ANALYSIS OF RESPONSE-RESPONSE RELATIONS: RESPONSE CLASS, CHAIN, AND PRECURRENT SEQUENCES

By

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To my parents: You reinforced all the right behavior

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TABLE OF CONTENTS

LIST OF FIGURES

Abstract of Dissertation Presented to the Graduate School
of the University of Florida in Partial Fulfillment of the
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By

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Severe problem behavior poses a challenge to assessment due to potential risks during a functional analysis (FA). One proposed solution for reducing risk is the precursor FA, in which assessment contingencies are placed on responses that precede and are assumed to be members of the same response class as the target behavior. However, a response class is only one example of a relation in which one response reliably precedes another: Response-response relations also include response chains or precurrent-current relations, which may be obscured in an FA of precursor behavior. The purpose of this study was to show how response-response relations, established differently, may nevertheless yield similar outcomes under contingencies typical of a precursor FA. First, response classes, chains, and precurrent-current relations were established separately using arbitrary responses. Contingencies analogous to those used in an FA of target (problem) and precursor behavior subsequently were implemented with each relation. Results for six subjects showed similarities as well as differences among response patterns under the three trained relations.

CHAPTER 1
INTRODUCTION

A functional analysis (FA) of problem behavior involves systematic manipulation of antecedent and consequent events to identify maintaining contingencies (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994). In a typical FA, separate test conditions are conducted to determine if behavior is maintained by social positive, social negative, or automatic reinforcement. For example, a test condition for behavior maintained by social negative reinforcement might involve presentation of academic or vocational tasks (antecedent event) and brief removal of those tasks (consequent event) contingent on problem behavior. If behavior persists in this condition, social negative reinforcement (escape from task demands) would be identified as the variable responsible for the maintenance of problem behavior, and a treatment based on this analysis subsequently would be implemented. Although the clinical benefits of using FAs as the basis for treatment development have been demonstrated in hundreds of studies (see reviews by Beavers, Iwata, & Lerman, 2013; Hanley, Iwata, & McCord, 2003), one potential limitation of the FA is that increased rates of severe problem behavior during the FA may produce greater risk to the individual or others if problem behavior is particularly severe (e.g., self-injurious behavior [SIB] or aggression).

Smith and Churchill (2002) proposed a potential solution to this problem in a study conducted with four individuals who engaged in SIB or aggression. The authors noticed that each subject generally engaged in other, less severe, topographies of behavior prior to engaging in severe problem behavior, and noted the possibility that these “precursor” responses (responses that reliably preceded problem behavior) might be members of the same functional response class (i.e., maintained by the same

consequences) as the problem behavior itself. After the precursor responses were identified by caregiver report and confirmed through direct observation of the individuals in their residences, Smith and Churchill conducted two FAs: In the first, contingencies in each assessment condition were applied to problem behavior; in the second, the contingencies were applied to the precursor responses. Results for all subjects showed that both the problem behavior and precursor FAs identified the same source of reinforcement responsible for behavioral maintenance. In addition, lower rates of problem behavior were observed during the precursor FAs.

The important implication of the Smith and Churchill (2002) findings was that an analysis of precursor behavior might be helpful in identifying the function of problem behavior while at the same time reducing the risk of assessment by evoking less problem behavior. A number of studies have replicated this general outcome or illustrated quantitative methods for identifying precursor responses (e.g., Borrero & Borrero, 2008; Herscovitch, Roscoe, Libby, Bourret, & Ahearn, 2009; Fritz, Iwata, Hammond, & Bloom, 2013). Also, data reported by Najdowski, Wallace, Ellsworth, MacAleese, and Cleveland (2008) suggested that an effective treatment for problem behavior might be developed based on results of an FA conducted only on precursor behavior; this hypothesis was confirmed by Dracobly and Smith (2012) for one individual who engaged in low-rate, but severe, SIB, and by Fritz et al. for two individuals who engaged in severe SIB or aggression.

The rationale for the precursor FA is that precursor and problem behaviors are members of the same functional response class (Smith & Churchill, 2002) and are hierarchically organized based on response dimensions (e.g., effort; Lalli, Mace, Wohn,

& Livezey, 1995) or reinforcer dimensions (e.g., rate, delay, quality, magnitude; see Mace, 1994 for a review). For example, given the necessary environmental conditions, the less effortful precursor response will occur, but if it is not reinforced, the more effortful problem behavior will follow. As both responses have a history of maintenance by the same reinforcer, either response functions as a “substitute for the other” (Baer, 1982, pp. 238). However, the response class represents only one example of the relation between precursor and target (problem) behavior because precursor behavior is defined purely in a probabilistic sense: Precursor behavior is simply behavior that precedes and predicts the occurrence of later behavior. Another type of precursor relation can be seen in the response chain, in which each response must occur in sequence in order to obtain reinforcement (Ferster & Skinner, 1957). For example, to make a peanut butter sandwich, one gets two slices of bread, spreads the peanut butter onto one slice of bread, then puts the two slices of bread together. Failure to engage in all of the steps in the correct order will not produce the reinforcer maintaining the response chain (eating a peanut butter sandwich). Each earlier response in the chain precedes and predicts later responses, which meets the definition of precursor behavior. A third precursor relation exists when “precurrent” behavior increases the effectiveness of other (current) behavior that it precedes (Skinner, 1953, 1957): Placing one’s keys by the door (precurrent response) increases the likelihood of finding them (current response) when leaving the house later. Thus, precurrent responses also fit the definition of precursor behavior.

Precursor behavior and problem behavior may be part of a response class, chain, or precurrent-current relation. For example, rolling up one’s shirt sleeve and SIB

in the form of scratching one's arm may be members of the same response class if, in the past, reinforcement in the form of attention from caregivers has been delivered contingent on either response. If SIB often is preceded by rolling up one's sleeve, caregivers may deliver attention when either response occurs. However, rolling up one's sleeve and SIB also may be part of a chain, if SIB typically has been reinforced only when one scratches on bare skin and never when scratching occurs over clothing. In this case, scratching is reinforced only when it is preceded by rolling up one's sleeve, and either response in isolation is not reinforced. Finally, rolling up one's sleeve and SIB may be part of a precurrent-current relation if rolling up the sleeve increases the probability that reinforcement will be delivered contingent on SIB. For example, rolling up one's sleeve may increase the likelihood that caregivers will notice SIB has occurred (physical damage is more visible), which in turn increases the probability that attention for SIB will be delivered.

