# COMPETING CONTINGENCIES FOR ESCAPE BEHAVIOR: EFFECTS OF NEGATIVE REINFORCEMENT MAGNITUDE AND QUALITY

By

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To my family – Mom, Dad, and Stephanie

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| | |
|---|---|
| FA | Functional analysis |
| SIB | Self-injurious behavior |
| EO | Establishing operation |
| NCR | Noncontingent reinforcement |
| NCE | Noncontingent escape |
| EXT | Extinction |
| DRA | Differential reinforcement of alternative behavior |
| DRO | Differential reinforcement of other behavior |
| DNRA | Differential negative reinforcement of alternative behavior |
| DNRO | Differential negative reinforcement of other behavior |
| HP | High preferred |
| RPM | Responses per minute |
| $S^{r-}$ | Negative reinforcement |
| $S^{r+}$ | Positive reinforcement |
| BL | Baseline |
| PD | Property destruction |
| Mag | Magnitude |
| LQ | Low quality |
| MR | Mental retardation |

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COMPETING CONTINGENCIES FOR ESCAPE BEHAVIOR: EFFECTS OF NEGATIVE REINFORCEMENT MAGNITUDE AND QUALITY

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Previous research has shown that problem behavior maintained by social-negative reinforcement can be treated without escape extinction by enhancing the quality of positive reinforcement for an appropriate alternative response such as compliance. By contrast, negative reinforcement (escape) for compliance generally has been ineffective in the absence of extinction. It is possible, however, that escape for compliance might be effective if the magnitude or quality of negative reinforcement for compliance is greater than that for problem behavior. This study examined the effects of negative reinforcement magnitude and quality on problem behavior and compliance that occurred in the context of demands. In Study 1, we evaluated the effects of negative reinforcement magnitude on the escape-maintained behavior of 7 individuals with developmental disabilities. Across all treatment phases, compliance produced escape of an equal, greater, or (in some cases) lesser duration than problem behavior. Problem behavior decreased for 2 of 7 subjects when equal magnitudes of reinforcement were delivered for both response options. One subject demonstrated reductions in problem behavior and improvements in compliance in the absence of escape extinction when compliance was positively reinforced. The remaining 4 subjects, however, showed no improvement until extinction was added as a treatment component. In Study 2, we evaluated the effects of negative

reinforcement quality on the escape-maintained behavior of 3 individuals by blocking problem behavior for the duration of its occurrence during the escape interval. Treatment effects were achieved for 2 of 3 subjects when the quality of negative reinforcement was manipulated. Enhancing the quality of positive reinforcement for compliance was required for the remaining subject. Taken together, results suggest that (a) very small breaks following problem behavior may be sufficient to maintain behavior that is sensitive to escape as a reinforcer, but that (b) reducing the quality of negative reinforcement for problem behavior via blocking may be effective even though task demands are removed for a period of time.

# CHAPTER 1
# INTRODUCTION

## Functional Analysis of Problem Behavior

Functional analysis methodology is the benchmark standard for assessment in applied behavior analysis (cf. Hanley, Iwata, & McCord, 2003; Iwata, Kahng, Wallace, & Lindberg, 2000). This experimental approach identifies environmental variables that maintain problem behavior through the systematic manipulation of antecedent and consequent events that are known to influence behavior. Thus, a functional analysis aims to recreate the conditions under which problem behavior is likely to occur. This series of studies focuses on the functional analysis and treatment of problem behavior that occurs in the context of instructional demands.

Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994) were the first to demonstrate the utility of functional analysis (FA) methodology in elucidating both the social and nonsocial sources of reinforcement that may maintain problem behavior exhibited by individuals with developmental disabilities. They created a series of three test conditions and one control condition, which were alternated rapidly in a multielement design. The test conditions included: alone (the subject was in a barren environment, and no programmed consequences were placed on problem behavior; this condition tested for maintenance by automatic reinforcement), social disapproval (no attention was provided to the subject except contingent on problem behavior; this condition tested for maintenance by social-positive reinforcement), and academic demand (instructions were presented on a fixed-time schedule and were removed contingent on problem behavior only; this condition tested for maintenance by social-negative reinforcement). A play condition served as the control, in which the subject had noncontingent access to preferred items and social interaction; the purpose of this condition was to nullify test components of the other conditions. Differential responding in one or more test conditions indicated the source of reinforcement that maintained problem behavior, and Iwata et al. demonstrated that the self-injurious behavior (SIB) of 6 of 9 subjects was reliably associated with a specific stimulus condition, thus, empirically supporting early hypotheses (e.g., Carr, 1977; Smolev, 1971) that such problem behavior could be maintained by operant contingencies.

## Function-Based Treatment Selection

Although Iwata et al. (1982/1994) noted the implications of their findings for assessment and treatment, the full scope of FA methodology has become more apparent in the years since its original publication. The procedures have been replicated in hundreds of studies across various populations, settings, and topographies of problem behavior (see Hanley et al., 2003, for a discussion). Furthermore, the use of FA methodology has been cited as a prime factor contributing to a decrease in the use of punishment (Pelios, Morren, Tesch, & Axelrod, 1999), government regulations specifying “best practice” (e.g., Individuals with Disabilities Educational Act; IDEA, 1997), and the development of more effective treatments overall.

Perhaps the most pragmatic feature of FA methodology is that it can be used to guide the selection of treatments based on principles of reinforcement to yield the most efficient and effective outcomes. Prior to the use of FA methodology, reinforcement-based interventions often were applied haphazardly based on one’s best guess as to what approach might prove most effective. Because the success of such arbitrary approaches to treatment selection often hinged on the ability of the programmed reinforcer to compete with the behavior’s maintaining contingency, these early attempts at treatment sometimes failed or were less effective than procedures based on punishment (e.g., Cataldo, 1991).

A number of function-based treatments that center on principles of reinforcement have been identified over the past 20 years (cf. Iwata, Vollmer, Zarcone, & Rodgers, 1993). These procedures are best classified according to their underlying behavioral processes. Problem behavior can be suppressed through: (a) eliminating the relevant establishing operation or EO that influences the "value" of a reinforcer (noncontingent reinforcement), (b) eliminating the maintaining contingency (extinction), and (c) strengthening a competing response (differential reinforcement). These general strategies are common across problem behavior, although procedural differences arise based on the source of reinforcement that maintains a particular behavior.

## Treatment of Problem Behavior Maintained by Escape

Social-negative reinforcement plays a prominent role in the maintenance of problem behavior (cf. Iwata, 1987). Epidemiological studies indicate that avoidance of or escape from task demands may account for the largest proportion of problem behavior shown by individuals with developmental disabilities – roughly 40% (Derby et al., 1992; Iwata et al., 1994b). Therefore, an understanding of the role that negative reinforcement plays in the development and maintenance of problem behavior is important to the development of effective treatment.

A number of reinforcement-based treatments for escape-maintained behavior have been developed over the years (see Cipani & Spooner, 1997, for a review). These procedures are best classified according to the three fundamental approaches noted previously, namely: noncontingent reinforcement (EO manipulations), extinction, and differential reinforcement.

### Noncontingent Reinforcement

Noncontingent reinforcement (NCR) decreases behavior by eliminating the EOs that make behavior reinforcing in the first place. In typical application, NCR involves the delivery of the consequence that is responsible for behavioral maintenance according to a time-based schedule (see Carr et al., 2000, for a review). For problem behavior maintained by negative reinforcement, this may mean that escape (a break from work) is delivered frequently in a demand context, irrespective of the subject's behavior (NCE; e.g., Vollmer, Marcus, & Ringdahl, 1995).

Alternatively, noncontingent access to *positive* reinforcers during instructional trials also has been used to treat escape-maintained behavior. For example, Wilder, Normand, and Atwell (2005) found that 1 subject's self-injury and food refusal decreased when she was given noncontingent access to preferred videos during feeding sessions. Another antecedent intervention that has been shown to reduce problem behavior maintained by escape is stimulus fading, in which the difficulty (e.g., Weeks & Gaylord-Ross, 1981) or frequency (e.g., Pace, Iwata, Cowdery, Andree, & McIntyre, 1993; Pace, Ivancic, & Jefferson, 1994) of the task initially is reduced to the point where problem behavior no longer is evoked, and then gradually increased to baseline levels while low rates of problem behavior are maintained. Finally, the high-probability instructional sequence or "high-*p* sequence" involves presenting a series of instructions with which the subject is likely to comply immediately before an instruction with which the subject is not likely to comply – the "momentum" of compliance generated by the high-*p* responses is believed to facilitate response persistence in the face of changing conditions (i.e., low-*p* demands) (e.g., Mace & Belfiore, 1990). The common feature among all of these procedures is the alteration of an antecedent event that typically evokes problem behavior.

**Extinction**

Extinction (EXT) suppresses behavior by discontinuing the response-reinforcer relationship (Ferster & Skinner, 1957). Identification of the behavior's maintaining contingency, therefore, is a prerequisite for the effective use of EXT (Iwata, Pace, Cowdery, & Miltenberger, 1994a). For problem behavior maintained by negative reinforcement, EXT involves continued presentation of demands and prevention of escape contingent on the occurrence of problem behavior (Iwata, Pace, Kalsher, Cowdery, & Cataldo, 1990). Iwata et al. (1990) found that the escape-maintained SIB of 5 of 6 individuals with developmental disabilities rapidly decreased when problem behavior no longer produced a break, and also observed concomitant improvements in the subjects' compliance – even though the contingencies for compliance remained unchanged. These effects have been replicated in numerous studies, and escape EXT may well be regarded as the most effective and efficient method of decreasing problem behavior that occurs in the context of demands (cf. Iwata, 1987). In short, it is a key component of many behavioral procedures (e.g., NCR, differential reinforcement, as well as punishment), and the effectiveness of these procedures may be a function solely of EXT (see Lerman & Iwata, 1996b, for a review).

**Differential Reinforcement**

Differential reinforcement, including differential reinforcement of alternative behavior (DRA) and differential reinforcement of other behavior (DRO), suppresses problem behavior by strengthening a competing response or some feature of a response, such as longer inter-response times in the case of DRO (see Vollmer, 1999, for a discussion). Differential reinforcement for escape-maintained behavior may take one of several forms. First, negative reinforcement may be delivered contingent on an appropriate alternative response (DNRA). For example, escape from task demands for a period of time may be delivered contingent upon a request for a break (e.g., "finished"; Marcus & Vollmer, 1995); similarly, aversive characteristics of the task may be reduced contingent on an appropriate request for assistance (e.g., "help"; Carr & Durand, 1985). Alternatively, escape may be provided contingent on compliance (Marcus & Vollmer). By contrast, DRA for escape-maintained behavior may include delivering potent positive reinforcers (e.g., preferred edible items or toys) contingent on an appropriate alternative response, such as compliance (DeLeon, Neidert, Anders, & Rodriguez-Catter, 2001; Lalli et al., 1999; Piazza et al., 1997). Finally, differential negative reinforcement of other behavior (DNRO) involves providing escape from task demands contingent on the omission of problem behavior for a period of time (e.g., Kodak, Miltenberger, & Romaniuk, 2003; Vollmer et al., 1995). Collectively, results of these studies have shown that, when reinforcement is delivered contingent on some characteristic of behavior other than the target problem behavior, a decrease in that problem behavior typically is observed (see Vollmer & Iwata, 1992, for a general review of differential reinforcement procedures). It is important to note that differential reinforcement almost always includes an EXT component, which eliminates the possibility that problem behavior might compete with alternative behavior.

