

USING COMPETING STIMULI TO MINIMIZE RESURGENCE OF CHALLENGING
BEHAVIOR DURING FIXED-LEAN SCHEDULES OF REINFORCEMENT
FOLLOWING FUNCTIONAL COMMUNICATION TRAINING FOR
CHILDREN WITH INTELLECTUAL AND
DEVELOPMENTAL DISABILITIES

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DISSERTATION ABSTRACT

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Doctor of Philosophy

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Title: Using Competing Stimuli to Minimize Resurgence of Challenging Behavior during Fixed-lean Schedules of Reinforcement Following Functional Communication Training for Children with Intellectual and Developmental Disabilities.

Individuals with intellectual and developmental disabilities, such as Autism Spectrum Disorder, often engage in challenging behavior that severely limits positive outcomes. Although treatment packages comprising functional communication training and multiple schedules of reinforcement have demonstrated great promise to both increase appropriate, socially acceptable communication responses for preferred items and decrease challenging behavior associated with not having access to preferred items, resurgence of challenging behavior has been reported to occur during lengthy periods when preferred items are not available (i.e., extinction). This study evaluated whether noncontingent access to an alternative item during an abrupt shift to a lengthy period of extinction would reduce the extent of challenging behavior. Two children with Autism Spectrum Disorder participated. The results of this study indicated that (a) functional communication training successfully reduced challenging behavior and increased the rate of functional communication responses (FCR) for both participants, (b) multiple schedules of reinforcement (i.e., signaled periods of reinforcement and extinction for FCRs) successfully produced discriminated FCRs, and (c) no major differences in challenging behavior were observed when alternative items were presented during the

abrupt shift to a terminal period of extinction versus when alternative items were not presented. Limitations and future directions of research are discussed.

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CHAPTER I

INTRODUCTION

This purpose of this chapter is to review major issues discussed in this study. First, developmental disabilities and behavioral challenges exhibited by individuals with intellectual and developmental disabilities (IDD) will be reviewed. Next, applied behavior analysis will be used as the conceptual framework for common assessment and treatment approaches with this unique population. Finally, common treatment challenges and limitations of the extant literature will be presented as a means to frame the present investigation.

Intellectual and Developmental Disabilities

Developmental disability is a term that includes a range of physical and/or cognitive impairments that manifest for individuals before age 22 (American Association on Intellectual and Developmental Disabilities [AAIDD], 2013). The World Health Organization (2014) indicated that over 15% of the world's population has a disability, and prevalence rates are increasing; many individuals with a disability do not have access to appropriate health care. Service providers should strive to enhance the functioning of individuals with IDD, so that they can lead a successful and satisfying life (AAIDD, 2013). Further, service providers need to deliver evidence-based practices in order to support and promote positive outcomes for individuals with IDD and help them lead a more enriched life.

Impairments in behavioral, language, learning, and physical domains (Centers for Disease Control and Prevention, 2013) can have major implications for the life outcomes of individuals with IDD. For example, impairments in physical, cognitive, and

communication skills can limit children and youth participation in leisure activities (Bult, Verschuren, Jongmans, Lindeman, & Ketelaar, 2011). Individuals with IDD have been reported to experience worsened postsecondary education and employment outcomes (Brouck, 2014; Shattuck et al., 2012), and often require assisted living as adults (Brouck, 2014). Positive outcomes are further reduced for individuals with IDD who also display challenging behavior (Baker et al., 2003; Matson, Terlonge, Minshawi, 2008; Sigafoos, Arthur, & O'Reilly, 2003). Emerson et al. (2001a) reported that individuals with IDD who exhibited greater levels of challenging behavior needed more assistance with adaptive (e.g., eating, dressing, washing) and communication (i.e., receptive and expressive) skills. Further, it has been reported that individuals with IDD whom exhibit greater levels of challenging behavior reside in more restricted institutional settings (Schroeder, Tessel, Loupe, & Stodgell, 1997; Sigafoos et al.). Thus, the challenges faced by individuals with IDD can be exacerbated by concomitant issues with challenging behavior; thus, requiring intervention to reduce the likelihood of negative life outcomes.

Autism Spectrum Disorder. The prevalence of Autism Spectrum Disorder is on the rise (Christenson et al., 2016). Individuals with ASD typically have deficits in social communication and repetitive behavior, which could impede further opportunities, such as enrollment in educational programs, to develop social and life skills. As a result, increasingly larger gaps may exist compared to typical peers (Lane & Ledford, 2016). A longitudinal study has shown that the extent of community inclusion and adaptive living skills for adults with ASD was highly restricted as the majority lived with their parents or were under someone else's care (e.g., Gray, Keating, Taffe, Brereton, Einfeld, Reardon, & Tonge, 2014). In contrast, optimal outcomes have been demonstrated with individuals

with ASD who had average scores on measures of adaptive and problem behavior, which highlights the need for intervention (Kelley, Nagles, & Fein, 2009).

Challenging Behavior Exhibited by Individuals with IDD

Challenging behavior has been defined in terms of its destruction, harm, disruption, or unacceptability that occurs either frequently or with high intensity and causes major concern to other individuals or a social group within a given context (Sigafoos et al., 2003). Of particular concern to society is when challenging behavior is directed toward the self (i.e., self-injury) or others in the form of aggression. Crotty, Doody, and Lyon (2014) characterized severely challenging behavior into five typologies, including verbal aggression, physical aggression, self-injurious behavior, property destruction, and inappropriate sexual behavior. Within each typology, aggressive behavior may manifest as many, distinct topographies. For example, common topographies associated with verbal aggression may include, but are not limited to, yelling/screaming, verbal abuse, and profanity. Emerson et al. (2001a) reported from a 1995 sample of 264 individuals with IDD in England that 79% engaged in two or more specific forms of aggressive behavior, and 19% engaged in five or more specific forms of aggressive behavior.

The prevalence of severely challenging behavior for individuals with IDD can vary substantially based on the specific type of disability. For example, in a review of 39 articles Powis and Oliver (2014) found that the prevalence of aggression for individuals with one out of eight genetic syndromes ranged from less than 15% for Williams and Down syndromes to more than 70% for Cri du Chat, Smith-Magenis, Fragile X, Angelman, Cornelia de Lange, and Prader-Willi syndromes. In one sample of 400

children with autism, 25% were reported to have aggressive behavior problems (Hill et al., 2014). More generally, Emerson et al. (2001a) reported that approximately 10-15% of individuals with IDD exhibit some topography of severely challenging behavior during their lifetime.

Although challenging behavior can occur as early as six months of age (Berkson & Tupa, 2000), it typically emerges between two and three years (Emerson et al., 2001a; Feldman, Hancock, Rielly, Minnes, & Cairnes, 2000; Fodstad, Rojahn, & Matson, 2012). Emerson et al. (2001a) indicated that prevalence rates tend to increase markedly during childhood and adolescence. An initial increase in prevalence for challenging behavior may occur due to children's increased strength and fluency with motor skills, and the effects of these better-developed repertoires are likely to be more noticeable and concerning for caregivers during this time (Sigafoos et al., 2003); challenging behavior may become more increasingly difficult to manage for bigger children.

Challenging behavior exhibited by individuals with IDD generally persists over time (Totsika & Hastings, 2009). In two longitudinal studies, Totsika, Toogood, Hastings, and Lewis (2008) and Emerson et al. (2001b) reported that severe challenging behavior persisted in approximately 70% of individuals with IDD in residential treatment centers across a span of 11 and 7 years, respectively. Green, O'Reilly, Itchon, and Sigafoos (2005) found similar results for 13 preschoolers with developmental disabilities who continued to engage in challenging behavior three years later. Another longitudinal study showed that 80% of individuals who engaged in aggressive behavior in 1988 continued to do so in 1993 (Kiernan & Alborz, 1996); 88% of the parents in this study reported that they had received no advice to manage their child's challenging behavior

during the five-year period. The implications are that challenging behavior will generally persist if left untreated (Schroeder, Richman, Abby, Coutemanche, & Oyama-Ganiko, 2014).

Challenging behavior not only impacts the life of the individual, but also has adverse effects on their family. Prior research has demonstrated that caregivers of individuals with IDD report higher levels of depression (Davis & Gavidia-Payne, 2009; Lach et al., 2009), issues with family functioning (Davis & Gavidia-Payne, 2009; Lach et al.), and lower perceptions of social support (Faust & Scior, 2008; James, 2012; Lach et al.). Baker et al. (2003) reported a reciprocal relationship between parenting stress and challenging behavior exhibited by children. That is, higher levels of parenting stress predicted greater levels of challenging behavior, and vice versa. Further, parents' marital satisfaction was shown to be related to the existence of behavior problems by adolescents and adult children with autism spectrum disorders (Hartley, Barker, Baker, Seltzer, & Greenberg, 2012). These factors demonstrate a heightened need for effective treatments for individuals with IDD who engage in challenging behavior.

Conceptual Bases for Examining Challenging Behavior

A primary conceptual basis for examining challenging behaviors is Applied Behavior Analysis (ABA). ABA is the study of environmental variables that control behavior which are of social importance, such as challenging behavior (Baer, Wolf, & Risley, 1968). Thus, the object of behavioral researchers and clinicians that espouse ABA is to document the environmental variables that are "responsible for the occurrence or non-occurrence" of behavior and to demonstrate control over the behavior (p. 94). This focus on the environment obviates the need for attributing behavior to mentalistic

concepts, such as purpose and intention (Skinner, 1963), that are not readily amenable to direct measurement.