A limitation in studying the relation between precursor and problem behavior in a typical applied setting is that the history of reinforcement for both responses is unknown; thus, any one of these relations may exist prior to conducting an FA. Although it is often assumed that high responding in the same test condition in both an FA of problem behavior and a precursor FA is indicative that both responses are members of the same functional response class, no studies have examined the veracity of this assumption. In the precursor FA, because reinforcement is delivered contingent on the precursor response rather than problem behavior, the original relation between the two may be obscured. That is, later responses in the sequence (the target problem behavior) may simply not occur in the precursor FA because reinforcement is delivered

for initial responses in the sequence, rendering later responses unnecessary regardless of their history of reinforcement. In addition, even if precursor and target problem behaviors were not originally members of the same response class, a precursor FA may create a new response class because the reinforcer that maintains the target problem behavior is delivered for a response that happens to precede it.

The purpose of this current study was to show how the contingencies in a precursor FA affect both precursor and target responses in known response-response relations. First, response classes, chains, and precurrent-current relations were established using arbitrary responses (i.e., responses unlikely to have been reinforced in subjects' natural environments). Subsequently, contingencies analogous to those used in an FA of both problem behavior and precursor behavior were implemented with each relation to see if similarities and differences in response patterns under the three trained relations would emerge.

CHAPTER 2
METHOD

Subjects and Setting

Six male students from a special day school for individuals with pervasive developmental disabilities participated. Subjects were selected for inclusion based on their availability as well as teacher report that the students did not engage in severe problem behavior. All subjects complied with simple instructions (e.g., “have a seat at the table”). Leroy was a 19-year-old male, who had been diagnosed with developmental disabilities, traumatic brain injury, and a seizure disorder and labeled as language-impaired. Jace was a 19-year-old male, who was labeled as orthopedically- and speech/language-impaired. Marvin was an 8-year-old male, who also was labeled as orthopedically- and speech/language-impaired. Michael was an 18-year-old male who had been diagnosed with autism and developmental disabilities and was labeled as language-impaired. Nicky was a 4-year-old male, who was labeled as developmentally delayed. Aubrey was a 16-year-old male, who had been diagnosed with developmental disabilities and was labeled as language-impaired.

All sessions were conducted at a school for individuals with intellectual disabilities. Research sessions were conducted in an empty classroom at the school at times when the subjects were not engaged with classroom, therapy, or special activities (i.e., during subjects’ free time). The classroom contained tables, chairs, and various educational materials, as well as materials needed for sessions (described below). Training sessions ranged from one to five min in duration, and experimental (FA) sessions were ten min in duration. One to five sessions were conducted per day, three to five days per week.

Response Measurement and Interobserver Agreement

Because this study required assessment of behavior having a known history of reinforcement, response-response relations were established in different ways before exposure to the main experimental conditions. Therefore, for the purposes of demonstration, arbitrary responses (card touches) were used as target responses rather than actual problem behavior. Two cards were placed on a board; one card (R1) was located approximately 13 cm in front of the subject, and the other card (R2) was located approximately 25 or 38 cm in front of the subject, depending on the subject's height. A card touch was defined as some part of the subject's hand contacting some part of the card, and the dependent variable was the frequency of each card touch (R1 and R2).

Interobserver agreement was assessed by having a second observer independently record data for at least 30% of all sessions. Sessions were divided into 10-s intervals, and observers' records were compared on an interval-by-interval basis using formulas created within a Microsoft Excel spreadsheet. Agreement was calculated by dividing the smaller number of responses by the larger number of responses in each interval, averaging these fractions across the session, and multiplying by 100%. Recently an error within the Microsoft Excel spreadsheet was discovered: If greater than 750 responses were scored within a single session, some responses were not included in the agreement calculation. Thus, interobserver agreement will be recalculated prior to submission for publication. Mean interobserver agreement based on the existing data was 91.0%, 96.3%, 90.6%, 95.4%, 95.1%, and 96% in the training conditions and 88.2%, 92.6%, 93.4%, 94.8%, 94.4%, and 92.5% in the experimental conditions for Leroy, Jace, Marvin, Aubrey, Michael, and Nicky, respectively.

General Procedure

Each precursor relation (response class, chain, and precurrent-current relation) was evaluated in a separate manipulation. All manipulations were conducted within a reversal design (ABAB). Prior to each manipulation, a paired stimulus preference assessment (Fisher et al., 1992) was conducted to identify highly preferred edible or leisure (Marvin only) items (selected on 80% or more trials) to be used as reinforcers. Following the preference assessment, the subject was trained on the target relation under study. Subjects were always exposed to the response class relation prior to the chain and precurrent-current relations; the sequence of exposure to training on the other relations was alternated across subjects. Leroy and Marvin were trained first on the response class relation, then the chain relation, and last on the precurrent-current relation, whereas Jace and Aubrey were trained first on the response class relation, then the precurrent-current relation, and last on the chain relation. Michael was trained only on the response class and chain relations, and Nicky was trained only on the response class relation.

Response Class Training

The purpose of response class training was to establish a relation in which a less effortful (R1) and more effortful (R2) response had identical histories of reinforcement, such that they were substitutable. The response class relation was trained using a trial-based arrangement. Each training session consisted of 20 trials. The first trial of each session began with the presentation of the board with one of the two cards (depending on the target response under training; see below). If the subject touched the card within 30 s, he was given a reinforcer (one piece of a highly preferred edible item or 15 s access to a highly preferred leisure item). Subsequent trials began immediately

following delivery of the reinforcer. If the target response was not emitted within 30 s from the start of each trial, least to most prompting was implemented: First, the therapist gave a verbal prompt, “Touch the card.” If the subject did not touch the card within 5 s of the verbal prompt, the therapist said, “Touch the card like me,” and modeled the target response. If the subject did not touch the card within 5 s of the model prompt, the therapist said, “Touch the card,” while physically guiding the subject’s hand to emit the target response. Following the occurrence of the prompted target response, the therapist delivered the reinforcer to the subject. The R1 response was trained first. During these sessions, only the R1 card was available, and reinforcement was delivered for touching the R1 card. When the subject emitted 100% independent responding on all trials across three consecutive sessions of R1 training, the R2 response was trained. During these sessions, only the R2 card was available, and reinforcement was delivered for touching the R2 card. When the subject emitted 100% independent responding on all trials across three consecutive sessions of R2 training, training sessions were terminated, and the experimental conditions were implemented.

