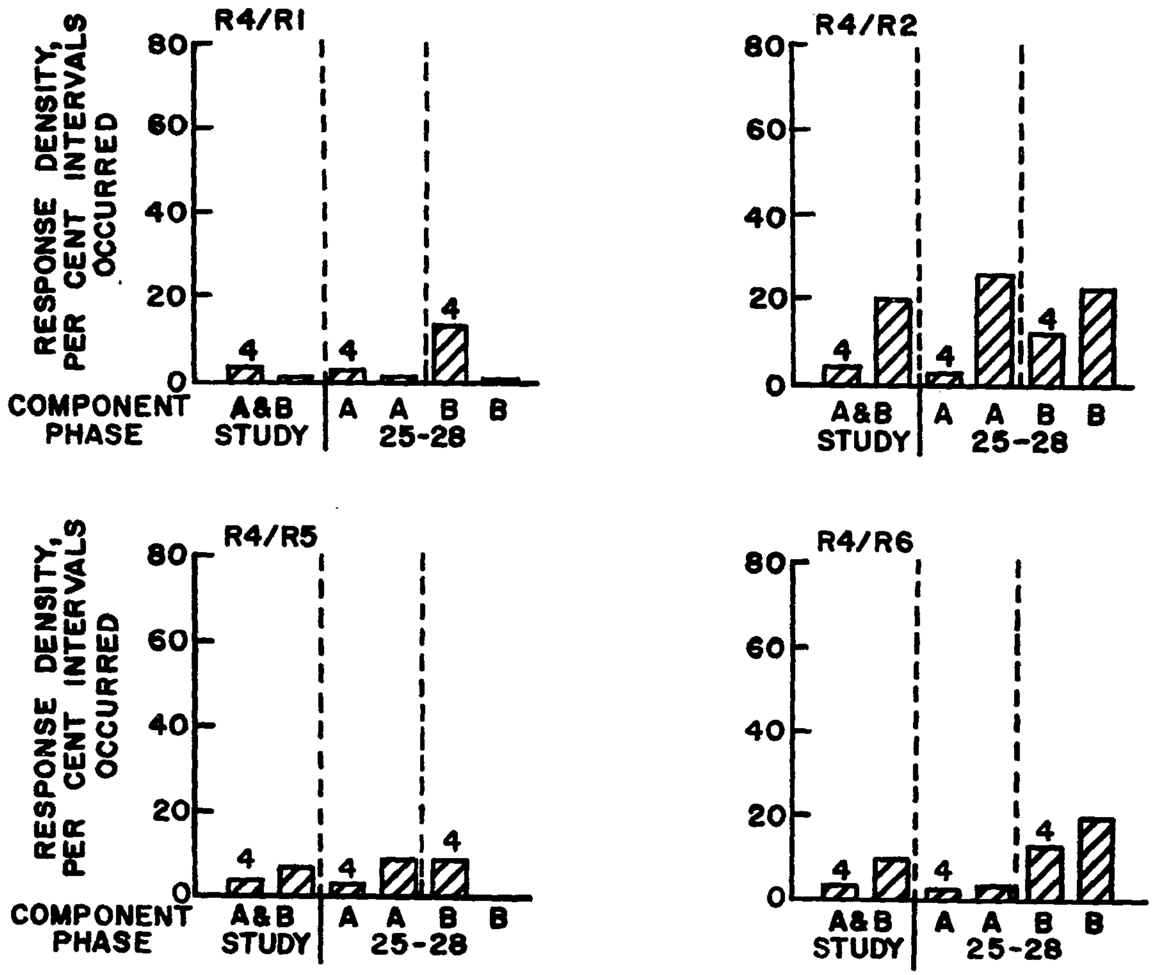

R4/R1
R4/R2
R4/R5
R4/R6
RESPONSE DENSITY, PER CENT INTERVALS OCCURRED
COMPONENT
PHASE
A&B
STUDY
A A B B
25-28

FIGURE 22

Conditional Interactions of R5, Looking at the Cue Lights, with Other Responses, Moment-by-Moment Analyses

