IDENTIFICATION OF ENVIRONMENTAL DETERMINANTS OF BEHAVIOR DISORDERS THROUGH FUNCTIONAL ANALYSIS OF PRECURSOR BEHAVIORS

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Methods for the determining the functional properties of problem behaviors are necessary for the design of successful treatments. Many of the currently utilized methodologies are chosen based on their speed, ease of application or for the perceived risk-reduction they afford. However, when thoroughly analyzed many of these methods fall short of their intended purpose. The current study attempted to assess dangerous problem behavior through a functional assessment of functionally related precursor behaviors during analog sessions. Results indicate that for three participants, placing the reinforcing contingencies on these related precursor behaviors produced differentiated outcomes during the assessment. These outcomes matched the outcomes of assessments of the more dangerous problem behaviors.

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CHAPTER 1

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INTRODUCTION

Functional analysis methods for assessing and treating behavior disorders are among the most significant contributions of applied behavior analysis. The general assumption underlying this approach is that problem behaviors, like many other human activities, are best characterized as operant behaviors, maintained by their reinforcing consequences. Carr (1977) suggested that self-injurious behavior (SIB) might be maintained by contingencies of positive reinforcement (e.g., attention from caregivers), negative reinforcement (e.g., escape from training routines), and self-stimulation. This general logic has been extended to explain occurrences of other problematic behaviors, such as aggression (Pelios, Morren, Tesch, & Axelrod, 1999), disruption (Northup et al., 1995), and bizarre speech (Mace & Lalli, 1991). Research has shown that different contingencies may be operative both between individuals (e.g., SIB may be maintained by positive reinforcement for a given individual, but by negative reinforcement for another individual) and within individual cases (e.g., SIB may be maintained by both

positive reinforcement and negative reinforcement within a single individual) (Iwata, et. al., 1994). It has also been shown that knowledge of operative contingencies can form the basis for the development of effective, non-aversive interventions (Neef & Iwata, 1994).

Based on these findings, the need for procedures to identify operative contingencies of reinforcement for the problem behaviors of individuals is apparent. Several methods have been developed to identify the maintaining variables of problem behaviors. Indirect methods involve the collection of information about the client, his/her history, and/or features of the problem behavior(s) (e.g., the form of behaviors exhibited, settings in which the behavior occurs, etc.) from individuals familiar with the client. Descriptive analyses involve direct observation of the problem behavior and its environmental antecedent and consequent conditions in natural settings. Finally, experimental (analog) analyses involve systematic manipulation of environmental variables suspected to enter into functional relations with the problem behavior.

Indirect Methods

Indirect methods for determining environment/behavior relations include procedures such as rating scales, structured interviews, and checklists. These methods are attractive to clinicians because they appear to require less training to conduct and interpret than descriptive and experimental procedures. Additionally, these assessments can be completed very rapidly, often within a few minutes. Thus, risks associated with the problem behavior (e.g., tissue damage to the client [SIB] or others [aggression]) may

be minimized because it is not necessary to directly observe occurrences of the target behavior and because intervention can be developed and implemented very quickly.

The Motivational Assessment Scale (MAS) is a commercially available instrument that is frequently used to assess the functional properties of problem behavior (Durand & Crimmins, 1988). This 16-item rating scale is completed by caregivers, who respond to questions about the frequency of their client's problem behavior in various situations. Each item is rated using a 6-point Likert-type scale ranging from 0 ("never") to 6 ("always"). Each question is designed to provide information about possible variables associated with problem behavior (e.g., attention from caregivers, access to tangibles, escape from aversive situations, sensory reinforcement). Durand and Crimmins showed it to be reliable across respondents (i.e., independent raters produced uniform responses to the scale) and valid (i.e., outcomes of the MAS supported the same interpretations as those generated by experimental analyses). However, several subsequent investigations have been unable to replicate the results of the reliability analysis, (Zarcone, Rodgers, Iwata, Rourke, & Dorsey, 1991; Newton & Sturmey, 1991; Churchill, Smith, Gonzalez & Garcia, 1996), producing low interrater agreement coefficients. When independent raters disagree about the variables associated with a given person's problem behaviors, it is unclear which, if any, rater has accurately identified those variables. Thus, both the reliability and validity of the MAS as a method for assessing problem behavior and a foundation for the development of effective treatment are questionable.

Another anecdotal method for assessing problem behaviors is the Functional Analysis Screening Tool (FAST) (© The Florida Center on Self-Injury, 1995). This instrument contains questions about the relationship between the informant and the client (e.g., the nature and length of relationship, situations in which the informant typically observes the client, etc.), as well as characteristics of the problem behavior. Informants respond "yes" or "no" to questions about the variables associated with the problem behavior, and the results are quantified to provide information about the functional properties of the behavior. A preliminary evaluation of this assessment indicated that, although agreement coefficients were higher than those often obtained with the MAS (i.e., independent informants produced uniform responses to the items), they were insufficient to support confident interpretations about maintaining variables (DeLeon & Iwata 1997). The authors urge caution when using this tool and recommend its use as an initial screening tool only.

These and similar outcomes of evaluations of anecdotal methods for functional assessment (e.g., Sigafoos, Kerr, Roberts, & Couzens, 1993) indicate that conclusions based on their outcomes should be made with caution, and that more information should be gathered to form a basis for treatment. Thus, although these assessments are relatively easy to conduct and require less time or and resources than other methods, their proper role appears to be as a preliminary source of information upon which further investigation (e.g., experimental analysis) can be based. No strong evidence exists that anecdotal assessment either reduces the amount of time needed for assessment or eliminates the need for direct observation of the problem behavior.

Descriptive Analyses

Descriptive analysis is an alternative approach to the identification of relationships between problem behaviors and maintaining variables. Descriptive procedures involve direct observation of the behavior in natural settings and include scatter plots, antecedent-behavior-consequence (ABC) charts, and real-time analyses. Advantages of these methods include the apparent ease with which they are conducted, their objectivity, and their use of direct observation of behavior in the natural setting. These features allow the implementation of descriptive procedures by attending staff throughout the day, and so these procedures are frequently employed in institutions as a primary method of behavioral data collection.

Scatter plots (e.g., Touchette, MacDonald, & Langer, 1985) represent occurrences of a client's problem behavior on a grid, which is segmented into time-intervals. Typically, days of the month are represented across the horizontal axis and hours of the day are represented vertically. When the target behavior occurs, observers enter marks into cells of the grid that correspond to particular time intervals. Different types of marks can be used to specify whether the behavior occurred at a high or low frequency during specified time intervals, and cells corresponding to intervals during which no target behaviors occur are usually left blank. After the grid is completed a temporal display of behavior emerges that shows how responses are distributed across certain times of the day or across days. An analysis of the scatter plot showed that effective interventions could be developed based on its outcomes (Touchette et al., 1985). For example, Touchette et al. used a scatter plot analysis within a reversal design to show that the SIB

of one participant was associated with the presence of a particular aide. Rearranging the participant's daily schedule to reduce contact between the aide and the participant resulted in a decrease in SIB. Among the advantages of the scatter plot are ease of data collection and interpretation (patterns may be revealed as raw data are entered on the grid, thus eliminating the need for transformation of the data).

