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An applied evaluation of resurgence: functional communication training (FCT) and treatment relapse

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AN APPLIED EVALUATION OF RESURGENCE: FUNCTIONAL COMMUNICATION TRAINING (FCT) AND TREATMENT RELAPSE

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ABSTRACT

Extinction is a very important component of functional communication training (FCT). Thus, the potential undesirable effects of extinction must be considered before this type of treatment is implemented. Resurgence, the recurrence of previously reinforced behavior when another behavior is placed on extinction, is a possible undesirable effect of extinction. Resurgence may account for some instances of treatment relapse in situations where problem behavior recovers following implementation of extinction-based treatments such as FCT. Despite the potential relevance of resurgence to understanding why problem behavior may re-emerge, few applied studies have examined resurgence effects. The current study attempted to determine whether resurgence of problem behavior occurred when a newly taught alternative behavior was placed on extinction or contacted a thin schedule of reinforcement and if the resurgence effect could be repeated within an individual. The present investigation also replicated and extended the results of Experiments 2 and 4 in Lieving and Lattal (2003) by examining resurgence with human participants who engaged in aberrant behavior.

INTRODUCTION

Approaches to the Treatment of Problem Behavior

Problem behavior may be defined as a behavioral excess that is socially significant and warrants complaint by some person (Hanley, Iwata, & McCord, 2003). Problem behavior may occur so frequently or intensely in some children that it can be life-threatening or significantly hinder educational progress. It is not uncommon for typical children to engage in challenging behavior sometime in their childhood. For example, Tremblay (1998) found that 70% of children take toys away from other children, 46% push others to get what they want, and 21% to 27% are likely to bite or kick peers by the age of 17 months. It is especially common for children and adults with developmental disabilities to exhibit problem behavior. Johnson and Day (1992) reported that 14% to 59% of individuals with profound or severe levels of mental retardation display self-injurious behavior (SIB). Among children with autism, 90% engage in tantrums and 10% to 20% engage in SIB or aggression (Smith, Magyar, & Arnold-Saritepe, 2002). Certain characteristics may also increase the probability of problem behavior in individuals with developmental disabilities. For instance, higher rates of problem behavior have been linked to greater communication deficits (Baker, Cantwell, & Mattison, 1980; Talkington, Hall, & Altman, 1971).

One approach for the treatment of problem behavior is the behavioral approach. This approach has received wide empirical support. There is a substantial body of literature (see the *Journal of Applied Behavior Analysis [JABA]* or *Research in Developmental Disabilities [RIDD])* demonstrating the effectiveness of behavioral interventions for decreasing the problem behavior of individuals with developmental disabilities. Behavioral treatment is the primary empirically supported intervention for autism and includes procedures designed to decrease SIB, aggression, and other behavior problems displayed by this population (Smith et al., 2002). Behavioral treatments are also well validated and highly effective in reducing problem behavior in other populations of children, such as those diagnosed with ADHD (Fabiano & Pelham, 2002).

One reason behavioral interventions may be effective is that pretreatment functional assessments, which have some of the best treatment validity, are a key component to this approach (Iwata et al., 1994; Kratochwill & McGivern, 1996). Despite some evidence supporting the possibility that the problem behavior displayed by individuals with developmental disabilities has a biological determinant, the outcomes of basic and applied studies suggest that most problem behavior is a function of immediate antecedents and consequences in the environment (Iwata, Vollmer, & Zarcone, 1990). The purpose of functional assessment is to determine the environmental variables responsible for the maintenance of problem behavior. Results of a pretreatment functional assessment are beneficial to treatment planning because the antecedent conditions that evoke problem behavior are identified and the reinforcing consequences that should be withheld or scheduled differently are known (Iwata, Vollmer, & Zarcone, 1990). In addition, interventions that may be counter-therapeutic can be identified and avoided. For example, if it is determined that an individual’s problem behavior is maintained by negative reinforcement in the form of escape from demands, time out would not be effective in decreasing this individual’s problem behavior. However, this treatment can only be ruled out if the function of the behavior is known. A final benefit of basing treatments for problem behavior on the function of the behavior is that doing so has been shown to decrease the need for punishment-based treatments (Pelios, Tesch, & Axelrod, 1999).

The function of a problem behavior is identified using functional assessment strategies that can be indirect, descriptive, or experimental in nature. Indirect assessments consist of gathering verbal reports from parents, teachers, or others familiar with the individual regarding the environmental variables that occasion or maintain problem behavior. Examples of indirect assessments include behavioral interviews and questionnaires, such as the Motivation Assessment Scale (MAS; Durand & Crimmins, 1992), Functional Analysis Interview Form (FAIF; O'Neill, Horner, Albin, Storey, & Sprague, 1990), or Questions About Behavior Function (QABF; Matson & Vollmer, 1995). A descriptive analysis consists of detailed observations conducted in the natural environment to identify the antecedents and consequences of problem behavior (Bijou, Peterson, & Ault, 1968; Mace & Lalli, 1991; Repp, Felce, & Barton, 1988). Indirect and descriptive techniques can be useful for developing hypotheses about the function of problem behavior. However, these types of functional assessments may have poor reliability and validity due to the fact that they do not directly test these hypotheses by manipulating antecedent variables or consequences hypothesized to evoke and/or maintain the problem behavior (Gresham, Watson, & Skinner, 2001; Paclawskyj, Matson, Rush, Smalls, & Vollmer, 2001).

In contrast, experimental functional assessment strategies include systematic manipulation of the environmental variables that are thought to occasion and maintain problem behavior. Also referred to as functional analyses, these types of assessments allow clinicians to empirically demonstrate the function of problem behavior (e.g., Carr, Newman, & Binkoff, 1976,1980; Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994; Lovaas, Freitag, Gold, & Kassorla, 1965; Lovaas & Simmons, 1969; Pinkston, Reese, LeBlanc, & Baer, 1973).

Perhaps the best known type of functional analysis is the formalized assessment methodology described by Iwata et al. (1982/1994). Within the functional analysis methodology described by those authors, test and control conditions were rapidly alternated in a multielement design. Relevant antecedents (i.e., establishing operations [EOs] and discriminative stimuli [S^Ds]) and consequences were manipulated in each condition. During a condition designed to evaluate the influence of attention on problem behavior, a therapist was present in the room but pretended to be busy, and the child was provided with low to moderately preferred toys. The therapist withheld attention unless the child engaged in problem behavior. When problem behavior occurred, the therapist delivered brief verbal reprimands (e.g., “Stop that, you are going to hurt yourself.”). This condition tested whether problem behavior was maintained by social-positive reinforcement in the form of attention. During the demand condition, the therapist delivered instructions to the child using a progressively more intrusive prompting strategy (least-to-most prompting). Demands were continued until the child exhibited problem behavior, at which point the task materials were removed, and the child was given a brief break. This condition was designed to test whether problem behavior was maintained by social-negative reinforcement. In the alone condition, the child was left alone in the therapy room without any materials. This condition tested whether problem behavior was maintained by automatic reinforcement. That is, it evaluated whether the behavior occurred independent of social consequences. The control condition excluded the antecedents and consequences that were evaluated in the other conditions. The child had noncontingent access to highly preferred toys and attention, and no demands were delivered. In addition, no consequences were provided contingent upon the occurrence of problem behavior. For six of the nine participants, consistent patterns of responding were demonstrated in which problem behavior was higher in a particular condition, suggesting a functional relationship between a consequence and problem behavior (Iwata et al., 1990).

Functional Communication Training with Extinction

In most instances, once the reinforcer(s) maintaining problem behavior has been identified, the functional reinforcer can be withheld for problem behavior (called "extinction") and provided contingent upon a more appropriate alternative response (Vollmer, Roane, Ringdahl, & Marcus, 1999). This type of treatment is called differential reinforcement of an alternative response (DRA). One variant of DRA, in which the alternative behavior consists of a communicative response, has been labeled functional communication training (FCT) (Carr & Durand, 1985). For example, if an individual's behavior were maintained by negative reinforcement in the form of escape from demands, escape would be withheld for the problem behavior but provided following the vocal response "break please." This variant of DRA has repeatedly been shown to be effective in decreasing problem behavior (Carr & Durand; Day, Horner, & O'Neill, 1994; Donnellan, Mirenda, Mesaros, & Fassbender, 1984; Doss & Reichle, 1989; Durand, 1990; Durand & Crimmons, 1987; Lalli, Casey, & Kates, 1995; Wacker et al., 1990; Wacker & Reichle, 1993).

To help ensure the effectiveness of FCT, the communicative response should be more efficient in attaining reinforcement than the existing problem behavior (Wacker & Reichle, 1993). Thus, extinction is a very important component of FCT (e.g., Hagopian, Fisher, Sullivan, Acquisto, & LeBlance, 1998; Shirley, Iwata, Kahng, Mazaleski, & Lerman, 1997; Shukla & Albin, 1996). Shirley et al. examined the effectiveness of FCT with and without extinction, finding that FCT was ineffective if implemented without an extinction component. Likewise, Hagopian et al. observed increases in problem behavior when FCT was implemented without extinction across 11 participants.

Undesirable Effects of Extinction

While FCT and other extinction-based treatments have proven useful in the treatment of problem behaviors, several undesirable effects of extinction have been noted in the basic and applied literatures (see Lerman & Iwata, 1996, for a review). Given that extinction is typically a component of FCT, these potential undesirable effects of extinction must be considered before this type of treatment is implemented. The most commonly cited undesirable effect of extinction is the extinction burst. An extinction burst is defined as a temporary increase in the frequency, duration, or intensity of behavior that occurs at the beginning of an extinction procedure (Lerman & Iwata). Increases in aggression and other emotional behavior (e.g., crying) also have been associated with extinction, perhaps because the withdrawal of reinforcement is an aversive event that elicits such behavior (Azrin, Hutchinson, & Hake, 1966). In addition, responding may temporarily increase when a novel stimulus such as a buzzer or a bright light is presented during extinction. This phenomenon is known as disinhibition and has not been reported in any applied studies (Lerman & Iwata).

Some additional potential undesirable effects of extinction described in the literature are related to response recovery. This term is used when a behavior that has been previously exposed to extinction returns to baseline levels in the absence of reinforcement. Three types of response recovery are described in the basic literature: induction, spontaneous recovery, and extinction-induced resurgence. As defined by Catania (1998), induction refers to the spread of the effects of reinforcement to behaviors other than those defining the operant class. Suppose, for example, that a pigeon's key pecks on red and green keys are reinforced in a concurrent operants arrangement, and then responses on both keys are placed on extinction. Induction could be said to have occurred if an increase in key pecks on the red key is observed when reinforcement is reintroduced for key pecks on only the green key. That is, an increase in one behavior may occur when another behavior is reinforced following extinction.

Spontaneous recovery is defined as the reappearance of a behavior that previously appeared to be extinguished. In basic research, spontaneous recovery has been observed with humans and animals within a few minutes of extinction to more than a month following extinction (e.g., Sheppard, 1969; Youtz, 1938). No applied studies have thoroughly examined the characteristics of spontaneous recovery, and several variables have been proposed as being responsible for the relapse in behavior. For example, spontaneous recovery of problem behavior has been attributed to the failure of treatment effects to generalize (C. Williams, 1959; Durand & Mindell, 1990).