Chain Training

The purpose of chain training was to establish a relation in which only a particular sequence of responses (R1 followed by R2) produced reinforcement. The chain relation also was trained using a trial-based arrangement. Each training session consisted of 20 trials. The first trial of each session began with the presentation of the board containing both the R1 and R2 cards. If the subject touched the R1 card and then the R2 card within 30, he received a reinforcer. Subsequent trials began immediately following delivery of the reinforcer. During all training sessions, reinforcement was delivered for touching the R1 card followed by the R2 card within 30 s, regardless of whether the

target response sequence was emitted independently or was prompted (attempts to touch both cards simultaneously or in an incorrect order were blocked). In addition, if the subject failed to emit the R1-R2 sequence within 30 s, the therapist physically guided the subject to complete the sequence. In the first session, the therapist physically guided the subject to emit the R1-R2 sequence for all 20 trials. In subsequent sessions, physical prompts were delivered in the first 10 trials until 100% independent responding was observed in the last 10 trials of one session. Physical prompts then were delivered only on the first 5 trials until 100% independent responding was observed in the last 15 trials of one session. A physical prompt then was delivered only on the first trial until 100% independent responding was observed in the last 19 trials of one session (note: Aubrey did not experience this condition due to therapist error). Finally, physical prompts were removed completely until 100% independent responding was observed across three consecutive sessions. At that point, training sessions were terminated, and the experimental conditions were implemented.

Precurrent-Current Training

The purpose of precurrent-current relation training was to establish a relation in which the occurrence of a prior response (R1) increased the probability of reinforcement for a subsequent response (R2). Unlike the response class and chain relations, the precurrent-current relation training could not be established in a trial-based format. That is, if the therapist prompted the subject to engage in the precursor response (R1) prior to target (R2), the relation trained would meet the definition of a chain, rather than a precurrent-current relation, as reinforcement would follow only the occurrence of the R1-R2 sequence. Rather than directly prompt the R1-R2 sequence, we needed an arrangement in which either R1-R2 or R2 alone could be reinforced. Therefore, we used

2-min, free-operant sessions in which contingencies were arranged such that the R1-R2 sequence always produced reinforcement, whereas R2 produced reinforcement intermittently. Prior to training, sessions were conducted in which only the R2 card was available, and the reinforcer (one piece of a highly preferred edible item or 15 s access to a highly preferred leisure item) was delivered for touching the R2 card, first on an FR1 schedule, and next on a variable ratio (VR) 10 schedule, to ensure maintenance of the R2 response under conditions of intermittent reinforcement. No schedule thinning was used. The VR10 schedule consisted of ratios between 5 and 15 and was semi-randomized in that no consecutive large ratios (i.e., 10 or greater) were allowed. Once stable R2 responding was observed under the VR10 schedule, the precurrent-current training condition was implemented. During these sessions, both cards were available. Reinforcement was delivered on an FR1 schedule contingent on the occurrence of the target response sequence (R1-R2 within 30 s); however, reinforcement also was delivered on a VR10 schedule for any R2 responses that occurred without a preceding R1 response. This arrangement typified a precurrent-current relation in that R2 alone was reinforced occasionally, whereas R1 followed by R2 increased the probability of reinforcement for R2. The presence of the R1 card was alternated across sessions in a multielement design until stable responding was observed on the R2 card in both the presence and absence of R1 and consistent responding on the R1 card also was observed when the R1 card was available. If the subject ceased to emit responses on the R2 card for 1 min, the therapist physically prompted the subject to touch the R2 card the required number of times as dictated by the VR10 schedule and then delivered the reinforcer. R1 (precurrent) responses were never prompted. Once stable responding

under this arrangement was observed, training sessions were terminated, and the experimental conditions were implemented.

Experimental Conditions

These conditions mimicked contingencies of reinforcement in an FA of target problem behavior, in which reinforcement was delivered only for the target behavior (Sr+ R2 / EXT R1 condition), and in an FA of precursor behavior, in which reinforcement was delivered only for the precursor behavior (Sr+ R1 / EXT R2 condition). During the Sr+ R2 / EXT R1 condition, reinforcement was delivered on an FR1 schedule contingent on the R2 (target behavior) response, whereas no programmed consequences were delivered for the R1 response. During the Sr+ R1 / EXT R2 condition, reinforcement was delivered on an FR1 schedule contingent on the R1 response, whereas no programmed consequences were delivered for the R2 response. No prompts of any type were delivered during any of the experimental conditions.

CHAPTER 3
RESULTS

Figures 3-1, 3-2, and 3-3 show data for the subjects during training of each relation. Figure 3-1 shows data from response class training. All six subjects met the training criterion (100% independent responding on all trials across three consecutive sessions of each training condition) in 15 or fewer sessions. Figure 3-2 shows data from chain training. Jace, Marvin, and Aubrey met the training criterion (100% independent occurrences of the R1-R2 sequence across three consecutive sessions) for the chain relation in six sessions, whereas Leroy and Michael required 71 and 90 sessions, respectively, to meet the criterion. Figure 3-3 shows data from precurrent-current training. Jace, Aubrey, and Marvin showed stable responding on both cards fairly quickly. When the R2 card was the only card available, and reinforcement was delivered on a VR10 schedule, these subjects consistently engaged in the R2 response. When the R1 card was also available, and reinforcement was delivered on a VR10 schedule for engaging in the R2 response alone or on an FR1 schedule for engaging in the R1-R2 sequence, these subjects consistently engaged in the R1-R2 sequence. Leroy initially displayed more variable responding; thus, he was given additional exposure to the training sessions.

Figures 3-4 through 3-6 show data from the experimental conditions following training on each response-response relation. Figure 3-4 shows data for all subjects following training on the response class relation. When reinforcement was delivered contingent on the R2 response and extinction was implemented for the R1 response (Sr+ R2 / EXT R1), all subjects engaged in higher rates of the R2 response, and the R1 response decreased to near-zero rates for five subjects (Michael, Marvin, Aubrey, Leroy

and Nicky). Jace was the exception; he continued to emit both R1 and R2 responses during the first two exposures to this condition, despite the lack of programmed consequences for engaging in the R1 response. In subsequent exposures to the Sr+ R2 / EXT R1 condition, Jace's R1 response quickly extinguished. When reinforcement was available only for R1 responses, and extinction was implemented for R2 responses (Sr+ R1 / EXT R2), all subjects emitted high rates of R1 responses, and R2 responses decreased to zero or near-zero levels.