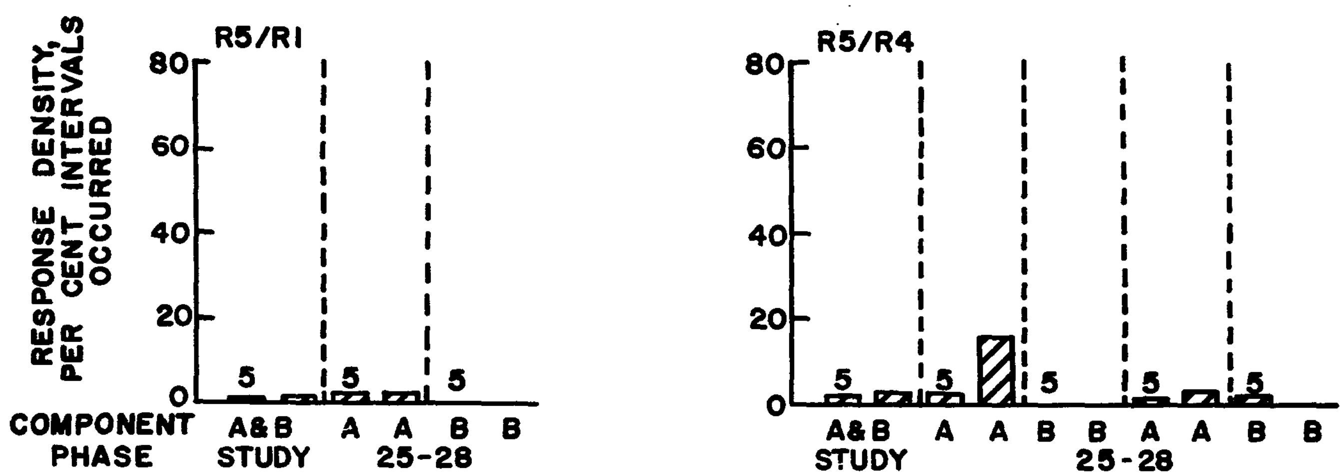
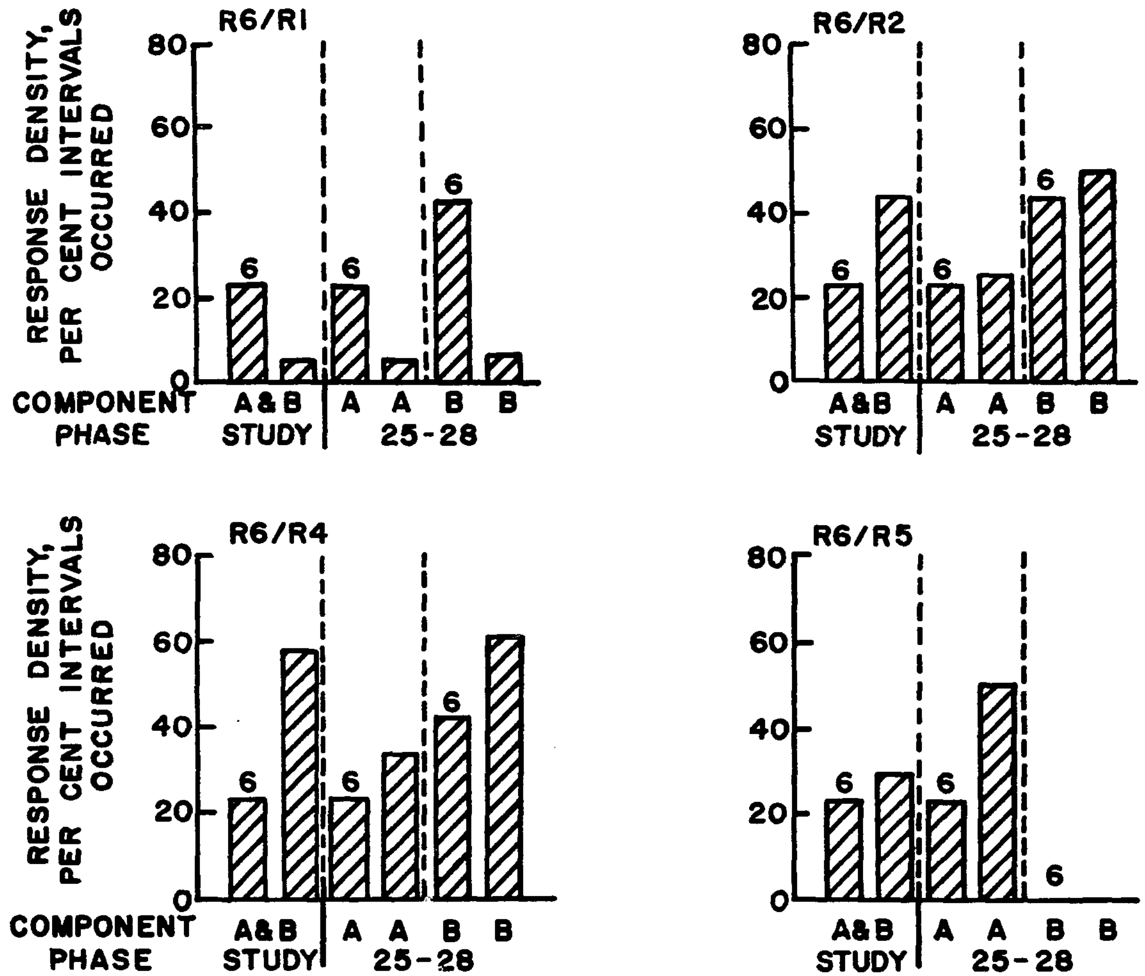

R5/R1
RESPONSE DENSITY, PER CENT INTERVALS OCCURRED
80
60
40
20
0
5
5
5
COMPONENT
PHASE
A&B
STUDY
A
A
B
B
25-28
R5/R4
80
60
40
20
0
5
5
5
5
5
A&B
STUDY
A
A
B
B
A
A
B
B
25-28

FIGURE 23

Conditional Interactions of R6, Non-Task Related Talking, with Other Responses, Moment-by-Moment Analyses


R6/R1
R6/R2
R6/R4
R6/R5
RESPONSE DENSITY, PER CENT INTERVALS OCCURRED
0
20
40
60
80
6
COMPONENT
PHASE
A&B
STUDY
A
A
B
B
25-28

The two "phases" presented in these figures represent the study as a whole and Sessions 25-28 as a block.

Analysis of response interactions within individual subjects, without grouping data, is possible from inspection of Table 2. Subject 1 showed the lowest density of R1 for the overall study. He had, conversely, the highest densities of R2 and R6, out-of-seat and non-task related talking. R4, aggressive responding, was second out of five subjects in rank for S1. S4 had the highest density of R1 for the overall study, and the lowest densities of the undesirable responses, R2 and R6. S2 had the second highest density of R1, and the second lowest density of R6, with the lowest density of R4.