There are however, several drawbacks to these procedures that limit their utility as the sole means of data collection. A major limitation of this tool is its inability to identify specific antecedent and consequent events surrounding target responses. That is, because only the client's target behavior is directly measured by the scatter plot, other potentially important environmental events are not recorded and can only be inferred. Also, several days to several weeks might be required before such patterns begin to emerge (in the Touchette et al. study, initial assessments lasted 10, 12, and 21 days for their 3 participants), during which participants remain at risk due to problem behavior. Additionally, clients who have little structure to their days may never produce interpretable patterns. In a study by Kahng, et al. (1998), visual inspection of scatter plots for 15 participants revealed no temporal patterns of responding. Additionally, interobserver agreement (IOA) scores below 80% were obtained for 5 of 20 original participants, and the data from those 5 subjects were excluded from further interpretation based on the low interobserver agreement. Thus, limitations of the scatter plot, including failure to identify specific antecedent and consequent conditions, failure to consistently reveal temporal patterning of behavior, the length of time necessary to conduct assessment, and low IOA, call its utility as a pretreatment assessment into question.

Narrative records of problem behaviors, frequently referred to as ABC analyses, are the most common form of data collection used by those charged with the care of individuals with problem behaviors. Observers using these methods record each occurrence of the behavior as well as environmental events and conditions occurring just before (antecedents) and after (consequences) the behavior. Although this can produce a more complete picture of the context surrounding the behavior, these procedures are difficult to implement because they require extensive staff attention, effort, and time (Bijou, Peterson, & Ault, 1969). Often, staff caring for individuals who engage in problem behavior have neither the time, nor sufficient training to carry out these difficult procedures. Finally, ABC analyses cannot produce information about whether antecedent and subsequent conditions are *differentially* associated with the target behavior. That is, without information about the presence or absence of these environmental events *when the problem behavior does not occur*, contingencies between behavior and those conditions cannot be inferred. For example, attention may be identified as a consequence for 75% of ABC sequences; however, if attention normally occurs around 75% of the time regardless of whether the target behavior occurs, then no differential relationship between the behavior and attention is present. Thus, the appearance of a reinforcement contingency may be produced when a particular event frequently occurs subsequent to, but not as a consequence of, the target behavior. To summarize, although ABC recording has strengths including direct measurement of behavior and potentially relevant environmental events, its drawbacks include difficulty of implementation, length of time necessary to conduct, and failure to identify contingencies among variables.

Descriptive procedures have been developed to measure both behavioral and environmental events continuously during observation periods. Lerman and Iwata (1993) used an interval-based method to assess the SIB of 6 adults. Environmental events as well as target behaviors were scored throughout observation periods and, thus, the authors were able to calculate conditional probabilities among potentially relevant events. Data were calculated not only to show probabilities of environmental events given target behaviors but also of target behaviors given environmental events. However, results did not show clear relationships among target behaviors and their antecedent and subsequent conditions for 5 of 6 participants. For 5 subjects, outcomes suggested that social variables were related to the behavior, but it was unclear whether social-positive reinforcement or social-negative reinforcement was operative. For the other participant, the behavior was observed to occur in the absence of social antecedents and consequences, indicating a non-social maintaining variable. When results of this assessment were compared with those of an experimental analysis, results were "matched" for only 1 of the 6 cases. Furthermore, the experimental method quickly identified contingencies maintaining SIB, whereas the descriptive analyses were slower and results more difficult to interpret.

Several studies have attempted to address some of the limitations of descriptive analyses. By combining descriptive and experimental analyses in classroom settings Sasso et al. (1992), were able to obtain matching results from the two methods. However, to achieve this it was necessary to collect descriptive data during activities that most closely resembled their experimental conditions. That is, data were only collected

during activities that were either solitary, or had differing level of teacher demands and attention. Limiting the times and activities that can be used in this procedure may restrict the usefulness of these procedures elsewhere.

In a unique variation of descriptive assessment procedures, Taylor and Romanczyk (1994) inferred the function of students' problem behavior by directly observing the distribution of teacher attention across students. Teachers were seated across the table from 3 students, and presented 3 discrete-trial tasks to each student. The percentage of 10-s intervals containing teacher attention directed at each student was measured. The authors hypothesized that negative reinforcement (escape) or positive reinforcement (attention) contingencies could be identified based on the amount of teacher attention received by each student. The authors predicted that students with escape maintained problem behavior would receive teacher attention in many 10-s intervals. Conversely, they predicted students with attention maintained problem behavior would receive teacher attention in very few 10-s intervals. Thus, it appeared that recording the distribution of teacher attention might be an effective way to determine the functional properties of student problem behaviors. However, it is not clear whether these procedures could be replicated in other, more complex, settings. For example, it would be difficult to assess the distribution of a caregiver's attention to individuals in large groups such as sheltered workshops or normal classrooms. In addition, this study involved a contrived arrangement of antecedent conditions and, thus, requires a disruption of ongoing activities. Finally, this type of assessment will be unlikely to identify cases in which problem behaviors are maintained independent of social variables.

Thus, although this procedure was effective within the context of this study, its more general utility to assess problem behaviors in a variety of contexts is questionable.

Mace and Lalli (1991) combined descriptive and experimental methods to determine the functional properties of the bizarre speech of a 46-year-old man. In this study the authors developed hypotheses about the problem behavior based on the outcomes of descriptive analysis. Results of the descriptive analysis suggested that the man's behavior was maintained by negative reinforcement (escape from task demands) or by positive reinforcement (access to attention). Results from the experimental analysis suggested that the behavior was maintained by contingent attention. Thus, the experimental analysis was ultimately necessary to develop an appropriate treatment. Had treatment been developed based on the descriptive analysis alone, the intervention may have actually *exacerbated* the problem behavior by providing attention for this behavior (e.g., redirection, guided compliance) during tasks. Further, the contribution of descriptive assessment outcomes to the development of experimental analysis conditions was not clear; most experimental analyses already include conditions designed to evaluate positive and negative reinforcement functions. Thus, it may be more efficient to conduct experimental analyses that evaluate the effects of the contingencies generally suspected to be associated with problem behaviors *first*, rather than rely on descriptive analyses to identify idiosyncratic but potentially relevant variables.

Descriptive analyses are often favored over more controlled experimental methods of assessment due to the perception that they require less time, effort, and training; that they can be relatively easily interpreted; and that they do not involve

arrangements designed to intentionally produce the problem behavior. However, a review of current procedures shows that these procedures may produce low IOA, can take long periods of time to conduct (during which problem behaviors continue to occur under *uncontrolled* conditions), can be difficult to interpret, and may not identify relevant behavior-environment relationships.