**Treatment With Escape Extinction**

Although the interventions described above have been found to be extremely effective in treating behavior that occurs in the context of demands, most share one common element that may be partially or wholly responsible for observed treatment effects – namely, the use of EXT. Most research has shown that EXT is a critical component of treatment (Mazaleski, Iwata, Vollmer, Zarcone, & Smith, 1993; Zarcone, Iwata, Hughes, & Vollmer, 1993; Zarcone, Iwata, Mazaleski, & Smith, 1994; Zarcone, Iwata, Smith, Mazaleski, & Lerman, 1994). For example, in a series of studies, Zarcone et al. demonstrated that escape EXT contributed to the success of the high-*p* instructional sequence and demand fading procedures, and that (in some cases) EXT alone was sufficient to suppress problem behavior and increase compliance (e.g., Zarcone et al., 1993).

Despite the fact that EXT is a highly effective treatment, adverse side effects such as bursting (a temporary increase in responding) or EXT-induced aggression have been observed occasionally, which may preclude its use in applied settings (Goh & Iwata, 1994; Lerman, Iwata, & Wallace, 1999). Moreover, the severity of problem behavior or the size of the individual who exhibits it may prevent the use of EXT for escape-maintained behavior. That is, because EXT requires the continued presentation of demands and prevention of escape, which also may require physical intervention, it may not be feasible with large or combative individuals. Thus, an important treatment consideration is whether it is possible to decrease problem behavior maintained by escape without EXT.

## Treatments Without Escape Extinction

Results of some studies have suggested that antecedent interventions such as demand fading (Pace et al., 1994) and activity choice (Romaniuk et al., 2002), as well as consequent interventions such as DRA (Horner & Day, 1991; Lalli, et al., 1999; Piazza et al., 1997), might be effective even when escape-maintained behavior continues to be negatively reinforced – with greater emphasis being placed on DRA. Although most research on DRA for escape-maintained behavior has incorporated EXT, several studies have shown that DRA without EXT may be effective when qualitatively *different* reinforcers are used. For example, positive reinforcement for compliance, either alone (e.g., an edible item; DeLeon et al., 2001; Lalli et al.) or combined with negative reinforcement (e.g., access to preferred activities and/or attention during the escape interval; Hoch, McComas, Thompson, & Paone, 2002; Lalli & Casey, 1996; McComas, Goddard, & Hoch, 2002; Piazza et al.) has been shown to reduce escape-maintained behavior without EXT. Because the contingencies arranged in these studies involved different reinforcers (i.e., positive reinforcement for compliance versus negative reinforcement for problem behavior), these arrangements can best be described as unequal or asymmetrical (see Fisher & Mazur, 1997, for a discussion).

Several studies also have examined whether negative reinforcement (alone) for an appropriate alternative response may compete with problem behavior maintained by escape in the absence of EXT. Because the contingencies arranged in these studies involved qualitatively similar reinforcers (negative reinforcement for both compliance and problem behavior), these arrangements incorporate equal outcomes. Although the majority of studies have shown negligible effects when escape for appropriate and problem behavior was equivalent (DeLeon et al., 2001; Hoch et al., 2002; Lalli et al., 1999), results of some studies have suggested that escape for an appropriate alternative response may compete with escape for problem behavior. For example, Piazza et al. (1997) found that the escape-maintained problem behavior of 1 of 3 subjects eventually decreased to zero when both compliance and problem behavior produced equal durations of negative reinforcement. Similarly, Horner and Day (1991) found that escape for an appropriate alternative response produced both reductions in problem behavior and improvements in the alternative response when the alternative response (mand) was either more efficient or reinforced more frequently than the target response. In general, however, idiosyncratic results have been obtained in studies evaluating the effects of DNRA on escape-maintained behavior when equal outcomes are incorporated.

One method that might enhance the effects of negative reinforcement for compliance would be to increase the magnitude (duration) of escape for appropriate behavior relative to that for problem behavior. Some applied research has shown that increasing the magnitude of positive reinforcement may decrease behavior that is maintained by access to tangible items. For example, Carr, Bailey, Ecott, Lucker, and Weil (1998) obtained lower rates of responding when a relatively large amount of food was delivered noncontingently (i.e., in the NCR-high condition), whereas baseline rates of responding were obtained when smaller amounts of food were delivered in the NCR-low condition. Roscoe, Iwata, and Rand (2003) extended these findings by showing that larger magnitudes of reinforcement, defined functionally based on rates of responding during contingent reinforcement, can reduce response rates under NCR even when session time is corrected to account for reinforcer consumption time. Lerman, Kelley, Van Camp, and Roane (1999) also showed that DRA + EXT produced consistently lower levels of problem behavior when a functionally equivalent alternative response resulted in a longer duration of access to the putative reinforcer (i.e., toys).

Although magnitude has been shown to be a somewhat influential parameter for behavior maintained by positive reinforcement, the effects of negative reinforcement magnitude are less certain. Very little applied research has been conducted on the effects of negative reinforcement magnitude. A notable exception is a study by Lerman, Kelley, Vorndran, Kuhn, and LaRue (2002), who examined the effects of reinforcement magnitude on the appropriate communication of 3 subjects whose problem behavior was placed on EXT throughout the evaluation. For subjects whose problem behavior was maintained (at least in part) by escape from task demands, the duration of escape delivered contingent on appropriate communication was varied. Results generally showed that the subjects' rates of communication were similar across the 20-, 60-, and 300-s magnitude conditions, thus suggesting that negative reinforcement magnitude may not be a major determinant of behavior. It is possible, however, that the single reinforcement schedule for appropriate behavior, in which only one magnitude was available in a given experimental condition, partially contributed to the negative results obtained. It has been noted that concurrent schedules, in which different parameters are compared directly by making both available but for different responses, are better suited to examine the relative effects of reinforcement magnitude (cf., Catania, 1963). Additionally, because problem behavior was placed on EXT throughout the evaluation, the relative effects of negative reinforcement magnitude on problem behavior maintained by escape remain unknown.

It is also possible that escape-maintained behavior could be treated without EXT by altering qualitative characteristics of negative reinforcement. Most research on competing contingencies for behavior has shown that the quality of *positive* reinforcement is a highly influential determinant of reinforcement effects (e.g., Kodak et al., 2007; Lalli et al., 1999; Mace, Neef, Shade, & Mauro, 1996; Neef, Mace, Shea, & Shade, 1992; Neef, Shade, & Miller, 1994). However, it remains unknown whether *negative* reinforcement quality would prove to be an equally powerful parameter. One way its effects could be evaluated would be to block problem behavior for the duration of its occurrence, which might reduce the quality of reinforcement because escape is available only to the extent that blocking is in effect. Thus, reductions in problem behavior might be obtained even though problem behavior continues to produce escape on some level. This question has direct clinical relevance because the severity of the behavior (i.e., SIB or aggression) sometimes necessitates immediate intervention to ensure the safety of the individual or others. Surprisingly, very little research has been conducted in this area. A notable exception is a study by Peck et al. (1996), who found that the escape-maintained problem behavior of 2 subjects decreased when problem behavior was blocked; however, because both the magnitude of negative reinforcement and quality of positive reinforcement associated with the appropriate alternative response also were enhanced in this study, the effects of blocking per se on problem behavior maintained by escape remain unknown.

In summary, although the majority of applied research suggests that negative reinforcement (alone) for compliance is ineffective in reducing escape-maintained problem behavior without EXT, additional research is warranted. That is, little research been conducted on methods for strengthening negative reinforcement for appropriate behavior relative to that for problem behavior. The purpose of this study therefore is to determine whether increases in compliance and decreases in escape-maintained problem behavior may be obtained when the magnitude or quality of negative reinforcement for problem behavior is lessened relative to that for compliance.

# CHAPTER 2
# FUNCTIONAL ANALYSIS OF PROBLEM BEHAVIOR

## Method

### Subjects and Setting

Nine individuals diagnosed with developmental disabilities who were referred for assessment and treatment of problem behavior participated. Subject characteristics are listed in Table 2-1. Functional analyses were conducted initially as a screening procedure to identify subjects whose problem behavior was maintained by escape from task demands. Sessions were conducted in a self-contained classroom at a special education school or in an observation room at an adult day program. Session areas contained a table and chairs, as well as materials that varied according to the condition in effect. Setting and room characteristics remained the same across Studies 1 and 2. Sessions were 10 min in duration; 1 to 5 sessions were conducted each day, and sessions typically were conducted 2 to 5 days per week depending on the subjects' schedules.

### Response Measurement and Reliability

The primary dependent measure was the number of responses per minute of problem behavior. Topographies of problem behavior included property destruction (Emma, Tim, John, and Keith), self-injury (Braxton and Kendra), and aggression (Gary, Rita, and Ethan). Operational definitions of the target problem behaviors for each subject are listed in Table 2-1. Data also were collected on the subjects' compliance with demands (Emma, Braxton, Tim, John, Rita, and Ethan), which was defined as completion of the task following either a verbal or model prompt.

Several therapist behaviors also were recorded. Attention delivery was defined as the therapist initiating verbal or physical interaction with the subject. A prompt was defined as the initial instruction in a three-step sequence. Escape was defined as the therapist terminating demands and turning away from the subject for 30 s. Tangible was defined as the therapist handing the subject an item or placing an item directly within reach of the subject.