In one of the first empirical demonstrations examining the relation between environmental variables and severe challenging behavior, Lovaas, Freitag, Gold, and Kassorla (1965) manipulated the delivery of social positive reinforcement (i.e., praise and smiles) to a nine-year-old girl with schizophrenia during alternating phases when the child danced (i.e., clapped and wiggled) to music. That is, the researchers withheld reinforcement for dancing in one phase of the investigation (A), reinforced the child's dancing in the next phase (B), and then withheld reinforcement again during the final phase (A; i.e., presented in a reversal ABA design; Baer et al., 1968). The results of their experiment demonstrated that the child was more likely to engage in elevated levels of self-injurious behavior (e.g., head banging, arm banging) when social reinforcement was withheld; these findings were replicated two more times across different scenarios within the same study. This study demonstrated control of behavior by manipulating environmental events and offered an alternative explanation for the etiology of severely challenging behavior (e.g., purely organic or mentalistic) for individuals with a disability (Lovaas et al., 1965) which were widely accepted then (e.g., Cain, 1961; Hartmann, Kris, & Loewenstein, 1949) and now (Chandler & Dahlquist, 2010).

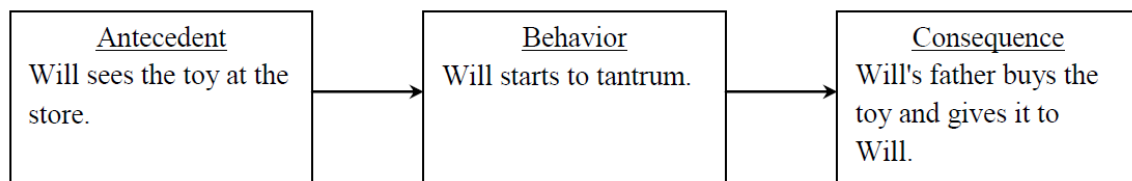
In Lovaas et al. (1965), it is important to consider why the child systematically engaged in challenging behavior when social positive reinforcement was withheld. Skinner (1963) indicated that an organism's prior learning history with the environment will influence the organism's behavior under future stimulus conditions that are similar, and that one can increase or decrease the rate of behavior by manipulating the

consequences for a given response. Accordingly, it may have been the case that the child in Lovaas et al. had a history of reinforcement in the form of adult attention for engaging in self-injurious behavior in the natural environment. Thus, when attention was withdrawn from the child, the child simply reverted to topographies of behavior (i.e., self-injury) that produced adult attention for her in the past.

As implied above, positive reinforcement occurs when a stimulus that follows a behavior increases the likelihood that the organism will engage in the response under future conditions that are similar (Skinner, 1974). For example, attention (e.g., praise, smiles, or verbal reprimands) would be considered positive reinforcement if the organism is more likely to engage in the target behavior that historically produced attention from others as a consequence; thus, the target behavior would be strengthened or increased in the future. Like positive reinforcement, Skinner (1974) indicated that negative reinforcement also strengthens a response. Negative reinforcement occurs when a stimulus is removed following some response, thereby increasing the likelihood that the response will occur again under future conditions that are similar. For example, the aversive stimulus, a headache, terminates when an individual takes medicine. As a result, an individual may be more likely to take medicine when he or she has a headache, because taking medicine is followed by the removal of the aversive stimulus (i.e., the headache). If taking medicine failed to result in the removal of the headache, the individual would be not be likely to take medicine again in the future if he or she has a headache.

Thus, effective treatments for challenging behavior require the identification environmental events that maintain the behavior (Carr, 1977; Iwata, Dorsey, Slifer,

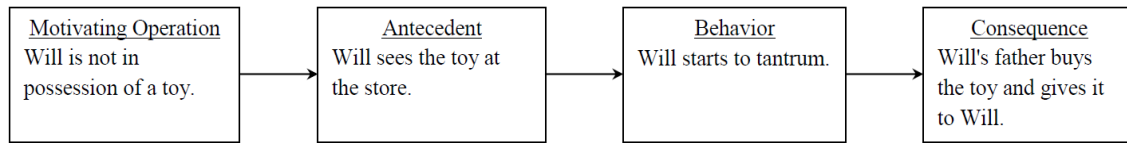
Bauman, & Richman, 1982/1994). Carr, Langdon, and Yarbrough (1999) noted that most challenging behavior "produce observable benefits for the people exhibiting these behaviors" (p. 10). Similarly, O'Neill, Horner, Albin, Storey, and Sprague (1990) insisted that individuals with IDD do not solely engage in challenging behavior because they have a disability; rather, "[t]here is a logic to their behavior" (p. 4). The accompanying "benefit" or "logic" associated with challenging behavior occurs through positive and negative reinforcement (Carr, 1977; Skinner, 1974), as described above. Skinner (1963) described the most basic operant relation as the three-term contingency, which is exemplified by the model below.



In the above example, Will sees the stimulus (i.e., a toy) and begins to tantrum. As a result, his father buys the toy and gives it to Will. Thus, Will accesses a toy when he engages in a class of behavior (e.g., crying, screaming and yelling). If Will became more likely to tantrum under future conditions that are similar (e.g., seeing a toy on a different occasion at the store), then this would be an example of positive reinforcement because the delivery of the toy (consequence) following a tantrum (behavior) made the tantrum more likely to occur.

Behavioral researchers and clinicians also consider motivating operations as important factors that contribute to behavior (Laraway, Snyderski, Michael, & Poling, 2003; Michael, 1993). A motivating operation is an environmental event or stimulus condition that momentarily alters the reinforcing effectiveness of a consequence, and the

likelihood that an organism will engage in a response that produces that consequence (Laraway et al., 2003; Michael, 1993). The model below illustrates the four-term contingency.



In this example, the motivating operation relates to a state of deprivation. That is, Will have a toy in his possession. This state of deprivation increases the value of the toy (i.e., the momentary effectiveness of the toy as a reinforcer) thereby increasing the likelihood that Will engages in a response that produces access to the toy. Had Will already been in possession of the toy, the likelihood that Will would tantrum would likely be lower.

Similarly, a child who is presented with frequent and difficult demands in school (motivating operation) may be more likely engage in challenging behavior when a subsequent task demand is presented (antecedent), because the value of removing those task demands is greater. Thus, the child is likely to tantrum or engage in other responses that produce escape from the task.

Assessment of Challenging Behavior

In light of the theory described above, the purpose of functional assessments for challenging behavior is to identify the environmental variables, including antecedents, consequences, and contexts that occasion or maintain behavior (Chandler & Dahlquist, 2010; Horner & Carr, 1997; Huete, Kurtz, & Boyd, 2012; Iwata et al., 1982/1994; Lydon, Healy, O'Reilly, & Lang, 2012; Matson et al., 2011; O'Neill et al., 1990), that commonly evoke challenging behavior for individuals with IDD (Beavers, Iwata, & Lerman, 2013; Huete et al., 2012). Indirect and direct approaches have been developed (e.g., interviews,

direct observation, and systematic environmental manipulations; Carr et al., 1999; O'Neill et al., 1990). O'Neill et al. (1990) indicated that functional assessments typically include each of these approaches, in a progression from interviews to observations to systematic manipulations, although one or two of these strategies may be sufficient to identify the environmental variables that occasion and maintain challenging behavior. Nevertheless, caution should be exercised with respect to the degree of confidence that one places for any single strategy for assessment. For example, Thompson and Iwata (2007) found very little agreement (i.e., three out of 12 cases) between descriptive assessments (i.e., direct observation with no environmental manipulation) and experimental functional analyses (i.e., systematically manipulating environmental variables) in the function of challenging behavior for individuals with severe to profound intellectual disabilities. Further, Herzinger and Campbell (2006) found in a meta-analytic review of studies employing descriptive and experimental approaches for assessment and treatment of challenging behavior that treatments based on the results of experimental manipulations were more effective at suppressing behavior than treatments derived solely from indirect assessments. Mace, Lalli, and Lalli (1991) indicated, however, that descriptive assessments can be suggestive of functional relations, and should be used in conjunction with more formal analyses. Fittingly, Belva et al. (2013) emphasized that the best approach to functional assessment does not rely on any one single approach; rather, treatment decisions should be informed by multiple sources of assessment data.

Indirect Assessment of Challenging Behavior. Indirect assessments can help develop hypotheses for environmental factors that maintain challenging behavior (Belva, Hattier, & Matson, 2013; Boyd & Kennedy, 2014; O'Neill et al., 1990), and have been

identified as a helpful first step in functional assessment (Boyd & Kennedy, 2014). Indirect assessments include interviews and ratings scales based on the report of significant others in the individual's life, and do not rely on direct observation of the challenging behavior (Didden, 2007). One indirect assessment, *Questions About Behavioral Function* (QABF; Matson & Vollmer, 1995), involves completing a 25-item questionnaire that is used to identify the function of challenging behavior, including attention, escape, tangible, nonsocial, and physical functions (Belva et al., 2013). Paclawskyj, Matson, Rush, Smalls, and Vollmer (2000) indicated this assessment has been demonstrated to be technically sound based on adequate test-retest (i.e., range, 0.80 - 0.99) and inter-rater reliability (i.e., range, 0.43 - 0.92) across subtests, and overall internal consistency (i.e., 0.60). This questionnaire requires approximately 20 minutes to administer; thus, this assessment has been reported to be a viable approach to functional assessment. However, a major limitation to this assessment is that this rating scale, as is the case with other retrospective reports, is subject to the interviewer's influence, bias, or other inaccuracies (Boyd & Kennedy, 2014; Schroeder et al., 2014).

The *Functional Assessment Interview Form* (FAI; O'Neill, Horner, Albin, Sprague, Storey, & Newton, 1997) is another standardized approach for functional assessment, which involves a semi-structured interview and checklist (Belva et al., 2013; Schroeder et al., 2014). Unlike the QABF, however, the FAI is a relatively lengthy assessment that can require up to 90 minutes for administration. Nevertheless, a major strength of this assessment is that it yields information that is critical for assessment and treatment of challenging behavior, including, but not limited to, target behaviors, antecedents, consequences, response efficiency, functionally equivalent alternative

responses, and preexisting communication skills within the individual's repertoire (Belva et al., 2013). Thus, this instrument has much utility for functional assessment and, more importantly, treatment of challenging behavior, provided that the information being reported is accurate. A limitation, however, is that the technical adequacy of this assessment has not been evaluated (Belva et al., 2013).