Experimental Methods

Experimental methods for assessing the function of problem behavior involve controlled simulations of contingencies that might be functionally related to the behavior in the natural environment (i.e., "analog" conditions). These arrangements allow direct evaluation of the effects of specific behavior-environment contingencies via systematic manipulation of antecedent and consequent variables. In addition to direct control over variables that might be functionally related to the target behavior, experimental methods permit control over or elimination of the "noise" (e.g., inconsistent application of contingencies, chaotic environments, and confounding variables) that makes such relationships difficult to identify in natural settings.

Although several variations of these procedures have been developed, the most ubiquitous general procedure for conducting experimental, or analog, analyses, was described by Iwata and his colleagues (Iwata et al., 1994). Participants were exposed to three test conditions (Alone, Social Disapproval, and Academic Demand) designed to simulate situations in the natural environment that may produce and maintain problem behavior and a control condition (Unstructured Play) against which the others were compared. An Alone condition simulated an austere environment in which self-

stimulatory or automatically reinforced SIB might be expected to occur. In the Social Disapproval (Attention) condition, SIB resulted in attention from the therapist in the form of reprimands and/or concern statements (e.g., "No, don't do that. You may hurt yourself." Or "Hey, don't bang your head"), testing whether SIB was sensitive to positive reinforcement in the form of social interactions from the therapist. In the Academic Demand condition, SIB resulted in the termination of task trials, testing whether SIB was sensitive to negative reinforcement (escape from task demands). Finally, the Unstructured Play condition simulated an "enriched environment" in which attention and leisure activities were freely available and no task trials were presented. This condition served as a control against which to compare other conditions. When one or more test conditions produced higher levels of problem behavior relative to the Unstructured Play condition, the contingencies of the test condition(s) were implicated as the maintaining variable(s). This study produced differential outcomes for 6 of the 9 participants, suggesting that these procedures could reveal controlling variables for SIB.

Subsequently, a large and growing body of research has evaluated, extended, and validated experimental analysis procedures as pretreatment assessment for a range of problem behaviors such as aggression (Day, Horner & O'Neill, 1994), cigarette pica (Piazza, Hanley, & Fisher 1996), and bizarre speech (Mace & Lalli 1991). A large-scale study (Iwata, et al. 1994) including 152 participants and spanning 11 years, provided additional evidence that these procedures revealed the functional properties of SIB and served as a basis for the development of effective treatment for a majority (95.4%) of participants. In that study, treatment outcomes for some subjects (n=121) combined with

outcomes of treatment components naturally occurring within some analog sessions for others were used to add strength to assertions that treatments based on outcomes of this type of functional analysis are effective.

Although experimental analysis procedures have been shown to be valid methods for evaluating the environmental determinants of problem behaviors, several limitations have been identified. For example, clinicians are often reluctant to employ these procedures due to the perception that they require excessive amounts of time and training to complete and that they may be generally unsafe for participants. The second objection, that experimental analysis may entail undue risk to participants, is the topic of the following discussion. The central thesis of this objection is that, because these procedures systematically evoke and reinforce the behavior being assessed, participants (or, in the case of aggression, other people) may incur new injuries during the assessment itself. Thus, the necessity of *producing* the behavior being assessed poses risk to the participant and/or others in the environment. Several methodological variations of the basic functional analysis procedures might address this limitation (e.g., abbreviated assessments, using protective equipment during assessment, placing assessment contingencies on some other, related, behavior).

Vollmer, Marcus, Ringdahl, and Roane (1995) used single-session phases based on those described by Iwata et al. (1994) to identify the functional properties of problem behavior in 20 participants. The study was conducted in four phases and, for any given participant, the assessment was considered complete when response differentiation was obtained during any phase. First, within-session patterns of the target behaviors were

inspected for evidence of behavioral function. For example, decreasing trends within alone sessions would be inconsistent with a non-social mechanism of behavioral maintenance. If no interpretation was possible after inspecting within-session patterns, Phase 2 was initiated. The second phase of the assessment consisted of extended exposure to the experimental conditions in a multielement format (as described by Iwata et al., 1994). If no differentiation was observed during the multielement assessment then a third phase consisting of extended no-interaction sessions was conducted. If the behavior persisted at levels similar to those in Phase 2, a non-social maintaining variable was inferred. Finally, if the behavior extinguished during Phase 3, the original test conditions were presented again, using a reversal design to prevent interaction effects across conditions (Phase 4). The data from 6 of the 20 participants showed response differentiation during Phase 1; 4 data sets showed differentiation during Phase 2; 5 data sets showed differentiation during Phase 3; and 2 data sets showed differentiation during Phase 4. Data from 3 participants showed no response differentiation throughout this study. Although this method permitted more rapid identification of the variables associated with problem behaviors for several participants, up to 12 hours of total assessment time (almost 90, 10-min sessions) was required for confident interpretations for some participants, and behavioral function was not identified for 3 participants. Thus, these participants were exposed to lengthy assessment conditions during which continued risk for injury was present.

Derby et al. (1992) reported outcomes of brief functional assessments with 79 clients. These assessments consisted of single-session conditions similar to those

described by Iwata et al. (1994). Of the 79 participants, only 63% (n=50) engaged in the target behavior during the assessment. Among these participants, variables maintaining their problem behavior were identified for only 74% (n=37) during the initial assessment. The remainder of participants required additional assessments before the functional properties of their problem behaviors were identified. Thus, although the brief assessments may have been associated with reduced risk to participants, their utility as a method to identify maintaining variables is questionable. Kahng and Iwata (1999) compared the outcomes of 50 extended functional analyses to the corresponding outcomes of 2 types of brief analyses. After full assessments were conducted using methods described by Iwata et al. (1994), the data were re-analyzed according to two brief assessment methods. One brief analysis was achieved by plotting overall session data from the first session of each condition. The outcomes of this brief assessment method corresponded to the full assessment in 66 % of the cases. A second method involved replotting the data from the first session of each condition on a minute-by-minute basis. The outcomes for this method correspond to the outcomes of the full assessment in 68% of the cases. Thus, approximately 33% of participants required a full analysis to determine the function of their aberrant behavior.

Results of studies using brief assessment procedures suggest that they may represent a possible direction for increasing client safety during experimental analyses. A significant problem with these procedures is the frequent reliance on the single data point phases. This reliance may make assessing low-frequency behavior problematic.

That is, for many participants, more lengthy assessments are required to reveal behavioral function, further delaying treatment application and exposing clients to additional risk.