Figure 3-5 shows data for subjects following training on the chain relation. In the Sr+ R2 / EXT R1 condition, all subjects engaged in high rates of the R2 response, and Aubrey and Marvin engaged in zero or near-zero rates of the R1 response. By contrast, Michael and Jace also emitted equally high rates of the R1 response in this condition. In the Sr+ R1 / EXT R2 condition Aubrey, Marvin, Michael, and Jace emitted high rates of the R1 response and low rates of the R2 response. Compared to the other subjects, Leroy exhibited more variable responding overall. Leroy received three exposures to the Sr+ R2 / EXT R1 condition, and, similar to Michael and Jace, he emitted comparable rates of R1 and R2 responses each time this condition was initially implemented. R1 response rates decreased towards the end of his second and third exposures to this condition. In the Sr+ R1 / EXT R2 condition, Leroy emitted high rates of the R1 response. Although Leroy emitted fewer R2 responses during this condition, brief increases of R2 responding to near-R1 rates were occasionally observed.

Figure 3-6 shows data for the subjects following training on the precurrent-current relation. When reinforcement was delivered contingent on the R2 response and extinction was implemented for the R1 response (Sr+ R2 / EXT R1), all subjects

engaged in high rates of the R2 response. Aubrey also engaged in high rates of the R1 response for the first session of this condition, after which his R1 responding decreased to zero levels. Jace engaged in the R1 response at similarly high rates throughout his initial exposure to this condition, but not in his second exposure. By contrast, Leroy continued to engage in the R1 response throughout both exposures to this condition. Marvin's data showed a third pattern: His R1 response did not maintain in the first exposure to the Sr+ R2 / EXT R1 condition, but did maintain when the condition was implemented a second time. In the Sr+ R1 / EXT R2 condition all subjects emitted high rates of the R1 response. Aubrey engaged in zero or near-zero levels of R2 responding throughout this condition. In his initial exposure to this condition, Jace engaged in R2 responses at rates similar to R1 for the first five sessions; thereafter, R2 responses decreased to zero. Leroy engaged in variable but lower overall rates of the R2 response throughout his first exposure to this condition. In his second exposure to this condition, Leroy engaged in similar rates of both R1 and R2 responding. Marvin engaged in lower but more variable rates of R2 responses throughout both exposures to this condition.

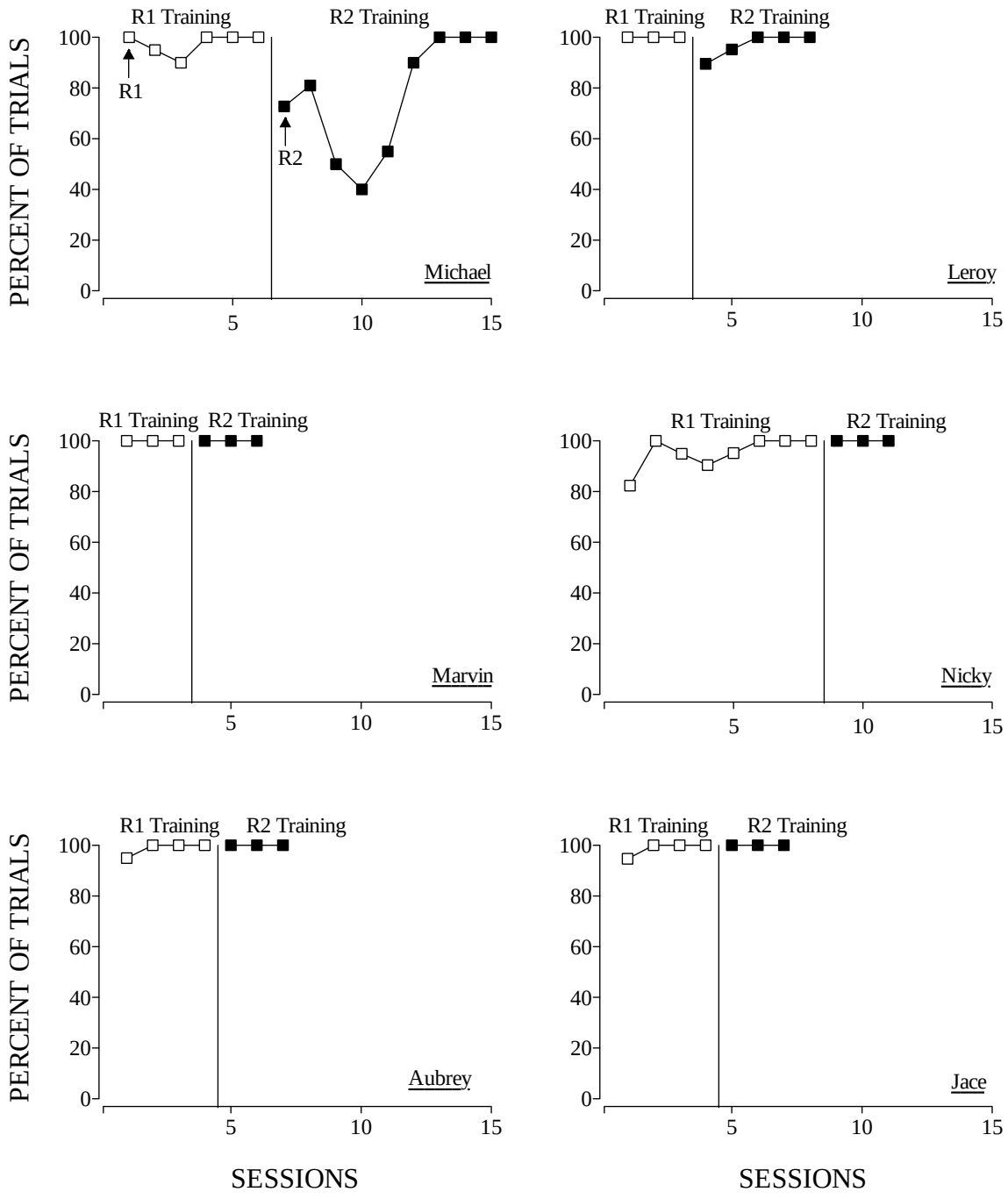

Figure 3-1. Percent of trials on which independent precursor responses (R1) and target responses (R2) occurred for subjects in response class relation training.