Observers recorded the frequency of subject target problem behavior, subject compliance, and therapist behavior during continuous 10-s intervals using a handheld Palm PDA. Interobserver agreement was assessed by having a second observer simultaneously but independently collect data during at least 25% of the FA sessions for all subjects. Proportional agreement percentages were calculated for each response by comparing the two observers' recorded frequencies during each 10-s interval. The smaller number of responses was divided by the larger number in each interval with a disagreement, the fractions were summed across all intervals, and the total was added to the total number of agreement intervals in the session. The sum was divided by the total number of intervals in the session and multiplied by 100% to yield reliability scores for each dependent measure. Mean reliability scores were as follows: Emma, 94.5% for property destruction (range, 84.2% to 100%), 96.7% for compliance (range, 93.3% to 100%), and 94.4% for therapist behaviors (range, 90% to 100%); Braxton, 100% for SIB, 100% for compliance, and 97% for therapist behaviors (range, 89.2% to 100%); Tim, 97.1% for property destruction (range, 88.5% to 100%), 96.7% for compliance, and 91.7% for therapist behaviors (range, 80% to 100%); Gary, 99.8% for aggression (range, 99.2% to 100%) and 97.5% for therapist behaviors (range, 93.3% to 100%); John, 100% for property destruction, 100% for compliance, and 97% for therapist behaviors (range, 90% to 100%); Rita, 96.1% for aggression (range, 95% to 100%), 100% for compliance, and 96.9% for therapist behaviors (range, 93.3% to 100%); Keith, 99.5% for property destruction (range, 96.7% to 100%) and 100% for therapist behaviors; Ethan, 98.5% for aggression (range, 94.2% to 100%), 96.7% for compliance, and

93.5% for therapist behaviors (range, 73.3% to 100%); and Kendra, 100% for SIB and 100% for therapist behaviors.

**Procedures**

FAs were conducted using procedures similar to those described by Iwata et al. (1982/1994). Test and control conditions were alternated in a multielement design. Attention, play, and demand conditions were included in all FAs. An ignore condition generally was not included if the target response was aggression, and a tangible condition was conducted only if caregiver report suggested that problem behavior might be maintained by access to preferred items or activities. Specific stimuli (e.g., different therapists, session areas, or colored shirts) were associated with each FA condition to enhance discrimination of the contingencies in effect (Conners et al., 2000).

**Ignore:** The purpose of this condition was to determine if problem behavior would persist in the absence of social contingencies, suggesting that problem behavior was maintained by nonsocial (automatic) reinforcement. The subject was in an isolated area of the room without access to leisure items or social interaction. The therapist also was present but did not interact in any way with the subject throughout the session.

**Attention:** The purpose of this condition was to determine if problem behavior was maintained by social-positive reinforcement in the form of attention. The subject had access to 2-3 moderately preferred toys identified via a paired-stimulus (Fisher et al., 1992) or a multiple-stimulus (DeLeon & Iwata, 1996) preference assessment. At the start of the session, the therapist told the subject, “I have some work to do, but you can play with these toys if you’d like.” The therapist sat next to but did not interact with the subject. Contingent upon each occurrence of target problem behavior, however, the therapist delivered a brief reprimand and statement of concern (e.g., “You shouldn’t do that; you’re going to hurt yourself!”) and gentle physical contact (e.g., placed a hand on the subject’s arm).

**Tangible:** The purpose of this condition was to determine if problem behavior was maintained by social-positive reinforcement in the form of access to preferred items. The subject was given approximately 60-s access to 3 high-preferred (HP) edible items (identified in a preference assessment) immediately before the start of the session. At the start of the session, the therapist removed the items from the subject but remained nearby. If the subject initiated interaction with the therapist during this condition, the therapist briefly responded to the subject and then terminated the interaction (e.g., quickly answered a question or said “We’ll talk later.”). Contingent on the occurrence of problem behavior, one small edible item was delivered.

**Demand:** The purpose of this condition was to determine if problem behavior was maintained by social-negative reinforcement in the form of escape from task demands. The subject was seated at a table with task materials present. The therapist initiated academic or vocational trials on a fixed-time 30-s schedule using a graduated, three-step prompt sequence (verbal instruction, model prompt, physical guidance at 5-s intervals if compliance did not occur). Contingent on compliance, the therapist delivered verbal praise and began a new trial. Contingent on problem behavior, the therapist discontinued the demands and moved away from the subject for 30 s.

**Play:** This condition served as the control condition in which antecedent and consequent events likely to occasion problem behavior were absent. The subject and therapist were seated at a table or on the floor. The subject had continuous access to 2-4 HP leisure items (identified in a preference assessment), and the therapist initiated friendly interaction with the subject approximately every 30 s (contingent upon a 5-s absence of problem behavior) or any time the subject initiated appropriate interaction. No consequences were delivered following the occurrence of problem behavior.

## Results

Figure 2-1 shows results of the FAs for each subject who participated in Studies 1 and 2. Emma, Braxton, Tim, Gary, John, Rita, and Keith engaged in higher rates of problem behavior in the demand condition and little or no problem behavior in any other condition, indicating that their problem behaviors were maintained by escape from task demands.

Ethan and Kendra also engaged in high rates of problem behavior in the demand condition. However, their problem behavior occurred at somewhat similar rates in the tangible condition. Thus, Ethan’s aggression and Kendra’s hand biting appeared to be maintained not only by escape from task demands but also by access to preferred edible items.

Taken together, data for all subjects indicate that their problem behaviors were maintained (at least in part) by social-negative reinforcement, which was a prerequisite for participation in the treatment phases of this study.

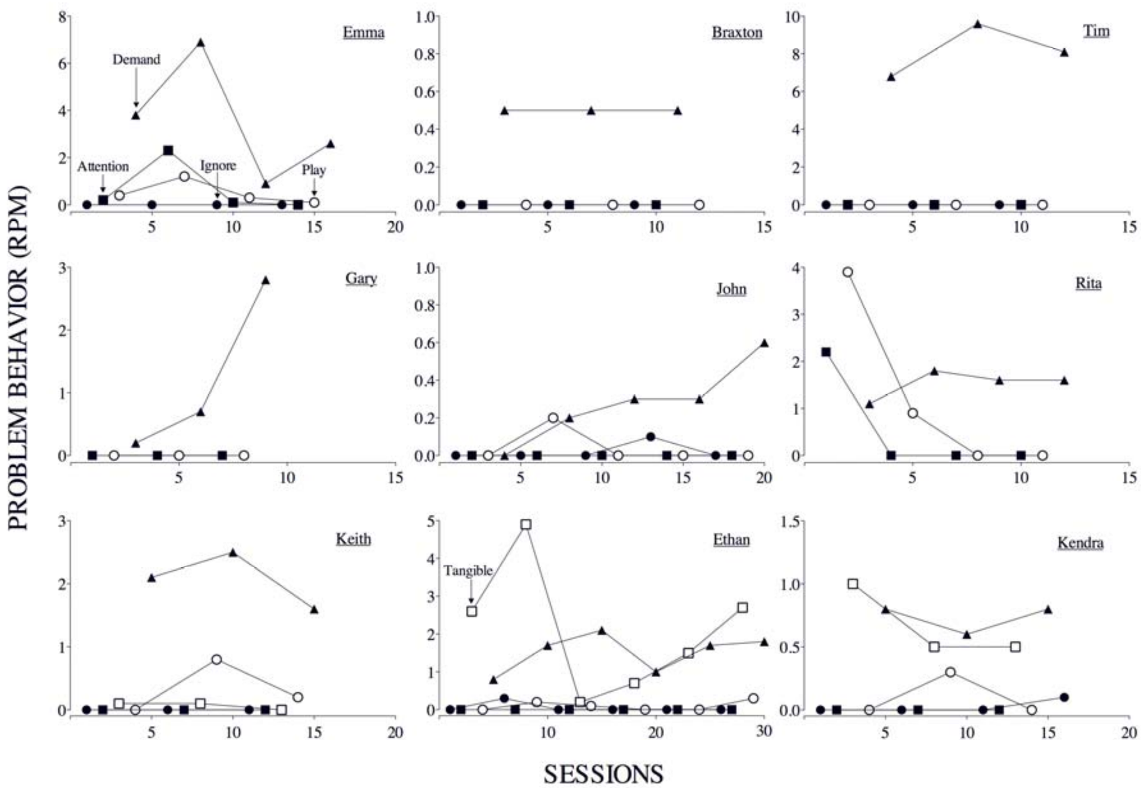


Figure 2-1. Functional analysis results for all subjects. Emma, Braxton, Tim, Gary, John, Rita, and Keith participated in Study 1; Keith, Ethan, and Kendra participated in Study 2.

CHAPTER 3
STUDY 1: EFFECTS OF NEGATIVE REINFORCEMENT MAGNITUDE

## Method

### Subjects and Setting

Emma, Braxton, Tim, Gary, John, Rita, and Keith participated in Study 1. Sessions were 10 min in duration; 1 to 8 sessions were conducted each day, and sessions typically were conducted 2 to 5 days per week depending on the subjects' schedules.

### Response Measurement and Reliability

The primary dependent measure was the number of responses per minute of problem behavior (see Table 2-1 for definitions). Data also were collected on subjects' compliance with demands, as previously defined. The demands included for each subject are listed in Table 3-1.

The frequency of therapist behavior, including initial verbal instructions and reinforcer delivery (i.e., escape and edible item, if applicable) was recorded. Additionally, data were collected on reinforcer consumption time (the duration of the escape interval), which was subtracted from session time, yielding a conservative estimate of the rate of problem behavior that was not artificially suppressed merely as a function of reduced time spent in the presence of demands.

Interobserver agreement was calculated as previously described. Mean reliability scores were as follows: Emma, 96.6% for property destruction (range, 86.6% to 100%), 97% for compliance (range, 93.3% to 100%), 92.2% for therapist instructions (range, 84.2% to 100%), and 98% for therapist reinforcer delivery (range, 91.6% to 100%); Braxton, 98.9% for SIB (range, 92.5% to 100%), 98.6% for compliance (range, 90.3% to 100%), 93.4% for therapist instructions (range, 85% to 100%), and 95.9% for therapist reinforcer delivery (range, 55% to 100%); Tim, 97.7% for property destruction (range, 86.5% to 100%), 96.7% for compliance (range, 90% to 100%), 97.1% for therapist instructions (range, 87.8% to 100%), and 97% for therapist reinforcer delivery (range, 86.7% to 100%); Gary, 96.8% aggression (range, 87.5% to 100%), 96.1% for compliance (range, 84.1% to 100%), 93.3% for therapist instructions (range, 79.9% to 100%), and 94.7% for therapist reinforcer delivery (range, 82.5% to 100%); John, 96.1% for property destruction (range, 87.5% to 100%), 98% for compliance (range, 90% to 100%), 91.9% for therapist instructions (range, 68.3% to 100%), and 97.3% for therapist reinforcer delivery (range, 86.7% to 100%); Rita, 95.6% for aggression (range, 80.6% to 100%), 98.4% for compliance (range, 90% to 100%), 93.3% for therapist instructions (range, 79.2% to 100%), and 97.3% for therapist reinforcer delivery (range, 86.7% to 100%); and Keith, 94.4% for property destruction (range, 81.7% to 100%), 97% for compliance (range, 79.2% to 100%), 95.7% for therapist instructions (range, 84.2% to 100%), and 96.7% for therapist reinforcer delivery (range, 89.2% to 100%).