Another possibility for increasing the safety of functional assessment procedures is to allow participants access to protective equipment during sessions (e.g., helmets, arm-splints, padded mittens). Functional assessment procedures are traditionally conducted without protective equipment to avoid interference with the results. Le and Smith (1999) conducted functional assessments of self-injurious behavior of 3 participants without protective equipment. These problem behaviors were next assessed with protective equipment normally utilized in the natural environment. Outcomes of assessments with protective equipment neither matched the outcomes of the assessments conducted without protective equipment nor did they produce independent evidence about the function of the self-injurious behavior. The results of this study support the widely held notion that protective equipment may produce outcomes incapable of providing treatment direction if utilized during functional assessments.

An alternative method for assessing problem behavior while increasing client safety stems from the observation that manipulating variables associated with one behavior may result in similar effects to other members within the same response class. Several studies in the field of applied behavior analysis have attempted to reduce or eliminate specific problem behavior by treating functionally related behavior. Lalli and Mace (1995) suggested that related behaviors may substitute for each other or are hierarchically ordered. In their study, when treatment was applied to the first response a response class that was hierarchically ordered the remaining 2 responses within the class

were eliminated as well. Two additional studies (Parrish, Cataldo, Kolko, Neef, & Egel 1986; Sprague, & Horner 1992) demonstrated similar decreases in target behaviors when responses within the same class were manipulated. These findings held true for response-class members that were both topographically similar and dissimilar.

Given the results of these studies, it is reasonable to suspect that independent functional assessments of the members of a response class would produce similar results. It is also reasonable to suspect that most dangerous problem behaviors will be part of a greater response class. This greater response class is likely to be comprised of both dangerous behavior (e.g., SIB, aggression) and more innocuous behavior (e.g., screaming, pacing, foot stomping). If innocuous behavior is part of a greater response class, than assessing such behavior could permit valid inferences about the determinants of the more dangerous behavior without the need to evoke the dangerous problem behavior. Thus, the present study conducted assessments of related precursor behavior (innocuous behavior) as well as assessments of the problem behavior using procedures based on those developed by Iwata, et al. (1994). Outcomes of the traditional functional assessments were compared to assessment outcomes of functionally related precursor behavior. Outcomes were determined to match when the functional properties of the problem behavior matched the functional properties identified by the assessment of precursor behaviors.

CHAPTER 2

METHOD

Subjects

Two adult males and one adult female, all diagnosed with profound mental retardation, participated in this study. The participants, Chuck, Will, and Grace lived at a residential facility for individuals with developmental disabilities. Chuck was 35 years old at the time of the study. He had no expressive language and very little receptive language, but could respond to simple instructions. Chuck was ambulatory with the help of a walker. He took no medications at the time of the study. Chuck was referred to a day program for the assessment and treatment of aggression toward care-providers and severe self-injury. Will was 53 years old at the time of the study. He had no expressive and little receptive language. Will could respond to instructions but rarely did so. He was ambulatory but wore a gait belt to assist with an extremely unsteady gait. Will took Thioridazine HCL daily for behavior management. He was referred to a day program for assessment and treatment of self-injurious wrist biting and body hitting. Grace was 41 years old at the time of the study. She had no expressive language and very little receptive language. Grace could respond to instructions but rarely did so. She was ambulatory but walked with an unsteady gait. Grace took no medications at the time of the study. She was referred to a day program for the assessment and treatment of severe and chronic head banging and body hitting.

Apparatus and Setting

All sessions were conducted at a day program for the assessment and treatment of severe behavior problems, located on the premises of the state facility where the participants lived. The experimental room in which sessions were conducted contained a table, and chairs, a couch, and appropriate materials for each analog session.

Target Behaviors

Chuck's primary target behavior was aggression (hitting and kicking others), which was defined as contact of the hand or foot to any part of another person. Will's primary target behaviors were wrist biting and body hitting. Wrist biting was defined as contact of the teeth with any part of the forearm. Body hitting was defined as contact of the open hand to any part of the body. Grace's primary target behaviors were head banging, body hitting, and knee banging. Head banging was defined as any audible contact of the head to any stationary surface. Body hitting was defined as audible contact of the open hand to any part of the body. Knee banging was defined as any audible contact of the knees to a stationary surface.

Chuck's precursor behaviors were crying, reaching, and foot stomping. Crying was defined as audible whining emitted at a volume above that which is normally used in a typical conversation. Reaching was defined as extending the arm toward another person. Foot stomping was defined as audible contact between the bottom of the foot and any stationary object. Will's precursor behavior was vocalizations, defined as any audible vocal sound other than laughter. Grace's precursor behaviors were screaming, grabbing others, foot stomping and falling to the ground. Screaming was defined as any

vocalization emitted above normal conversational volume. Grabbing was defined as closure of the hand around any body part of another person. Foot stomping was defined as audible contact between the bottom of the foot and any stationary object. Falling was defined as moving from a standing or sitting position to the floor.

For each participant, precursor behaviors were selected based on reported and observed correlations with problem behavior. The experimenters interviewed caregivers about responses that often occur just prior to the problem behavior. Next, the experimenters entered the participant's homes and observed the clients directly. In each case the reported precursor behaviors were observed to occur directly before the targeted problem behavior.

Observation Procedures and Interobserver Agreement

Target behaviors were recorded by trained observers using hand-held computers (Apple Newton MessagePad™, models 100 and 120) with data collection software (Behavior Observer System). For Will and Grace, all data were calculated as responses per min (rpm) by dividing the total number of target responses by the session length in minutes. A partial interval method was used to record Chuck's precursor behaviors. Session time was divided into 10-s intervals and observers scored the presence or absence of responses in each interval. Percentage scores were calculated by dividing the total number of intervals containing target behavior by the number of total number of intervals in each session and multiplying the results by 100.

A second observer simultaneously, but independently scored data during 23%, 37.5% and 30% of sessions for Chuck, Will and Grace respectively. Interobserver

agreement was calculated by dividing the session length into 10-s intervals. Within each interval, the smaller number of recorded responses was divided by the larger. The results were summed across the session, divided by the total number of intervals and multiplied by 100. Due to the use of a partial interval method for Chuck a different method was used to calculate IOA for his behavior. IOA for this response was calculated by dividing the session length in to 10-s intervals. Matched corresponding intervals containing the presence or absence of crying were calculated as agreeing. Percentage of agreement was calculated by dividing the total number of intervals containing agreement by the total number of intervals in each session and multiplying the results by 100. Mean interobserver agreement scores for Chuck were 99.9% for aggression, (range, 98.8% to 100%) and 97.3% for precursor behaviors (range, 85.5% to 100%). Mean interobserver agreement scores for Will were 99.3% for SIB (range, 93.5% to 100%) and 97.3% for his precursor behavior (range, 87% to 100%). Mean interobserver agreement scores for Grace were 100% for SIB and 97.6% for precursor behaviors (range, 85% to 100%).

General Procedure, Experimental Design and Conditions

Experimental analysis conditions (Alone, Attention, Tangible [Grace only], Play, and Demand) were presented using a multielement format. All sessions were 15 minutes in length and were conducted in the above order. One to four sessions were run per day, at the same time each day, five days a week. Chuck, Will and Grace's sessions were conducted over a period of 2, 2, and 3 months, respectively.