Thus, some major advantages associated with indirect assessments are that they are relatively efficient in terms of cost and time, and require less training and expertise to implement (Boyd & Kennedy, 2014; Herzinger & Campbell, 2006). Further, indirect assessments do not require examiners to evoke challenging behavior, which can be an ethical concern that is associated with experimental functional analyses (Herzinger & Campbell, 2006). As previously noted, however, informant-based reports can be inaccurate and there may be poor inter-rater reliability for examiners who employ these methods for functional assessment (Belva et al., 2013; Boyd & Kennedy, 2014).

Direct Observations of Challenging Behavior. Although Thompson and Iwata (2007) reported that descriptive assessments in the form of direct observations with no systematic environmental manipulations yielded inaccurate conclusions about behavioral function when compared to the results of experimental functional analyses, a limitation associated with this study was that the researchers did not specify the time or context in which the observations occurred. O'Neill et al. (1990) indicated that the interview process (as described above) should be used to inform the range of behaviors, settings, and functions that are examined during direct observations. Adhering to these recommendations allows one to examine the correspondence between interviews and other indirect assessments, and yields the data necessary to hypothesize the conditions

under which challenging behavior may be likely to occur (Boyd & Kennedy, 2014; Horner & Carr, 1997).

A range of recording methods have been developed for direct observations of challenging behavior. Two examples of descriptive assessments are event recording and time sampling (Belva et al., 2013). Event recording involves *contingency event recording* and *continuous event recording*. The Antecedent-Behavior-Consequence (A-B-C) assessment (Bijou, 1968) is a commonly employed contingency event recording strategy in which the data collector examines the natural environment and records antecedents and consequences for each instance of the target behavior. This assessment not only provides a frequency count of the target behavior within a given time period, but also provides summary information about each instance of challenging behavior, such that examiners can hypothesize the conditions under which the behavior is most likely to occur.

Apart from the interview described above, the FAI includes an adapted version of the A-B-C assessment that is presented in a checklist format. This assessment allows data collectors to record information about antecedents, behaviors, consequences, and potential functions concisely. Further, data collectors can identify a range of behaviors to examine, including appropriate behavior, and the checklist has been organized such that it affords examiners more flexibility in data collection, such as additional descriptive notes (Belva et al., 2013).

Continuous event recording entails recording continuous antecedent information within a predetermined time interval (e.g., every 30 seconds) regardless of whether the target behavior occurs; consequence information is also recorded when the target behavior occurs. Belva et al. (2013) indicated that the advantage of this method of data

collection is that the examiner can precisely determine the number of times a target behavior has followed any particular antecedent (thus, providing an indication regarding the strength of the response), and how many times a certain consequence follows a specific target behavior.

Alternatively, time sampling procedures entail dividing the observation period into equal intervals (e.g., 30 seconds), and recording whether the behavior occurs. Three common time sampling techniques are whole interval, partial interval, and momentary time sample (Belva et al., 2013). For whole interval recording, the behavior must occur for the entire duration of the interval in order for the examiner to record an instance of the target behavior. Thus, if the target behavior only occurs for a relatively brief duration during each interval (e.g., 10 seconds out of a 30-second interval), the target behavior is not recorded. Not surprisingly, a limitation with this approach is that it underestimates the occurrence of the target behavior (Powell, Martindale, & Kulp, 1975; Powell, Martindale, Kulp, Martindale, & Bauman, 1977). For partial interval recording, an instance of the target behavior is recorded within the pre-specified time interval if a behavior occurs at any point during the interval regardless of its duration. A limitation with this approach is that it overestimates the occurrence of the target behavior (Powell et al., 1975; Powell et al., 1977), because an occurrence is recorded even given a brief instance of the behavior (e.g., 1 second during a 30-second interval). Finally, momentary time sampling involves recording an instance of the target behavior if the individual is engaged in the target behavior at the end of the pre-specified time interval (i.e., the behavior must occur at the end of the interval in order for an occurrence to be recorded). This technique was demonstrated to be superior to whole- and partial interval recording in terms of its

accuracy for the actual occurrence of the behavior, although this strategy was also reported to over- and underestimate the occurrence of the target behavior (Powell et al., 1975; Powell et al., 1977). A major benefit associated with all time-sampling procedures is that these data may be used to assess the degree to which challenging behavior occurs in relation to informant reports.

There are limitations that are associated with descriptive assessments, including the information being correlational or suggestive of controlling variables, at best, because the environment is not systematically manipulated to examine the impact on behavior (Belva et al., 2013; Mace, Lalli, & Lalli, 1991). Further, time sampling procedures are not designed to assess antecedents or consequences for the target behavior. Thus, there are substantial limitations on the causal inferences that one can draw solely from these data. However, one major advantage with conducting descriptive assessments is that one can compare this information with that collected from indirect assessments and assess the degree of agreement across various sources of information (Carr et al., 1999). Greater agreement may enhance the confidence in these data, and use it to develop individualized treatment strategies. A greater advantage yet is that the information obtained from descriptive assessments can be used to define the conditions in experimental functional analyses that are hypothesized to maintain challenging behavior; this approach has yielded greater corroboration across assessments and precision in treatment (Carr et al., 1999).

Experimental Functional Analysis. Compared to the methods described above, a more rigorous and reliable approach to identifying the function of challenging behavior is to systematically and experimentally manipulate environmental variables and record

instances of the target behavior (Lydon et al., 2012); this has been deemed to be the "gold standard" for functional assessment based on the accuracy of results that are typically obtained (Belva et al., 2013; Boyd & Kennedy, 2014). Iwata et al. (1982/1994) standardized this experimental approach to rigorous functional assessment, which has since been conducted, extended, or discussed in over 2,000 articles and chapters (Beavers et al., 2013). During five or 10 minute sessions, environmental stimuli are strategically manipulated to identify or isolate the putative factor(s) controlling the target behavior (Herzinger & Campbell, 2006). Iwata et al. (1982/1994) included the following conditions in their initial assessment: (1) social disapproval, wherein experimenters provide verbal statements (e.g., "Don't hit yourself") following instances of challenging behavior; (2) academic demand, wherein experimenters briefly terminate demands for the individual to complete academic tasks contingent upon occurrences of challenging behavior; (3) unstructured play, wherein the child has access to toys, no demands are placed, and there are no programmed consequences (e.g., comments or disapproval) following instances of challenging behavior; and, (4) alone, wherein the individual is alone in the therapy room, and does not have access to tangibles or other programmed activities. Sessions for each condition are conducted in random order. Recorded instances of the target behavior relevant to each condition are then charted to examine the variation and/or consistency of levels of the behavior that are compared to a control condition (e.g., play). Elevated levels of the target behavior in one condition relative to control allows one to make causal inferences between environmental variables and the target behavior. Thus, a major benefit associated with experimental functional analyses is the potential to accurately diagnose behavioral function and the implications for effective treatment (Carr

et al., 1999; Herzinger & Campbell, 2006; Horner & Carr, 1997; Iwata et al., 1982/1994; Lydon et al., 2012).

Despite the advantage of functional analyses to identify clear, causal relations between environmental variables and behavior, several limitations associated with standard functional analyses have been reported, including that they are lengthy (Carr et al., 1999; Horner & Carr, 1997; Kodak, Fisher, Paden, & Dickes, 2013; Lydon et al., 2012; Northup et al., 1991; O'Neill et al., 1990) and labor intensive (Carr et al., 1999; Horner & Carr, 1997; O'Neill et al., 1990; Schroeder et al., 2014). Moreover, standard functional analyses may be impractical to conduct in certain settings, such as schools or early intervention classrooms (Carr et al., 1999; Horner & Carr, 1997; Kodak et al., 2013; Lydon et al., 2012). Further, occasioning challenging behavior may elevate the level of risk of harm for the child or others in the environment (Belva et al., 2013; Bloom, Iwata, Fritz, Roscoe, & Carreau, 2011; Boyd & Kennedy, 2014; O'Neill et al., 1990). Finally, functional analyses involve evoking and reinforcing challenging behavior, which may be an ethically questionable practice (Boyd & Kennedy, 2014; Carr, 1977; Herzinger & Campbell, 2006).

To address the limitations associated with standard functional analyses, many variations have been developed (Lydon et al., 2012; Boyd & Kennedy, 2014). One such variation is the brief functional analysis (Northup et al., 1991) which has been demonstrated to be a viable alternative to standard functional analysis, because it requires reduced session durations and/or fewer sessions overall. Like standard functional analyses, differential levels of challenging behavior within and across conditions are used to infer causal relations between experimental conditions and challenging behavior. This

adapted variation may be more appropriate in settings where there are time constraints and/or there is a need to intervene quickly.

Another approach is a latency functional analysis in which the latency to the first instance of challenging behavior in each condition is examined instead of overall rates of challenging within each session (Call, Pabico, & Lomas, 2009; Thomason-Sassi, Iwata, Neidert, & Roscoe, 2011). This strategy minimizes the overall extent to which challenging behavior occurs in the session, because the session is discontinued following the first instance of challenging behavior. This approach might be utilized when the topography of challenging behavior is severe or if the assessment is being conducted in a setting (e.g., home or school) that is not typically equipped with padded equipment or other resources to safely manage severe challenging behavior. Nevertheless, an inherent assumption with this approach is that the factors maintaining challenging behavior are also the factors that will evoke challenging behavior the fastest. Nevertheless, Call et al. (2009) and Thomason-Sassi et al. (2011) reported an inverse relationship in the rate and latency to challenging behavior in a comparison between standard functional analyses and latency-based functional analyses; thus, confirming the results of the modified assessment technique, and demonstrating its utility.