Finally, extinction-induced resurgence has been defined as the recurrence of previously reinforced behavior when another behavior is placed on extinction (Lieving, Hagopian, Long, & O'Connor, 2004). Several basic studies have demonstrated resurgence when reinforcement of an alternative behavior was withdrawn (e.g., Epstein, 1983, 1985; Leitenberg, Rawson, & Bath, 1970; Leitenberg, Rawson, & Mulick, 1975; Mulick, Leitenberg, & Rawson, 1976). Most of these studies utilized a three-condition procedure to test for resurgence. A response was reinforced in the first condition, and an alternative response was reinforced in the second condition. Depending on the study, the first response may have been completely extinguished prior to (Epstein, 1983; Lieving & Lattal, 2003 Experiment 1) or during the second condition (Epstein, 1985; Leitenberg, Rawson, & Bath, 1970; Lieving & Lattal, 2003 Experiments 2, 3, and 4). In the third condition, the first response reemerged when the alternative response was placed on extinction.

In an early example of resurgence using pigeons as subjects (Epstein, 1983), pecking a key was reinforced in the first condition and then subsequently extinguished. In the second condition, an alternative response (e.g., wing flapping) was reinforced. Finally, when wing flapping was placed on extinction in the third condition, key pecking recurred even though reinforcers were not provided for doing so.

Little basic and applied research has been conducted on variables that may control the likelihood, amount, or duration of resurgence. One notable exception was a series of four experiments by Lieving and Lattal (2003). The purpose of Experiment 1 was to examine the effects of reinforcement recency (i.e., the extent of previous reinforcement of an alternative behavior) on the amount and duration of response recovery. Four pigeons participated in Experiment 1, which was conducted using an ABCD design. For each pigeon, the sequence of conditions was as follows: pretraining, key-peck reinforcement (A), key-peck extinction (B), treadle-press reinforcement (C), and treadle-press extinction (resurgence, D) to examine resurgence. During pretraining, a shaping procedure was used to teach the pigeons to peck a key. After shaping, a fixed-ratio (FR) 1 schedule of reinforcement for key pecking was thinned to FR 15. During the key-peck reinforcement condition, key pecking was maintained on a variable interval (VI) 30-s schedule, which was in place for at least 20 sessions and continued until responding had stabilized. Treadle presses resulted in no programmed consequences. After 60 reinforcers were delivered during each of the pretraining and key-peck reinforcement conditions, sessions were terminated. In the key-peck extinction condition, key pecking was extinguished across 10 30-min sessions. During the treadle-press reinforcement condition, key pecking remained on extinction but was still recorded. Treadle pressing was shaped and maintained using the same procedures described above for key pecking. Reinforcement of treadle pressing lasted 5 sessions for 2 pigeons and for 30 sessions for the other two pigeons. In the treadle-press extinction condition, reinforcement was withheld for both key pecking and treadle pressing. Resurgence was measured by the number of key pecks during each of the 10 30-min extinction sessions. For all pigeons, a brief resurgence of key pecking occurred during the treadle-press extinction condition. With the exception of one pigeon, key pecking decreased to zero by the end of the treadle-press extinction condition. In addition, resurgence effects were similar regardless of whether treadle presses were reinforced for 5 or 30 sessions before the treadle-press extinction condition.

The purpose of Experiment 2 was to examine the time course of the resurgence effect and to determine whether this effect was repeatable within an organism. An ABCABC reversal design was used, and four pigeons participated. For each pigeon, pretraining, key-peck reinforcement (A), treadle-press reinforcement (B), and treadle-press extinction (resurgence, C) conditions were conducted, with each condition identical to the corresponding condition from Experiment 1. These three conditions were then repeated. The key-peck reinforcement and treadle-press reinforcement conditions were conducted for at least 15 sessions and until responding stabilized. The key-peck extinction condition was not conducted in this experiment or in any of the remaining experiments. Instead, key pecking was placed on extinction during the treadle-press reinforcement condition. Resurgence of key pecking was observed in all but one of the treadle-press extinction conditions (7 of 8). Resurgence of key pecking was also observed during the replication phase for all pigeons. Thus, the resurgence effect did appear to be repeatable, with no decrease in the magnitude of the effect during the second exposure to extinction.

The purpose of Experiment 3 was to determine whether delivering reinforcement noncontingently would produce resurgence similar to that observed with extinction. Noncontingent reinforcement (NCR) involves elimination of the response-reinforcer relation which meets the definition for extinction. Thus, the authors hypothesized that NCR would produce resurgence similar to conventional extinction (Lieving & Lattal, 2003). An ABCDEFGD reversal design was used. For each pigeon, pretraining, key-peck reinforcement (A), treadle-press reinforcement (B), NCR (nontraditional resurgence; C), and then treadle-press extinction (traditional resurgence; D) conditions were conducted. These conditions were similar to those described in Experiment 2 with two exceptions. A variable time (VT) 30-s reinforcement schedule was in place during the NCR condition, during which food was delivered independent of responding. The treadle-press extinction condition was implemented for only for 5 sessions (D). The same condition sequence was then repeated, but the value of the VI schedule during the key-peck and treadle-press reinforcement conditions was increased to120 s (E and F). In addition, the VT schedule was increased to 120 s during the NCR condition (G) because resurgence did not occur under the denser schedule of noncontingent reinforcement (VT 30 s). It was hypothesized that extinction effects such as resurgence may have been more likely with a thinner schedule. Resurgence of key pecking was not obtained under either VT schedule but it did occur when the treadle-press response was extinguished for all subjects. Thus, disrupting the response-reinforcer relationship through delivery of NCR, as opposed to with conventional extinction, did not produce resurgence.

The purpose of Experiment 4 was to examine whether a thin schedule of reinforcement rather than extinction would produce resurgence. An ABCD design was used. For each pigeon, the pretraining, key-peck reinforcement (A), treadle-press reinforcement (B), and resurgence (C) conditions were conducted as described in Experiment 2 with one exception. During the resurgence condition, treadle pressing was reinforced on a VI 360-s schedule. Treadle pressing was placed on extinction (D) following the resurgence condition. Resurgence effects for key pecking were not obtained when treadle presses were reinforced on a VI 360-s schedule for one pigeon. However, small increases in key pecking were obtained with the remaining two pigeons. For all pigeons, typical patterns of resurgence occurred when extinction was implemented in the final phase. Thus, resurgence was also demonstrated under “extinction-like” conditions (Lieving & Lattal, 2003).

In sum, results of the studies conducted by Lieving and Lattal (2003) indicated that reinforcement recency did not influence resurgence effects and that resurgence could be replicated within an organism. Results also suggested that noncontingent delivery of reinforcement did not produce resurgence but that behavior did resurge under a thin schedule of reinforcement.

Treatment Failure in the Natural Environment

Treatments for problem behavior such as FCT are sometimes shown to be effective in clinical settings or when implemented by professionals, but the treatment effects do not maintain over time when subsequently implemented by care providers in the natural environment (Mace & Roberts, 1993). For example in a study by Durand and Carr (1991), one participant's SIB decreased when professionals implemented the treatment, but SIB increased when the treatment was conducted in the classroom. In another example (Durand & Kishi, 1987), FCT was used to decrease problem behavior in five participants. One participant was taught to raise her hand to gain access to staff attention. Eventually, some staff members reported being unable to provide attention each time the participant raised her hand and the effectiveness of the treatment deteriorated in the natural environment.

There are several explanations as to why treatments fail in the natural environment. The effects of treatment may not generalize to settings outside of the therapy room or to people other than the therapist. FCT may also be unsuccessful in the natural environment because the communicative response is not recognizable by caregivers and is not reinforced. In the Durand and Carr (1991) study mentioned above, it was found through sequential observation analyses that the participant's teacher could not understand the participant’s verbal requests for assistance during work situations. As a result, she failed to provide help when he asked for it, and the participant began to engage in SIB again. After the participant received training to increase his articulation skills, the teacher responded appropriately to his requests for help, and SIB decreased in the classroom. Findings such as this one suggest that poor treatment integrity often may be responsible for treatment failures in the natural environment.

Resurgence may account for some instances of treatment relapse in situations where problem behavior recovers following implementation of extinction-based treatments such as FCT (Lieving & Lattal, 2003). If a newly taught alternative response is no longer reinforced in the natural environment, problem behavior may resurge even if reinforcement is also withheld for that behavior. For example, an individual’s SIB may be maintained by escape from demands before treatment is implemented (condition 1). During treatment, the individual may be taught to say, “break please,” to appropriately request a break while escape is no longer provided for problem behavior (condition 2). In the natural environment, the individual’s caregivers may not implement the treatment with integrity for the reasons described above. Furthermore, the reinforcer may not be readily available or may be difficult to deliver, resulting in periods of extinction for appropriate communicative responses (condition 3). Thus, although SIB remains on extinction, SIB may still resurge because reinforcement is withdrawn for the newly taught appropriate response. Results of Lieving and Lattal also indicate that resurgence may occur if a thin schedule of reinforcement is in effect for the alternative behavior. Using the previous example, this implies that SIB may resurge if SIB is on extinction and the appropriate response produces occasional but inconsistent reinforcement (as commonly seen during generalization or maintenance).

<u>Applied Research on Extinction-Induced Resurgence</u>

Despite the potential relevance of resurgence to treatment relapse in the natural environment, few applied studies have examined resurgence effects. In a notable exception, Lieving et al. (2004) demonstrated resurgence of problem behavior with two participants. In the first condition, two topographies of problem behavior were shown to be maintained by access to tangible items. In the second condition, one topography of problem behavior was extinguished while the other topography of problem behavior continued to be reinforced. In the third condition, the previously extinguished topography of problem behavior resurged when reinforcement was withdrawn for the other topography.

Other studies examining response class hierarchies may be tangentially related to the phenomenon of resurgence, although the authors did not specifically conceptualize the findings as resurgence (e.g., Harding, Wacker, Berg, Barretto, Winborn, & Gardner, 2001; Lalli, Mace, Wohn, & Livezey, 1995). Typically, these studies showed that reinforcing mild topographies of problem behavior prevented the occurrence of more severe topographies. When these mild forms of problem behavior were placed on extinction, the more severe topographies of problem behavior increased. Although the more severe problem behavior was reinforced while the less severe forms were exposed to extinction, it is possible that the more severe response topographies would have initially emerged in the absence of reinforcement due to resurgence effects.

PURPOSE

Further applied research on variables that influence extinction-induced resurgence may lead to strategies for reducing or preventing the recovery of problem behavior during treatments like FCT. For example, the reinforcement schedule for the alternative response may influence the amount or likelihood of resurgence. As part of treatment with FCT, the schedule of reinforcement for the alternative response is often thinned to promote maintenance or for practical reasons (Hagopian, Toole, Long, Bowman, & Lieving, 2004). Therefore, future research is needed to determine whether schedules of reinforcement that are too thin or that are thinned too quickly, thus resembling extinction, result in resurgence of problem behavior. If extinction-like conditions also result in resurgence of problem behavior, the magnitude of the resurgence effect may be decreased by thinning the schedule of reinforcement more gradually. Future research also is necessary to examine whether a participant's history with extinction affects resurgence. If an individual has a history of previous attempts to extinguish problem behavior, resurgence may not occur even when reinforcement is temporarily withheld for appropriate communicative responses. In this case, it may be important for clinicians to establish a long history with extinction before fading treatment with FCT. Resurgence of problem behavior also may be more likely to occur if the alternative response is especially effortful. If so, clinicians may be able to reduce the likelihood of resurgence by selecting alternative responses that are low in effort.

However, due to the lack of applied research in this area, an initial study is needed to determine the likelihood that resurgence of problem behavior will be observed when reinforcement is withheld for an alternative behavior. If resurgence is commonly observed, this phenomenon may play a key role in the effectiveness of treatment with differential reinforcement. It is likely that the alternative response will contact periods of extinction in the natural environment, resulting in the temporary recovery of problem behavior. This increase in problem behavior may result in a loss of positive treatment outcomes if not managed correctly (Lieving et al., 2004).