**Procedures**

A concurrent-schedule arrangement, in which two or more response options are available to a subject, each associated with a different consequence (Catania, 1963), was used to evaluate the effects of negative reinforcement magnitude on compliance and on problem behavior. The magnitude (duration) of escape associated with compliance and/or problem behavior was systematically manipulated across conditions, such that (a) compliance did or did not produce a break (or access to positive reinforcement), and (b) problem behavior did or did not produce a break of equal, lesser, or (in some cases) greater magnitude than compliance. The contingencies in effect were not described to the subjects at any time. Treatment conditions are labeled with two symbols (e.g., Praise/ $S^{r-}$); the first symbol denotes the consequences for compliance, and the second symbol denotes the consequence for problem behavior.

**Baseline (Praise/ $S^{r-}$):** Procedures were similar to the demand condition of the FA. Compliance resulted in verbal praise followed by resumption of task demands. Problem behavior produced 30-s escape.

**Equal Escape ($S^{r-}$/ $S^{r-}$):** Procedures were similar to those used in baseline, except that compliance also produced a 30-s break.

**Enhanced Reinforcement Magnitude for Compliance (Enhanced $S^{r-}$/ $S^{r-}$):** Procedures will were similar to those used in the equal $S^{r-}$/ $S^{r-}$ condition, except that compliance now produced 120-s escape from the task, whereas problem behavior continued to result in 30-s escape (i.e., 120/ 30). If this phase proved ineffective, the magnitude of reinforcement for problem behavior was reduced, such that problem behavior produced only 5-s escape (i.e., 120/ 5).

**Positive Reinforcement for Compliance ($S^{r+}$/ $S^{r-}$):** Escape no longer was provided for compliance. Rather, contingent on compliance, one of three HP edible items was delivered in a varied format (Egel, 1981). Immediately following the delivery of the HP edible item, the therapist instructed the subject to complete another task. Problem behavior continued to produce 30-s escape.

**Positive Reinforcement plus Extinction ($S^{r+}$/ EXT):** Procedures were similar to those used in the previous $S^{r+}$/ $S^{r-}$ phase, except that extinction (EXT) now was in effect for problem behavior. Contingent on the occurrence of problem behavior, the therapist physically guided the subject to complete the task and then presented the next demand; no break was provided.

**Experimental Design**

Experimental control was established by way of a multiple baseline across subjects (Emma and Braxton) or reversal designs (Tim, Gary, John, Rita, and Keith). The A condition consisted of baseline, the B condition consisted of equal $S^{r-}$/ $S^{r-}$, the C condition consisted of enhanced magnitude $S^{r-}$/ $S^{r-}$ (i.e., 120/ 30 or 120/ 5), the D condition consisted of $S^{r+}$/ $S^{r-}$, and the E condition will consisted of $S^{r+}$/ EXT. Treatment conditions were implemented sequentially, such that a given condition was implemented only after the previous condition was found to be ineffective.

## Results

Table 3-2 summarizes means and ranges for subjects' problem behavior and compliance across baseline and treatment conditions. Figure 3-1 shows results for Emma and Braxton. Emma exhibited variable rates of property destruction and low levels of compliance during baseline. When the equal escape ($S^{r-}$/ $S^{r-}$) condition was implemented, her problem behavior decreased to near-zero rates, and her compliance increased steadily across this condition. Braxton engaged in lower rates of problem behavior than did Emma during baseline. His compliance also was low but increased gradually throughout the condition. Braxton's hand biting immediately decreased to zero rates when equal $S^{r-}$/ $S^{r-}$ was implemented; however, unlike Emma, his compliance improved very little. The enhanced reinforcement magnitude condition (enhanced mag $S^{r-}$/ $S^{r-}$) therefore was implemented in an effort to increase his compliance. However, increasing the relative magnitude of negative reinforcement for compliance from 30/ 30 to 120/ 30 was not an effective strategy for Braxton, as his compliance remained relatively unchanged from the previous condition. Because Braxton typically complied with the same two demands only (i.e., touch card, hand therapist card), it was concluded that additional teaching strategies – rather than augmented amounts or qualities of reinforcement – were necessary to further increase his compliance with the other tasks selected (i.e., "touch [body part]").

Tim (Figure 3-2) engaged in variable levels of property destruction and compliance during baseline. The equal $S^{r-}$/ $S^{r-}$ condition did not produce clinically significant reductions in his problem behavior, although his compliance did improve. Similar results were obtained in the subsequent enhanced magnitude $S^{r-}$/ $S^{r-}$ conditions (120/ 30 and 120/ 5), as both property destruction and compliance remained relatively unchanged. When a preferred edible item was delivered contingent on compliance during the $S^{r+}$/ $S^{r-}$ condition, his property destruction quickly decreased and his compliance increased sharply, even though problem behavior continued to be negatively reinforced. When baseline was reinstated, Tim's problem behavior escalated to the highest rates obtained throughout the evaluation. When the $S^{r+}$/ $S^{r-}$ condition was reimplemented, treatment effects were replicated and maintained.

Figure 3-3 shows results for Gary, John, Rita, and Keith. Although slight differences were seen in their rates of problem behavior and compliance during baseline and across subsequent conditions, all subjects showed the same general pattern of responding. No significant improvements were observed in their behavior during either the equal or enhanced magnitude $S^{r-}$/ $S^{r-}$ conditions. Similarly, the $S^{r+}$/ $S^{r-}$ condition had either negligible effects on behavior (Gary, Rita, and Keith) or beneficial effects on compliance but not on problem behavior (John). When the $S^{r+}$/ EXT condition was implemented, large reductions in problem behavior were observed for all subjects, and improvements in compliance were observed for 3 subjects (Rita was the exception). Following a return to baseline, these effects were replicated during the final $S^{r+}$/ EXT condition.

In summary, 2 of 7 subjects (Emma and Braxton) exhibited reductions in problem behavior in the equal $S^{r-}$/ $S^{r-}$ condition; however, only 1 subject's (Emma's) compliance increased. Enhancing the magnitude of negative reinforcement for compliance, relative to that for problem behavior (enhanced mag $S^{r-}$/ $S^{r-}$ condition), was ineffective for all 6 subjects who were exposed to this condition. These results suggest that providing a break following problem behavior – no matter how brief – may be sufficient to maintain problem behavior that is sensitive to escape as a reinforcer as long as compliance also produces escape. Providing a preferred edible item contingent on compliance while problem behavior continued to produce escape ($S^{r+}$/ $S^{r-}$ condition) was effective for only 1 of 5 subjects in this study. It appeared that, for Tim, positive reinforcement was a more potent reinforcer than negative reinforcement – even though his problem behavior was maintained by escape. However, because we did not include a tangible condition in Tim's FA, it remains unknown whether his property destruction also was maintained by access to preferred items. Finally, escape EXT was required to decrease the remaining 4 subjects' problem behavior. Although not all subjects were exposed to EXT because it was implemented only if other procedures were ineffective, the fact that a majority of subjects showed reliable improvements in behavior only when EXT was used were consistent with a great deal research showing rapid reductions in problem behavior during EXT.

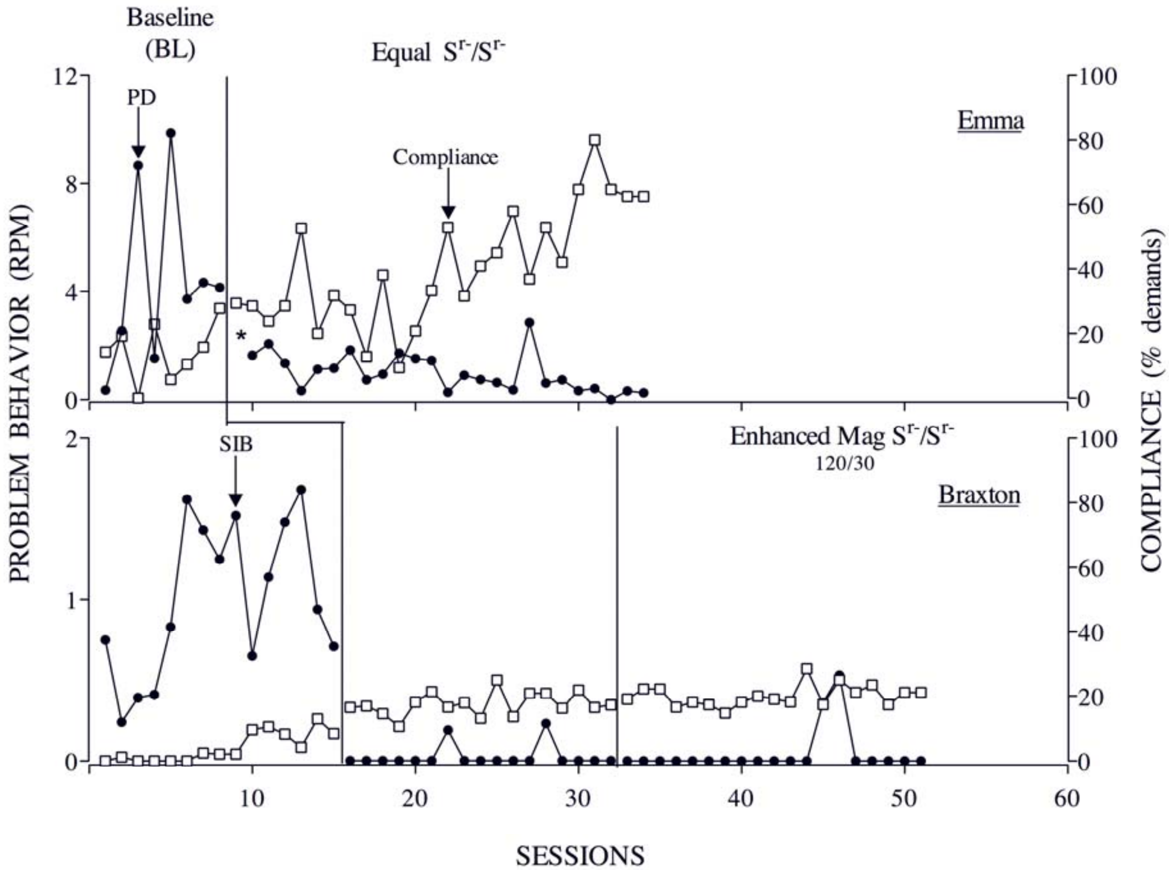


Figure 3-1. Treatment results for Emma and Braxton in Study 1. (* The asterisk below Emma's compliance data point in the first equal $S^{r-}$/ $S^{r-}$ session [session #9] indicates that problem behavior is not plotted; corrected rates could not be calculated due to a missing data stream.)