Symptom-Response Substitution

Symptom substitution was redefined in the introduction as inverse response covariance of an undesirable nature. For the purposes of this investigation, instances of symptom-response substitution were defined operationally as any decreases in certain responses in VI components of Phase 2, concomitant with increases in undesirable responses in the same VI components. However, all responses except for R1, conjoint in-seat and attending, increased in Phase 2 relative to Phase 1. The specific prediction that a decline in R2, out-of-seat, would necessarily result in increases in the rate of R1 responding, and that in turn stereotyped

TABLE 2

Response Densities for Individual Subjects Across the Study

Subject	1	2	3	4	5	6
1	.6295	.0479	.2668	.0479	.0337	.2591
2	.6786	.0291	.2672	.0291	.0026	.2143
3	.6486	.0324	.3315	.0342	.0072	.2306
4	.7063	.0240	.2817	.0360	.0040	.1923
5	.6705	.0244	.2665	.0487	.0086	.2421

or other undesirable responding would increase in VI, was precluded by increases in the rate of out-of-seat responding in Phase 2. Thus, although undesirable responses such as out-of-seat, stereotyped responding, aggressive responding, and disruptive talking all showed density increases in VI components of Phase 2, symptom-response substitution could not occur, since no undesirable response showed rate declines in VI components. Only the desirable response, R1, declined in Phase 2 relative to Phase 1. (See Figure 12 for specific percentages of response densities in the various phases.)

Temporal Effects Within Components

Temporal effects were analyzed within components by dividing each component into five bins of equal sizes. Percentages were then obtained for responding within components by phases, for the study as a whole, and for responding within A and B components separately. Chi-square analyses (Alder and Roessler, 1964) were computed on the obtained distributions to evaluate differences from expected distributions. If responding were evenly or unsystematically distributed within components, then division into five bins of equal interval sizes should have resulted in 20% of the occurrences of each response occurring in each bin.

Table 3 presents percentages of responses occurring within components for the study as a whole, collapsing

TABLE 3

Responding Within Components According to Percentages of Response Occurrence Divided into Five Bins of Equal Interval Size, with Chi-Square to Test Differences from Expected Distributions of 20% Occurrence Within Each Bin

STUDY AS A WHOLE, ACROSS COMPONENTS

Response	Bin 1	2	3	4	5	
1	20	20	20	20	20	NS
2	31	20	19	19	17	*
3	19	22	19	19	21	NS
4	22	18	19	23	18	NS
5	70	10	10	7	3	***
6	22	20	18	20	20	NS
8	20.5	20.5	20.5	20.5	18	

*p < .10 **p < .05 ***p < .01

SESSIONS 25-28

Response	Component	Bin 1	2	3	4	5	
1	A	21	18	20	21	20	NS
1	B	12	18	15	30	25	**
2	A	26	37	11	0	26	***
2	B	36	21	15	14	14	***
3	A	16	24	18	24	18	NS
3	B	20	19	19	16	26	NS
4	A	50	33	0	17	0	***
4	B	20	17	33	20	10	***
5	A	100	0	0	0	0	***
5	B	0	0	0	0	0	---
6	A	20	19	16	21	24	NS
6	B	26	17	20	20	17	NS

*p < .10 **p < .05 ***p < .01

across phases and A and B components. Bin distributions are also presented for Sessions 25-28, when discrimination between A and B components was clearly obtained. Looking at the study on an overall basis, R1 and R8, the individual and group-contingent conjoint responses of in-seat and attending, were nonsignificantly different from expected ($\chi^2 = 0$, df = 4, $p > .05$); ($\chi^2 = .25$; df = 4, $p > .05$). Their distributions within components exactly or closely approximated 20% relative densities within each of the five bins, showing that R1 and R8 occurred with equal probabilities within different temporal compartments of components. Again considering the study as a whole, R3, stereotyped responding, also showed even distribution within components ($\chi^2 = .40$, df = 4, $p > .05$). R6, non-task related talking, also resulted in even or nonsystematic distributions within components ($\chi^2 = .40$, df = 4, $p > .05$), when considering the study as a block, as did R4, aggressive and/or complaining behavior ($\chi^2 = 1.1$, df = 4, $p > .05$). R2, out-of-seat responding, however, resulted in higher percentages of response occurring in initial bins of the components, or soon after transitions ($\chi^2 = 9.0$, df = 4, $.10 > p > .05$). Seventy percent of the occurrences of R5, looking at the cue light, occurred in the first bin after transitions; the distribution is significantly different from an expected distribution of 20% per bin at the .01 level ($\chi^2 = 157.9$, df = 4).

In considering distributions of the various responses within components of Sessions 25-28, interesting differences were obtained as functions of whether the component was "A," or VI, or "B," EXT. The temporal distribution of R1 responding within the VI components of Sessions 25-28 was nonsystematic ($\chi^2 = .30$, df = 4, $p > .05$). However, R1 responding within the extinction components showed density increases in the last two bins that divided the components. The first bin yielded 12% of the responses that occurred in the EXT components of Sessions 25-28, while the last two bins showed 30% and 25% figures. The obtained distribution was significantly different from expected at the .05 level ($\chi^2 = 10.9$, df = 4).

For R2, out-of-seat, responding with both A and B components yielded distributions that differed significantly from expected at the .01 level of significance (A: $\chi^2 = 42.1$, df = 4); (B: $\chi^2 = 17.7$, df = 4). However, while relative occurrence of R2 responding in the VI components of Sessions 25-28 was high in the first two bins, declining in the third and fourth bins, and increasing again in the fifth bin, the pattern differed in the B, or extinction components. Consistent decline in R2 responding during extinction was yielded from the first bin to the fifth, or last bin. In other words, initial high relative occurrence of out-of-seat was seen initially after transitions from

VI and TO, with progressive decreases as the EXT component progressed, and the onset of a VI component approached.

R3, stereotyped responding, and R6, non-task related talking, yielded approximately equal bin distributions, regardless of the component type in Sessions 25-28. The distributions were nonsignificantly different from expected at the .05 level. However, it may be of interest that the highest relative percentage of non-task related talking in the VI components of Sessions 25-28 occurred in the last bin, or the bin preceding transition to TO and EXT. On the other hand, the highest relative occurrence of R6 in the EXT components was found in the first bin, or the intervals following transitions from TO to VI.