An initial study examining resurgence is also necessary to establish a methodology for studying this phenomenon in application. The resurgence effect must first be demonstrated to reliably replicate within subject so that single-subject designs can be used later to study factors that influence the likelihood or degree of resurgence. To date, the methodology used by Lieving and Lattal (2003) has not been replicated with humans and clinically relevant problem behavior. At this point, it is not entirely clear whether resurgence of problem behavior will reliably occur in an applied situation. The three-condition procedure described in the basic literature could serve as an analogue for what happens in the natural environment when reinforcement for an alternative behavior is inconsistent or discontinued. Thus, it seems logical to begin by replicating the results of a basic study on resurgence with humans who display aberrant behavior and a treatment that is commonly used to eliminate problem behavior (FCT) prior to conducting the extensions of this line of research described above.

The purpose of the current investigation was to examine resurgence of problem behavior within the context of FCT. This study attempted to determine whether resurgence of problem behavior would occur when a newly taught alternative behavior was placed on extinction or contacted a thin schedule of reinforcement and if the resurgence effect could be repeated within an individual. The present investigation also replicated and extended the results of Experiments 2 and 4 in Lieving and Lattal (2003) by examining resurgence with human participants who engage in aberrant behavior.

GENERAL METHOD

Participants and Setting

Participants were five children diagnosed with autism or developmental disabilities who were referred for the assessment and treatment of self-injurious, aggressive, or disruptive behavior. The children ranged from five to nine years of age. Ben was a 9-year-old boy who engaged in self-injury, aggression, and disruption. Bella, an 8-year-old girl, exhibited self-injury and aggression. Sam and Max were both 5 years old and engaged in aggression and disruption. Connor was a 5-year-old boy who engaged in aggression. Two of the five participants were blind and attended a school for visually impaired students (Ben and Bella). Sam and Max attended self-contained classrooms for students with developmental disabilities in regular public schools, and Connor attended a university-based pre-kindergarten program before his placement ended due to his problem behavior.

Ben and Bella did not have any expressive language skills. Max primarily communicated by pulling people towards objects or pointing, but he did use one-word utterances to communicate occasionally. Sam engaged in more advanced verbal behavior. He had extensive expressive and receptive language repertoires, could speak in full sentences, and displayed some intraverbal behavior. Connor communicated primarily using 4- to 5-word utterances. All participants could also follow one-step instructions. Ben received Guanfacine™, Depakote™, and Seroquel™. Bella received Clonidine™. Sam was not taking medication during the study. Max received Lexapro™ and Metadate™. Connor received Flovent™ twice a day for asthma. Over the course of the study for each child, no medication changes were reported.

Ben, Bella, and Sam participated in Experiment 1. Ben, Max, and Connor participated in Experiment 2. Inclusion criteria included the identification of single or multiple social functional reinforcer(s) for problem behavior. The function of problem behavior was determined by visual inspection of data from a functional analysis (described below). A participant was excluded from the study if results of the functional analysis were inconclusive or if the participant's problem behavior was found to be maintained by automatic reinforcement.

Sessions were conducted in classrooms at Louisiana State University or in unused rooms at the participants' schools. Classrooms contained materials necessary to conduct the sessions (e.g., tables, chairs, leisure items, etc.). One to two session blocks were conducted per day, with at least a one-hour break between session blocks. Three to five 10-min sessions were conducted during each session block.

Data Collection and Reliability

The frequency of each participant's problem behavior and alternative response was recorded on laptop computers during all conditions. All data were converted to a rate measure by dividing the frequency of the behavior by the number of minutes in the session. *Hitting* (Ben, Bella, Sam, and Connor) was defined as forceful contact of an open or closed hand with another person's body and throwing objects at another person (Sam). *Grabbing* was defined as wrapping the fingers tightly around another person's body part, hair, or clothing if pulled outward at least 1 inch (Ben, Sam, Max, and Connor); and pulling another person's clothing at least 2 inches from the body with more than two fingers or clinching another person's skin with hand (Bella). *Scratching* (Ben, Sam, Max, and Connor) was defined as rapidly scraping the fingernails across another person's skin.

Biting (Bella, Max, and Connor) was defined as closure of the teeth against another person's body. *Pinching* (Bella, Sam, Max, and Connor) was defined as tightly squeezing another person's skin between two or more fingers. *Kicking* (Ben, Sam, and Connor) was defined as striking another person with the foot. *Head butting* (Connor) was defined as forceful contact of the head with another person's body. *Pushing* (Ben and Sam) was defined as shoving a person with both hands. *Disruption* (Ben, Sam, and Max) was defined as throwing objects with a forward thrusting or swiping motion of the arm(s) or forcefully knocking furniture over. *Head/torso hitting* (Bella) was defined as forceful contact between a single open hand (fingers together, wrist stiff) and the head or torso from a distance of at least 5 inches. *Head banging* (Ben) was defined as forceful contact between the head and hard surfaces. *Face/body scratching* (Ben) was defined as scraping of the fingernails across the skin on the face or body. *Hand biting* (Bella) was defined as upper and lower teeth closed against the skin on the hand or wrist.

The specific topography of the alternative response depended on the participant's skills and teacher/caregiver preference. For Ben, a card pull was chosen as the alternative behavior. A 2-inch by 4-inch card on a retractable string was attached to his waistline. *Card pulling* was defined as placing the hand on the card and moving the card out at least 5 inches. For Bella and Max, an approximation of the American Sign Language sign for break was selected as the alternative behavior. The *break sign* was defined as forming the hands into fists and then tapping the sides of any part of the hands together without assistance. Vocal verbal responses were selected for Sam and Connor. Sam was required to say, "Talk to me, please" and Connor was required to say, "Toy, please." Previously trained graduate or undergraduate students served as observers. An observer was considered trained when agreement coefficients met or exceeded 80% for all dependent variables across three consecutive sessions.

Interobserver agreement was assessed by having a second data collector score behavior simultaneously but independently during a mean of 41% of the sessions (range, 33% to 49%) for each child during Experiment 1 and a mean of 50% of the sessions (range, 44% to 56%) for each child during Experiment 2. Interobserver agreement was determined by dividing each session into consecutive 10-s intervals and comparing the data of the two observers. Agreements were defined as the same number of responses scored within a 10-s interval. Agreement coefficients were calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100%. Across participants in Experiment 1, mean interobserver agreement of problem behavior and alternative behavior was 97% (range, 96% to 98%) and 97% (range, 95% to 98%), respectively. Across participants in Experiment 2, mean interobserver agreement of problem behavior and alternative behavior was 95% (range, 94% to 96%) and 96% (range, 94% to 98%), respectively.

Procedures

A functional analysis was conducted using procedures described by Iwata et al. (1982/1994) to identify the function of each participant's problem behavior. Prior to the functional analysis, a doctoral student collected information about antecedents and consequences hypothesized to contribute to the occurrence of each child's problem behavior by interviewing parents/teachers and observing the child in the home or classroom.

Prior to conducting the functional analyses, preference assessments were conducted for each participant to identify highly preferred toys for the toy play and tangible conditions and low to moderately preferred toys for the attention condition. For Sam, Max, and Connor, a paired-choice preference assessment was conducted using procedures similar to those described by Fisher et al. (1992). Given their visual impairments, it was not possible to conduct this type of preference assessment with Bella or Ben. For this reason, alternative preference assessment formats were used. For Bella, the therapist briefly placed her hands on each toy and then on the table between the two items before delivering the instruction, “Pick one” (Paclawskyj & Vollmer, 1995). For Ben, a preference assessment similar to that described by Deleon, Iwata, Conners, and Wallace (1999) was used because he did not choose between two items presented to him. Each potential reinforcer was presented one at a time for 2 min. The duration of item interaction and frequency of problem behavior were scored. The items associated with the longest durations of interaction and the lowest amounts of problem behavior were considered the most preferred.

During the functional analysis, attention, demand, no interaction, and toy play conditions were alternated in a multielement design. A tangible condition was included if direct observation or teacher/caregiver report indicated that the child may have engaged in problem behavior due to a history of reinforcement of problem behavior with tangible items. Results of the multielement functional analysis were inconclusive for Bella. However, caregiver report and anecdotal observation suggested that Bella’s problem behavior was maintained by escape from walking. Thus, a pairwise comparison of toy play and escape from walking conditions was conducted (see below).

Attention. The therapist provided the participant with moderately preferred toys and then diverted her attention by engaging in an activity (e.g., reading a magazine). Contingent upon the occurrence of problem behavior, the therapist delivered mild verbal reprimands or consoling statements (e.g., “Don’t do that, you are going to hurt yourself”) for 20 s. All non-targeted behaviors displayed by the participant were ignored. The purpose of this condition was to test for sensitivity to attention as a maintaining variable.

Tangible. Prior to each session, the participant was provided with 1 min to 2 min of access to a preferred item. At the beginning of the session, the therapist restricted access to that preferred item. Contingent upon the occurrence of problem behavior, the participant received 20-s access to the preferred item after which the item was removed until another problem behavior occurred. All other behavior displayed by the participant was ignored. The purpose of this condition was to determine if problem behavior was maintained by tangible reinforcement. The tangible condition was included in the functional analyses for Sam, Max, and Connor. A slinky, bumpy ball, and wand with flashing lights were used for Max; a plastic fish, pterodactyl action figure, vibrating cat, and helicopter were used with Sam (he was able to choose 2 of the 4 prior to each session); and a koosh ball and toy helicopter were used for Connor.

Demand. Instructions were presented to the participant using a graduated prompting sequence (e.g., verbal, gestural, and then physical prompts). Contingent upon compliance, the participant received brief verbal praise (e.g., “good job”). Contingent upon the occurrence of problem behavior, a 20-s break was provided. During breaks, the task materials were removed, and the therapist turned away from the participant for 20 s. All of the participant’s behavior was ignored during the reinforcement interval. The purpose of this condition was to determine if problem behavior was maintained by escape from demands.

Escape from Walking. This condition was similar to the demand condition, but the instruction was continuous walking. Bella was blind and walked very slowly; thus, the therapist guided her to walk at a faster pace by placing one hand on her back and the other on one of her forearms. Contingent upon problem behavior, Bella was no longer required to walk. That is, the therapist stopped guiding Bella to walk and moved away from her for 20 s.

No Interaction. The participant was not given access to toys or other materials and was in a room with the data collectors. All participants engaged in aggression, thus, a therapist was also present in the room to allow for the occurrence of that topography of problem behavior. Both the data collectors and therapist ignored all of the participant's behavior. The purpose of this condition was to determine if the problem behavior would persist in the absence of social consequences, indicating that the behavior was maintained by automatic reinforcement.

Toy Play. During the toy play condition, the participant was provided with continuous, noncontingent attention and highly preferred items throughout the session. In addition, no demands were delivered. There were no programmed consequences for problem behavior. This condition served as a control condition.

METHOD EXPERIMENT 1

Procedures

Ben, Bella, and Sam participated in Experiment 1. An ABCABC reversal design was used. For each participant, baseline (A), FCT and FCT maintenance (B), and extinction (C) conditions were conducted. These three conditions were then repeated. Sessions were 10 min throughout all conditions.