Each participant was exposed to the multielement analog assessment until the variables maintaining their maladaptive behavior were revealed. During these sessions

occurrences of precursor behaviors were recorded as well. Next, a second analog assessment was conducted for each subject with experimental contingencies placed on precursor behaviors, rather than the primary target behaviors that were the focus of the original assessment. All other procedural variables (therapists, number of session, and sequence of sessions) were identical to the original assessment. The following is a general description of the procedures (see Iwata et al., 1994, for a more complete description of these procedures).

Alone. The participant was seated in a room with no leisure materials present. No therapist was present and no programmed consequences occurred for target behavior. This condition tests for behavior that is maintained by automatic or non-social consequences. If target behaviors persist in these sessions a non-social maintaining variable is inferred.

Attention. The participant was seated in a chair in the experimental room. Leisure materials (e.g., toys, games, and magazines) were scattered throughout the room. Occurrences of target behaviors produced attention from the therapist (i.e., the therapist approached the participant and delivered statements of concern or reprimands). These interactions lasted for approximately 5 s. No other interaction between the participant and therapist occurred during these sessions. If target behaviors persist in this condition the inferred maintaining variable is positive reinforcement (attention).

Play. The participant was seated in a chair in the experimental room. Leisure materials (e.g., toys, games, and magazines) were scattered throughout the room. No demands were given, but approximately every 30 s the therapist approached and

interacted with the participant (i.e., "Chuck, how are you doing today?"). These interactions lasted for approximately 5 s. There were no programmed consequences for problem/precursor behavior and no demands were given. Approximately every 30 s the therapist approached and interacted with the participant. Target behaviors occurring immediately before a scheduled interaction resulted in a 5 s delay of the interaction. There were no other programmed consequences for target behavior. This condition served as a control to which the other conditions were compared.

Demand. The participant was seated in the experimental room devoid of leisure materials. Every 30 s the therapist approached the participant and issued a task demand (e.g., "Grace, put the puzzle piece in the box.") using a three-prompt sequence consisting of verbal prompting, modeling, and physical guidance. This rate of task demands was held constant throughout all demand sessions. Compliance following either of the first two prompts resulted in statements of praise (e.g., "Great job stacking that paper, Grace.") and a break for the remainder of the 30 s trial. No praise was given if physical guidance was required to complete the task. Target behaviors occurring during the three-prompt sequence resulted in termination of that trial. Occurrences of target behaviors immediately before a task demand was scheduled resulted in a 5 s delay in its presentation. If problem behaviors persisted, trials were postponed until 5 s passed without the presence of target behavior. This condition tested whether target behaviors were maintained by negative reinforcement in the form of escape from task demands.

Tangible (for Grace). Anecdotal reports from direct care staff suggested that Grace sometimes appeared to engage in SIB to gain access to preferred items. Therefore,

a fifth condition was conducted with Grace. Immediately before the start of each Tangible session Grace was allowed access to highly preferred items for approximately 10 s. Next, she was seated in the experimental room with the therapist who held the items in plain view and no demands were presented. Target behaviors resulted in access to the items for approximately 10 s at which time they were again removed. This condition tested whether her behavior was sensitive to positive reinforcement in the form of presentation of tangible items.

CHAPTER 3

RESULTS AND DISCUSSION

Subject 1: Chuck

Figure 1 shows the results of Chuck's experimental analysis. The top panel shows that, during the first phase of the assessment (contingencies on primary targets), aggression occurred almost exclusively in the attention condition, strongly indicating that it was sensitive to positive reinforcement in the form of attention from the therapist. The bottom panel of Figure 1 shows that precursor behaviors occurred across conditions but at highest levels during attention sessions. In Phase II, when the experimental contingencies were placed on the precursor behaviors, very little aggression occurred in any condition and precursor behaviors occurred almost exclusively during attention sessions. Thus, outcomes of the experimental analysis of aggression matched outcomes of the experimental analysis of related precursor behaviors. Additionally, the rate of Chuck's problem behavior during attention sessions decreased from a mean of .86 rpm in Phase I, to .13 rpm in Phase II. Chuck's results show that maintaining variables for his primary target behavior could be inferred from the results of an experimental analysis of precursor behavior. In addition, target behaviors occurred less frequently during the assessment of precursor behaviors than during the assessment of primary target behaviors.

Subject 2: Will

Figure 2 shows the results of Will's experimental analysis. The scale for Will's target behaviors differs from the scale for Will's precursor behaviors to give a clear visual depiction of the response differentiation across experimental conditions. The top panel shows that, during the first phase of the assessment (contingencies on primary targets), SIB occurred almost exclusively in the demand condition, strongly indicating that it was sensitive to negative reinforcement in the form of contingent withdrawal of a therapist's task demands. The bottom panel of Figure 2 shows that precursor behaviors also occurred at highest levels during demand sessions. In Phase II, when the experimental contingencies were placed on the precursor behavior, very little SIB occurred in any condition and the precursor behavior occurred almost exclusively during demand sessions. Thus, outcomes of the experimental analysis of SIB matched outcomes of the experimental analysis of a related precursor behavior. Additionally, the rate of Will's SIB during demand sessions decreased from a mean of 1.1 rpm in Phase I to .05 rpm in Phase II. Will's results show that the function of his primary target behavior could be inferred from results of an experimental analysis of a precursor behavior and that target behaviors seldom occurred during that assessment.

Subject 3: Grace

Figure 3 shows the results of Grace's experimental analysis. The scale for Grace's target behaviors differs from the scale for Grace's precursor behaviors to give a clear visual depiction of the response differentiation across session conditions. The top panel shows that, during the first phase of the assessment (contingencies on primary targets), SIB occurred almost exclusively in the demand condition, strongly indicating that it was

sensitive to negative reinforcement in the form of contingent withdrawal of a therapist's task demands. Additionally, SIB occurred at lower rates during tangible sessions, indicating a possible sensitivity to positive reinforcement in the form of contingent presentation of tangible items. The bottom panel of Figure 3 shows that precursor behaviors occurred at highest levels during demand and tangible sessions during phase I. In Phase II, when the experimental contingencies were placed on the precursor behaviors, almost no SIB occurred in any condition and precursor behaviors occurred almost exclusively during demand sessions. Thus, outcomes of the experimental analysis of SIB matched outcomes of the experimental analysis of a related precursor behavior. Additionally, the rate of Grace's SIB during demand sessions decreased from a mean of 1.3 rpm in Phase I to .01 rpm in Phase II. These results show that the function of her primary target behavior could be inferred from results of an experimental analysis of precursor behaviors and that target behaviors seldom occurred during that assessment.