Precursor functional analyses rely on less severe topographies of challenging behavior as indices for severely challenging behavior. The basic premise is that less severe topographies (e.g., yelling and climbing on furniture) are precursors to more severe topographies of challenging behavior (e.g., hitting with a closed fist), because they serve the same purpose; thus, they are functionally equivalent responses (Langdon, Carr, & Owen-DeSchryver, 2008). Reinforcing precursors of challenging behavior may be

considered a more appropriate option within the context of assessment, because they are less severe and pose less overall risk to the individual and others in the environment. However, an important consideration is whether the topography of problem behavior (e.g., pinching as a form of self-injury) is within the same response class as other forms of challenging behavior. For example, self-pinching and another topography (e.g., biting oneself) may serve different functions and it is important to ensure that both responses are within the same class of behavior when determining which responses to target during assessment and treatment.

Finally, trial-based functional analyses have also demonstrated much utility for identifying the function of challenging behavior (Sigafoos & Sagers, 1995). Each condition is conducted in the form of a trial instead of a session, wherein particular antecedents are arranged in the first portion of the trial for up to two minutes (e.g., diverted attention) and then the reinforcing consequence (e.g., attention) is delivered for the remainder of the trial contingent upon the first instance of challenging behavior. Like a latency-based functional analysis, the benefit is that one can complete the assessment without having to evoke nearly as much challenging behavior as compared to a standard functional analysis. This assessment has gained popularity for assessment in applied settings, such as home and school based on its relative feasibility (Rispoli, Ninci, Neely, & Zaini, 2014).

Summary of the Assessment of Challenging Behavior. Many variations and approaches for functional assessment have been identified. Huete et al. (2012) noted that no individual strategy should be understood as a fixed and unalterable tool; rather, functional assessment should be conducted in such a manner that the relation between

environmental events and the behavior of concern are made clear. Appropriate assessments may require multiple assessment methodologies and specific procedural adaptations that are designed to capture the unique variables that influence an individual's behavior. Further, the assessment process should consider the well-being of all individuals involved in the assessment, and should ensure that the approach is both practical and feasible in the settings in which it is employed.

Treatment of Challenging Behavior

Although the topography of challenging behavior may be the same across individuals, the function may differ; thus, making some interventions appropriate for certain individuals under certain conditions but not for other individuals under different conditions (Boyd & Kennedy, 2014). For example, an individual with limited verbal behavior may aggress toward his or her caretakers by hitting them, because it produces escape from some aversive stimulus or situation (e.g., undergoing a procedure at the dentist). In contrast, another individual may engage in the same behavior, because it produces some stimulus (e.g., a toy at a store). Thus, behavioral function—not behavioral topography—should guide treatment planning (Didden, 2007). Thus, treatment of challenging behavior for individuals with IDD relies first on accurately identifying the motivational sources for challenging behavior (Carr 1977; Carr et al., 1999; Carr & Durand, 1985; Horner & Carr, 1997; Iwata et al., 1982/1994; Mace et al., 1991; Matson et al., 2011), and then implementing an intervention accordingly (Didden, 2007; Horner & Carr, 1997; Langdon et al., 2008; Mace et al., 1991).

While the range of topographies varied widely, Matson et al. (2011) reported from a review of 173 studies employing various functional assessment methodologies that the

functions for individuals with IDD who displayed challenging behavior were few. Matson et al. (2011) reported that the function identified most for aggression and self-injurious behavior was negative reinforcement in the form of escape from demands. In other words, most participants in the studies examined aggressed toward others, because it resulted in the termination of demands (e.g., school work). Social positive reinforcement was the next most highly reported function of challenging behavior for participants, and participants reportedly engaged in challenging behavior because it produced access to attention or tangible items. Finally, many participants' challenging behavior was also maintained by automatic reinforcement (i.e., the act of the behavior itself produces reinforcement), although to a lesser extent than the other sources of reinforcement noted above. Although Matson et al. (2011) did not report this to be the case for the participants in the studies that they examined, functions may co-occur and are not mutually exclusive; thus, comprehensive treatments should be carefully devised such that it meets the individual's unique needs (Boyd & Kennedy, 2014; Horner & Carr, 1997).

Antecedent-based strategies have been cited to be effective intervention approaches for challenging behavior exhibited by individuals with IDD (Conroy & Stichter, 2003). Smith (2011) indicated that there are two general classes of antecedent-based strategies: default interventions and function-based interventions. Default strategies, such as environmental enrichment (Horner, 1980; Rapp, 2004), use of protective equipment (Smith, 2011), and restraint (Smith, Lerman, & Iwata, 1996) have all been demonstrated to be effective forms of antecedent interventions for challenging behavior exhibited by individuals with IDD. Other antecedent based strategies, including

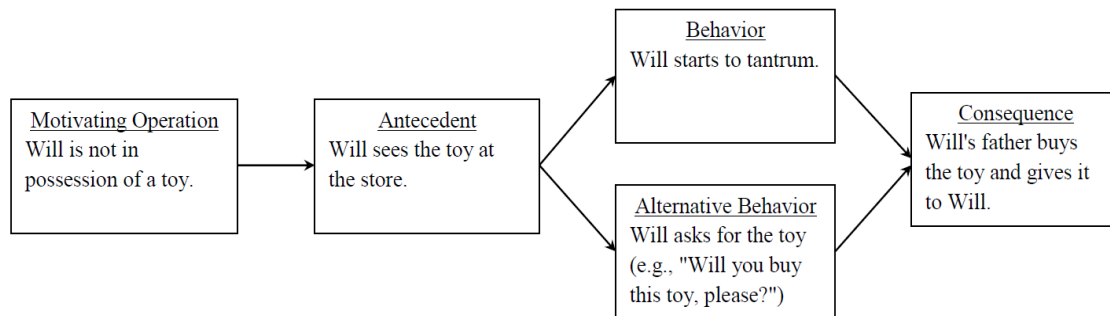
the provision of choice during instructional activities (Conroy & Stichter, 2003; Dunlap et al., 1991; Horner & Carr, 1997; Shogren, Flagella-Luby, Bae, & Wehmeyer, 2004) and curricular revisions (e.g., varying the task type and difficulty), have demonstrated to effectively reduce or eliminate challenging behavior for individuals with IDD (Dunlap et al., 1991; Horner, Day, Sprague, O'Brien, & Heathfield, 1991).

Noncontingent reinforcement is a function-based, antecedent strategy, which involves the delivery of a reinforcer on a fixed- or variable-time schedule that is presented independently of challenging behavior (Boyd & Kennedy, 2014; Didden, 2007). Noncontingent reinforcement may be effective, because it reduces the likelihood that the individual will engage in a response that produces access to a consequence that he or she already has access to. For example, Dunlap, Kern-Dunlap, Clarke, and Robbins (1991) reported that a child engaged in aggression and disruption that was maintained by escape from lengthy instructional sessions. After an intervention package was implemented that included relatively shorter periods of work with noncontingent access to frequent breaks, the child engaged in minimal levels of challenging behavior in addition to elevated levels of on-task behavior during instruction. Thus, the preemptive strategy to infuse breaks following shorter periods of instruction may have reduced the value of additional breaks that were otherwise obtained following instances of challenging behavior. Similarly, noncontingent reinforcement has been demonstrated to be effective for minimizing challenging behavior that is maintained by access to attention and tangible items as well (Wallace, Iwata, Hanley, Thompson, & Roscoe, 2012).

As implied above, the efficacy of some antecedent intervention strategies, such as noncontingent reinforcement, may relate to their impact on motivating operations

(Conroy & Stichter, 2003; Smith, 2011). For example, delivering attention on a short, fixed-time schedule to a child motivated by attention may reduce the likelihood that the child will engage in an inappropriate response that produces more access to attention. Thus, the individual may satiate on the reinforcer, thereby making challenging behavior less likely to occur (Smith, 2011). Alternatively, antecedent interventions, such as restraint, may signal the unavailability of reinforcement for engaging in a maladaptive response (Smith, 2011), thereby reducing the occurrence of the behavior.

Differential reinforcement of alternative behavior is another common function-based treatment for challenging behavior for individuals with IDD (Boyd & Kennedy, 2014; Carr, Coriarty, & Dozier, 2000; Didden, 2007; Horner & Carr, 1997), and is exemplified by the model below.



In this model, Will may obtain the reinforcer that is acquired by engaging in challenging behavior or by using an alternative, socially acceptable response (i.e., Will asks for the toy). Carr and Durand (1985) posited that training individuals to use an alternative communication response should reduce the extent to which the individual will engage in challenging behavior if the appropriate communication response is functionally-equivalent (i.e., results in the same consequence) to challenging behavior. Carr and Durand (1985) taught four children with IDD whose maintaining consequence for

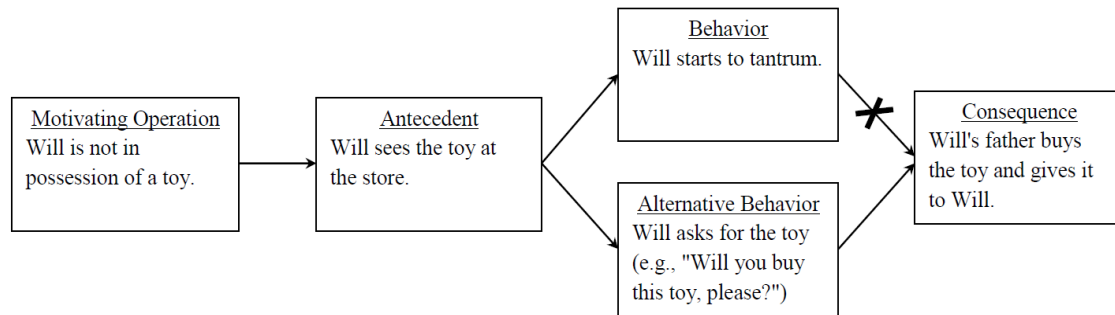
challenging behavior was either assistance on a difficult task or attention in the form of praise to use socially acceptable functional communication responses (FCRs). The researchers reported that challenging behavior was reduced to near-zero levels after functional communication training (FCT) and the respective reinforcers were delivered contingent on FCRs.