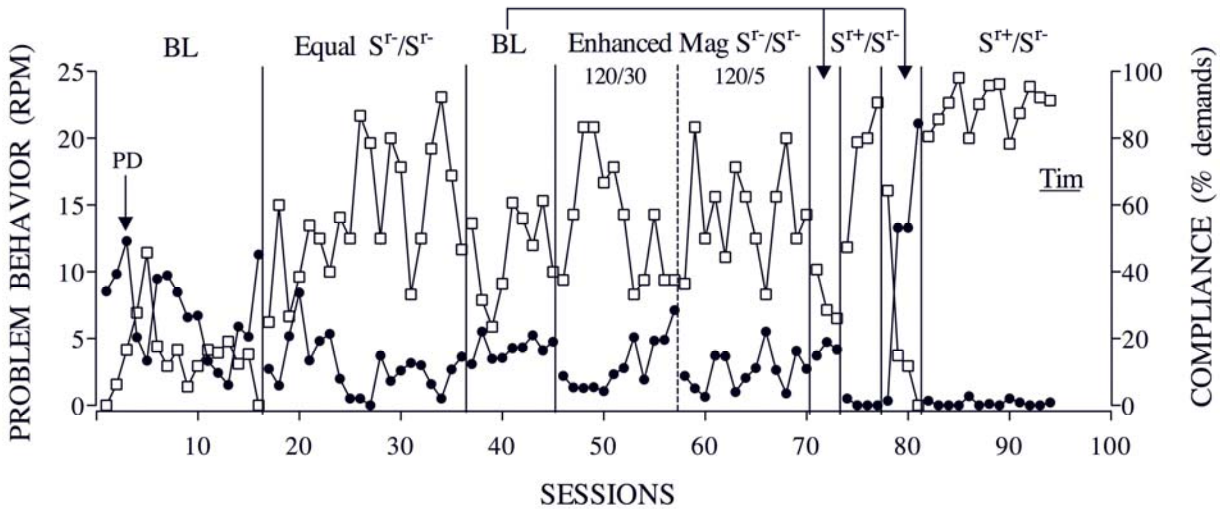


Figure 3-2. Treatment results for Tim in Study 1.

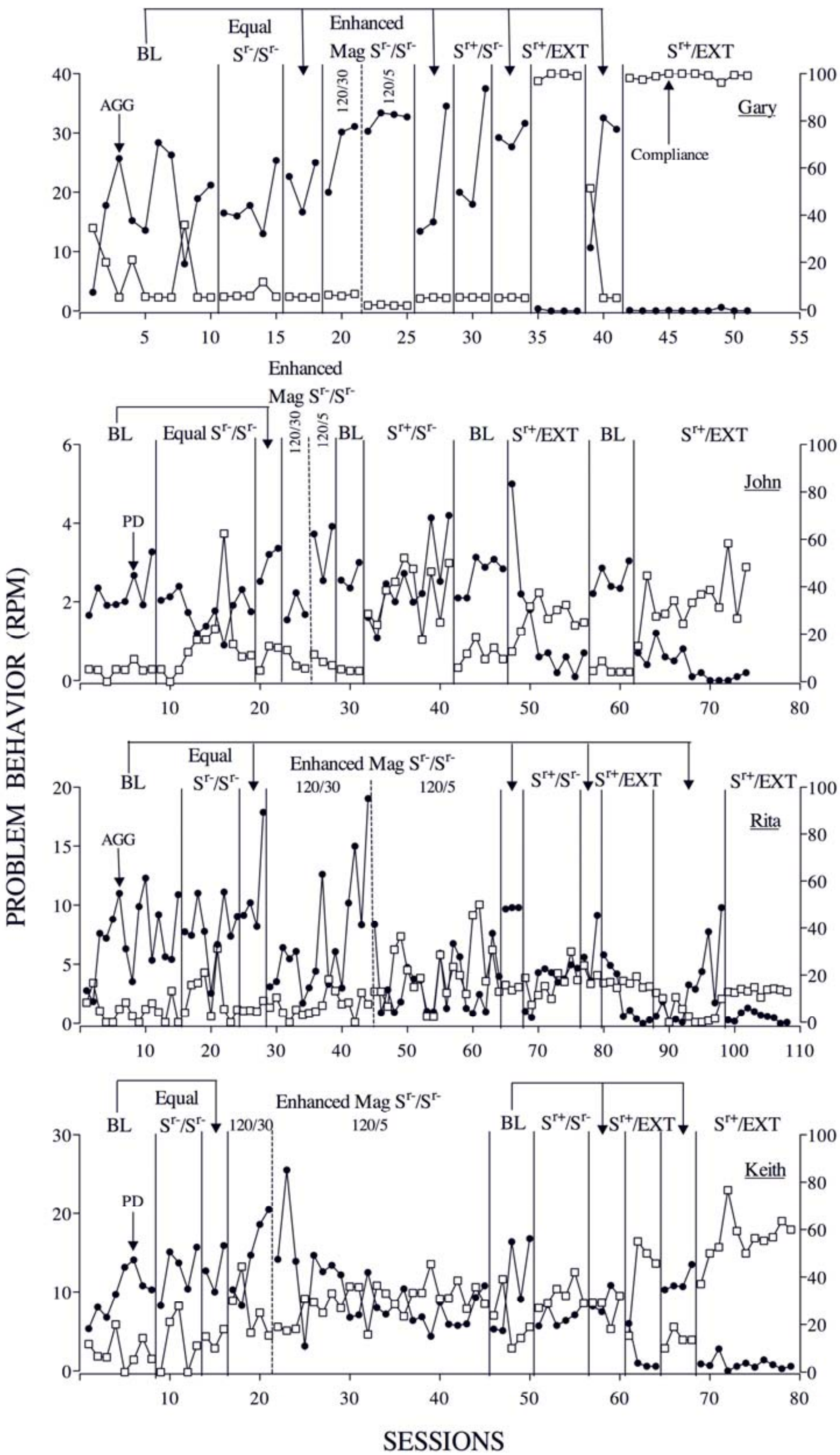


Figure 3-3. Treatment results for Gary, John, Rita, and Keith in Study 1.

# CHAPTER 4
# STUDY 2: EFFECTS OF NEGATIVE REINFORCEMENT QUALITY

Results of Study 1 suggested that enhancing the magnitude of negative reinforcement for compliance may not be effective when problem behavior continues to produce escape, and that EXT may be necessary to reduce the problem behavior of most subjects. However, as previously discussed, it may not always be possible for caregivers to implement EXT for escape-maintained behavior. Given that reinforcement quality has been found to be an important determinant of reinforcement effects, it is possible that problem behavior maintained by escape may be treated by reducing the quality of negative reinforcement available for problem behavior relative to that for compliance. The purpose of Study 2, therefore, was to examine the effects of negative reinforcement quality on problem behavior and on compliance when EXT is not used.

## Method

### Subjects and Setting

Ethan, Keith, and Kendra participated in Study 2. Sessions were 10 min in duration; 1 to 4 sessions were conducted each day, and sessions typically were conducted 2 to 5 days per week depending on the subjects' schedules.

### Response Measurement and Reliability

The primary dependent measure was the number of responses per minute of problem behavior (see Table 2-1 for definitions). Attempts to engage in the target problem behavior also were recorded during conditions that included response blocking. Ethan's attempts to engage in aggression were defined as raising or swinging his hand, arm, or leg in the direction of the therapist; placing his mouth within 1 inch of the therapist; and rapidly moving his body within 6 inches of the therapist. Keith's attempts to engage in property destruction were defined as picking up an item and raising his forearm (containing the item) to a 45-degree angle or more, placing his thumb and one or more fingers at the top of a sheet of paper in such a manner that the paper could tear if he rotated his fingers in opposite directions, reaching his hand within 6 inches of a wall containing paper, or swinging his hand or arm within 6 inches of an item (e.g., furniture) in a rapid and forward motion. Kendra's attempts to engage in SIB were defined as placing her mouth within 6 inches of her palm. Data also were collected on subjects' compliance, as previously defined. The demands included for each subject are listed in Table 4-1.

The frequency of therapist verbal instruction, reinforcer delivery (i.e., escape and edible item, if applicable), and response blocking onset and offset also was recorded. Additionally, because escape and blocking periods were not always equal, duration data on these measures were recorded. As in Study 1, reinforcer consumption time during the escape intervals was subtracted from session time when calculating response rates, although blocked responses were included in the corrected response rates.

Interobserver agreement was calculated as previously described. Mean reliability scores were as follows: Ethan, 96.5% for aggression (range, 85.9% to 100%), 96.8% for compliance (range, 90% to 100%), 94.5% for therapist instructions (range, 83.3% to 100%), 95.6% for reinforcer delivery (range, 86.7% to 100%), 99.1% for blocking onset (range, 95.8% to 100%), and 98.4% for blocking offset (range, 90.8% to 100%); Keith, 97% for property destruction (range, 82.5% to 100%), 97.9% for compliance (range, 90% to 100%), 96% for therapist instructions (range, 88.3% to 100%), 96.3% for reinforcer delivery (range, 86.7% to 100%), 97.9% for blocking onset (range, 86.7% to 100%), and 98.8% for blocking offset (range, 95% to 100%); and Kendra, 97.1% for SIB (range, 86.4% to 100%), 95.4% for compliance (range, 71% to 100%), 95.3% for therapist instructions (range, 80.6% to 100%), 95.0% for reinforcer delivery (range, 80.4% to 100%), 98.8% for blocking onset (range, 91.7% to 100%), and 99.4% for blocking offset (range, 93.3% to 100%).

**Procedures**

A concurrent schedule was used to evaluate the effects of negative reinforcement quality on compliance and on problem behavior. Across all phases, problem behavior produced escape from the task demands, whereas compliance did or did not result in escape. As in Study 1, treatment conditions are labeled with two symbols; the first symbol denotes the consequences for compliance, and the second symbol denotes the consequence for problem behavior.

**Baseline (Praise/ $S^{r-}$):** Procedures were similar to the demand condition of the FA. Compliance resulted in brief verbal praise followed by another task demand. Problem behavior produced 30-s escape.

**Equal Escape ($S^{r-}$/ $S^{r-}$):** Procedures were similar to those used in baseline, except that compliance also produced a 30-s break.

**Low Quality (LQ) Negative Reinforcement for Problem Behavior ($S^{r-}$/ LQ $S^{r-}$):** Compliance continued to produce 30-s escape. However, attempts to engage in problem behavior now were blocked by briefly interrupting the response with the minimum amount of contact necessary to prevent problem behavior.