R4, aggressive and/or complaining behavior, yielded high relative rates of occurrence in the first two bins after transitions from EXT and TO, as can be seen in Table 3. What appeared to be transpiring during the course of these sessions, within the VI components, was that aggressive behavior would carry over from TO periods into the initial intervals of the "A," or VI components. Aggressive behavior was not mutually exclusive with the contingent response, in-seat and attending, but the two types of behavior were strongly inversely related. When the schedule exerted effect, and reinforcers were delivered, usually well past the first few intervals after transition in this phase, aggressive responding then declined. The distribution obtained for R4 responding in bins within extinction components of Sessions 25-28 was also significantly different from expected ($\chi^2 = 13.9$, df = 4, $p < .01$). However, there was not a clearly high relative rate of occurrence of R4 responding in the initial bins. The highest relative rate within the EXT components was in the third, or middle, bin. The lowest relative rate of aggressive and/or complaining behavior within the EXT components of Sessions 25-28 was in the last bin, or the intervals preceding transition to VI components. It should be noted, parenthetically, that since R4 occurred in EXT at a factor of three times the rate of its occurrence in VI of these sessions, the frequencies contributing to the percentages portrayed in Table 3 are discrepant according to component type. Thus, the percentages of 4B are less affected by one or two occurrences of the response than those of 4A.

R5, looking at the cue light, did not occur within EXT components in Sessions 25-28. Although it occurred only four times, once in each session, in the VI components of Sessions 25-28, its occurrence was solely restricted to the first bin, or the intervals starting a session of following transitions.

Responding following reinforcement was also analyzed using a bin approach. As expected, reinforcement delivery resulted in momentary disruption of the contingent response for the group and for the individual subject under observation, followed by increases back to pre-delivery levels of occurrence. Out-of-seat, aggressive, and disruptive talking behavior all increased in the bins following reinforcement delivery and soon declined to pre-delivery levels.

Another result showing precise temporal compartmentalization was previously described under Schedule Control. Frequently, immediately upon transition to TO, one or more subjects would engage in out-of-seat, stereotyped, aggressive, and/or non-task related talking behavior. Disproportionately high rates, relative to components, of these behaviors were thus yielded in TO periods.

CHAPTER IV

DISCUSSION

The primary purpose of this investigation was to extend the behavioral stream approach (Schoenfeld and Farmer, 1970) in experimental, theoretical, and applied areas. Interactions of multiple responses were studied in order to approximate the complexity of ongoing behavior, and to extend past investigations of the effects of contingent stimulation on noncontingent responding (Ferritor et al., 1972; Gibson, 1974; Kirby and Shields, 1972; Rand, 1974; Schoenfeld and Farmer, 1970; Staddon and Simmelhag, 1971). The responses investigated were chosen for theoretical relevance to important issues such as response compatibility and incompatibility (Hinde, 1970; Terrace, 1974) and symptom-response substitution (Cahoon, 1969; Mischel, 1968). A multiple schedule was used to investigate the effects of distal stimulus input on current responding in the stream. A moment-by-moment analysis was employed to elucidate response interactions occurring in close temporal proximity, and to investigate temporal relations between responses and stimulus events. Before proceeding to discussion of these areas, an important, although unexpected, finding that resulted from the study of multiple responses in interaction, will be discussed: a relationship between response density and interrater reliability.

Interobserver Agreement, Response Density, and Multiple Responses

A direct relationship between response density, or relative frequency, and interobserver agreement was found across observers, occasions, and responses. The strength of the relationship was moderately strong (.55-.61 correlation) when the entire range of response densities was considered. When densities at the extreme low end of the range were dropped from the analysis, the relation between density of responding and interobserver agreement was extremely high (.92-.96). Johnson and Bolstad (1973) from a personal communication with Gerald Patterson, reported a correlation of .49 between interobserver agreement and response frequency. However, no data were presented.

These findings indicate that empirically one might expect to obtain higher percentages of interobserver agreement when responding is relatively frequent in time. On a chance level alone, using the particular formula used in this study to calculate interobserver agreement, agreement is expected to increase as a curvilinear function of response density. The level of interobserver agreement obtained empirically might be profitably measured against the level expected by chance. For example, interobserver agreement of 80% might be considered excellent for a response that occurred in 30% of scoring intervals, since by chance alone nine percent agreement would be the expected level. However, if the response occurred 85% of the time, interobserver agreement of 80% would not look nearly as impressive alongside the chance expected figure of 73% agreement.

Chance alone could not have accounted for the reliability figures obtained in this study, since they were significantly different from chance, and differed in obtained levels between the two observers. Possible factors affecting the empirically obtained functions in this investigation include not only chance and probability, but also variables that could be subsumed under vigilance and stimulus control. Additional study would be required to specify the controlling variables. Investigation of any possible relationships between response density, interobserver agreement, and validity await studies in which response density is objectively known.

In spite of these findings, the suggestions to researchers who use humans for observation purposes are in harmony with previous reviewers who have discussed reliability and associated methodological problems (Johnson and Bolstad, 1973; Lipinski and Nelson, 1974a). The formulas used to calculate interobserver agreement can yield differing figures, given that the data remain the same (Johnson and Bolstad, 1973; Lipinski and Nelson, 1974a; Repp, Deitz, Boles, Deitz, and Repp, 1974). Problems of reactivity have occurred with the presence of human observers in the experimental situation and observer bias has been found to have contaminated results (Johnson and Bolstad, 1973; Lipinski and Nelson, 1974a). Knowledge that interobserver data are being taken has been found to affect the agreement levels obtained (Lipinski and Nelson, 1974a, b; Reid, 1970). Instead of concluding that obtaining figures of interobserver agreement is a futile endeavor, reviewers (Johnson and Bolstad, 1973; Lipinski and Nelson, 1974a; Repp et al., 1974) have suggested that various findings be applied in ways that enhance the meaning of measurements of inter-observer agreement in the experimental literature. In harmony with this orientation, the findings of the current investigation in regard to what is commonly known as reliability point up the need to consider response density and chance levels of agreement in evaluating reliability data.