Baseline. This condition was identical to the functional analysis condition in which a functional relationship between problem behavior and a specific form of social reinforcement was demonstrated prior to the study. If multiple functional reinforcers were identified for problem behavior, only one function was targeted in the resurgence evaluation based upon feasibility and teacher/careprovider preference. The attention function was selected for Sam. During baseline, no programmed consequences were provided for appropriate communicative responses. At least 4 sessions were conducted, and sessions continued until responding was stable as determined by visual inspection (i.e., either a stable or counter-therapeutic trend). In addition, a changeover delay (COD) was implemented during this condition to avoid adventitious reinforcement of appropriate communicative responses in cases where communication and problem behavior occurred in close temporal proximity. If the participant engaged in the appropriate communicative response, problem behavior was ineligible for reinforcement until 5 s had elapsed.

FCT. During the FCT condition, the participant was taught to request the functional reinforcer using the alternative communicative behavior identified earlier. For Ben and Bella, a physical prompt with a progressive time delay was used to teach the alternative behavior. For Sam, a vocal model prompt with a progressive time delay was used to teach the alternative behavior. Initially, the controlling prompt was delivered after 10 s (Ben and Bella) or 30 s (Sam). The delay was increased by 10 s each time an 80% reduction in problem behavior relative to the mean rate of the last three baseline sessions was observed for 2 consecutive training sessions. However, when Ben had not acquired the alternative response with a 1-min delay, the delay was increased to 2 min to capitalize on the establishing operation (EO). It was hypothesized that 1 min of demands was not always aversive to Ben. Thus, increasing the length of time before physical guidance was provided may have increased the aversiveness of the demands, increasing the likelihood of Ben engaging in the alternative behavior. Problem behavior was placed on extinction during this condition. A COD was also in effect during this condition to avoid adventitious reinforcement of problem behavior. That is, if the participant engaged in problem behavior, the appropriate communicative response was ineligible for reinforcement until 5 s had elapsed. There were two criteria for moving to the FCT maintenance condition: (a) The participant independently engaged in the alternative response (i.e., required no experimenter prompting) at a rate that was at least 50% of the mean rate of problem behavior during the last 3 sessions of baseline (e.g., if the mean rate of problem behavior was 1.0, then the alternative response would have had to occur at a rate equal to or greater than 0.5 per min), and (b) there was an 80% reduction in the rate of participant problem behavior relative to the mean rate during the last 3 sessions of baseline. Both of these criteria had to be met across three consecutive sessions.

FCT Maintenance. The procedures used in the FCT maintenance condition were identical to those in the FCT phase. However, no prompts were delivered for the communication response. At least 10 sessions were conducted, and sessions were continued until the rate of the alternative response was stable as determined by visual inspection (i.e., either 3 consecutive data points with no evident trend or with an increasing trend). In addition, an 80% reduction in problem behavior relative to the last 3 sessions of baseline must have been observed for at least 3 consecutive sessions before moving to the next condition.

Extinction (Test for Resurgence). The procedures were similar to those in the FCT maintenance condition, with the exception that both problem behavior and the alternative communicative response were placed on extinction. In other words, the functional reinforcer was no longer provided for either response. This condition was in effect for 10 sessions. The purpose of this condition was to test for resurgence. Resurgence was defined as the occurrence of problem behavior at a rate exceeding levels observed during the FCT maintenance condition in at least one of these 10 sessions.

METHOD EXPERIMENT 2

In Experiment 4 of Lieving and Lattal (2003), the authors evaluated whether "extinction-like" conditions would produce resurgence. Results of Experiments 1 and 2 of that study demonstrated resurgence when extinction was implemented across several consecutive sessions, but it was unclear whether the shorter periods of extinction associated with thin schedules of reinforcement would produce resurgence. The authors hypothesized that the periods of nonreinforcement associated with a very thin schedules of reinforcement for the alternative response (treadle presses) would resemble extinction and produce resurgence of key pecks. When the thin schedule of reinforcement was implemented for treadle presses, resurgence of key pecks was obtained with 2 out of 3 pigeons; however, the magnitude of the resurgence effect was smaller than that observed with traditional extinction. Thus, the authors then implemented extinction of treadle presses (traditional resurgence) and a larger resurgence effect was demonstrated for all pigeons.

In clinical applications of FCT, the schedule of reinforcement for the alternative response often is thinned to promote maintenance of the response or to make the treatment more practical to implement (Hagopian et al., 2004). For example, if a child repeatedly requests breaks from an ongoing task, little work will be accomplished if each request is reinforced. Therefore, the break may be provided following every fifth request for a break. Depending on how quickly the schedule of reinforcement is thinned, the periods of nonreinforcement may be similar to extinction. Thus, it was important to determine whether problem behavior resurged if the schedule of reinforcement was thinned or was thinned too quickly for the alternative response. In Experiment 2, the procedures of Lieving and Lattal (2003, Experiment 4) were replicated with children who exhibited problem behavior and were taught to engage in alternative communicative responses to access the functional reinforcer (FCT).

Procedures

Ben, Max, and Connor participated in Experiment 2. Baseline (A), FCT and FCT maintenance (B), and intermittent reinforcement (modified resurgence; C) conditions were conducted as described in Experiment 1 with two variations. During the intermittent reinforcement condition, the appropriate communicative response was not exposed to extinction. Rather, reinforcement for appropriate communicative responses was delivered on a thin schedule. When the alternative behavior was taught, the controlling prompt was a physical prompt for Ben and Max and a vocal model prompt for Connor. Initially, the controlling prompt was delivered after 30 s for Ben and 10 s for Max and Connor. Although Ben participated in Experiment 1, the alternative behavior was taught again so that there was no variation in procedures across participants. In addition, ensuring that Ben could still engage in the correct alternative behavior was important due to his visual impairment and low functioning level. Multiple reinforcers maintained Connor’s problem behavior, and the tangible function was evaluated during Experiment 2. A brief multiple stimulus without replacement preference assessment (MSWO; DeLeon & Iwata, 1996) was conducted with Connor prior to every session to prevent satiation for the preferred items.

In Experiment 4 of Lieving and Lattal (2003), the variable interval (VI) 30-s schedule of reinforcement used in the maintenance condition was changed to a VI 360-s schedule for the alternative behavior during the modified resurgence condition. That is, the original schedule requirement was increased by a factor of 12 to convert it into the thin schedule. Therefore, the schedule of reinforcement during the intermittent reinforcement condition of the present study was also increased by a factor of 12 by providing the functional reinforcer after 12 alternative responses [fixed-ratio (FR 12) schedule of reinforcement]. An FR schedule was used in the current study rather than a VI schedule because FR schedules are more commonly used in clinical applications (Hagopian et al., 1998; Shirley et al., 1997). In addition, the schedule of reinforcement for the appropriate communicative response was not faded gradually but was increased abruptly from FR 1 to FR 12 to replicate the procedures used by Lieving and Lattal.

Design

An ABCABC reversal design was used. That is, baseline (A), FCT and FCT maintenance (B), and intermittent reinforcement (C) conditions were conducted and then repeated using the same procedures previously described for those conditions. It was important to examine whether resurgence was a repeatable phenomenon within the same individual when an intermittent schedule of reinforcement was in effect for appropriate communication.

RESULTS

Functional Analysis

Ben, Bella, and Max's problem behavior was maintained by social negative reinforcement in the form of escape from demands. Sam's problem behavior was maintained by social positive reinforcement in the form of access to adult attention and access to preferred tangible items. The maintaining reinforcer evaluated during Experiment 1 with Sam was access to attention. Connor's problem behavior was sensitive to escape from demands and social positive reinforcement in form of access to preferred tangible items. The maintaining reinforcer evaluated during Experiment 2 with Connor was access to preferred tangible items. (Please refer to the Appendix)

Experiment 1

Responses per minute of problem behavior for each participant are shown in Figures 1, 2, and 3. During Ben's initial baseline, problem behavior occurred at a moderate level (M = 1.1), while the alternative behavior occurred at near-zero levels (M = 0.1). When the alternative behavior was first taught, Ben initially engaged in variable rates of problem behavior, which then gradually decreased to zero or near zero (M = 0.1). Forty-three sessions were required to teach the alternative behavior to criterion levels. During the FCT maintenance condition, problem behavior remained at or near zero (M = .02) and the alternative behavior occurred at variable levels (M = 0.7). During the first test for resurgence, problem behavior increased relative to the previous condition, reaching a peak of 1 response per minute, with some variability, and then eventually decreasing to zero responses per minute (M = 0.2). Problem behavior in this phase reached the mean level of problem behavior observed during baseline. The alternative behavior decreased to near zero immediately and remained there for the remainder of the phase, with the exception of the last data point (*M* = 0.1).

Very low levels of problem behavior were observed for the first 18 sessions of Ben’s second baseline condition. It was hypothesized that the demands had lost their aversive properties, perhaps due to habituation. Thus, the task was replaced with a new one, after which the rate of problem behavior increased (*M* = 0.7). Ben exhibited the alternative behavior in the first session of the reversal to baseline, but then never displayed the alternative behavior again during the second baseline phase (*M* = .02). During the second FCT condition, Ben’s problem behavior was somewhat variable, but rates were lower than those observed in baseline (*M* = 0.1). In addition, he acquired the alternative behavior more rapidly (twenty sessions) than in the first FCT condition. In the second FCT maintenance condition, no problem behavior was observed (*M* = 0) and high levels of the alternative behavior occurred (*M* = 2.4). During the second exposure to the extinction condition, Ben’s rate of problem behavior (*M* = 0.5) far exceeded levels observed during both the baseline and FCT maintenance conditions before decreasing to zero by the third session. The highest peak was 3.2 responses per minute. An extinction burst was observed with the alternative behavior, reaching the highest level for that response in the analysis (*M* = 1.1). There was also increased persistence of this response, with some alternative behavior occurring in all sessions of the phase with the exception of one.

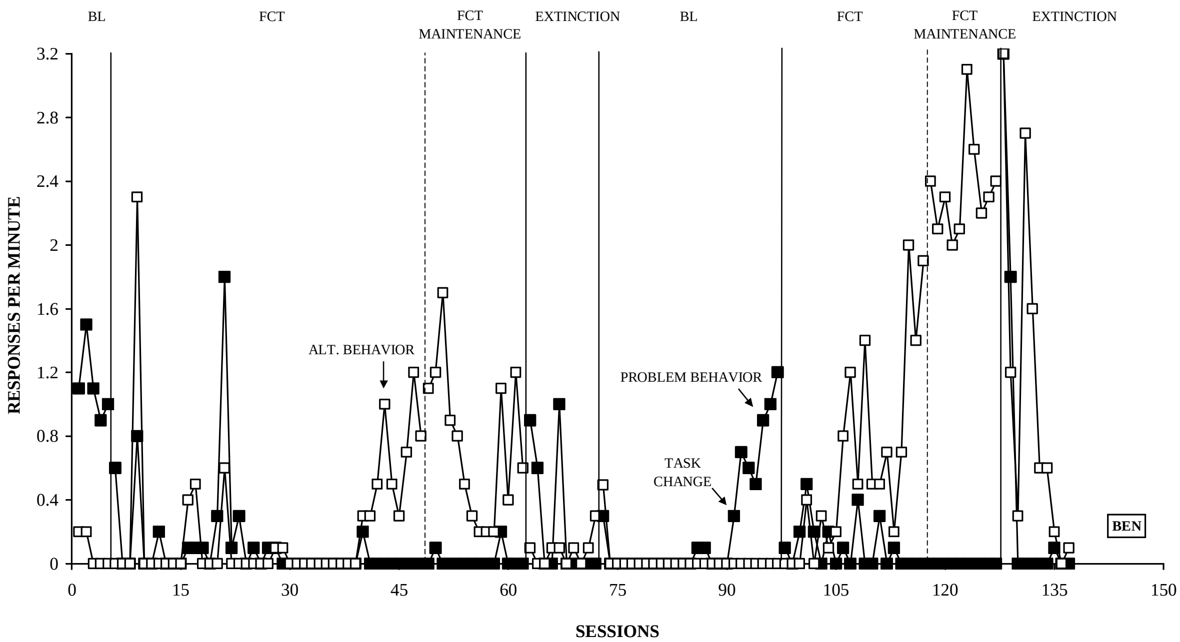

Figure 1. Problem behavior and alternative behavior per minute during baseline, FCT, FCT maintenance, and extinction conditions for Ben in Experiment 1.