Sprague and Horner (1992) obtained similar results for two individuals with IDD who engaged in severely challenging behavior. In their study, the researchers evaluated the efficacy of teaching a functionally-equivalent mand response (i.e., saying, "help") for obtaining assistance during difficult work tasks versus a non-function-based treatment package, including response blocking and verbally reprimanding problem behavior (i.e., no assistance was provided with the task). Consistent with the results of Carr and Durand (1985), the children engaged in much less challenging behavior when the function-based interventions were employed. Interestingly, the authors reported that the children engaged in other topographies of challenging behavior during the non-function-based intervention condition; thus, resulting in no reduction of challenging behavior overall during this condition. This type of extinction-induced variability of responses has been demonstrated in non-human and human organisms alike (Grow, Kelley, Roane, Shillingsburg, 2008; Lattal, St. Peter, & Escobar, 2014), and further supports the notion that teaching functionally-equivalent responses may be critical to reduce challenging behavior.

It may be insufficient to simply train an FCR to reduce challenging behavior; interventionists should also consider whether the FCR *efficiently* produces access to the reinforcer. For example, a relatively lengthy vocal verbal communication response (e.g., "Will you buy this toy, please?") may be a highly effortful response for a child with IDD

who has limited vocal verbal communication skills. To elucidate, Horner and Day (1991) taught a child with IDD to emit American Sign Language (ASL) responses instead of challenging behavior to obtain a break from a self-care task (i.e., putting a shirt on). The child engaged in elevated levels of challenging behavior and very few FCRs when the target FCR was an entire sentence in ASL. However, when the sentence was shortened to a single word, the child engaged in little to no challenging behavior and demonstrated concomitant increases in the alternative sign response. The researchers reported similar results when the number of alternative responses varied between a fixed-ratio (FR) 1 to FR-3 schedule of reinforcement. That is, the child engaged in more challenging behavior when he was required to engage in the response three times in order to obtain the reinforcer, and lower levels of challenging behavior when he was required to engage in the response one time to obtain reinforcement. Thus, the utility of FCT is strongly related to the amount of effort associated with FCRs, and suggests a need to identify alternative responses that are easy to emit and/or already in the individual's repertoire (Fisher & Bouxsein, 2011).

Another way to enhance treatment outcomes is to eliminate the response-reinforcer dependency through extinction (Lattal et al., 2014). Extinction can be employed as a standalone intervention (e.g., planned ignoring; Buck, 1992), or in conjunction with other interventions (e.g., FCT), as exemplified by the model below.



In this model, Will's tantrums are put on extinction (i.e., challenging behavior no longer results in access to the toy) while FCRs are still reinforced. This arrangement should further diminish the likelihood that Will engages in challenging behavior and increases the likelihood that Will engages in the FCR under future conditions that are similar. In fact, Hagopian, Fisher, Sullivan, Acquisto, and LeBlanc (1998) reported that the majority of patients with whom FCT was employed demonstrated greater reductions of challenging behavior when extinction was added to the treatment package compared to FCT alone. Others (Boyd & Kennedy, 2014; Didden, 2007; Fisher & Bouxsein, 2011; Kelley, Lerman, & Van Camp, 2002) have reiterated the idea that FCT should be combined with extinction in order to enhance treatment outcomes (cf. Davis, Fredrick, Alberto, & Gama, 2012).

Extinction can also be employed locally, such as the interval of time when reinforcement is unavailable under a noncontingent reinforcement paradigm, or for the responses that go unreinforced in an FR schedule (e.g., the first four responses that are not reinforced in an FR-5 schedule of reinforcement; Lattal et al., 2014). Worsdell, Iwata, Hanley, Thompson, and Kahng (2000) demonstrated the relative contribution of extinction for reducing challenging behavior exhibited by children with IDD after they received FCT. Although one participant displayed reduced levels of challenging behavior

when FCRs and challenging behavior were both reinforced on an FR-1 schedule, the remaining four participants only displayed lower levels of challenging behavior when leaner schedules of reinforcement were implemented for challenging behavior (e.g., FR-2, FR-3, FR-20) while FCRs met continuous reinforcement (i.e., FR-1) through each phase of the study. This highlights the need to put challenging behavior on extinction within the context of FCT in order to minimize the likelihood that challenging behavior will persist.

Summary of Treatment for Challenging Behavior. There are many approaches that service providers may employ for the treatment of challenging behavior, including antecedent-based interventions (e.g., noncontingent reinforcement), and variations of differential reinforcement of alternative behavior, among others. Although there is general consensus that function-based interventions should be employed to minimize challenging behavior, there is no single treatment that is most appropriately suited for each function of challenging behavior (Horner & Carr, 1997). This is corroborated by evidence of challenging behavior that is maintained by more than one function (Boyd & Kennedy, 2014). As such, comprehensive interventions should be developed that cater to the unique needs of each individual.

Schedule Thinning for Functional Communication Responses

Researchers have described several strategies to thin the schedule of reinforcement for FCRs after the individual reliably engages in the alternative response and engages in relatively low rates of challenging behavior. Fisher, Thompson, Hagopian, Bowman, and Krug (2000) indicated that schedule thinning within the context of FCT should be employed to promote feasibility of the intervention, because some

reinforcers cannot be readily delivered when requested (e.g., food), some reinforcers should not be delivered when requested (e.g., escape from health-related tasks, such as a visit to the dentist), or the individual engages in excessively high rates of the FCR (also see Betz, Fisher, Roane, Mintz, & Owen, 2013; Fisher, Kuhn, & Thompson, 1998; Hagopian, Boelter, & Jarmolowicz, 2011; Hanley, Iwata, & Thompson, 2001; Kuhn, Chirighin, & Zelenka, 2010); these factors may render the intervention with dense schedules of reinforcement as being impractical.

In a review of FCT and schedule thinning procedures, Hagopian et al. (2011) indicated that four strategies have been identified to fade the initial intervention plan, including delay schedules (i.e., temporally delaying reinforcer delivery following the FCR), chain schedules (i.e., presenting additional demands between the FCR and providing a break), multiple schedules (i.e., alternating periods of reinforcer availability and unavailability that correspond to some schedule-correlated stimulus), and response restriction (i.e., restricting access to the FCR, such as by taking the communication card away for a short period). A commonality between each of these schedule thinning procedures is that the delay between the FCR and contingent reinforcer delivery is systematically increased following FCT. Although delay schedules, multiple schedules, and response restriction can each be employed for social positive reinforcement, an advantage associated with multiple schedules is that stimuli that are programmed into the environment can be used to signal the availability and unavailability of reinforcement; thus, responding has the strong potential of coming under the control of the stimuli associated with each component along with the relevant motivating operations (Hagopian et al., 2011). In other words, the individual might be likely to request the tangible item

when the stimulus that signals it is available is presented and to withhold their request when the stimulus that signals it is not available is presented.

Researchers have described several ways to thin the schedule of reinforcement following FCT. One method involves gradually and systematically thinning the schedule of reinforcement until some terminal criterion is met (Fisher et al., 2000; Hagopian et al., 2011; Hagopian, Kuhn, Contrucci, Long, & Rush, 2005; Hagopian, Toole, Long, Bowman, & Lieving, 2004; Hanley, Iwata, & Thompson, 2001; Jarmolowicz, DeLeon, Contrucci Kuhn, 2009; Rispoli, Camargo, Machalicek, Lang, & Sigafos, 2014; Rooker, Jessel, Kurtz, & Hagopian, 2013). For example, Hanley et al. (2001) evaluated three reinforcement thinning procedures with one participant who had positively-maintained challenging behavior. The method for the FR1 delay condition involved gradually increasing the delay to reinforcement following emission of the FCR using 1-, 2-, 4-, 8-, and 9-second increments, until a terminal criterion of 25 seconds had been reached. The fixed-interval (FI) condition involved gradually increasing the fixed-interval schedule using 1-, 2-, 4-, 8-, 9-, 10-, 11-, and 12-second increments (i.e., the first FCR that was emitted following the interval was reinforced) until a terminal criterion of 58 seconds had been reached. Finally, the multiple schedule involved signaled periods of reinforcer availability and extinction for FCRs using a fixed-time schedule for the reinforcement component (i.e., 60 seconds) and gradual increases in the extinction component (i.e., 15 seconds), until a terminal criterion of 240 seconds of extinction had been reached. All of these conditions included an *a priori* decision rule to progress to the next schedule based on two consecutive sessions with challenging behavior at or below 85% of the baseline mean. Each procedure had a different effect on behavior. Specifically, the researchers

reported that FCRs extinguished when the delay to reinforcement increased, and gradually increasing the fixed-interval schedule resulted in undesirably high rates of the FCRs. In contrast, the multiple schedule resulted in stable levels of the FCR as the duration of the extinction component increased. Thus, the multiple schedule approach was superior compared to the alternative schedule thinning techniques.

Hagopian et al. (2011) identified that one can also probe leaner schedules of reinforcement within the systematic and gradual process of schedule thinning for the purpose of efficiently progressing to the terminal schedule (i.e., without employing every step of extending the duration of extinction, as described above). Hagopian et al. (2005) probed the terminal criterion (i.e., a terminal delay of 300 seconds to reinforcement following an FCR) and reported that while challenging behavior initially increased during that session most of the sessions thereafter remained at near-zero levels. This demonstrated that every step of the schedule thinning process did not have to be employed in order to reach a terminal criterion.