CHAPTER 4

GENERAL DISCUSSION

For all participants in this study, outcomes of the analyses of precursor behaviors matched outcomes of analyses of primary targets. This suggests that it is possible to infer the environmental variables maintaining problem behaviors by placing experimental analysis contingencies on behaviors that are correlated with the problem behaviors. That is, when less challenging behaviors are observed to covary with severe problem behaviors, it may be possible to indirectly identify the functional properties of the problem behaviors by performing functional analyses of the covarient.

The current outcomes also show that target behaviors occurred at greatly reduced levels during the assessments of precursor behaviors. Taken in combination with the "matched" outcomes of the direct and indirect assessments, these results indicate that the assessment of precursor behaviors represents a promising method to decrease risk to participants during functional analysis procedures.

Other procedures to identify the environmental determinants of behavior disorders while providing for participant protection also have been investigated. These "safer" methods may be categorized in three general ways: indirect, descriptive, and variations on experimental methods.

Indirect methods, including rating scales, structured interviews, and checklists, rely on reports of target behavior from individuals who care for the clients. These methods are completed quickly and deemed safe because no direct observation of the

target behaviors is necessary. However, independent reports from separate raters rarely produce similar outcomes, leaving the utility of these methods questionable (e.g., Zarcone et al., 1991).

Descriptive analyses, including scatter plots, ABC charts, and real-time analyses, require direct observation of the target behaviors and environmental conditions in natural settings. These methods are frequently chosen because of their objectivity and because they do not require the disruption of the client's daily activities. Additionally, they are deemed safe because target behaviors are not systematically evoked as part of the assessment procedure (e.g., Touchette, MacDonald, & Langer, 1985; Bijou, Peterson, and Ault, 1969). A major limitation, however, stems from their inability to identify particular antecedent and subsequent conditions associated with the problem behaviors (e.g., scatter plots), or to determine whether antecedent and subsequent conditions are *differentially* associated with target behaviors (e.g., ABC assessments). Additionally, extensive training necessary for accurate data collection and complex data analyses limits the practicality of these methods (e.g., Lerman and Iwata, 1993). Finally, although target behaviors are not systematically evoked and/or reinforced during descriptive analyses, these procedures rely on extensive observation of target behaviors during uncontrolled situations; therefore, risk to participants is not reduced during such assessments.

Variations of experimental analysis procedures include brief assessments, sequential analyses, and the use of protective equipment while assessing problem behavior. These procedures have produced unclear results and/or, when interpretable

outcomes have been generated, have not proven to reliably offer a greater measure of protection.

The procedures outlined in the present study offer a viable alternative method in which a focus on responses related to problem behavior permits inferences about the functional properties of the problem behavior itself. Importantly, it appears that this can often be accomplished without the need to evoke or reinforce the problem behavior itself.

It is important to note that no participant in the current study engaged in behavior maintained independent of social contingencies. A limitation of this type of assessment is that it would not be possible to assess behavior so maintained because it is not possible to differentially withhold or present the "automatic" consequences presumed to be operative in such cases. That is, whereas it is possible to manipulate the various social consequences suspected to maintain problem behaviors and, thus, to arrange those consequences for either precursor behaviors or problem behaviors, automatically occurring consequences of problem behaviors typically cannot be withheld (although see Smith & Garcia, 1999, for a possible exception). Furthermore, in cases where it may be possible to withhold automatic consequences, it may not be possible to present those consequences contingent on other (e.g., precursor) behaviors. Thus, the current procedures do not provide a means of protection for clients whose behavior disorders are maintained independent of social contingencies. A recommended strategy for providing maximal protection for clients whose problem behaviors may be maintained automatically (e.g., clients with profound developmental delays, sensory deficits, or who present with certain topographies of SIB [e.g., eye-poking, hand-mouthing]) is to begin

assessment with an extended alone condition. If responding persists during this condition, treatment for automatically-maintained behavior could be initiated. If the behavior showed signs of extinction during this condition (e.g., bursting, followed by a decrease in rate), then an assessment of precursor behaviors could be initiated. This sequence of assessment procedures would allow for rapid identification of behavior maintained independent of social contingencies without requiring initial exposure to irrelevant assessment conditions.

A question that follows from this study concerns the nature of the precursor behaviors' origins. Interestingly, all precursor behaviors observed in this study were responses that were, themselves, somewhat undesirable (e.g., crying, foot-stomping, and grabbing others); however, in all cases, these behaviors were less extreme than the problems that resulted in original referral for treatment. The precursors appeared to share functional properties with target behaviors in that both target and precursor behaviors were sensitive to the same reinforcement contingencies. It may be concluded that they were members of common functional classes. That is, all members of the class share common consequences and may substitute for each other. In the current study, precursor behaviors were typically emitted before more problematic responses. Such orderly relationships have been referred to as response hierarchies (Lalli et al., 1995). Lalli et al. conducted a functional analysis showing that three problematic behaviors of a 15 year-old girl were each maintained by escape and that they typically occurred in a predictable sequence. When reinforcement contingencies were applied to the first of these responses to occur in this "response hierarchy sequence," Later members in the sequence were

suppressed. The authors speculate that the earlier responses were possibly less effortful, less likely to be punished, and produced a shorter latency to reinforcement than earlier members of the hierarchy. Additionally, one may speculate that in the natural environment earlier responses are frequently reinforced, making engaging in responses that otherwise occurred later in the hierarchy unnecessary. Similarly, Magee (1999) observed that when continuous reinforcement was available for a primary target behavior (during assessment), behaviors that were assumed to share functional properties were not observed. When extinction was applied to these responses in a systematic fashion, other members of the response class increased in rate. That is, when only one member of the response class was reinforced other members occurred with less frequency, especially if the responses appear to be hierarchically ordered. Additionally, applying extinction to one member of the response class increased the rate of one or more functionally related responses. That is, other members of the response class which typically produce the same effect on the environment became more probable. The current study utilized this logic to identify and place assessment contingencies on responses that were likely to occur early in hierarchical sequence (precursor behaviors), thus decreasing the likelihood of observing more problematic, subsequently occurring responses.

In natural settings, caregivers may occasionally apply reinforcement contingencies to early members of a response hierarchy in an attempt to "head off" an impending episode of problem behavior. That is, behaviors that are correlated with SIB, aggression, or other problem behaviors may produce attention, or caregivers may terminate an ongoing task demand. Such interventions might represent inadvertent

differential reinforcement of alternative behavior (DRA), and may result in an uneven distribution of responses in the class in favor of precursor behaviors (Sprague & Horner 1992). Thus, if these behaviors are less effortful, less painful, and equally likely to be followed by reinforcement, they may be more likely to appear early in a response class hierarchy (i.e., they may become "precursor" behaviors.) The result of the current study are consistent with this account of the development and maintenance of precursors as early-appearing members of a response-class hierarchy. Whereas placing contingencies on primary target behaviors did not produce significant decreases in the levels of precursor behaviors, placing contingencies on precursor behaviors did significantly reduce occurrences of primary targets. Thus, the order in which members of a response-class hierarchy are observed in the natural environment may be important when selecting related behaviors for assessment. Placing contingencies on behaviors that reliably *precede* the behavior targeted for assessment (rather than behaviors that are merely *correlated with* the target behavior) will not only allow for accurate inferences but will also reduce the likelihood of target behaviors.