**Positive Reinforcement for Compliance and LQ Negative Reinforcement for Problem Behavior ($S^{r+}$/ LQ $S^{r-}$):** This condition was similar to the previous $S^{r-}$/ LQ $S^{r-}$ condition, except that an HP edible item now was delivered contingent on compliance (i.e., no break was delivered). Problem behavior continued to be blocked for the duration of its occurrence, as in the previous condition.

## Experimental Design

A reversal design was used to establish experimental control. The A condition consisted of baseline, the B condition consisted of equal $S^{r-}$/ $S^{r-}$, the C condition consisted of $S^{r-}$/ LQ $S^{r-}$, and the D condition consisted of $S^{r+}$/ LQ $S^{r-}$. Treatment conditions were implemented sequentially, such that a given condition was implemented only after the previous condition was shown to be ineffective.

# Results

Table 4-2 summarizes means and ranges for subjects' problem behavior and compliance across baseline and treatment conditions. Figure 4-1 shows results for Ethan, Keith, and Kendra. The equal $S^{r-}$/ $S^{r-}$ condition produced no reliable decrease in problem behavior for any subject, although Kendra's compliance improved somewhat. When problem behavior was blocked ($S^{r-}$/ LQ $S^{r-}$ condition), Ethan's and Keith's problem behavior (attempts) decreased to near-zero levels, and both subjects showed large increases in compliance. Following a return to baseline, these effects were replicated in a subsequent $S^{r-}$/ LQ $S^{r-}$ condition. Kendra showed a different pattern of results when blocking was implemented. Her rate of hand biting increased markedly during the $S^{r-}$/ LQ $S^{r-}$ condition. However, when a preferred edible item was delivered for compliance in the $S^{r+}$/ LQ $S^{r-}$ condition, Kendra's hand biting immediately decreased to zero rates, and her task completion increased to near 100%. Following a return to baseline, treatment effects were replicated in the final $S^{+}$/ LQ $S^{r-}$ phase, as Kendra did not engage in any hand biting for several sessions, and she complied with the vast majority of task demands.

In summary, 2 of 3 subjects (Ethan and Keith) showed immediate reductions in problem behavior when response blocking was implemented, even though it resulted in escape from task demands following problem behavior. Concomitant improvements in their compliance also were observed in this $S^{r-}$/ LQ $S^{r-}$ condition, even though the contingency for compliance remained unchanged. By contrast, Kendra only showed sustained improvements in problem behavior and compliance when compliance produced an apparently more potent positive reinforcer ($S^{r+}$/ LQ $S^{r-}$ condition).

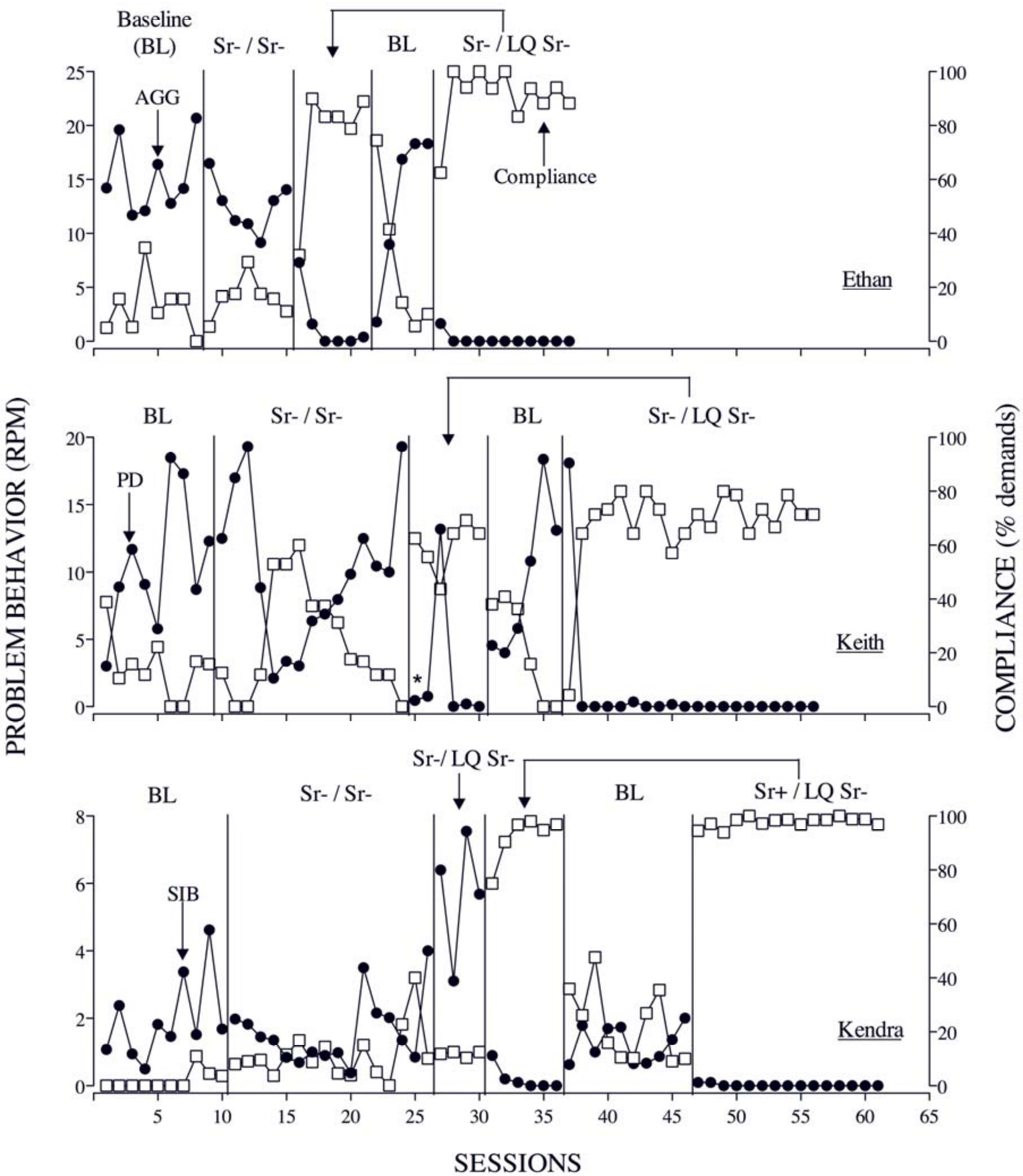


Figure 4-1. Treatment results for Ethan, Keith, and Kendra in Study 2. (* The asterisk above Keith's data point for problem behavior in the first $S^{r-}$/ LQ $S^{r-}$ session [session #25] indicates that this session was terminated early [at 5-min].)

# CHAPTER 5
# DISCUSSION

The present studies examined the influence of quantitative and qualitative parameters of negative reinforcement on escape-maintained behavior in the absence of EXT. The magnitude of escape for compliance (Study 1) and quality of escape for problem behavior (Study 2) were manipulated to determine their relative effects on compliance and problem behavior that occurred in the context of demands. Taken together, results indicated that very small breaks following problem behavior may be sufficient to maintain problem behavior that is sensitive to escape as a reinforcer (Study 1), but that reducing the quality of negative reinforcement for problem behavior via blocking may be effective even though task demands contingently are removed for a period of time (Study 2).

Results of Study 1 indicated that enhancing the magnitude (duration) of negative reinforcement for compliance, beyond that for problem behavior, had little therapeutic effect when problem behavior continued to produce escape. Although 2 of 7 subjects (Emma and Braxton) demonstrated reductions in problem behavior when equal escape durations were available for both response options, the remaining 5 subjects' problem behavior failed to decrease even when the duration of escape for compliance was increased relative to that for problem behavior. These data indicate that negative reinforcement for compliance is unlikely to be effective without EXT, but if it is, relative magnitudes of escape for compliance versus problem behavior seem unimportant. These findings are consistent with both basic and applied research, which generally has shown inconsistent or complex relations between reinforcement magnitude and response rate (Reed, 1991; Reed & Wright, 1988; Trosclair-Lasserre, Lerman, Call, Addison, & Kodak, 2008), and further suggest that *negative* reinforcement magnitude may be a relatively weak parameter of reinforcement (see Lerman et al., 2002, for a discussion).

However, it is possible that additional (uncontrolled) features of the experiment contributed to the negative results obtained. For example, although we included only one-step tasks that required minimal response time, it is possible that, if completing a task required more time than engaging in problem behavior, compliance with demands resulted in an increased delay to reinforcement. Given that reinforcer immediacy has been found to be a highly potent determinant of reinforcement effects (e.g., Neef, Mace, & Shade, 1993; Neef et al., 2005; Rachlin, 1974), one might expects subjects to allocate their responding toward the option that produced more immediate reinforcement – in this case, problem behavior. Although most applied research in this area has evaluated parameters of *positive* reinforcement, a notable exception is a study by Solnick, Kannenberg, Eckerman, and Waller (1980) who, using 90-dB white noise as the negative reinforcer, found that subjects preferred briefer, more immediate escape (i.e., 90-s escape delivered immediately) over longer, more delayed escape (i.e., 120-s escape delivered after 60 s). In short, results of Study 1 extend the literature in suggesting that enhancing the magnitude of negative reinforcement for an appropriate competing response (compliance) may not be effective when problem behavior maintained by escape continues to be reinforced. These results perhaps are not all that surprising. That is, because problem behavior continued to be negatively reinforced, subjects simply had to engage in more problem behavior in the enhanced reinforcement magnitude conditions to obtain similar durations of escape (as was provided for compliance). The clinical implication of these negative findings is important because the delivery of a longer break following task completion is an obvious treatment strategy that one might consider when attempting to reduce problem behavior that occurs in the context of demands. Although this strategy may seem reasonable, our data suggest that care providers should be cautious not to provide a break following problem behavior – no matter how brief – particularly when compliance is negatively reinforced.