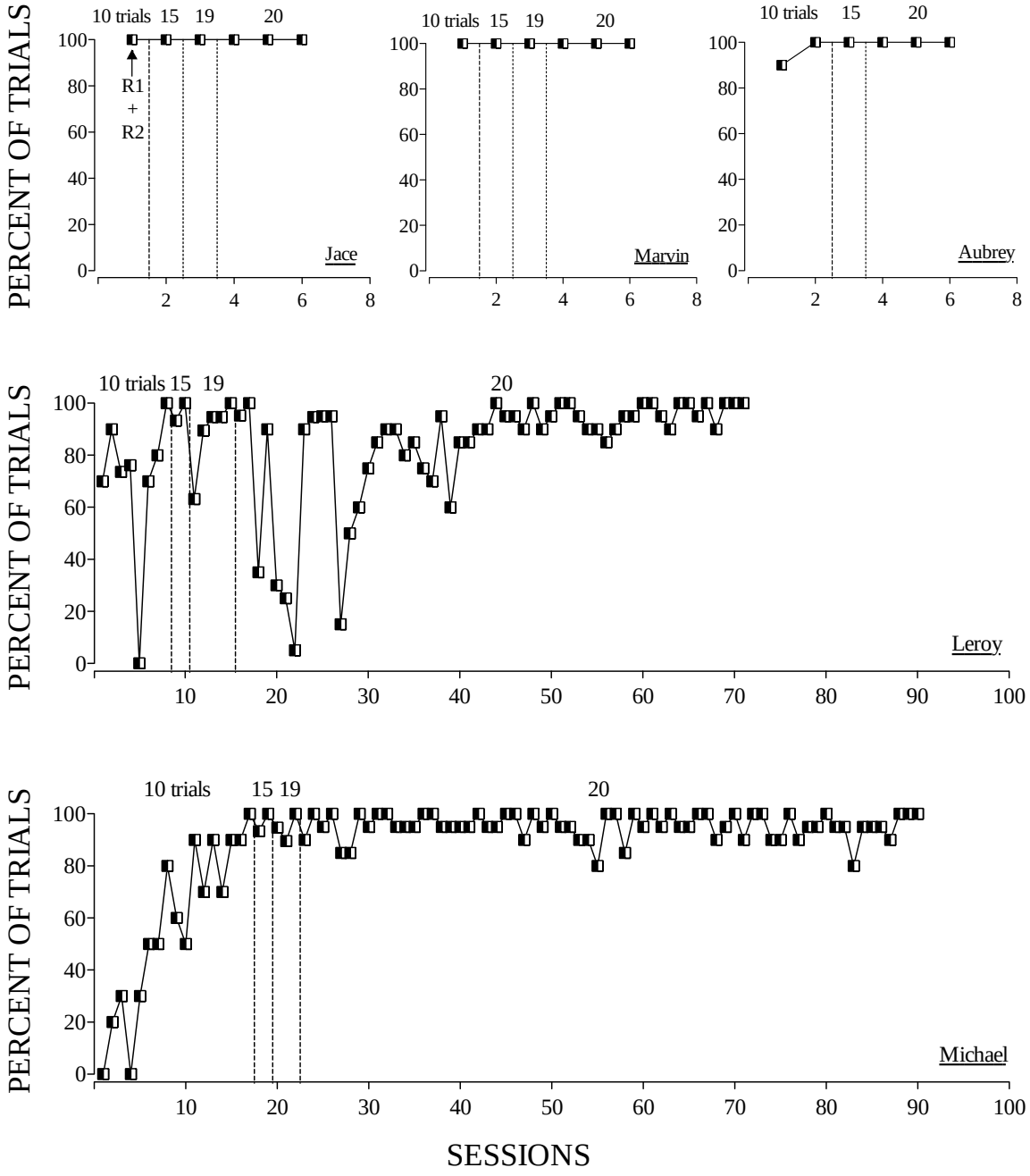

Figure 3-2. Percent of trials on which independent precursor responses (R1) and target responses (R2) occurred for subjects in chain training.

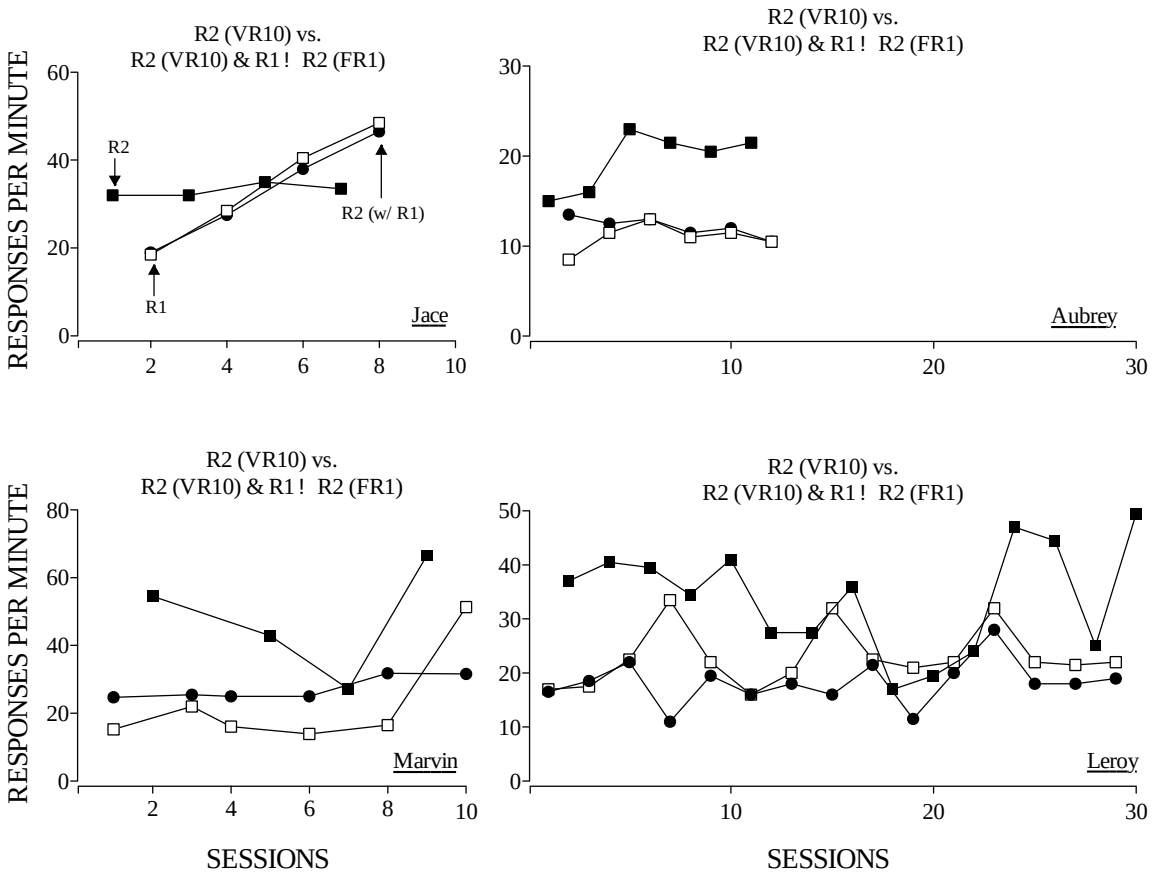

Figure 3-3. Responses per min of independent precursor responses (R1) and target responses (R2) for subjects in precurrent-current training.