Because the current outcomes showed suppression of the primary target behaviors, these procedures have treatment implications. That is, this procedure may be seen as a "fast track" to treatment for extreme problem behavior that needs to be terminated at once or that has not responded to other treatments. Differentiation of precursor behaviors during treatment, if accompanied by low levels of primary target behaviors, may serve as intervention per se (although no baseline condition against which to compare treatment effects will be available). Additionally, precursor behaviors may be

good starting points for shaping alternative behavior that is more acceptable. This would be especially relevant when precursor behaviors involve vocalizations that may be shaped into speech.

In the current study, precursor behaviors were chosen based on verbal reports by attending staff and casual observations by experimenters. Although this may limit the extent to which the current procedures can be directly replicated by other researchers, it also suggests that precursor behaviors may be easily and efficiently identified. For each of the three participants in this study, informal identification of precursor behaviors effectively and efficiently identified responses that, when entered into functional analysis contingencies, produced valid assessment results and reduced occurrences of related problem behaviors.

Future research into the identification of precursor behaviors; how they develop and become related to other, more detrimental behavior; and how the members of hierarchically-ordered response classes relate to each other and to environmental contingencies, is warranted. Such investigations may lead not only to the development of safer and more efficient assessment methods, but may also move toward more direct integration of treatment with assessment, in which elucidation of the functional properties of behavior disorders and identification of effective treatments are simultaneously accomplished.

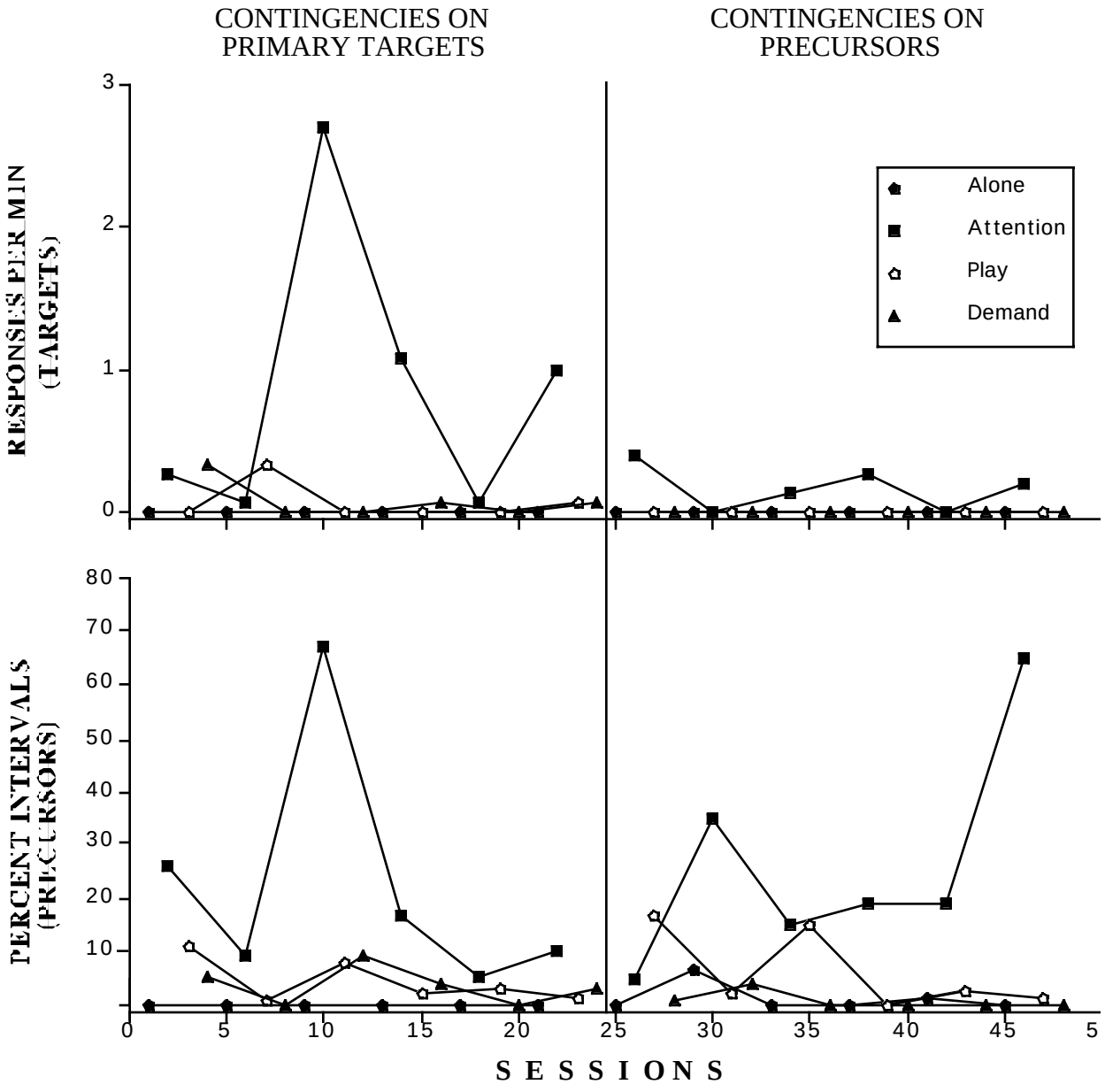

Figure 1. Responses per minute of target behaviors (top) and precursors (bottom) across phases for Chuck.