The low, although significant, levels of inter-observer agreement found in this investigation for the noncontingent responses, or R's, add "noise" to statistical analyses. Assuming that any effects found in the study are valid, they could be considered sufficiently robust effects to withstand "noise" from low levels of observer reliability. Additionally, it is possible that some effects were masked by "noise" from low levels of reliability.

Schedule Control

The minimal finding required to seriously consider relations between stimulus events and responding was discriminative control of the multiple schedule on responding. A group contingency was used in an attempt to produce discriminative responding in individual organisms. Contingent responding was significantly different in the second phase of the study between VI and extinction components of the schedule, whereas differences in contingent responding were not significantly different between reinforcement components in the first and third phases. Additionally, the undesirable responses of out-of-seat, aggression and/or complaining, and non-task related talking differed significantly in the second phase, but not in the first and third phases, between constant and shifted components. All six responses monitored in the study showed clearest and largest separations between components at the end of the second phase, MULT VI EXT, in Sessions 25-28. The differences were found both for the group of subjects as a whole and for the subjects individually.

The failure to find a complete discrimination between components,as would be evidenced by zero or near-zero rates of contingent responding in extinction components (e.g., Rand, 1974; Waite and Osborne, 1972) was probably due to several factors. Extinction in this investigation consisted procedurally of withholding M and M's, check marks, and the possibility of earning toys during extinction components. Social consequation, identical to that in reinforcement components, continued in extinction components. Subjects were told to "get back to work" after approximately two minutes of non-attending. Generalization from the ordinary classroom, past history of reinforcement for work completion, and past interactions from previous authority figures, probably were influencing factors in maintaining non-zero rates of attending during extinction. These factors might also help to account for the number of sessions before dramatic differences between rates of responding appeared in Sessions 25-28. These factors notwithstanding, Sessions 25-28 showed progressive declines in the rates of the contingent response in extinction, to the point in Session 28 where the contingent response occurred for the group at an average rate of 65% of the intervals in reinforcement components, and nine percent in the extinction components. Therefore, it is possible that continuation of the second phase might have resulted in a complete or near-complete discrimination in responding between the two types of components. Although various R̸'s also showed clear discrepancies that were increasing in Sessions 25-28, the presence of R̸ responding in reinforcement components is probably explicable in terms of induction and the contingent response not occurring at ceiling rates.

Although Phase 3, a recovery of baseline attempt, using MULT VI VI, did result in lessening of separations between components, equality between components was not fully achieved across all responses, nor were baseline rates of responding fully recovered. Possible explanations for this failure to obtain full recovery include the brevity of the recovery attempt (three sessions); the approaching end of the school year, which reportedly makes children more "active" across many situations; and persisting induction from the second phase to the third, recovery of baseline, phase.

Contrast, Induction, and Compartmentalized Responding: Effects of Distal Stimulus Input

Waite and Osborne (1972) were the first investigators to find sustained behavioral contrast with humans as subjects. Recently Terrace (1974) has also found contrast with humans, using a discrimination paradigm. Earlier work (e.g., Terrace, 1966) had viewed contrast phenomena as controlled by differences in reward densities between stimulus situations. Using the language employed in this investigation, contrast was seen as due to changed responding in a situation, due to the effects of distal stimulus input from another situation. Rachlin (1973), however, reviewed previous contrast work and concluded that contrast was due to interactions of two discrete responses between and within components of multiple schedules. The "operant" consisted of two different responses, one instrumental, the other "elicited." Contrast was thus due (in pigeons, at the least) to a stimulus-reinforcer relation and the so-called operant, rather than the operant's strength varying as a function of shifting reinforcement densities.

The current investigation sought to see if Rachlin's analysis was limited to nonhuman organisms by employing a "natural" response with no obvious response-reinforcer relations of the type discussed by Rachlin (1973). Contrast with humans, using a more "natural" response to the organism than lever- or button-pressing, was not found in this investigation. A shift in a distal stimulus condition from reward to extinction resulted in a decline, as opposed to the expected increase, in a constant reward condition. Additionally, the non-contingent responses under study increased in rate not only in the extinction components, as expected, but also in the constant reinforcement components of the second phase. Contrast did not occur with these responses, since the defining criterion is rate change in opposite directions in different components.

Reasons for the failure to obtain contrast are not limited to failure to employ responses with "elicited" components and stimulus-reinforcer-response prewired relationships. One possibility is that contrast does not appear until some time after a clear discrimination is obtained. In this study, large absolute differences in responding were not generally obtained until near the end of the second phase, in the last several sessions before the switch to a recovery attempt was required by the approaching end of subject availability. Decline to near-zero rates during EXT in the contingent response did not occur until the last session of the MULT VI EXT condition. If a precurrent condition to obtaining contrast is either large absolute rate differences between components or near-zero contingent responding in extinction, then failure to obtain contrast in this study may have been solely due to not running the second phase until any pre-condition was satisfied. Slight support for this hypothesis is contained in data showing that in Sessions 25-28, the rate of contingent responding in the constant reinforcement components was slightly higher than that in reward components of the second phase as a whole, although still markedly lower than in the first phase.