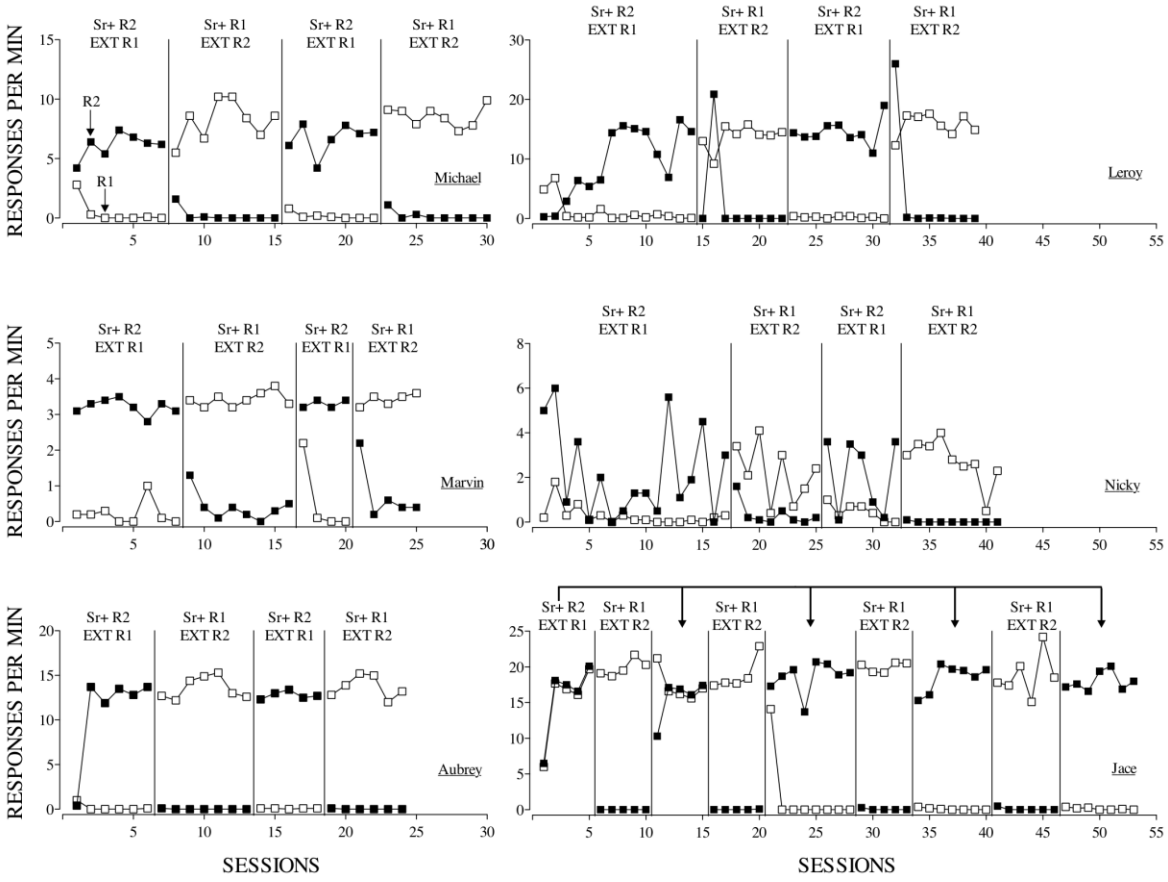

Figure 3-4. Responses per min of the precursor response (R1) and the target response (R2) for subjects following training on the response class relation.