For Bella, the rate of problem behavior was variable but elevated (*M* = 1.6), and she never engaged in the alternative behavior during the first baseline. During the initial FCT condition, problem behavior was low and variable (*M* = 0.5). Thirty sessions were conducted before Bella met criteria for acquisition of the alternative behavior. Problem behavior remained low (*M* = 0.1) and high levels of the alternative behavior (*M* = 6.2) continued throughout the FCT maintenance phase. During the initial exposure to extinction, rates of problem behavior increased (*M* = 1.5) relative to the FCT maintenance condition and then maintained at baseline levels. In fact, the rate of problem behavior during the first session was 4.9 responses per minute, which surpassed levels observed during baseline. Initially, the rate of alternative behavior increased substantially (consistent with an extinction burst), followed by a gradual decrease (*M* = 3). Zero rates of the alternative behavior were observed by the sixth session.

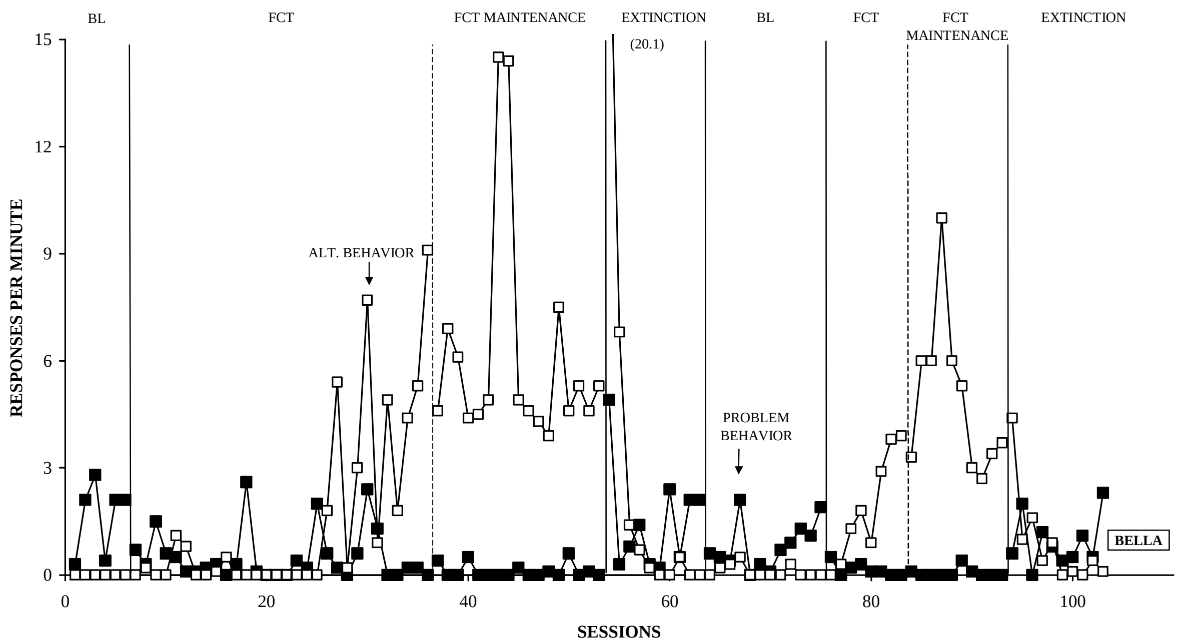

Figure 2. Problem behavior and alternative behavior per minute during baseline, FCT, FCT maintenance, and extinction conditions for Bella in Experiment 1.

During the reversal to baseline, Bella's problem behavior was variable, and an increasing trend was observed toward the end of the phase (*M* = 0.8). Low levels of the alternative behavior were observed (*M* = 0.1). Bella exhibited low rates of problem behavior during the second FCT phase (*M* = 0.2), and she reacquired the FCT response in eight sessions. Bella engaged in low rates of problem behavior (*M* = 0.1) and variable, but high rates of the alternative behavior (*M* = 5) during the second FCT maintenance phase. During the second test for resurgence, problem behavior increased (*M* = 0.9) relative to the second FCT maintenance condition and did not decrease by the end of the phase. In fact, mean rates of problem behavior during the baseline and extinction conditions were almost equivalent. An extinction curve was observed for the alternative behavior (*M* = 0.9).

Sam exhibited high levels of problem behavior (*M* = 2.6) and no alternative behavior during the initial baseline. With introduction of FCT, problem behavior decreased rapidly (M = 0.7) and the alternative behavior was acquired in 4 sessions. Sam displayed variable but low levels of problem behavior (M = 0.2) and high rates of the alternative behavior (M = 2.2) during the first FCT maintenance condition. The rate of problem behavior did not increase (M = 0.1) relative to the FCT maintenance condition during his first exposure to the extinction condition (test for resurgence), and the alternative behavior decreased to zero within 3 sessions (M = 0.2).

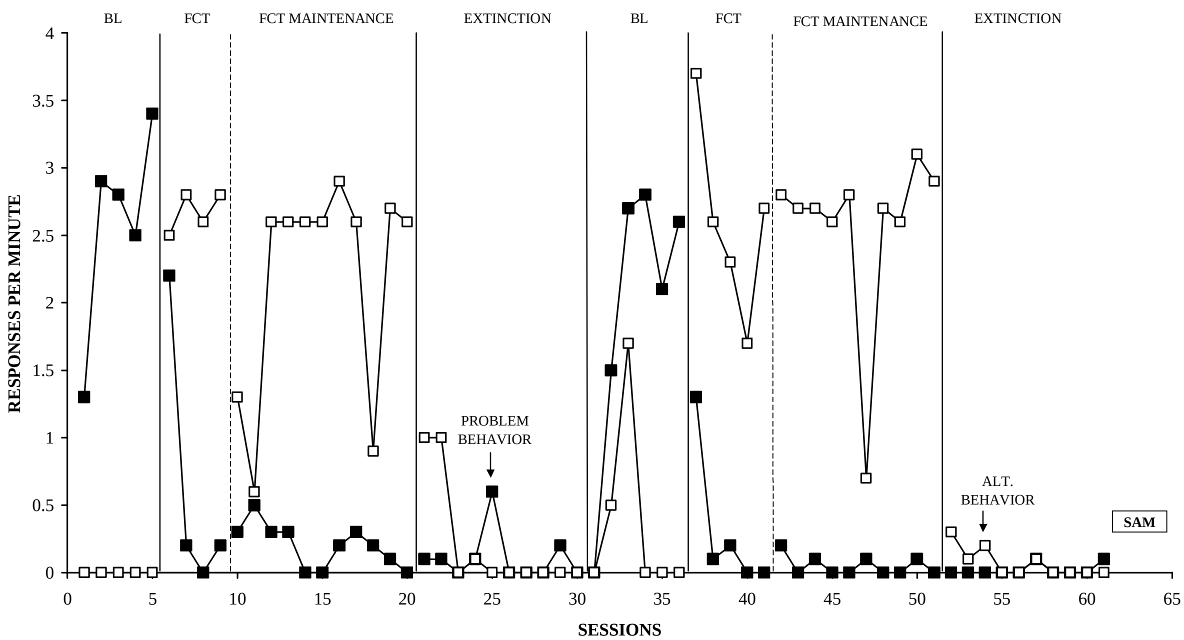

Figure 3. Problem behavior and alternative behavior per minute during baseline, FCT, FCT maintenance, and extinction conditions for Sam in Experiment 1.

During the reversal to baseline, Sam's problem behavior increased rapidly (M = 2). An increase in the alternative behavior was also observed before that behavior decreased to zero (M = 0.4). During the second FCT condition, problem behavior again decreased rapidly (M = 0.3), and the alternative behavior was reacquired in 5 sessions. Low rates of problem behavior (M = 0.1) and high rates of the alternative behavior (M = 2.6) occurred during the second FCT maintenance condition. Again, for Sam, problem behavior did not increase (*M* = .02) during the second exposure to extinction. The alternative behavior decreased to zero or near zero (*M* = 0.1) during this phase.

<u>Experiment 2</u>

Responses per minute of problem behavior for each participant are shown in Figures 4, 5, and 6.

For Ben, problem behavior maintained at moderate levels (*M* = 0.6) and the alternative behavior occurred at low levels (*M* = 0.3) during the initial baseline condition. With the introduction of the FCT condition, Ben met the acquisition criteria for the alternative behavior within 7 sessions and problem behavior decreased rapidly (*M* = .04). Rates of problem behavior remained at or near zero (*M* = 0.1) and high rates of the alternative behavior (*M* = 1.7) were observed throughout the FCT maintenance phase. During the initial intermittent reinforcement condition, increases in problem behavior were observed (*M* = 0.5) compared to the FCT maintenance condition (*M* = 0.1), but problem behavior had extinguished by the end of the phase. The highest rate of problem was 2.5 responses per minute, which was higher than that observed during any session of baseline. In addition, an extinction curve was observed for the alternative behavior (*M* = 0.7).

Moderate rates of problem behavior (*M* = 0.9) and low rates of the alternative response (*M* = 0.2) occurred during the reversal to baseline. During his second FCT condition, problem behavior decreased to zero or near zero very rapidly (*M* = 0.2), and the alternative behavior was reacquired in eight sessions. Problem behavior remained low during the second FCT maintenance condition (*M* = 0.1) while high rates of the alternative behavior (*M* = 2.2) were observed. During the second intermittent reinforcement condition, problem behavior increased (*M* = 0.2) compared to the FCT maintenance condition and then decreased to zero by the end of the phase. In addition, rates of problem behavior reached those observed during baseline. An extinction curve was observed with the alternative behavior (*M* = 0.3).

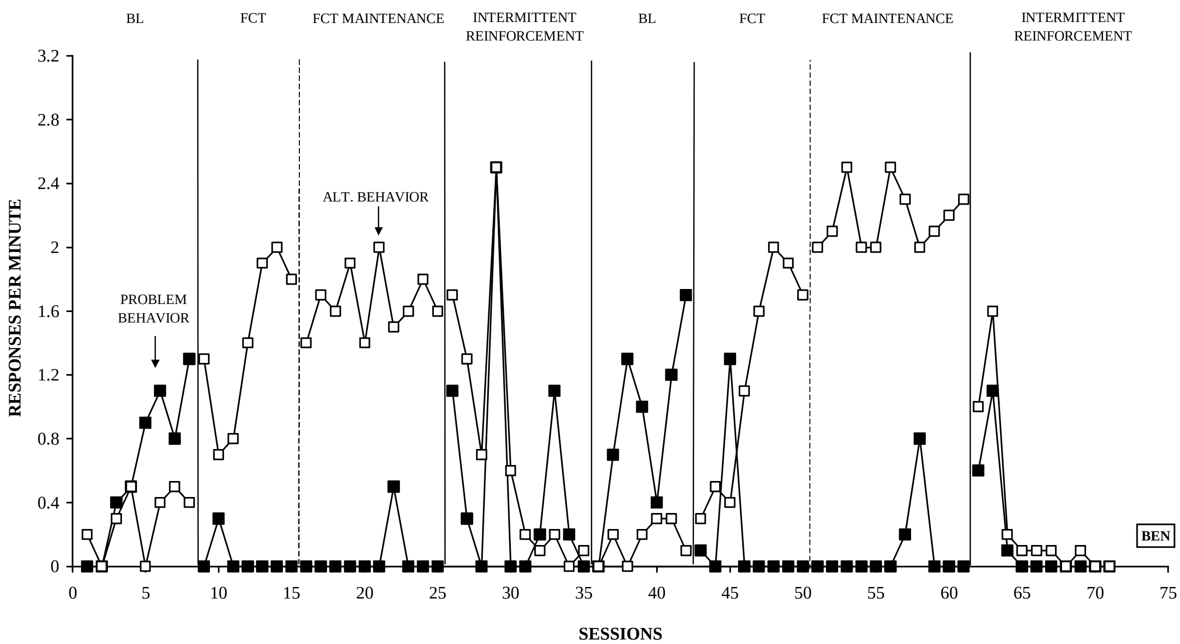

Figure 4. Problem behavior and alternative behavior per minute during baseline, FCT, FCT maintenance, and intermittent reinforcement conditions for Ben in Experiment 2.