The generally declining rate in contingent responding in constant reward components across the study could alternatively be due to decreasing potency of the social consequation in the components. As subjects found that social consequation was rarely backed up by more powerful or primary consequences, and primaries were withdrawn in extinction components while social consequation continued, the potency of any social consequation could have declined.

The decline in the potency of social consequation, if real, could have accounted or partially accounted for general decline in contingent responding in reward components as the study progressed. As mentioned before, a decline in contingent responding requires increases in rates in one or more noncontingent responses. Therefore, the increases in noncontingent responding in EXT would not be expected to be matched by contrast, or decrease, in the rate of non-contingent responses in VI, since the contingent response had decreased in VI. Other possibilities as to why contrast was not obtained in this study include general decline in attending to task as a function of the approaching end of the school year. However, increases in attending in recovery, comparing shifted component to shifted component (EXT to VI) of Phase 3 over Sessions 25-28, tend to weigh against this hypothesis. A ceiling effect is also possible, since it may be difficult to get children using a group contingency to attend over 80% of the time, as the subjects did in Phase 1. However, a ceiling effect, although precluding contrast from occurring in the contingent response, would not necessitate a rate decline, as did occur.

In this investigation, the use of a group contingency and "natural" responses did not result in contrast. The findings neither add nor detract from Rachlin's (1973) analysis, since many interpretations are possible in explanation of failure to obtain contrast.

The effects of distal stimulus input on current responding are more apparent when one turns to phenomena of induction, generalization, and compartmentalization in reference to responses other than the response that was under programmed contingency. Clear density increases were found for the undesirable responses of out-of-seat, aggressive and/or complaining, and non-task related talking, when comparing the constant VI components in Phase 2 and Sessions 25-28 to those in Phase 1. A shift in a distal stimulus condition from VI to EXT resulted in changes in responding in a constant, unshifted, VI condition. The conclusion would be more firmly supported if the recovery attempt in Phase 3 had returned rates of these responses to baseline levels. However, separation between components did decrease in the recovery phase. Persistence in increased rates of the noncontingent responses could be accounted for by brevity of the recovery attempt; nonrecovery of the rate of the contingent response, thus requiring relatively high levels of the noncontingent responses; continuing induction from the original shift; and/or the approaching end of the school year. In any event, the finding that increased noncontingent responding in a constant condition was coincident in time with change in a distal stimulus condition is not in doubt.

Distribution of responding across temporally compartmentalized bins yielded important results on response relations and stimulus events. Not surprisingly, it was found that reinforcement occurrence resulted in brief declines in the rate of the contingent response; brief increases in the rates of various noncontingent responses were also noted. Returns to pre-reinforcement rates of responding were found across responses soon after a brief period of rate changes. This finding is also not surprising, since the reward schedule in reinforcement conditions was a random VI; delivery of reinforcement did not predict interreinforcement time within components. Staddon and Simmelhag (1971) found similar effects using a VI schedule. Consummatory responses were in evidence in the brief periods of disruption following reinforcement delivery, at which time increases in out-of-seat behavior, aggression and/or complaining regarding the handing out and obtaining of M and M's, and non-task related talking would be expected. Nonpredictability of interreinforcement time from reinforcement delivery should have resulted in only momentary disruption in ongoing rates; the prediction was confirmed by the findings.

If, on the other hand, a fixed-interval (FI) schedule were used in reinforcement conditions, then bin analyses following reinforcement delivery should result in more than brief disruptions in ongoing responding, and clear temporal patterning should emerge. Staddon and Simmelhag (1971) found these results using an FI schedule and infra-human organisms;

a study replicating Staddon and Simmelhag (1971) using humans and an FI schedule has yet to be done.

Dividing A and B, or constant reward versus shifted reward-extinction components, into five bins of equal sizes, also yielded important findings. Collapsing across the study and across the two component types, it was found that responding was scattered approximately equally across bins within components for the contingent response, stereotyped responses, aggressive responding, and non-task related talking. Out-of-seat behavior showed a clear high relative rate of occurrence in early portions of components, soon after transition, collapsing across all phases of the study. Seventy percent of all occurrences of looking at the cue light occurred in the first bin after transition, or onset of a component.

The meaning of such results is of importance to an analysis emphasizing distal input and lawfulness in momentary responding. Findings regarding bin distributions of the various responses in Sessions 25-28, separated according to VI or extinction components, elucidate possible control of immediate responding by both current and distal stimulus input. For the contingent response, R1, conjoint in-seat and attending, responding was approximately equal across bins in the reward components. However, R1 responding was relatively higher in the last two bins of the extinction component than in the three earlier bins. Ferster and

Skinner (1957) found that responding in later portions of one component of a multiple schedule was sometimes affected by the other component. Rather than refer to "superstition" as did Ferster and Skinner (1957), it may be more appropriate to refer to proximity, as do Staddon and Simmelhag (1971) in explaining relations between compartmentalized responding and timed stimulus events. Nonsystematic distribution of R1 responding found in Sessions 25-28, reward components, of this study, indicates steady control of the prevailing reinforcement schedule. The increasing rate of R1, attending to task in the extinction components, may be due to proximity to the next successive component, which was a reward component.

Bin distributions of the undesirable responses yielded results that indicate possible control of immediate responding within components by proximity to temporally removed components. In general, the findings were that undesirable responding increased in VI components as proximity increased to onset of extinction components. Conversely, in general undesirable responding decreased in extinction components as proximity increased to onset of VI components.

Stereotyped behavior showed nonsystematic distributions of rate in all bin analyses conducted, including Sessions 25-28. Such behavior may be relatively independent of stimulus events, or may come under exteroceptive stimulus control only under extreme circumstances. However, effects could have been masked by "noise" from low reliability.