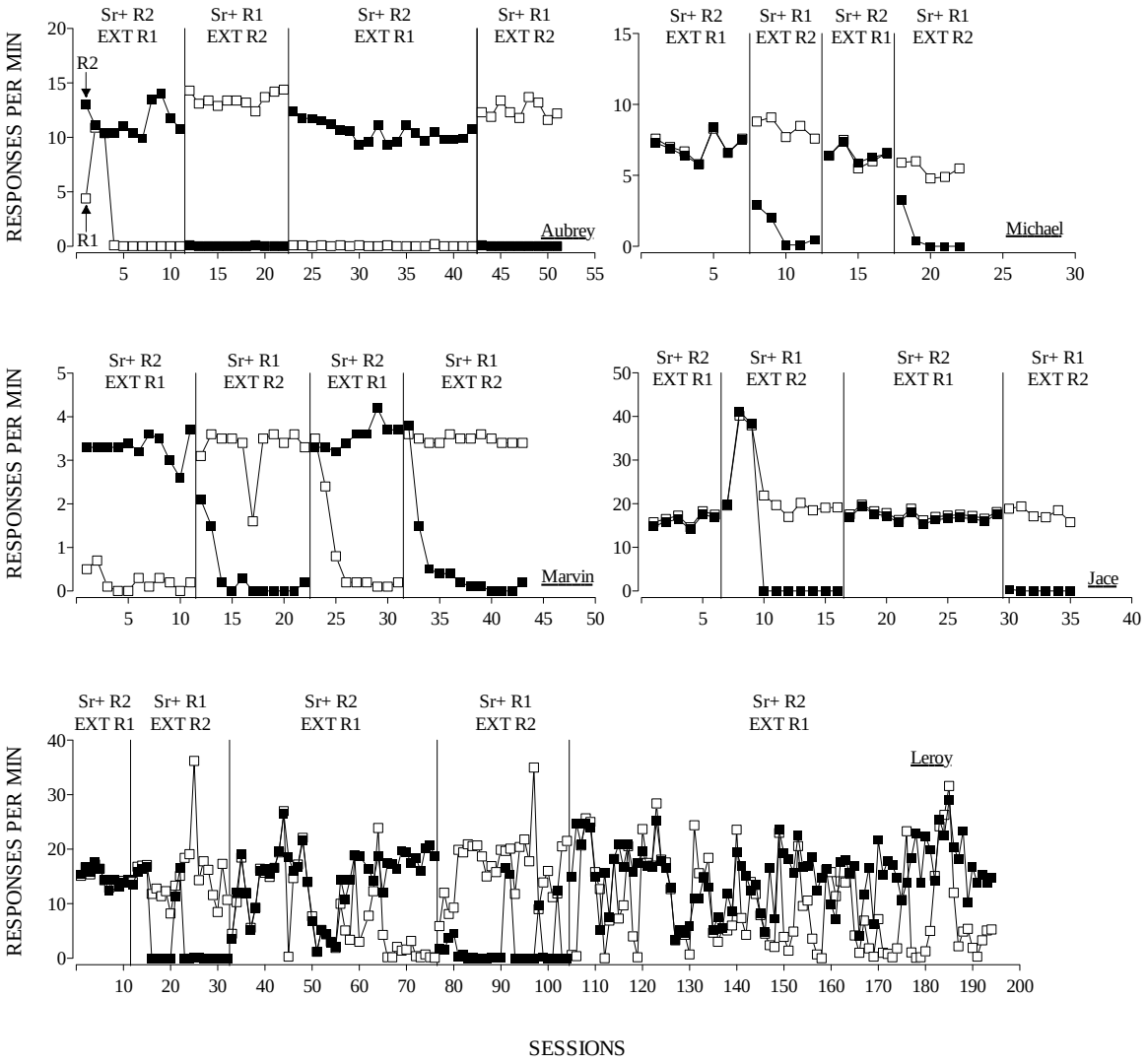

Figure 3-5. Responses per min of the precursor response (R1) and the target response (R2) for subjects following training on the chain relation.

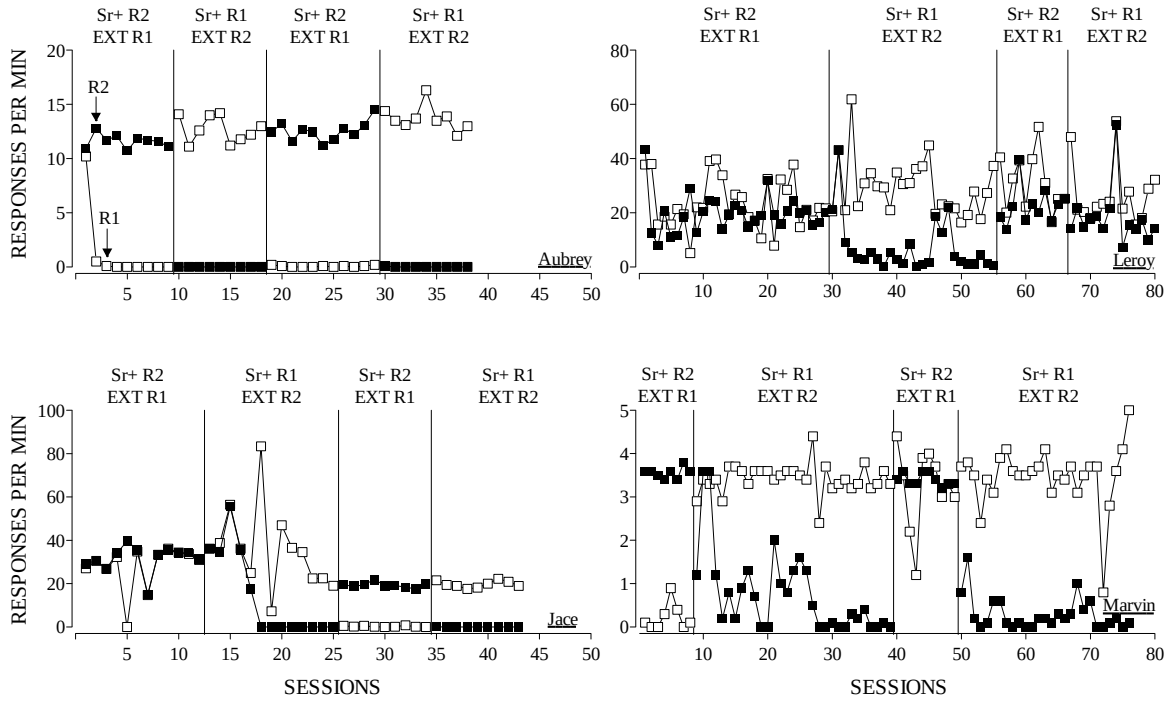

Figure 3-6. Responses per min of the precursor response (R1) and the target response (R2) for subjects following training on the precurrent-current relation.

CHAPTER 4
DISCUSSION

Results of this study showed similarities but also some differences among response patterns when contingencies analogous to those used in an FA of target problem behavior and precursor behavior were implemented with response-response relations that had been established previously in three different ways. Subjects' responding in the initial exposure to the experimental conditions (Sr+ R2 / EXT R1 followed by Sr+ R1 / EXT R2) are of particular importance because these conditions illustrate what typically occurs when individuals with unknown histories of reinforcement participate in studies on precursor FAs. That is, in the majority of applied studies in which the relation between precursor and target problem behavior was examined, subjects typically experienced an FA of problem behavior *prior to* an FA of precursor behavior (e.g., Smith & Churchill, 2002). Thus, comparing subjects' responding in the first exposures to the experimental conditions to results obtained by Smith and Churchill may provide some additional insight into relations between precursor and problem behavior in applied settings.

In the initial exposure to the condition analogous to an FA of problem behavior for the response class manipulation, only one subject (Jace) continued to engage in the less effortful precursor (R1) response when contingencies were placed on the more effortful target (R2) response, whereas the other subjects' R1 responding decreased rapidly. By contrast, in the initial exposure to the condition analogous to an FA of problem behavior for the chain and precurrent-current manipulations, three of the five subjects in the chain relation and two of the four subjects in the precurrent-current relation continued to engage in precursor (R1) behavior. Maintenance of precursor

behavior in the absence of reinforcement in the chain and precurrent-current relations was not as surprising given that subjects had a recent history of reinforcement for engaging in precursor behavior prior to target behavior in these relations, whereas the precursor-target behavior sequence was not directly reinforced in the response class relation. Interestingly, results obtained by Smith and Churchill (2002) showed that although two of their four subjects' precursor responding decreased somewhat over the course of the FA of problem behavior, the other two subjects' precursor responding remained fairly stable throughout the FA. Furthermore, none of the subjects' precursor responding extinguished completely during the FA of problem behavior. Given the present results, it appears that if precursor responses continue to occur when contingencies are placed on problem behavior (and precursor responses produce no consequences), it is possible that precursor and problem behavior more likely are part of a chain or precurrent-current relation than part of a response class.