A final process for schedule thinning identified by Hagopian et al. (2011) involves abruptly shifting to the terminal schedule of reinforcement immediately. Hagopian et al. (2004) evaluated the relative efficacy of dense-to-lean (i.e., gradual schedule thinning) and fixed-lean schedules (i.e., the terminal schedule) within the context of a multiple schedule paradigm for three children with IDD. The dense-to-lean condition entailed 10-, nine-, or seven steps that progressed from dense-to-lean schedules of reinforcement based on low rates of challenging behavior at each step. In the fixed-lean condition (1-minute reinforcement component followed by nine minutes of extinction), the terminal criterion was employed at the outset. The results indicated that

the fixed-lean schedule of reinforcement was effective for two out of the three participants to meet their clinical goals. That is, participants still engaged in discriminated FCRs during the fixed-lean schedule of reinforcement. The caveat, however, was that higher levels of challenging behavior occurred during this condition compared to the dense-to-lean schedule.

Betz et al. (2013) also demonstrated the efficacy of the fixed-lean multiple schedule with four children with IDD who engaged in challenging behavior. In this study, the reinforcement component was presented for 60 seconds while the extinction component was presented for 240 seconds. Unlike the results reported in Hagopian et al. (2004), however, the participants reportedly engaged in negligible levels of challenging behavior during the extinction component of the multiple schedule. A key difference between these studies, however, was the duration of the extinction component as these components were implemented for 9 minutes and 4 minutes by Hagopian et al. and Betz et al., respectively. Further, Betz et al. examined the utility of the fixed-lean schedule following a comparison between mixed (i.e., unsignaled reinforcement and extinction components) and multiple schedules on rates of FCRs during reinforcement and extinction components; thus, the participants in Betz et al. received a greater set of distributed training sessions with the multiple schedule, a factor that has been hypothesized to facilitate more efficient acquisition of stimulus control over responding during instruction (Haq & Kodak, 2015; Haq, Kodak, Kurtz-Nelson, Porritt, Rush, & Cariveau, 2015).

Multiple Schedules. Multiple schedules have been defined as two independent schedules of reinforcement that are each correlated with some stimulus (Ferster &

Skinner, 1957). When employed within the context of interventions for human participants, multiple schedules often involve one signaled component (S^D) in which reinforcement is available contingent on a target response and another signaled component in which reinforcement is unavailable regardless of responding (i.e., extinction or S^A ; e.g., Cammileri, Tiger, & Hanley, 2008; Fisher et al., 1998; Grow, LeBlanc, & Carr, 2010; Hanley et al., 2001; Jarmolowicz et al., 2009; Rooker et al., 2013; Tiger & Hanley, 2004; Tiger & Hanley, 2005; Tiger, Hanley, & Heal, 2006; Tiger, Hanley, & Larsen, 2008). This procedure has been demonstrated to be effective within the context of treatment for both minor (Cammileri et al., 2008; Grow et al., 2010) and severe (Fisher et al., 1998; Hanley et al., 2001; Jarmolowicz et al., 2009; Rooker et al., 2013) forms of challenging behavior.

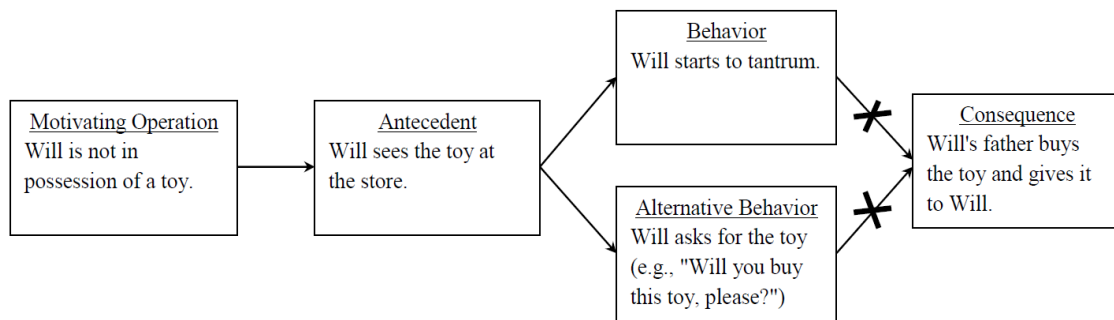
The effectiveness of multiple schedules relates to the concept of stimulus control, which refers to the likelihood that an individual will engage in a response in the presence of some antecedent stimulus (Terrace, 1966). Consider, for example, a child with IDD who wants her mother's attention. The child quickly learns that requesting attention from her mother when she is sitting on the sofa (S^D) is met with reinforcement, but not when her mother is talking on the phone (S^A). Thus, the child learns to discriminate the conditions under which her behavior (i.e., requesting attention) does and does not pay off. This form of differential reinforcement has been demonstrated to be critical for establishing stimulus control (Terrace, 1966). Researchers have programmed salient stimuli, such as color cards (Jarmolowicz et al., 2009), color leis worn around the neck (Tiger & Hanley, 2004; Tiger & Hanley, 2005), and color bracelets (Betz et al., 2013), to enhance discrimination between conditions during training for children with IDD whom

might otherwise have difficulty discriminating between conditions. Kuhn et al. (2010) described the use of naturally occurring stimuli to signal each component (e.g., someone sitting and listening to music to signal the reinforcement component while talking to another person or cleaning to signal extinction), which may be more ideal as it simulates naturalistic environments more closely (Hagopian et al., 2011). Although the latter may elect a more socially valid approach to intervention, more research is needed that evaluates how salient schedule-correlated stimuli need to be in order for individuals with IDD to discriminate across conditions.

The terminal duration of the reinforcement and extinction components of the multiple schedule have varied both within across studies and have typically occurred through a gradual process of schedule thinning as described above. Hagopian et al. (2011) indicated that the terminal schedule for the reinforcement component may be 2 minutes while the extinction component may be 8 minutes. Rooker et al. (2013) reported from a summary of 15 applications of multiple schedules that the average duration of the reinforcement component was 4 minutes (range, 15 seconds to 900 seconds) while the average duration of the extinction component was 7 minutes (range, 15 seconds to 900 seconds). Hanley et al., (2001) and Betz et al. (2013) both described the application of a multiple 60/240 schedule (i.e., 60-second reinforcement component, 240-second extinction component). Currently, there are no firm recommendations for the duration of each component nor how to proceed through the process of schedule thinning (Hagopian et al., 2011); rather, one should weigh the benefits and consequences associated with schedule thinning (e.g., resurgence of challenging behavior, as described below) and/or modify the procedure to further minimize the likelihood that resurgence will occur.

Minimizing Resurgence during Schedule Thinning

Resurgence relates to the recurrence of a response that has a history of reinforcement when a relatively recently reinforced alternative response does not yield reinforcement (Epstein, 1983).



In the model above, Will is not in possession of the toy, and we will assume that he is motivated to acquire the toy. As a result, he politely makes a request for the toy as he had been taught previously using FCT. However, Will's father does not buy the toy for Will this time despite the polite request (perhaps because his father wants to teach Will that one may not always get what they ask for, even if requested nicely). As a result, Will reverts to the behavior that has worked for him to acquire items at the store in the past (i.e., tantrum). Thus, motivating operations that maintain the alternative response may also maintain challenging behavior (i.e., they are in the same response class), and either response may be likely to occur if the alternate response is not reinforced (Hagopian et al., 2011). Epstein (1983) documented this phenomenon in a seminal study in which he trained pigeons to peck a certain key by delivering food reinforcers using an intermittent schedule of reinforcement. After a steady rate of responding was achieved, key pecks no longer produced reinforcement. After a 10-minute period in which no pecks were observed, an alternative response was reinforced (e.g., wing raise, head down) until a

steady rate of responding had been achieved. Finally, all reinforcement was withheld for the alternative responses. The pigeons were observed to cease engaging in the alternative response and reverted to the original key pecking response that was associated with a history of reinforcement despite the fact that key pecking was no longer reinforced.

Volkert, Lerman, Call, and Trosclair-Lasserre (2009) also reported that several children with IDD who had received either schedule thinning or extinction following FCT demonstrated resurgence of challenging behavior. Specifically, the researchers put FCRs on extinction completely or employed a FR-12 schedule of reinforcement to examine whether resurgence would occur. The results indicated that resurgence occurred for all but one participant when reinforcement was withheld for FCRs.

Resurgence may be demonstrated for appropriate behavior as well. For example, Hoffman and Falcomata (2014) taught three individuals with autism to mand (i.e., request) using one response before it was put on extinction (i.e., no longer reinforced). Then, another mand response was trained to obtain the same reinforcer. In a test for resurgence where all responses were put on extinction, all participants engaged in the initial trained response. Thus, this phenomenon has not only been demonstrated to occur for challenging behavior, but for appropriate behavior as well.

As suggested above, a plausible hypothesis governing resurgence of challenging behavior during periods of extinction for FCRs relates to the concept of motivating operations. If an environmental event or stimulus condition that acts as an abolishing operation for challenging behavior (i.e., if the event or stimulus condition reduces the value of the reinforcer) can be programmed during periods of reinforcer unavailability, deleterious effects associated with resurgence, such as reinforcing challenging behavior

during extinction, making challenging behavior a more durable response, may be reduced.

Horner, Day, and Day (1997) reported that three participants engaged in elevated levels of challenging behavior on days that an establishing operation (EO) was in place for escape-maintained challenging behavior (e.g., having fewer than 5 hours of sleep the previous night, postponing a previously scheduled activity until the next day). However, when other, neutralizing, routines were inserted between the relevant EO and the instructional task for each participant, challenging behavior was substantially reduced.