R5, looking at the cue light, occurred only in the first few intervals of reinforcement components in Sessions 25-28. It did not occur in extinction components, or was not observed to occur. It can be inferred that looking at the cue light, or being informed by another subject that the cue light was in a certain condition, governed not looking at the light in successive intervals of the reward components. No information would be added by subsequent inspection within a component.

The effects of distal stimulus input on current responding have been seen in results showing induction in constant situations following shifts in distal situations, and in results showing compartmentalization of responding as possible functions of conditions prevailing in antecedent or consequent conditions, removed from the ongoing component. Contrast, which when found may possibly be due to distal conditions, was not obtained in this study.

General Response Interactions and Symptom-Response Substitution

The conceptual logic of a behavioral stream, wherein an organism, if not engaging in a contingent response, must therefore be doing something else, or $\not{R}$, has been empirically extended in previous studies (e.g., Rand, 1974; Schoenfeld and Farmer, 1970; Staddon and Simmelhag, 1971;

Terrace, 1974). Findings in this investigation further extend the utility of the concept and its systematic investigation.

Inverse covariance between the contingent response and several untreated responses was found. Inverse covariance of the contingent response with undesirable responses was demonstrated in two ways: by comparisons within sessions and by comparisons within individual subjects, across the study.

Response variability previously found in studies with extinction periods (Azrin and Lindsley, 1956; Rand, 1974; Terrace, 1966; Terrace, 1974) was replicated in this investigation. In extinction periods of this study where a discrimination was clearly obtained between components, various $\not{R}$'s greatly increased in density, as the contingent response decreased in rate of occurrence. Terrace (1974) concluded that active non-responding appeared to be motivated by "the aversiveness of self-produced frustration, in the sense that active non-responding allows the subject to avoid the aversiveness of non-reinforced responding." Evidence that the extinction components and/or the S- signal were aversive to the subjects includes increased aggression and complaining in extinction components, verbalizations regarding the schedule conditions and requests to change conditions from non-reward to reward, and subjects looking at the cue lights only in the reinforcement components of sessions in which a discrimination was clearly evident.

Previous research with animals had shown extinction-induced aggression (Azrin, Hutchinson, and Hake, 1966) and escape and avoidance of the S- correlated with extinction (Rand, 1974).

Moment-by-moment analyses, or interval-by-interval comparisons, potentially allow the laying out of response interactions on a dimension of compatibility and incompatibility. The type of analysis was based on a conditional probability model; i.e., given that a certain response occurred, what was the probability that a certain other response occurred. Obtained figures, grouped across subjects and intervals, were then compared to responding that was unconditional.

Using the above analysis, it was found that the desirable response of in-seat and attending was virtually incompatible with the undesirable response of out-of-seat. This finding is expected by definition of the two responses; any compatibility at all must be accounted for by observer error. The desirable response showed strong inverse relations bidirectionally with the other undesirable responses, non-task related talking and aggressive and/or complaining behavior.

The undesirable responses were generally bidirectionally compatible and facilitatory with one another. Given that an undesirable response occurred in an observation interval, the probability of another undesirable response occurring was increased, relative to its unconditional occurrence. Inconsistency in relations between two of the undesirable responses, out-of-seat and non-task related talking, was found across components and phases. The need to consider prevailing stimulus conditions in the analysis of momentary response interactions is made clear by this result. However, "noise" from low levels of reliability for these responses could have masked possible effects.

In general, probabilities of stereotyped responses, conditional on the occurrences of other responses, were not different or were inconsistently different across phases and components, compared to unconditional probabilities of occurrence of stereotyped responding. Again, it is possible that "noise" masked possible effects. However, if the findings of compatibility without facilitation of stereotyped responding with other responses are valid, then it could be concluded that this type of responding was relatively independent of the occurrence of other responses.

Several major conclusions can be drawn from the findings on response interactions. First, a stream approach is extended experimentally, using "natural," everyday, practically relevant human responses. Second, various R's differ in their compatibilities with one another and the contingent response. Third, response compatibility does not necessarily imply facilitation. Fourth, there are indications that interactions between responses can differ according to prevailing stimulus conditions. Finally, there may be some types of behavior that occur relatively independently of stimulus conditions and other ongoing behavior, at least within the confines of this study.

A special type of response interaction, inverse response covariance of an undesirable nature, was sought in this study. As reviewed in an earlier section, this type of interaction, formerly referred to as symptom substitution and usually denigrated as a viable phenomenon by behaviorists (Bandura and Walters, 1963; Mischel, 1968), was not found in the current investigation. However, preconditions for the possibility of its occurrence were not met, since in Phase 2, VI components, contingent responding decreased instead of increased; and out-of-seat behavior increased instead of decreased. Therefore, hypothesized inverse relations were precluded from occurrence. Although the results of the investigation did not confirm the hypothesis that undesirable response substitution would occur, they certainly do not preclude the possibility that different responses and/or contingencies would result in such phenomena. Since the contingent response did not increase in the second phase relative to the first, a fair test was not conducted.

Implications for Experimental Research and the Understanding of the Behavior Stream

Rachlin (1973) explicated some previously puzzling animal research by analyzing a single operant into what were actually two discrete responses. Staddon and Simmelhag (1971), by monitoring multiple responses within temporal compartments, elucidated previous anomalies across a wide range of data and extended an approach to the understanding of behavior combining ethology (Hinde, 1970) and proximity to stimulus and reinforcer events. The present study combined the investigation of multiple responses, momentary analysis, temporal compartmentalization, and distal stimulus effects.