During the initial exposure to the condition analogous to an FA of precursor behavior, when contingencies were placed on the R1 response and extinction was implemented for the R2 response, the less effortful R1 response maintained and the more effortful R2 response decreased for all subjects, regardless of which response-response relation was previously trained. These results were similar to those obtained by Smith and Churchill (2002), who found that all subjects' problem behavior decreased to zero or near-zero levels when contingencies were placed on precursor behavior. Given that the "problem behavior" response (R2) occurred initially at higher levels along with the "precursor" response (R1) before dropping out for some subjects in the chain and precurrent-current manipulations (see data for Jace and Leroy in Figure 3-5 and for

Jace, Leroy, and Marvin in Figure 3-6), it is possible that precursor FAs may actually create a temporary functional response class when a response class did not previously exist. This gradual decrease in the problem behavior, however, may be a subtle detail that goes unnoticed during a typical FA of precursor and problem behavior (see Smith & Churchill, 2002, Figure 4, for one possible example).

Results of this study suggest that outcomes of precursor FAs may indicate that precursor behavior and target problem behavior are part of the same functional response class regardless of how the precursor-target relations were established initially in the natural environment, or that precursor FAs may create a new response class when one did not exist previously. From a clinical standpoint, this may not pose significant problems for treatment. One commonly prescribed intervention involves replacing the problem behavior with an alternative response (differential reinforcement of alternative behavior, also known as functional communication training, see Tiger, Hanley, & Bruzek, 2008, for a review). Typically, the alternative behavior selected is one that already exists within an individual's repertoire. Thus, reinforcing a precursor response may be both an effective and efficient method for preventing the occurrence of problem behavior, as long as the precursor behavior itself is not considered problematic by the caregivers (e.g., Dracobly & Smith, 2012). Reinforcing the precursor response did decrease the overall rates of target behavior for the subjects in the present study, with less success in some cases (see data for Leroy in Figure 3-5 and data for Leroy and Marvin in Figure 3-6).

One limitation of this study is the inclusion of only four subjects across the three potential relations; thus, future research might assess the generality of these results.

Nevertheless, until more is known about the influence of pre-existing response-response relations on the outcomes of precursor FAs, practitioners should exercise caution when considering an FA of precursor behavior to avoid unnecessarily strengthening other problem behaviors that may require intervention in the future. Fritz, Iwata, Hammond, and Bloom (2013) developed an objective checklist for identifying precursor behaviors emitted by 16 subjects and found a wide range in both number and severity of precursor topographies across subjects. If individuals engage in multiple precursor behaviors, practitioners should solicit caregiver opinions about which (if any) precursor topographies caregivers find acceptable for inclusion in subsequent assessment and treatment procedures. More important, researchers should be cautious in assuming the existence of a response-class relation in studies on precursor FAs, as these assumptions could hinder the discovery of other behavioral processes that may aid in the treatment of severe behavior disorders. At this time, little is known about what effects, if any, different response-response relations may have on treatment outcomes when treatment is implemented for only precursor behavior, target problem behavior, or both. For example, Fritz et al. implemented treatment for two subjects based on the results of precursor FAs, which consisted of noncontingent reinforcement (NCR) plus DRA for appropriate behavior. When NCR was implemented continuously, both subjects engaged in little to no precursor or target behavior, but when the NCR schedule was thinned, both subjects sometimes engaged in precursor behavior as well as target behavior prior to emitting the appropriate response. One subject (Amanda) required a supplementary procedure in which attempts to engage in precursor behavior were blocked. This modification suppressed precursor and target behavior and resulted in

increased rates of appropriate behavior. Dracobly and Smith (2012) suggested blocking precursor behavior as a potential method to determine whether precursor and target behavior are part of a response class or chain: If the target behavior decreases, this may indicate that precursor and target behavior are part of a chain, not a class. The data presented by Fritz et al. provide some verification of this hypothesis, but additional studies (both translational and clinical) are needed to fully address how these different relations may be identified and the impact of these relations on treatment outcomes.

This study provides a simple framework for examining the effects of established response-response relations, which researchers may find useful for further translational studies. A first step for future research is to replicate the training procedures used in the present study, but subsequently implement the condition analogous to an FA of precursor behavior, rather than following the condition analogous to an FA of problem behavior, to determine if the same results would be obtained. Similarly, trained relations could be exposed to commonly prescribed interventions (e.g., NCR, DRA, etc.) using both functional and arbitrary reinforcers to see if any similarities are observed in treatment outcomes across different relations. Studies of this nature may lead to methods for identifying the existence of a specific relation prior to implementing an FA in a clinical setting. Specifically, if translational studies find differences in treatment outcomes for the three relations when arbitrary reinforcers are used as part of different treatments, treatment probes prior to a clinical FA could be conducted to identify the relation between precursor and target behavior; such probes may even reduce the need for conducting an FA altogether. Another line of research could focus on the identification of precursors for appropriate behavior. Just as precursor behavior may

precede problem behavior as part of a chain or precurrent-current relation, it is reasonable to assume that precursor behavior may precede appropriate behavior as well. If precursor responses that are part of a chain or precurrent-current relation can be identified and environmental conditions arranged such that these precursor responses are evoked, then appropriate behavior would likely follow. Future clinical research should focus on both appropriate behavior and problem behavior that may enter into chain and precurrent-current relations, neither of which has been examined in the context of behavioral assessment, and which warrant further analysis.

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BIOGRAPHICAL SKETCH

Gracie received a Bachelor of Science in psychology from Georgia State University in 2005. Following graduation, she served as a teacher's aide in a special education classroom, during which time she stumbled upon the field of behavior analysis. Gracie subsequently earned a Master of Science in applied behavior analysis from the Florida Institute of Technology, where she assisted with research on the emergence of verbal behavior in young children with autism and procedures to increase compliance in preschool students with and without developmental disabilities, and conducted a thesis on the effects of treatment integrity on efficacy of time out procedures with young children. Gracie was delighted to continue her education in the prestigious behavior analysis program at the University of Florida, where she learned from top scholars in the field. Gracie is thrilled to have accepted a position as an assistant professor in the College of Education at her alma mater, Georgia State University, which she will begin immediately following graduation.