Max exhibited moderate rates of problem behavior (*M* = 1.5) and no alternative behavior during the initial baseline. While the alternative behavior was taught to Max, rates of problem behavior were variable (*M* = 1.6) and surpassed baseline on a few occasions before decreasing to zero or near zero responses per minute. Twenty-four sessions were conducted before Max met the criteria for acquisition of the alternative behavior. Rates of problem behavior remained at or near zero (*M* = .02) and high rates of the alternative behavior (*M* = 7.9) were observed throughout the FCT maintenance phase. For Max, the first exposure to the intermittent reinforcement condition resulted in a large increase in problem behavior (*M* = 6) relative to the previous condition (*M* = .02), and no reduction in the rate of problem behavior was observed by the end of the phase. Problem behavior reached a rate of 11.6, which far exceeded levels of problem behavior that occurred during baseline. The alternative behavior decreased rapidly (*M* = 2.7), reaching zero levels by the 9th session.

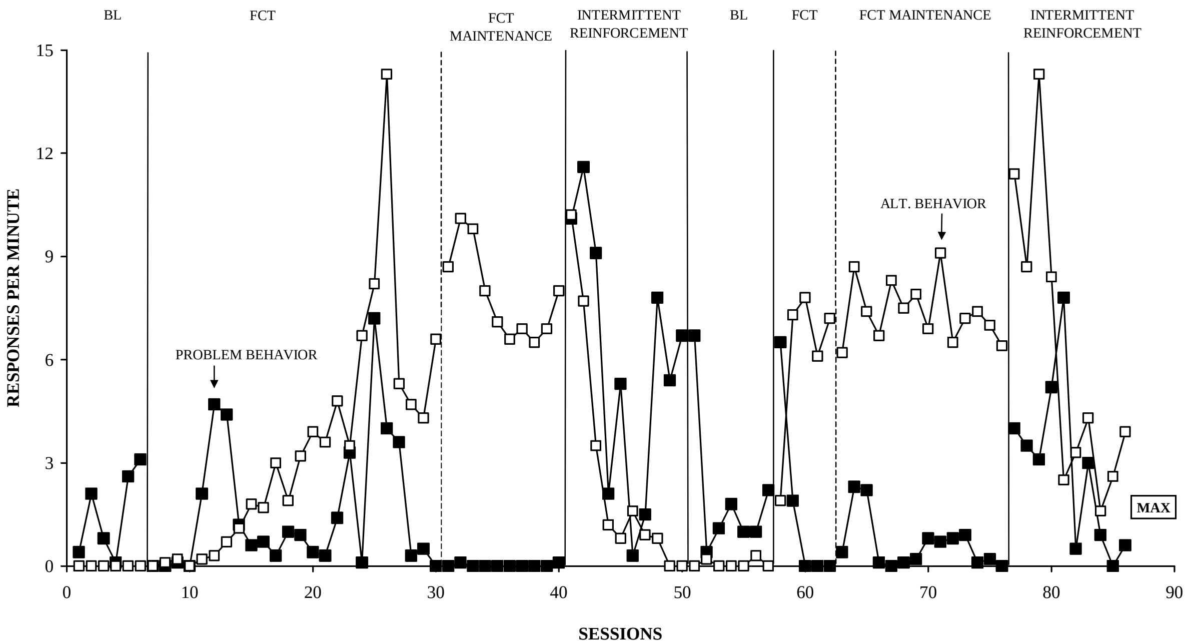

Figure 5. Problem behavior and alternative behavior per minute during baseline, FCT, FCT maintenance, and intermittent reinforcement conditions for Max in Experiment 2.

Variable rates of problem behavior (*M* = 2.03) and near-zero rates of the alternative behavior (*M* = 0.1) occurred during Max’s reversal to baseline. An extinction burst occurred with problem behavior during the second FCT condition (*M* = 1.7), but problem behavior decreased in fewer sessions compared to the initial FCT phase. In addition, the alternative behavior was acquired much more rapidly when taught the second time (5 sessions). During the second FCT maintenance condition, low and variable levels of problem behavior (*M* = 0.6) and high rates of the alternative behavior occurred (*M* = 7.4). During the second exposure to intermittent reinforcement, problem behavior increased (*M* = 2.9) compared to the FCT maintenance condition (*M* = 0.6) and then decreased to near zero levels by the end of the condition. The highest rate of problem behavior (7.8) exceeded levels observed during baseline. Initially, the alternative behavior increased relative to the previous condition, but then maintained at moderate levels (*M* = 6.1).

For Connor, moderate levels of problem behavior (*M* = 2.6) and zero levels of the alternative behavior were observed during the initial baseline. Variable rates of problem behavior occurred before that behavior decreased to zero during the initial FCT condition (*M* = 0.8). The alternative behavior was acquired in twelve sessions. Rates of problem behavior remained at or near zero (*M* = 0.1) and high rates of the alternative behavior (*M* = 2.1) were observed throughout the FCT maintenance phase. During the first exposure to the intermittent reinforcement condition (test for resurgence), problem behavior increased (*M* = 1) compared to the FCT maintenance condition (*M* = 0.1), reaching a level similar to that of the first baseline phase, and then decreased to zero or near zero levels for the remainder of the phase. An extinction burst was observed with the alternative behavior before that behavior extinguished (*M* = 1.8).

High levels of problem behavior (*M* = 5.5) and moderate levels of the alternative behavior (*M* = 1.3) were observed during Connor’s reversal to baseline. During the second FCT condition, problem behavior decreased (*M* = 0.7) relative to the baseline condition at first, but then became variable before returning to zero levels. The alternative behavior increased immediately during the FCT condition and remained high (*M* = 2.4). Although the alternative behavior was not occurring at a rate of at least 50% of that observed in the second baseline, it had clearly been reacquired, as it was occurring at a rate of at least 50% of the first baseline phase. During the second FCT maintenance, problem behavior occurred at zero or near-zero levels (*M* = .02) and high rates of the alternative behavior were observed (*M* = 2.7). Problem behavior remained at zero for two sessions and then an increasing trend was observed (*M* = 1.4) during the second exposure to the intermittent reinforcement condition. The first two intermittent reinforcement sessions were conducted at the end of a session block, and it was hypothesized that satiation may have occurred, resulting in a diminishing of the resurgence observed. In the second to last intermittent reinforcement session, problem behavior reached baseline levels. Rates of the alternative behavior were variable but maintained at moderate levels (*M* = 2.7).

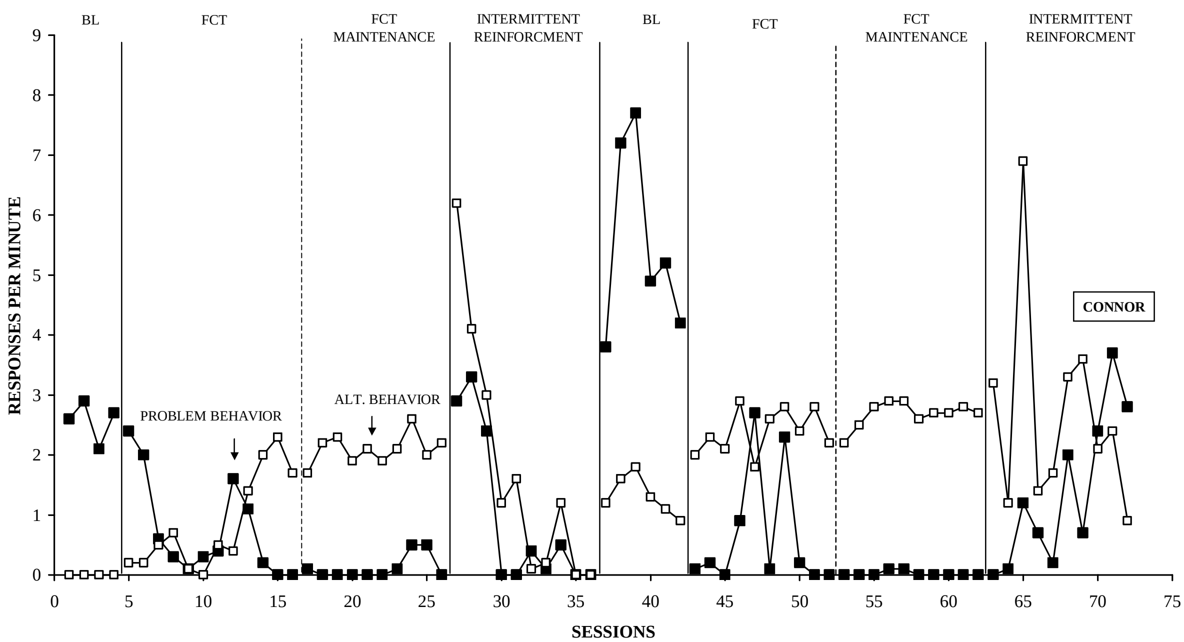

Figure 6. Problem behavior and alternative behavior per minute during baseline, FCT, FCT maintenance, and intermittent reinforcement conditions for Connor in Experiment 2.

DISCUSSION

Summary of Findings

The findings of this investigation replicated those of Lieving and Lattal (2003) with human participants. Resurgence of problem behavior was observed with two of three participants in Experiment 1 and with all participants in Experiment 2. Thus, results of Experiment 1 indicated that resurgence of problem behavior occurs in some instances and that repeated exposure to extinction does not lessen the magnitude of the resurgence effect. In fact, the resurgence of problem behavior for Ben was larger during the second exposure to extinction in Experiment 1. Results of Experiment 2 indicated that resurgence of problem behavior also can occur when an alternative response is reinforced on a thin schedule. This finding suggests that if reinforcement for the alternative response is thinned too rapidly during FCT treatments, problem behavior may resurge even if it remains on extinction. Furthermore, the phenomenon appeared to be as robust as that obtained in Experiment 1. In Experiment 4 of Lieving and Lattal (2003), the magnitude of the resurgence effect obtained when the second response (treadle presses) contacted a thin schedule of reinforcement was smaller than that obtained when treadle presses contacted extinction. In sum, the results of the present investigation provide preliminary evidence that resurgence may account for some instances of recovery of problem behavior during treatments involving extinction or extinction-like components.