Two factors are consistently in play in ongoing behavior, and probably often affect experimental results. Much of the time an organism is engaged actively in responding other than the response under experimenter-programmed contingency. This responding, or $\not{R}$, could often affect rates and/or the timing of the occurrence of the contingent response under study. Although the $\not{R}$'s in any experiment may bear trivially obvious relations to the contingent response, and vary predictably as a function of the experimenter-programmed conditions, this may not always be the case. The $\not{R}$'s may be of interest in and of themselves, as the $\not{R}$ of aggression has been in extinction studies (Azrin, Hutchinson, and Hake, 1966; Ulrich et al., 1964). The $\not{R}$'s may be of theoretical interest, as the R̸ of looking away from the signal was in the investigation of possible aversiveness of the S- signal (Rand, 1974). And perhaps most importantly, R̸'s could interact with the contingent response in ways that would affect results and any derived interpretations, such as found by Rachlin (1973) and Staddon and Simmelhag (1971). It is possible that some interactions of multiple responses might be found to be essentially response-response relations, either partially or totally independent of prevailing stimulus conditions. It would not be surprising if some of the present anomalies were explicated in the future by investigations of what the organism is when it is not engaged in the instrumental response.

A second ongoing factor in the behavioral stream is a stream of ongoing stimulus events, with fluctuating periods of high and low reinforcement densities. Staddon and Simmelhag (1971) found that in periods of low density, other than nominal extinction, interim behaviors are likely to increase, while the contingent response tends to occur in proximity to reinforcement. In a sense, ongoing stimulus events consist of a complex higher-order schedule, with periods of relatively high and low reinforcement densities and associated cues. Where cues are not available to the organism, either through exteroceptive stimulus input or response-produced mechanisms, it was predicted that contingent responding would be only momentarily interrupted. This prediction was validated in the current investigation by the use of a random VI for reward conditions. Extension to humans of Staddon and Simmelhag's analysis by way of direct replication awaits the use of an FI schedule, wherein responding in low density periods following reinforcement should fall into patterns of interim and terminal responding. The proximity analysis invoked by Staddon and Simmelhag (1971) was supported by responding within components as possible functions of proximity to distal differing components. Responding in the stream, in summary, may therefore be more of a function of proximity to reinforcement and distal input, than of absolute presentation or removal of a reinforcer.

It is suggested that studies seeking to understand behavior in its complexity investigate multiple responses, response interactions, the effects of multiple and complex scheduling, and momentary temporal events, responding, and compartmentalization. Results from this and other studies (e.g., Staddon and Simmelhag, 1971; Rachlin, 1973) show that isolation of response and stimulus from the stream is no longer parsimonious in all instances.

Implications for Behavior Therapy

The study of multiple responses in interaction under distal stimulus input has a multitude of potential implications and applications for practioners of and researchers in behavior therapy. The use of the model "Antecedents, Behavior, Consequences" to summarize the understanding and controlling variables of behavior could result in committing grossly simplistic distortions and ignoring potentially efficacious therapeutic tactics.

Findings in this investigation do not belie the adages that behavior is situation specific; if a situation is constant, behavior tends to remain constant; and if a situation changes, behavior is likely to change (Mischel, 1968). However, the results indicate that situations outside of immediate situations can affect responding in the current conditions. The effects can be very localized temporally, and can persist. Ongoing behavior is under the potential control of complex schedules; potentially, distal scheduling or events can affect more immediate responding. Put simply, the implication for behavior therapists is that situations outside of those usually assessed can affect responding and the ability to work with a target situation and a target response. Inaccuracies in assessment, failure to program generalization, and lack of maintenance of behavior change might be reduced in incidence if the therapists were attuned to the complexity of the stream and the potential controlling effects of distal situations.

Paying attention to response interactions has several potential advantages. Choice of target response to work with might be guided by attending to momentary interactions. For example, it might be found that an aggressive child usually emitted an idiosyncratic sound at about the same time that he/she aggressed. Further analysis might reveal that the sound preceded the aggressive act in time. Therapeutic intervention, using the sound as the target response, might be more efficacious in terms of time, cost in pain to surrounding children, etc. Another use of the interacting response stream approach would be to predict and evaluate the effects over time of changing a response on other responses. Since covariances in time are to be the rule of response occurrence, changing a response might reasonably be assumed to affect other responses. Awareness of and attention to this fact might aid in selection of target responses. Target responses could be selected to maximize the likelihood that certain other responses would be changed in one direction or another in terms of density, or to leave certain other responses unchanged, as a function of what was desired therapeutically.

To aid in the selection of target responses and orient professionals to likely interactions, it is suggested that a nomothetic table be compiled of response interactions. Responses would be categorized on dimensions of compatibility and incompatibility. Studies also could be conducted as to the effect of changing a response on selected other responses (Ferritor et al., 1972; Gibson, 1974), and a hierarchy of interrelated responses could then be devised. The nomothetic approach would serve only for guiding further research and initial assessment, since many interactions might be expected to be idiosyncratic. It would be of great utility to know *a priori* what the effects of intervention were likely to be on untreated collateral responses. Differing hierarchies might be yielded as functions of the type of intervention employed, i.e., punishment, extinction, reinforcement, and whether the baseline under which the responses are occurring is positive or negative.

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APPENDIX A

Observation Sheet, Spot Checker

Date_____ Session_____ Page_____

CODE:
1. ISA--in seating area and attending to task
2. OS--out of seating area or standing
3. ST--stereotyped activity
4. AC--aggressive physical behavior or complaining verbal behavior
5. CL--looking at the cue lights
6. TA talking to another child or children

Order of observing: 1) 2) 3) 4) 5)

ISA CL OS TA ST AC	ISA CL OS TA ST AC	ISA CL OS TA ST AC	ISA CL OS TA ST AC	ISA CL OS TA ST AC	ISA CL OS TA ST AC

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