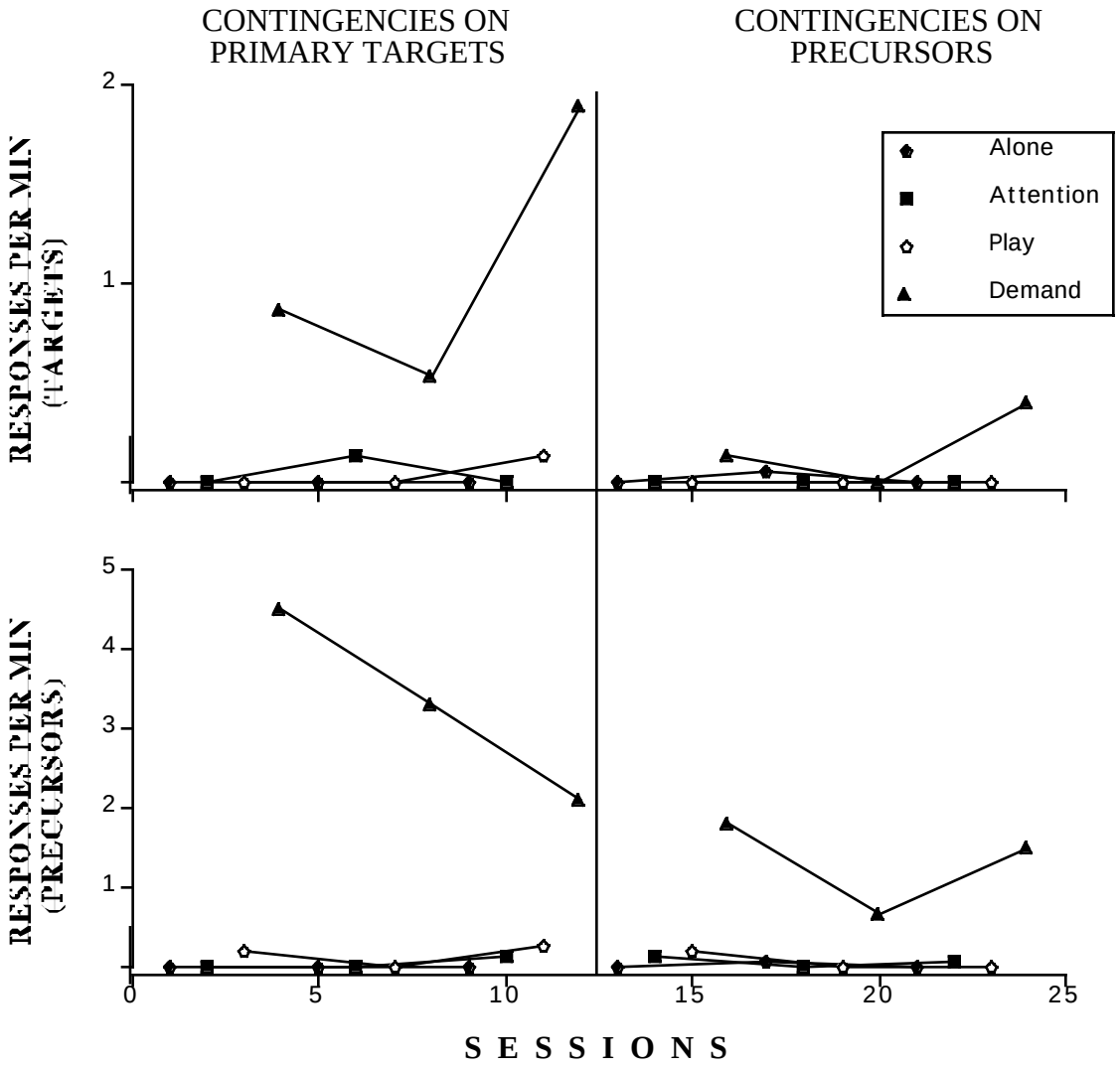

Figure 2. Responses per minute of target behavior (top) and precursors (bottom) across phases for Chuck.

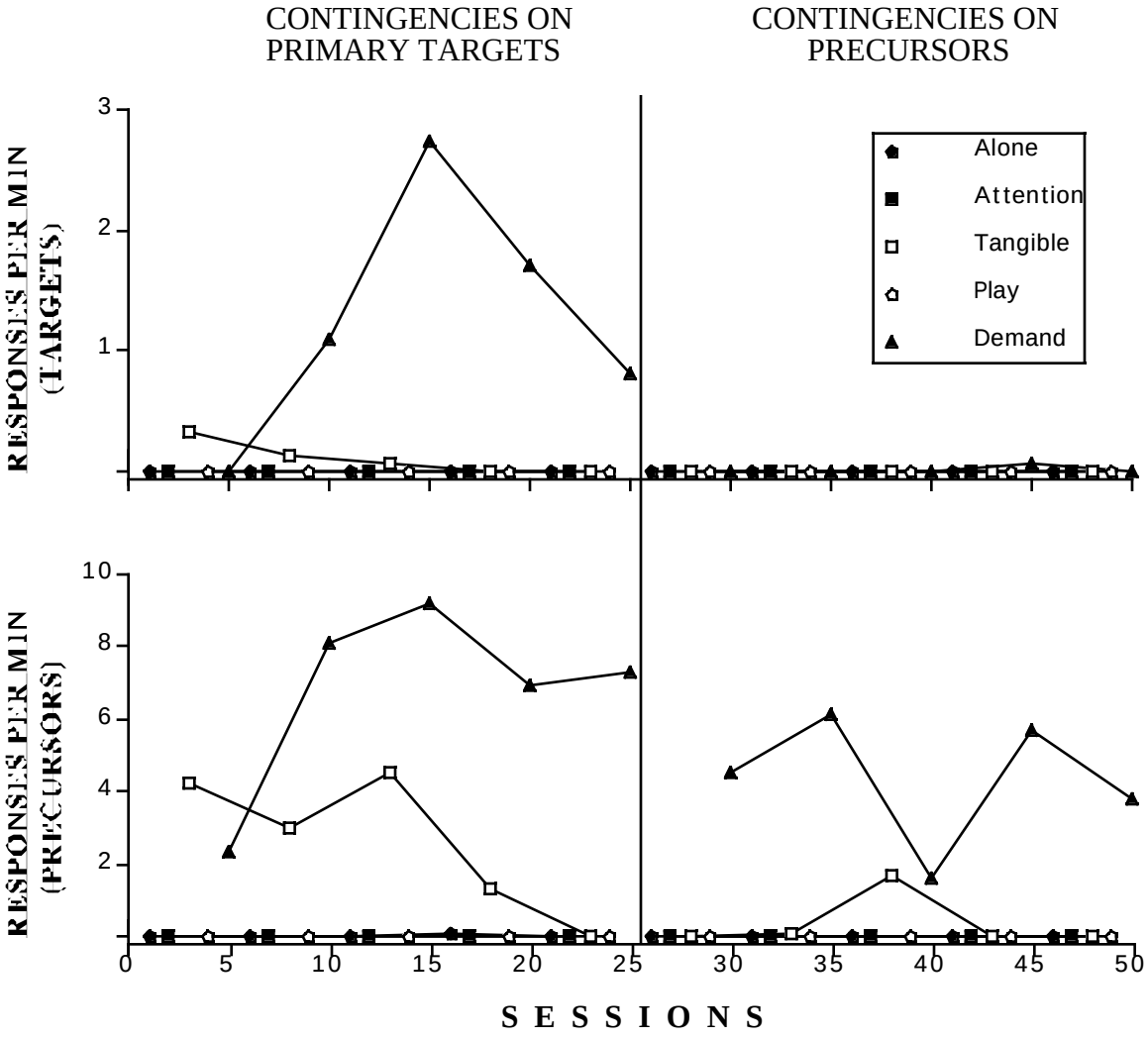

Figure 3. Responses per minute of target behaviors (top) and precursors (bottom) across phases for Grace.

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