In another study, Fisher et al. (2000) reported that although contingent punishment (i.e., a 30-second basket-hold time out) was effective to minimize resurgence of challenging behavior (including self-injurious behavior, aggression, property destruction, and/or inappropriate sexual behavior) during delays to reinforcement for one participant, the treatment package was unsuccessful for another participant. As a result, the researchers embedded academic tasks with praise for correct responding during delay periods between the FCR and tangible reinforcer delivery; this successfully reduced rates of challenging behavior during the delay to criterion levels. Thus, engaging in an alternative activity may serve as an abolishing operation during periods of extinction; thus, minimizing the likelihood that challenging behavior will occur.

Finally, Hagopian et al. (2005) systematically evaluated whether the noncontingent delivery of alternative stimuli (e.g., toys, puzzles, books) during the gradually-thinned reinforcer delays would yield lower levels of challenging behavior. Following a functional analysis to identify the maintaining function for challenging behavior, a competing stimulus assessment was conducted to identify a stimulus item that

was inversely related to each child's challenging behavior. The stimulus item that yielded the lowest levels of challenging behavior during the assessment was delivered during periods of extinction following FCT. The researchers demonstrated that noncontingent delivery of competing stimuli during extinction resulted in lower levels of challenging behavior compared to extinction without competing stimuli; thus, facilitating the attainment of treatment goals faster.

Examining Treatment Acceptability for FCT.

Treatment acceptability is commonly examined using questionnaires or rating scales (e.g., *Treatment Acceptability Rating Scale - Revised*; Reimers & Wacker, 1988), although very few studies have employed them within the context of FCT for children with IDD who engage in challenging behavior. Dunlap, Ester, Langhans, and Fox (2006) examined mothers' perceptions of the compatibility between FCT and implementation in the home setting using a standard questionnaire. In addition, the researchers asked a mother whose child engaged in challenging behavior but did not participate in the study to watch videos of baseline and intervention sessions for children receiving FCT and to rate various components, including the child's frequency of use for the FCR, and the intensity and frequency of challenging behavior, using a Likert scale. In another study, Groskreutz, Groskreutz, Bloom, and Slocum (2014) employed a rating scale to assess caregiver and staff perceptions of FCT for children with autism, which revealed that consumers' ratings of the intervention were not always positive despite clearly efficacious treatment results.

Preferences have seldom been examined within the context of FCT for individuals with IDD. In one example, Hanley, Piazza, Fisher, Contrucci, and Maglieri (1997)

examined preferences of two children with IDD for whom noncontingent reinforcement and FCT were both effective at reducing challenging behavior by using a concurrent-chains procedure. The concurrent-chains procedure involved training trials in which three distinctly colored microswitches were each paired with a different contingency, including noncontingent reinforcement, FCT, or extinction. After training, the children were asked to press one switch, and then the session associated with that switch was initiated. Both children selected the switch associated with FCT more than the switches associated with noncontingent reinforcement and extinction; thus, indicating that the children presumably preferred FCT over the other treatment options. Nevertheless, concurrent-chains arrangements may be appropriately employed when the child has the option to select between two or more treatments.

Dunlap and Koegel (1980) also examined interest and happiness for two children with IDD based on their overt behavior (e.g., smiles, responsiveness, and involvement) in relation to two instructional formats (i.e., keeping the task constant versus varying the tasks during instruction). The *Rating Scales for Child Affect* used involves a Likert scale that observers unaware of the study's purpose rate the child's behavior on two dimensions during each instructional format. The benefit associated with this procedure is that one may be able to rate the subjective experience of individuals that otherwise have limited communication skills based on behavioral indicators.

Limitations of the Extant Literature

Reinforcement schedule thinning following FCT appears to be a necessary component of the treatment package in order to promote its feasibility. This is particularly true when caregivers of individuals with challenging behavior are expected to

implement the intervention in natural settings where it may be difficult to immediately reinforce appropriate communication responses every time they occur (Fisher et al., 2000; Hanley et al., 2001). Given that resurgence of challenging behavior may occur when reinforcement is not unavailable (i.e., during extinction), additional research on strategies to minimize the likelihood of challenging behavior following FCT is warranted.

Although gradually thinning the schedule of reinforcement following FCT may minimize the likelihood of challenging behavior during progressively longer periods of extinction, low levels of challenging behavior may still occur when the reinforcement schedule is still relatively dense (Hanley et al., 2001). Moreover, the evidence suggests that gradually thinning the schedule of reinforcement may be insufficient to completely eliminate resurgence (e.g., Fisher et al., 2000; Hagopian et al., 2004; Hagopian et al., 2005; Hagopian et al., 2011). In addition, gradually thinned reinforcement schedules often require complicated decision rules to systematically progress and revert through schedules, as needed, that may be less feasible to employ in typical settings. In contrast, fixed-lean schedules of reinforcement, in which the terminal criterion is implemented relatively more quickly following FCT, may be comparatively easier to implement.

Although this approach holds much promise for maintaining highly differentiated FCRs during reinforcement and extinction components of multiple schedules (Betz et al., 2013; Hagopian et al., 2004; Saini, Miller, & Fisher, 2016), evidence suggests that resurgence is much more likely to occur when a lean schedule of reinforcement is abruptly employed following a dense schedule (e.g., Hagopian et al., 2004; Volkert et al., 2009). Resurgence may be problematic for caregivers and could result in deviations from the treatment protocol; this can slow or negatively impact treatment outcomes by making challenging

behavior more durable (Grow et al., 2009). This highlights the need to develop strategies to not only make reinforcement schedule thinning more feasible, but also equally effective at maintaining low rates of challenging behavior.

Finally, there is an overall paucity of research examining the social validity of FCT and treatment efficacy for challenging behavior. Although it is tempting to assume that any response other than those that are aggressive, disruptive, or self-injurious are relatively socially acceptable, researchers should attempt to document caregivers' acceptability and perceptions of treatment efficacy so that more socially meaningful outcomes could be achieved. Lack of agreement between treatment outcomes and consumer acceptability, as described by Groskreutz et al. (2014), supports the need to examine treatment acceptability for FCT. Further, attempts should be made to examine participants' agreeableness and/or preference for the services they receive (Van Houten et al., 1988). Although two strategies to assess the preference and agreeableness to the procedures have been described in the research literature (Dunlap & Koegel, 1980; Hanley et al., 1997), these strategies have not consistently been used by behavioral researchers.

Summary

Outcomes can be severely limited for individuals with IDD who engage in challenging behavior. Although there are many relevant assessment strategies to identify the cause of challenging behavior, service providers should choose one or a combination of options that are likely to both yield accurate and timely results. Functional communication training has been widely demonstrated to be an effective intervention strategy to teach alternative communication responses in place of challenging behavior,

and multiple schedules have much utility for making the intervention more feasible. Nevertheless, the process of schedule thinning can pose challenges in the form of resurgence of challenging behavior; thus, requiring an evaluation of procedural modifications to promote efficacious outcomes.

Purpose of the Current Investigation

The purpose of the present two-study investigation is to evaluate the efficacy of noncontingent delivery of competing stimuli during the extinction component of fixed-lean multiple schedules to maintain low levels of challenging behavior exhibited by children with IDD following FCT plus extinction. Further, the degree to which caregivers find the procedures associated with the intervention acceptable, as well as the degree to which participating children with IDD experience the procedures as a subjectively positive experience through behavioral indicators will be examined.

Research Questions: Study 1

1. What is the operant function of each participant's challenging behavior? This question will be addressed using the *Questions about Behavioral Function* questionnaire, *Functional Assessment Interview Form* survey, and experimental functional analyses (see Figure 1).
 - a. Participants who engage in attention- and/or tangibly-maintained challenging behavior and limited communication skills will be considered for inclusion in the study. Social-positive reinforcement is a common maintaining consequence for challenging behavior exhibited by individuals with IDD (Matson et al., 2011).

2. Is there a functional relation between reinforcement for FCRs plus extinction for challenging behavior and increases for FCRs with concomitant decreases in challenging behavior?
 - a. It was hypothesized based on the results of Betz et al. (2013), Fisher et al. (2000), Hagopian et al. (2008), Kuhn et al. (2010), and Sprague and Horner (1992), that participants will engage in higher rates of the FCR and negligible levels of challenging behavior during functional communication training.

Research Questions: Study 2

1. Is there a functional relation between reinforcement of FCRs plus extinction for challenging behavior and increases in FCRs and decreases in challenging behavior during the reinforcement component of the multiple schedule?
 - a. It was hypothesized based on the results of Betz et al. (2013), Hagopian et al. (2004), and Hagopian et al. (2005), that participants will engage in elevated FCRs during the reinforcement component of the multiple schedule with concomitant reductions in challenging behavior during the extinction component.
2. Is there a functional relation between the noncontingent delivery of a competing stimulus and reductions in challenging behavior during the extinction component of the fixed-lean multiple schedule?
 - a. It was hypothesized based on the results of Hagopian et al. (2004) that participants will engage in low levels of challenging behavior during the

extinction component of the fixed-lean multiple schedule when they had noncontingent access to a competing stimulus.

3. Will the extinction component during the fixed-lean multiple schedule with competing stimuli be associated with high levels of item interaction?
 - a. It was hypothesized based on the results of Hagopian et al. (2004) that participants will engage in elevated levels of item interaction.
4. Is there a functional relation between noncontingent delivery of a competing stimulus and elevated levels of participant affect during the extinction component of the fixed-lean multiple schedule?
 - a. It was hypothesized based on the results of Horner et al. (1997) that participants will demonstrate relatively high levels of affect during the extinction plus competing stimulus component compared to the extinction-only component.