Results of Study 1 also suggested that providing a preferred edible item contingent on compliance may not be effective in the absence of escape EXT. Four of 5 subjects continued to show baseline rates of problem behavior and (with the exception of John) compliance during the $S^{r+}$/ $S^{r-}$ condition. These results were unexpected and contradict those of previous research, which generally has shown positive reinforcement to compete quite well with negative reinforcement (i.e., Kodak, Lerman, Volkert, & Trosclair, 2007; Lalli et al., 1999). Several factors may have contributed to the negative results obtained for the majority of our subjects in the $S^{r+}$/ $S^{r-}$ condition. First, as previously noted, it is possible that compliance was associated with a relative delay to reinforcement. For those subjects for whom immediacy was a more potent parameter of reinforcement (i.e., than quality), it would be expected that they would allocate their responding toward problem behavior. Similarly, if compliance was the more effortful response, one might expect the subjects to allocate their responding toward problem behavior (cf. Horner & Day, 1991). Third, it is possible that positive reinforcement for compliance was ineffective because it was not a functional reinforcer for problem behavior. Some studies that have shown beneficial effects under the $S^{r+}$/ $S^{r-}$ contingency included subjects whose problem behaviors were maintained by both negative *and* positive reinforcement (i.e., DeLeon et al., 2001; Piazza et al., 1997); thus, perhaps it is not surprising that positive reinforcement for compliance was the superior treatment in these studies. However, because we did not include a tangible condition in the FAs of most of our subjects, we cannot conclude that their problem behaviors were not also sensitive to tangible reinforcement. Furthermore, because research has shown that positive reinforcement for compliance can compete with problem behavior that is maintained *solely* by escape (i.e., Lalli et al.), this interpretation seems unlikely. Fourth, the contingencies for compliance were not described to any of our subjects, which is a procedural difference from studies showing that $S^{r+}$/ $S^{r-}$ decreased problem behavior maintained by escape only (i.e., Hoch et al., 2002; Lalli et al.). Additionally, it is remotely possible that the subjects' lengthy history of escape for problem behavior biased their responding toward this alternative and contributed to the negative effects obtained in the $S^{r+}$/ $S^{r-}$ condition, as well as in the previous conditions wherein problem behavior continued to be negatively reinforced.

Finally, escape EXT was necessary to decrease the remaining 4 subjects' problem behavior in Study 1. Given the rapid reductions in problem behavior that were achieved when EXT was implemented, results of Study 1 indicated that (when possible) EXT should be used as the preferred method of treatment. These findings are supported by numerous studies that have shown that EXT may be a critical component of treatment (i.e., Mazaleski et al., 1993; Zarcone et al., 1993; 1994a; 1994b).

Results of Study 2 suggested the possibility of altering a different dimension of negative reinforcement – quality – when EXT for problem behavior is not feasible. Two subjects (Ethan and Keith) exhibited reductions in problem behavior when response blocking was implemented during the escape interval – even though problem behavior also resulted in the cessation of task demands for a period of time. These subjects also showed improvements in compliance when problem behavior was blocked during escape, despite the fact that the contingency for compliance remained unchanged. These results coincide with previous research, which generally has shown that compliance improves without additional contingencies when problem behavior maintained by escape is decreased (Iwata et al., 1990). These findings perhaps raise the question as to what mechanism was responsible for the reduced rates of problem behavior obtained for both Ethan and Keith. Previous research on the effects of response blocking on behavior maintained by automatic reinforcement suggests that blocking may function as either punishment (Lerman & Iwata, 1996a) or EXT (Smith, Russo, & Le, 1999). It is possible that similar behavioral processes were responsible for the decreased rates of problem behavior observed for these subjects in the $S^{r-}$/ LQ $S^{r-}$ condition, particularly considering that the quality manipulation involved a deterioration of conditions for problem behavior. Regardless, results for Ethan and Keith extend previous research (e.g., Peck et al., 1996) in demonstrating that blocking (alone) may be an effective treatment for problem behavior maintained by negative reinforcement. Furthermore, these results perhaps suggest that *negative* reinforcement quality also may be an influential parameter.

By contrast, Kendra exhibited a significant increase in problem behavior in the $S^{r-}$/ LQ $S^{r-}$ condition. Thus, blocking was not only ineffective for Kendra but – in the absence of additional contingencies for compliance – resulted in a worsening of problem behavior. Two factors may have contributed this. First, it is remotely possible that blocking somehow enhanced (rather than reduced) the quality of reinforcement that her hand biting produced in the $S^{r-}$/ LQ $S^{r-}$ condition. For example, anecdotal reports indicated that Kendra often laughed, smiled, and swayed her head back and forth (which she typically would do when playing) when blocking was implemented. Although the results of Kendra's FA did not suggest an attention function, she did not contact the contingency for problem behavior in any of the attention sessions (see Figure 2-1). Thus, although unlikely, perhaps her hand biting also was maintained by attention, but that her FA (as configured) was not sensitive enough to capture this function. A more probable explanation is that blocking, because of its aversive properties, elicited higher rates of problem behavior in the $S^{r-}$/ LQ $S^{r-}$ condition. Previous research has shown that aversive stimuli, when used as negative reinforcers, can acquire eliciting properties (Powell & Peck, 1969; Sidman, Herrnstein, & Conrad, 1957). Given the nature of Kendra's problem behavior, however, it was not feasible to remove the blocking component because of the risk of self-harm that her hand biting posed. Therefore, positive reinforcement in the form of preferred edible items was delivered for compliance while problem behavior continued to be blocked. An immediate and sustained decrease in Kendra's rate of hand biting was observed when the contingency for compliance was changed from negative to positive reinforcement. A marked increase in her level of compliance also was observed in this $S^{r+}$/ LQ $S^{r-}$ condition. Thus, contrary to the results of Study 1, Kendra's results coincide with previous research, which largely has shown that problem behavior maintained (at least in part) by escape may be treated without EXT by delivering high quality *positive* reinforcers contingent on compliance (e.g., DeLeon et al., 2001; Lalli et al., 1999).

Collectively, these results point to some directions for future research on competing contingencies of negative reinforcement for behavior that occurs in the context of demands. First, it is remotely possible that the subjects' lengthy history of escape for problem behavior rendered the enhanced reinforcement magnitude manipulation a very slow acting treatment, but one that might have been effective if given enough time. Future research could examine this possibility by exposing the subjects to the enhanced reinforcement magnitude condition for longer periods of time than they were in this study. Because treatment efficiency is an important consideration, however, the utility of this approach may be questionable. Second, perhaps the magnitudes we used in this study were not sufficiently different to shift the subjects' response allocation from problem behavior to compliance. Additional research therefore could examine the effects of negative reinforcement magnitude by providing considerably longer breaks contingent on compliance from the outset, relative to that for problem behavior. For example, sessions initially could be terminated following the first compliant response (e.g., resulting in a 9 min break or more if the subject complied immediately). As sustained improvements in the subjects' behavior are demonstrated, the rate of task demands could be increased while relatively larger magnitude of negative reinforcement continue to be available for compliance. Such an approach would combine both antecedent (demand fading) and consequent (DRA) interventions. Although demand fading has been shown to be ineffective in the absence of EXT (Zarcone et al., 1994b), it is possible that treatment effects could be achieved by combining the two procedures. Similarly, perhaps delivering larger magnitudes of negative reinforcement for compliance would prove effective if used in conjunction with an errorless learning or instructional fading procedure (Weeks & Gaylord-Ross, 1981). For example, difficult features of the task first could be removed by providing escape contingent on an appropriate break request. This might reduce any delay to reinforcement that could be associated with compliance; if so, the subjects might be more likely to allocate their responding toward the appropriate response. If problem behavior decreases to low rates, difficult features of the task could be reintroduced while the magnitude of escape for compliance is increased (as the contingency is changed from DRA [mand] to DRA [compliance]). Alternatively, future research could examine the relative effects of negative reinforcement magnitude on compliance and on problem behavior following an EXT baseline. Previous research has shown that problem behavior might be treated without EXT by capitalizing on such sequence effects (e.g., Vollmer, Roane, Ringdahl, & Marcus, 1999). The clinical implications of this approach, if effective, would be that sustained reductions in escape-maintained behavior might be achieved in the relevant environment *without* EXT by first treating problem behavior *with* EXT in a clinic setting (i.e., with skilled therapists).

Future research also could examine the conditions under which positive reinforcement for compliance will and will not compete with problem behavior maintained by escape. Previous research has shown that the success of positive reinforcement is dependent on factors such as the subject's preference for the item that is delivered contingent on compliance (i.e., high- versus low-preferred items; Kodak et al., 2007) and the response requirements of the task itself (DeLeon et al., 2001). Results of Studies 1 and 2 extend these findings in suggesting that the quality of negative reinforcement that problem behavior produces also might influence the effectiveness of the $S^{r+}$/ $S^{r-}$ procedure. That is, when problem behavior produces escape in the absence of additional consequences (i.e., no blocking), $S^{r+}$ for compliance might be largely ineffective (Study 1); however, when the quality of escape for problem behavior is reduced via blocking, $S^{r+}$ for compliance may be rendered more effective (Study 2). Additional studies could evaluate the conditions under which $S^{r+}$/ $S^{r-}$ is and is not an effective treatment for escape maintained behavior by examining the extent to which low rates of problem behavior are maintained under increasing schedule requirements for compliance (e.g., Lalli et al., 1999) or when $S^{r+}$/ $S^{r-}$ is implemented for longer periods of time (e.g., across the school day). Also, future research perhaps could compare the utility of the $S^{r+}$/ $S^{r-}$ procedure at decreasing problem behavior that is maintained *solely* by escape versus problem behavior that is maintained by both negative *and* positive reinforcement.

Additionally, it may be worth noting that our subjects differed on several demographic characteristics such as age, diagnosis and functioning level, history of reinforcement for problem behavior, and so forth. Therefore, it is somewhat possible that these characteristics contributed (at least in part) to the idiosyncratic results that were obtained in both Study 1 and Study 2. Future research may examine this possibility by evaluating the effects of negative reinforcement magnitude and quality on the escape-maintained behavior of individuals whose characteristics are more similar.

Finally, our reason for examining the effects of competing contingencies for problem behavior maintained by escape is that caregivers often do not implement EXT – which leads to questions about why not, and whether there are ways to improve caregivers' correct use of this procedure. Additional research in this area therefore is needed. One approach would be to conduct descriptive analyses (Bijou, Peterson, & Ault, 1968) of caregivers' use of escape EXT during naturally occurring demand situations, which would provide information regarding what actually happens when tasks are presented. For example, is it simply a matter of inconsistent (intermittent) application? Or do suspected problems (i.e., physical resistance on the part of the client) actually occur? This information might prove useful in designing strategies that may improve the consistency with which escape EXT is implemented by caregivers across relevant environments.

In summary, these studies extend previous research on treatments without EXT by evaluating the effects of quantitative and qualitative parameters of *negative* reinforcement on compliance and on problem behavior that occurs in the context of demands. Although positive reinforcement long has been recognized as a potent source of reinforcement for problem behavior, and treatment for this function generally is well understood, the role that negative reinforcement plays in the maintenance of both appropriate and problem behavior shown by individuals with developmental disabilities is less well developed (cf. Iwata, 1987). The utility of negative reinforcement for an appropriate competing response (compliance) in the absence of EXT is not evident, and the use of positive reinforcement for appropriate behavior is not simply a matter of competition between different reinforcers, but competition between different contingencies. Therefore, a number of parameters and contingency relations have yet to be explored in the treatment of problem behavior maintained by escape, and the hope is that this study will assist in guiding that line of research.