Only one participant (Sam) displayed a pattern of behavior suggesting the absence of a resurgence effect. These results suggest that brief periods of extinction of a newly trained alternative response may not be detrimental to the effectiveness of treatment as long as reinforcement for problem behavior is also withheld. However, there were several characteristics of this participant that may have contributed to these results. For example, Sam was the only participant with a known history of extinction for problem behavior prior to the onset of the study. He had participated in two additional studies during which problem behavior was exposed to extinction before entering the current study, although neither of those studies focused specifically on the treatment of his problem behavior and one of the studies addressed a negative reinforcement function. An additional treatment evaluation seemed warranted because Sam's caregivers had reported that he still frequently engaged in problem behavior at school and at the daycare. Further research is needed to determine whether establishing a long history of extinction with problem behavior can prevent resurgence.

In addition to having experience with extinction, Sam also had experience with several manipulations in schedules of reinforcement for alternative and problem behavior (e.g., DRA, FCT, and fading) due to his involvement in other studies. The other participants did not have known experience with such schedule manipulations during the year preceding the current investigation. Sam's functioning level was also somewhat higher than the other participants involved in the study. His verbal behavior skills were more advanced such that he may have exhibited rule-governed behavior (i.e., he generated his own rules) during the treatment evaluation, making his behavior less sensitive to changes in contingencies (Pierce & Cheney, 2004). Isolating the specific variable responsible for the results obtained with Sam would be difficult as a combination of historical variables probably contributed.

Implications for Research and Practice

One important implication of the current investigation is that a methodology was demonstrated for the further study of resurgence. The resurgence effect was reliably demonstrated using a within-subject design. A methodology is now available to examine the factors that influence the resurgence effect so that this behavioral phenomenon can be attenuated or prevented. Results of the current investigation suggest that this phenomenon will occur across repeated exposure to extinction. Thus, simple exposure alone may not reduce the possibility of a resurgence effect.

Most treatments designed to decrease problem behavior in individuals with disabilities involve an extinction component. Problem behavior is often placed on extinction and a more adaptive alternative behavior is reinforced. When extinction is used as part of treatments such as FCT, resurgence is a potential outcome if the treatment is not implemented correctly. Results of the current study suggest that resurgence is an undesirable effect of which researchers and clinicians should be aware, as it may explain treatment relapse in some situations. Once a treatment such as FCT is implemented, treatment may break down if the alternative behavior contacts extinction or extinction-like conditions. When a treatment such as FCT is generalized to home or school settings, the alternative behavior may be more likely to contact extinction. The schedule of reinforcement for the alternative behavior is often thinned to promote maintenance or to increase the practicality of a treatment in the natural environment. However, if the schedule is thinned too quickly, previous patterns of problem behavior may reemerge and treatment gains may be lost entirely if managed improperly (Lieving et al., 2004). Even if caregivers are very careful to keep problem behavior on extinction, problem behavior may reemergence anyway as a result of the thin schedule of reinforcement for the alternative behavior.

Limitations

This study contains limitations that warrant discussion. First, two methodological variations exist in the resurgence literature with respect to when extinction is implemented. In some studies (e.g., Epstein, 1985), the first response was fully extinguished in a control condition prior to reinforcement of the alternative response (Lieving, Hagopian, Long, & O'Connor, 2004). In other investigations, the first response was not extinguished in a separate condition (Lieving et al.; Leitenberg, Rawson, & Bath, 1970; Leitenberg, Rawson, & Mulick, 1975). In these studies, the first response was extinguished while the second response was trained. In application when using FCT, problem behavior is usually extinguished as the communication response is taught. Thus, in the current study, problem behavior was not extinguished before the alternative behavior was taught and reinforced, and it is possible that a phenomenon other than resurgence was observed, such as a delayed extinction effect (Leitenberg et al., 1970, 1975). That is, it is possible that problem behavior did not fully contact extinction, or was prevented from doing so, if the participant quickly learned the alternative response. Once the alternative behavior was no longer reinforced, the participant allocated responding to the previously reinforced problem behavior, which subsequently underwent extinction. Cleland, Foster, and Temple (2000) referred to this as the "prevention of extinction hypothesis." In Cleland, Foster, and Temple, door pushes of hens were first trained and reinforced. Then, door pushes were extinguished and head bobs were trained and reinforced. Finally, head bobs were placed on extinction. For other hens, the order of the behaviors was reversed. In some instances, a period of extinction followed the reinforcement of the first behavior and in others, no extinction session were conducted. Results of the Clelend, Foster, and Temple study suggested that the resurgence effect was greater when the original response was not extinguished prior to training and reinforcement of the second response, which lent support to their hypothesis. However, in the current investigation, extinction curves for problem behavior were observed for Ben and Bella in Experiment 1 and for Ben and Max (second FCT condition) in Experiment 2 as the alternative behavior was taught. In these cases, problem behavior did appear to contact extinction, which is inconsistent with the delayed extinction explanation.

Second, in Experiment 2, the thin schedule of reinforcement (FR 12) for the alternative behavior was chosen somewhat arbitrarily. Although the schedule selected was based on procedures described by Lieving and Lattal (2003), the schedule of reinforcement was not specifically based on each participant's pattern of responding during the FCT maintenance condition conducted prior to intermittent reinforcement. A more dense or thin schedule of reinforcement may have produced different results. The FR 12 schedule may have been too similar to extinction. However, all three participants in Experiment 2 contacted reinforcement for the alternative response at least once under FR 12. In fact, the alternative behavior maintained for Max and Connor during the second exposure to the intermittent reinforcement condition.

Nonetheless, ratio strain may explain the reemergence of problem behavior. A response may not maintain when the response requirement becomes too large (Cooper, Heron, & Heward, 1987). It is possible that ratio strain set the occasion for problem behavior when the schedule of reinforcement for the alternative response was increased from FR1 to FR12 during the intermittent reinforcement condition.

A third limitation was that the conditions designed to test resurgence (extinction or intermittent reinforcement) were only conducted for 10 sessions. Lengthier exposure to the resurgence test condition may have allowed for a more complete examination of the long-term effects of extinction or intermittent reinforcement on levels of problem behavior. For example, for Bella, it is not clear whether problem behavior would have eventually extinguished if more sessions had been conducted.

Fourth, all of the children who participated were diagnosed with mild to severe developmental disabilities and/or autism. It is not clear whether the results of the study can be extended, for instance, to individuals with ADHD or those without a formal diagnosis. In addition, resurgence was only demonstrated with four of five participants. To establish generality of results, replication of the current study with more participants is necessary.

Directions for Future Research

Now that it has been determined that resurgence of problem behavior can occur with human participants and in clinically relevant situations, the variables that control resurgence can be further investigated. When the variables that influence resurgence of problem behavior are known, the resurgence effect may be lessened or eliminated during treatments such as FCT. The potential research questions on this topic are myriad.

One such question is whether the speed at which the reinforcement for the alternative behavior is thinned following FCT would affect the probability of resurgence. That is, how rapidly can the reinforcement schedule for the alterative behavior be thinned without observing resurgence of problem behavior? Progressively thinning the schedule of reinforcement may prevent resurgence. Another question would be to determine whether resurgence occurs when different reinforcers are provided for problem behavior and the alternative behavior. In the current study, the fact that the two responses were maintained by the same reinforcer may have contributed to the occurrence of resurgence. Similarly, the degree of effort required to engage in the alternative behavior may influence the resurgence effect. It may be the case that resurgence will occur more rapidly if the alternative behavior is more effortful. Also, future investigations could examine the role of resurgence in response class hierarchies. For instance, if there are multiple topographies of problem behaviors that occur in a response class hierarchy, certain topographies may be more likely to recover first through resurgence. Clinically speaking, knowing whether more or less severe behaviors are likely to reemerge through resurgence could be important when treating problem behaviors. Exposing problem behavior to extinction prior to FCT may reduce the resurgence effect although basic research suggests that this would not be the case if the exposure is relatively brief (Epstein, 1985).

Several authors have provided alternative names or descriptions for the patterns of responding observed in the current investigation. One possibility is that resurgence is a very specific form of extinction-induced behavioral variability (Lieving et al., 2004). When a behavior is exposed to extinction, behavior sometimes becomes more variable in general (e.g., Antonitus, 1951; Millenson & Hurwitz, 1961). In the current investigation, it was unclear whether increases in behavior other than problem behavior would have occurred because data were not collected on topographies of behavior other than the two responses in question (i.e., problem behavior and the alternative response). Future research should examine whether behavior becomes more variable in general during the extinction phase of the resurgence test.

Cleland et al. (2001) proposed that resurgence is related to spontaneous recovery. After extinction of a behavior has occurred, periods of rest alone are sometimes associated with increases in the extinguished behavior (Kimble, 1961). In terms of resurgence, when the second response (alternative behavior) is reinforced during condition 2, this may be a period of rest for the first response, problem behavior. More research is needed to determine if there is a relationship between resurgence and spontaneous recovery.

As discussed previously, resurgence may be described more accurately as latent extinction when the first response is not extinguished prior to training and reinforcement of the second response (alternative behavior). That is, the first response does not completely extinguish because a competing response is reinforced. The behavior then still must undergo (complete) the extinction process when the competing response is no longer reinforced. Future investigations will be necessary to determine whether resurgence in this case is a separate phenomenon or latent extinction.

Resurgence is a behavioral phenomenon that will likely occur in application if a newly taught alternative behavior contacts extinction. Determining the variables that influence resurgence now becomes imperative so that reduction and prevention of this effect can be achieved.