Table 2-1. Subject characteristics

| Name | Age | Classification | Definition of Target Problem Behaviors |
|---|---|---|---|
| Emma | 11 | Down syndrome, MR | Property destruction (throwing items a distance of 6” or more, tipping over furniture) |
| Braxton | 19 | Cerebral palsy, seizure disorder, MR | SIB (hand biting: inserting palm past plane of the lips while forcefully biting down) |
| Tim | 21 | Angelman syndrome, seizure disorder, MR | Property destruction (tearing paper or clothing by at least 1” or audibly, throwing or swiping items a distance of 6” or more) |
| Gary | 12 | Autism | Aggression (hitting or kicking from a distance of at least 6” or audibly, head butting) |
| John | 6 | Autism | Property destruction (throwing or swiping objects a distance of 6” or more, knocking over furniture) |
| Rita | 17 | Angelman syndrome, MR | Aggression (hair pulling, hitting from a distance of at least 6” or audibly, pushing such that the therapist or wheelchair moves) |
| Keith | 43 | Seizure disorder, MR | Property destruction (throwing items a distance of 6” or more, ripping paper, hitting walls or furniture from a distance of at least 6” or audibly, tearing paper off of walls, knocking over furniture) |
| Ethan | 4 | PDD-NOS | Aggression (hitting or kicking from a distance of at least 6”, biting or attempts to bite by placing mouth within 1” of therapists body part, scratching by moving fingers at least 1” along therapist’s skin, pushing therapist with his body) |
| Kendra | 10 | Seizure disorder, retinopathy of the eye | SIB (hand biting: inserting palm past plane of the lips and biting down with teeth-to-skin contact) |

Table 3-1. Task demands included for each subject in Study 1

| Name | Definition of Task Demands |
|---|---|
| Emma | Sit at desk or table, place objects in a bin, touch body part (e.g., hair, belly, nose) |
| Braxton | Touch card, hand therapist card, touch body part (e.g., ear, head, belly, elbow) |
| Tim | Sit in chair, fold paper or clothing, stack paper, hand therapist paper, pick up trash, put items in trash bag |
| Gary | Object identification (i.e., "point to [x]"), write letter "G" |
| John | Sit in chair, establish eye contact with the therapist (i.e., "look at me"), object identification (i.e., "touch [x]"), hand therapist object, place objects in bin |
| Rita | Touch card, hand therapist card, touch body part (e.g., head, nose, belly) |
| Keith | Sit in chair, draw a line, wipe surface, hand experimenter object, put on shoe |

Table 3-2. Means and ranges of dependent measures for each subject Study 1

| Name | Condition | Problem behavior | Compliance |
|---|---|---|---|
| Emma | BL | 4.4 rpm (range, 0.36 to 9.87 rpm) | 14.5% (range, 0 to 27.8%) |
| | 30/ 30 | 0.98 rpm (range, 0 to 2.86 rpm) | 40.4% (range, 9.5 to 64.7%) |
| Braxton | BL | 1.0 rpm (range, 0.24 to 1.68 rpm) | 4.16% (range, 0 to 13%) |
| | 30/ 30 | 0.02 rpm (range, 0 to 0.23 rpm) | 17.6% (range, 10.7 to 21.9%) |
| | 120/ 30 | 0.05 rpm (range, 0 to 0.53 rpm) | 20.1% (range, 14.8 to 28.6%) |
| Tim | BL | 6.86 rpm (range, 1.53 to 12.3 rpm) | 15.0% (range, 0 to 45.8%) |
| | 30/ 30 | 2.87 rpm (range, 0 to 8.46 rpm) | 56.8% (range, 25.0 to 92.3%) |
| | 120/ 30 | 3.03 rpm (range, 1.08 to 7.14 rpm) | 59.4% (range, 33.3 to 83.3%) |
| | 120/ 5 | 2.57 rpm (range, 0.65 to 5.52 rpm) | 57.2% (range, 33.3 to 83.3%) |
| | $S^{r+}$/ $S^{r-}$ | 0.16 rpm (range, 0 to 0.69 rpm) | 89.4% (range, 78.3 to 98.1%) |
| Gary | BL | 17.8 rpm (range, 3.14 to 28.4 rpm) | 14.4% (range, 5.26 to 36%) |
| | 30/ 30 | 17.7 rpm (range, 13 to 25.4 rpm) | 6.93% (range, 5.55 to 11.8%) |
| | 120/ 30 | 27.1 rpm (range, 20 to 31.1 rpm) | 6.27 % (range, 5.88 to 6.67%) |
| | 120/ 5 | 32.4 rpm (range, 30.3 to 33.4 rpm) | 1.95% (range, 1.79 to 2.22%) |
| | $S^{r+}$/ $S^{r-}$ | 25.2 rpm (range, 18 to 37.5 rpm) | 5.26% (range, 5.26 to 5.26%) |
| | $S^{r+}$/ EXT | 0.08 rpm (range, 0 to 0.1 rpm) | 98.9% (range, 96.3 to 100%) |
| John | BL | 2.22 rpm (range, 1.66 to 3.27 rpm) | 5.01% (range, 0 to 9.52%) |
| | 30/ 30 | 1.77 rpm (range, 0.9 to 2.39 rpm) | 16.4% (range, 0 to 62.5%) |
| | 120/ 30 | 1.82 rpm (range, 1.54 to 2.23 rpm) | 8.51% (range, 5.56 to 13.3%) |
| | 120/ 5 | 3.4 rpm (range, 2.54 to 3.92 rpm) | 8.91 (range, 6.9 to 11.5%) |
| | $S^{r+}$/ $S^{r-}$ | 2.49 rpm (range, 1.08 to 4.2 rpm) | 37.2% (range, 17.7 to 52.2%) |
| | $S^{r+}$/ EXT | 0.37 rpm (range, 0 to 1.2 rpm) | 34.5% (range, 15.0 to 58.3%) |
| Rita | BL | 7.18 rpm (range, 1.85 to 12.3 rpm) | 5.17% (range, 0 to 16.7%) |
| | 30/ 30 | 7.86 rpm (range, 2.56 to 11.1 rpm) | 11.4% (range, 0 to 31.3%) |
| | 120/ 30 | 6.96 rpm (range, 1.71 to 19.1 rpm) | 7.03% (range, 0 to 18.2%) |
| | 120/ 5 | 3.29 rpm (range, 0.86 to 8.37 rpm) | 20.7% (range, 2.44 to 50.0%) |
| | $S^{r+}$/ $S^{r-}$ | 3.51 rpm (range, 0.51 to 4.96 rpm) | 16.6% (range, 7.4 to 30.0%) |
| | $S^{r+}$/ EXT | 0.56 rpm (range, 0 to 1.3 rpm) | 13.3% (range, 10.6 to 14.9%) |
| Keith | BL | 9.79 rpm (range, 5.35 to 14.1 rpm) | 8.73% (range, 0 to 14.3%) |
| | 30/ 30 | 12.6 rpm (range, 8.29 to 15.7 rpm) | 12.0% (range, 0 to 27.8%) |
| | 120/ 30 | 14.5 rpm (range, 8.3 to 20.5 rpm) | 26.3% (range, 15.4 to 44.4%) |
| | 120/ 5 | 9.75 rpm (range, 3.14 to 25.5 rpm) | 29.7% (range, 15.8 to 45.5%) |
| | $S^{r+}$/ $S^{r-}$ | 7.0 rpm (range, 5.7 to 8.6 rpm) | 32.3% (range, 27.0 to 42.0%) |
| | $S^{r+}$/ EXT | 0.87 rpm (range, 0 to 2.8 rpm) | 56.2% (range, 37.1 to 76.7%) |

Summary data for the first BL phase and last effective treatment phase are reported.

Table 4-1. Task demands included for each subject in Study 2

| Name | Definition of Task Demands |
|---|---|
| Ethan | Sit down, stand up, touch body part (e.g., head, nose, ear), "count to (x)", object identification (e.g., "show me [x]," "point to the [x] on the left/right," etc.) |
| Keith | Stack chairs, string bead, put puzzle piece in puzzle, zip bag, put on jacket, put on shoe |
| Kendra | Sit down, stand up, clap hands, put on shirt, put on shoe |

Table 4-2. Means and ranges of dependent measures for each subject Study 2

| Name | Condition | Problem behavior | Compliance |
|---|---|---|---|
| Ethan | BL | 15.2 rpm (range, 11.7 to 20.7 rpm) | 12.8% (range, 0 to 34.7%) |
| | 30/ 30 | 12.6 rpm (range, (9.15 to 16.5 rpm) | 16.2% (range, 5.5 to 29.4%) |
| | $S^{r-}$/ LQ $S^{r-}$ | 0.15 rpm (range, 0 to 1.65 rpm) | 90.7% (range, 62.5 to 100%) |
| Keith | BL | 10.6 rpm (range, 3.0 to 18.5 rpm) | 14.6% (range, 0 to 38.9%) |
| | 30/ 30 | 9.97 rpm (range, 2.11 to 19.3 rpm) | 23.6% (range, 0 to 60.0%) |
| | $S^{r-}$/ LQ $S^{r-}$ | 0.93 rpm (range, 0 to 18.1 rpm) | 67.7% (range, 4.3 to 80.0%) |
| Kendra | BL | 1.94 rpm (range, 0.5 to 4.62 rpm) | 1.92% (range, 0 to 11.0%) |
| | 30/ 30 | 1.58 rpm (range, 0.38 to 4.0 rpm) | 11.4% (range, 0 to 40.0%) |
| | $S^{r-}$/ LQ $S^{r-}$ | 5.69 rpm (range, 3.11 to 7.55 rpm) | 11.8% (range, 10.3 to 12.5%) |
| | $S^{r+}$/ LQ $S^{r-}$ | 0.01 rpm (range, 0 to 0.1 rpm) | 97.8% (range, 93.9 to 100%) |

Summary data for the first BL phase and last effective treatment phase are reported.

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# BIOGRAPHICAL SKETCH

Jennifer Hammond completed her bachelor's degree in psychology at the University of California, Santa Cruz in 1999 while gaining clinical experience with individuals with developmental disabilities. She subsequently obtained her master's degree in psychology at California State University, Stanislaus in 2001, where she continued to work and conduct research with children and adolescents diagnosed with a range of disabilities, including autism. Jennifer enrolled in the Ph.D. program in behavior analysis at the University of Florida in 2004, where she focused her studies on disorders of learning and behavior in developmental disabilities. She conducted clinical research in outpatient clinics, schools, and residential settings, and served as Clinical Director of a program for individuals with Prader-Willi Syndrome, while teaching courses in applied behavior analysis. Following graduation, Jennifer will begin a post-doctoral fellowship in psychiatry at Stanford University School of Medicine, where she will conduct interdisciplinary research on the neurological and environmental contributions to various genetic disorders and behavioral phenotypes.