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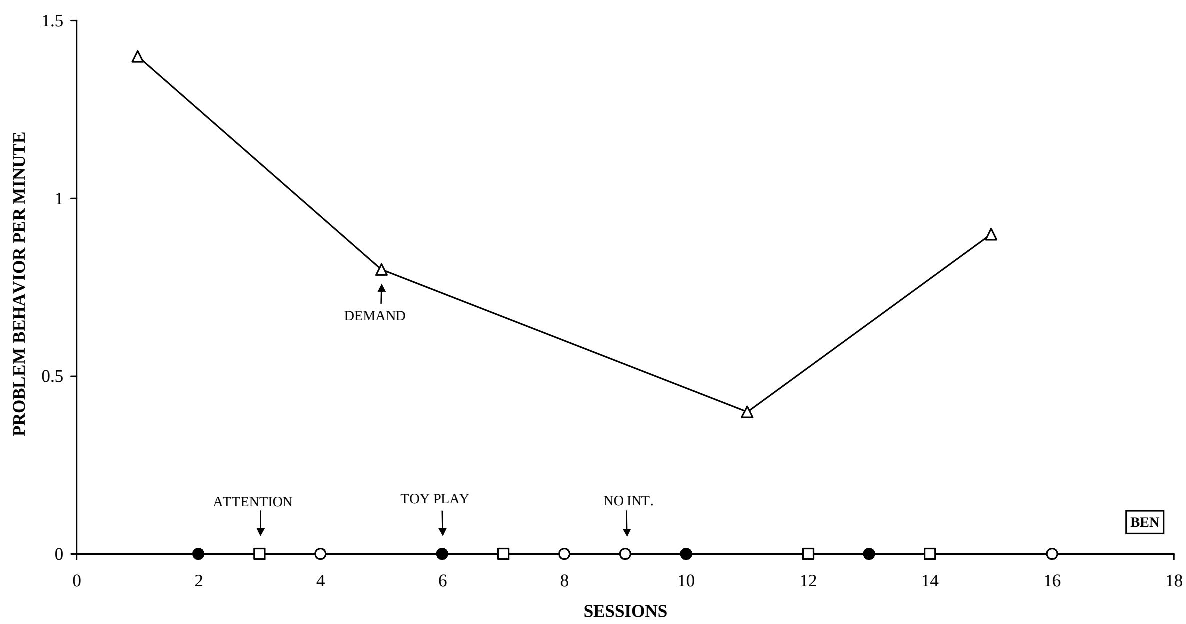
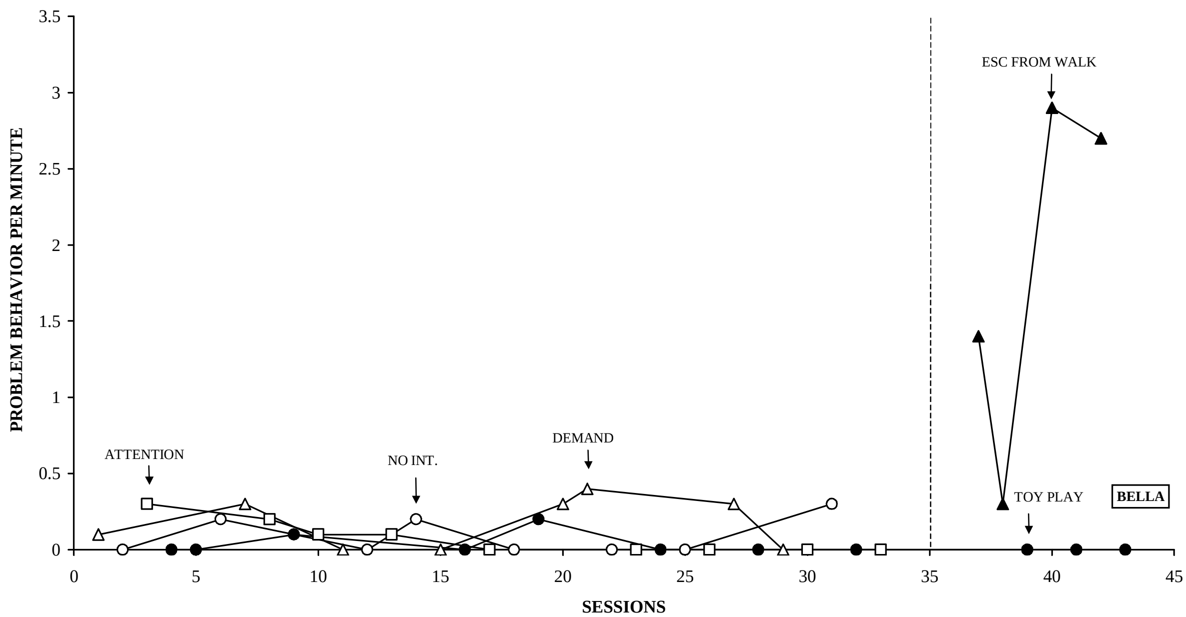
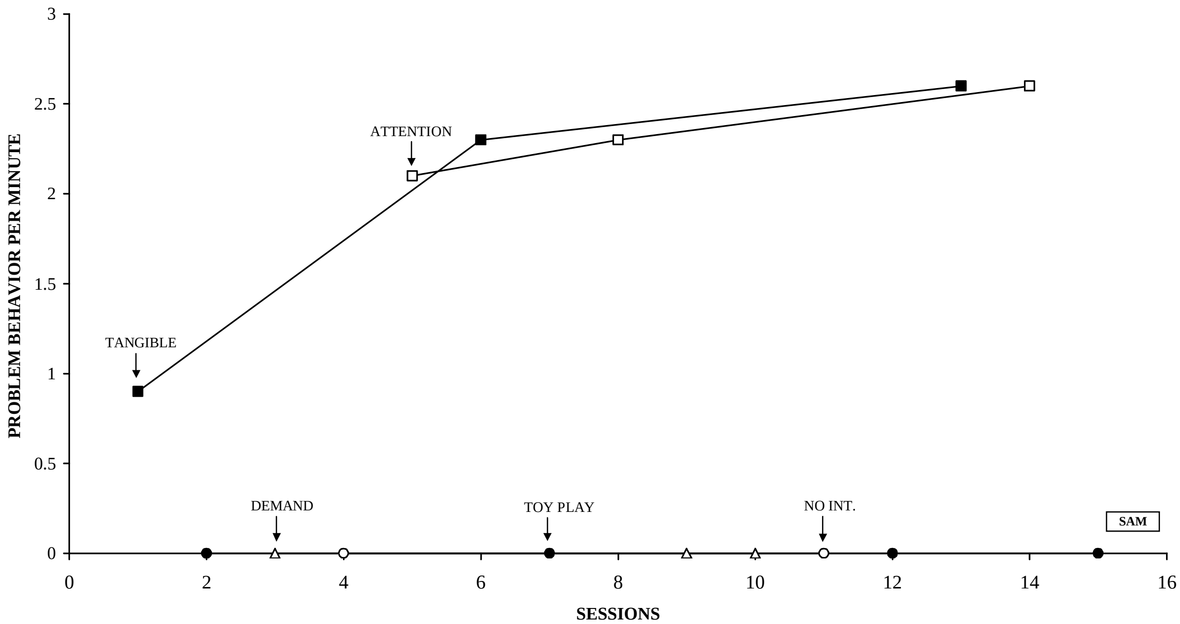
APPENDIX: FUNCTIONAL ANALYSIS GRAPHS



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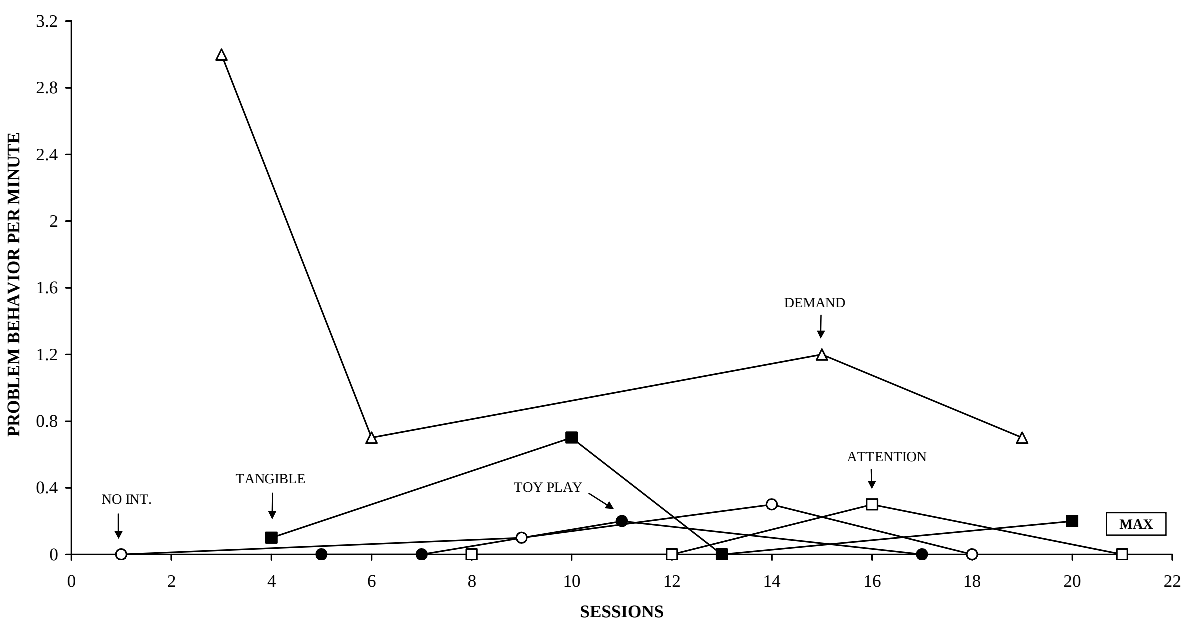
SESSIONS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PROBLEM BEHAVIOR PER MINUTE
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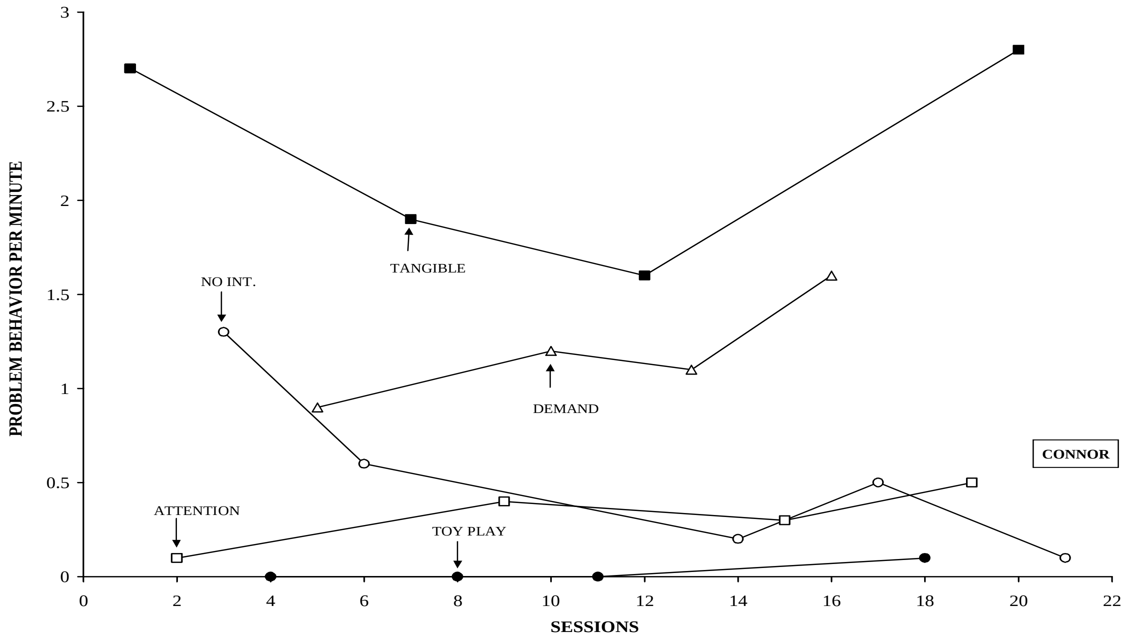

PROBLEM BEHAVIOR PER MINUTE
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VITA

Valerie Volkert received a Bachelor of Science degree at the University of Florida (UF) in 1999. Her undergraduate experience was a liberal arts education with an emphasis in psychology. During her four years at UF, Valerie received various awards and honors (e.g., President's Honor Role). In her final year at UF, she enrolled in two psychology classes with Dr. Brian Iwata that focused on applied behavior analysis. Through these classes, Valerie discovered an interest in behavior analysis and wished to gain clinical research experience. Immediately after graduating from UF, Valerie began working full-time at the Marcus Institute in Atlanta, a replication site of the Kennedy Krieger Institute, in an entry-level position (Behavior Data Specialist). She was trained by Dr. Wayne Fisher and Dr. Cathleen Piazza to provide clinical services to children with autism and mental retardation who displayed severe destructive behavior or feeding disorders, while simultaneously conducting behavior analytic research. Within 2 years, Valerie was promoted from the Behavior Data Specialist position to the Clinical Specialist III position. At the Marcus Institute, her research experience included functional analysis methodology and the development of function-based treatments for children with destructive behavior (e.g., aggression and disruption). She also gained experience creating research protocols (e.g. differential reinforcement, extinction, and stimulus fading) to increase oral consumption for children with pediatric feeding disorders. Through her experiences at the Marcus Institute, Valerie discovered she would like to dedicate a lifetime to the study of behavior. Thus, she pursued her doctoral degree in school psychology at the Louisiana State University. She completed her internship at the Marcus Institute.