CHAPTER II

METHODOLOGY

Participants

Children. Two children diagnosed with Autism Spectrum Disorder and a history of challenging behavior participated. Both participants were reported by their respective caregivers to engage in challenging behavior when preferred items were restricted and had limited communication skills; thus, both individuals met eligibility criteria to participate. Steve was a 10-year-old White boy who primarily engaged in self-injury and disruption. Steve's medication list included fluoxetine and risperdone. He occasionally communicated using one-word vocal responses for mands (requests). Albert was a 10-year-old White boy who engaged in aggression, disruption, and self-injury. He communicated using one-to-three word vocalizations. Albert's medication list included buspirone, guanfacine, fluoxetine, and clonidine.

Parents. Steve's mother, Ms. Smith, was a White woman in her early 40s and not employed when the study began. Ms. Smith was present during the majority of sessions conducted in the home. Albert's mother, Ms. Adams, was a White woman in her mid-30s who was not employed and also was present during the majority of sessions conducted with Albert.

Setting

Both participants lived in low-to-moderate income households located in small suburban cities in the Pacific Northwest of the United States. All assessment and treatment sessions took place in each participant's home in a common area (i.e., living room). Steve lived with his parents and three siblings. Albert lived with his parents and

one younger sibling. To collect data, an independent data collector stood or sat unobtrusively in a corner of the room to collect data. Data collectors did not interact with the participant during assessment or treatment sessions.

Materials

Session materials included a smart phone (Steve) or an Internet-enabled tablet (Albert), other tangible items (e.g., light up toys, videogame, edibles), a video camera (Steve) or laptop (Albert) to record sessions, 3-in wide red and green wrist sweatbands (Steve) or empty red and green FitBit™ wristbands (Albert), paper data sheets, stopwatch or smartphone timer, and pen.

Response Definitions and Measurement

Challenging Behavior. For Steve, self-injury was defined as open or closed hand contacting his own head or thigh from a distance of greater than 6 in and the heel of one foot contacting the shin of the opposite leg from a distance of greater than 6 in.

Disruption was defined as a negative vocalization at or above conversational level. For Steve, all challenging behavior was measured as a frequency. These responses were aggregated across each session and were expressed as a rate (i.e., response per minute) for each session on a line graph.

For Albert, aggression was defined as a closed hand contacting another person's body from greater than 6 in. Disruption was defined as grasping and pulling tangible items away from the therapist and emitting negative vocalizations at or above conversational level. Self-injury was defined as contact between top and bottom teeth on skin of hand, arm, or other body part. For Albert, challenging behavior was measured

using 10-s partial interval recording and expressed as a percentage for each session on a line graph.

Functional Communication Response. For Steve, functional communication responses were button presses on a single-button microswitch, such that an audible sound (i.e., “Phone, please”) was emitted. Steve’s FCRs were measured as a frequency, were aggregated across each session, and were expressed as a rate (i.e., response per minute) for each session on a line graph. For Albert, functional communication responses were moving a white card with a picture of a tablet and corresponding text 6 in toward a therapist. Albert’s FCRs were measured as a frequency and expressed as a rate for each session on a line graph.

Item Interaction. Item interaction was defined as approaching, touching, or looking at competing stimuli (Hagopian et al., 2005) during each 10-s interval. The number of 10-s intervals in which item interaction was recorded for each participant was expressed as a percentage for each session in which it was relevant and depicted on a line graph. Item interaction was measured using a 10-s momentary time sample for Steve and 10-s partial-interval recording for Albert. Partial-interval recording was employed with Albert, because his main topographies of challenging behavior included grabbing and holding items and engaging in negative vocalizations, all of which were continuous (as opposed to discrete) responses and the metric was consistent across all topographies. Item interaction was quantified as a percentage of intervals per session, and charted on a separate line graph for each participant.

Child Affect. Child affect was defined as interest (i.e., attending readily to the task, alert, and involved in the activity) and happiness (i.e., smiles, laughs, seems to be

enjoying self), using an adapted version of the Rating Scale for Child Affect (Dunlap & Koegel, 1980). Child affect was scored by observers blind to the study's procedures using a 0 to 5 Likert scale and was expressed as a composite. The interest and happiness measures were combined and depicted on a line graph as a composite score per session.

Data Collection, Interobserver Agreement, and Treatment Integrity

Data Collection. Data were collected by three male doctoral students (two in special education, one in school psychology), one female doctoral student in school psychology, and one male master's student in school psychology, all of whom were trained using descriptions of target behaviors and data sheets. In addition, a clip was played for each graduate student data collector from a mock video with individuals engaged in various forms of target behaviors (e.g., laughing during an independent work activity, out of seat, throwing items) or from actual treatment sessions conducted with Steve. Data collectors met the reliability criterion (i.e., $\geq 80\%$ agreement with the primary author or faculty supervisor across three sessions) prior to in-vivo data collection or video coding for this study.

For child affect, two senior, female undergraduate students in Family & Human Services and two female graduate students (one master's and one doctoral) in school psychology were trained by the primary author using general descriptions, examples, and non-examples of each rating.

Interobserver Agreement.

Percentage of Sessions with Reliability. Interobserver agreement (IOA) was assessed for Steve using proportional agreement by comparing data collected by two independent observers for 68.4% of all sessions during FCT (80% for baseline and 55.6%

for FCT conditions), 38.5% for discrimination training, and 39.3% for treatment comparison (25% for extinction only and 58.3% for extinction plus competing stimulus conditions). Interval-by-interval agreement was used to calculate IOA for 90% of all sessions in the functional analysis (90% for control and 90% for tangible conditions) and 39.3% of sessions during the treatment comparison for stimulus engagement. Trial-by-trial agreement was conducted for 38.5% of preference assessments during the treatment comparison. Affect ratings were compared by subtracting the difference across raters from the total possible scores on the Likert scale (i.e., 6 scores) for each variable (i.e., interest and happiness), dividing the result by the total possible scores, and multiplying by 100 to obtain a percentage. For example, if the primary data collector rated a participant's happiness to be a score of 3 and the second data collector rated a participant's happiness to be a score of 4, then the difference across scores (i.e., 1 point) was subtracted from the total possible scores (i.e., $6 - 1 = 5$), and that integer was divided by the total possible scores (i.e., $5 \div 6 = .83$) and multiplied by 100 to obtain a percentage (i.e., 83% agreement). Interobserver agreement on affect ratings were calculated for 100% of sessions during the treatment comparison for both participants during the treatment comparison.

For Albert, IOA was assessed using interval-by-interval agreement by comparing data independently collected by two observers for a minimum of 29.4% of sessions during the functional analysis (50% of all control and 18.2% of all tangible sessions), 51.5% of sessions for challenging behavior during FCT (53.9% for baseline and 50% for FCT conditions), 37.5% for challenging behavior during discrimination training, and 58.3% for challenging behavior during the treatment comparison (66.7% for extinction

only and 50% for extinction plus competing stimulus). For FCRs, IOA was assessed using proportional agreement for 51.5% of sessions during FCT, 37.5% during discrimination training, and 58.3% during the treatment comparison. Agreement on affect ratings for Albert's interest and happiness was calculated during 100% of sessions using the method described above for Steve.

Percentage of Agreement. Interobserver agreement for Steve's challenging behavior was 100% during control and tangible conditions in the FA; 88.9% (range, 67% to 100%) and 96.2% (range, 90% to 100%) during baseline and FCT conditions, respectively, in the FCT part of treatment; 84.2% (range, 76% to 98%) and 92% (range, 89% to 95%) during extinction and reinforcement components, respectively, during discrimination training; 99.3% (range, 98% to 100%) and 100% during the extinction and reinforcement components, respectively, of the extinction-only condition during the treatment comparison; 98.4% (range, 96% to 100%) and 100% during the extinction and reinforcement components of the extinction plus competing stimuli condition in the treatment comparison; 87.4% (range, 67% to 100%) and 91.5% (range, 83% to 100%) for interest and happiness, respectively, during the extinction-only condition of the treatment comparison; 87.3% (range, 67% to 100%) and 95.8% (range, 83% to 100%) for interest and happiness, respectively, during the extinction plus competing stimulus condition of the treatment comparison; and 100% for preference assessments.

For Steve's FCRs, IOA was 95.4% (range, 77% to 100%) during the FCT phase of the FCT evaluation; 97.6% (range, 88% to 100%) and 97.8% (range, 92% to 100%) during extinction and reinforcement components, respectively, of discrimination training; 100% and 95.8% (range, 83% to 100%) for extinction and reinforcement components,

respectively, during the extinction-only condition of the treatment comparison; and 100% for extinction and reinforcement components during the extinction plus competing stimuli condition of the treatment comparison. IOA for stimulus engagement was 98.4% (range, 92% to 100%) during the extinction plus competing stimulus condition of the treatment comparison. Treatment integrity was scored by an independent data collector as 100% of control and tangible conditions of the FA; 98.9% (range, 97% to 100%) and 100% for baseline and FCT conditions, respectively, during the FCT portion of the study; 99.4% (range, 97% to 100%) and 100% for extinction and reinforcement components, respectively, of discrimination training; 100% for extinction and reinforcement components of the extinction-only condition during the treatment comparison; and 100% and 99.7% (range, 98% to 100%) for extinction and reinforcement components, respectively, during the extinction plus competing stimuli condition of the treatment comparison.

Interobserver agreement for Albert's challenging behavior was 100% (range, 87% to 89%) during control and 88% in the tangible condition in the FA; 81.3% (range, 60% to 100%) (range, 90% to 100%) during baseline and 96.4% FCT condition, in the FCT part of treatment; 88% (range, 80% to 97%) and 99% (range, 97% to 100%) during extinction and reinforcement components, respectively, during discrimination training; 97.3% (range, 93% to 100%) and 87.4% (range, 66.7% to 100%) during the extinction and reinforcement components, respectively, of the extinction-only condition during the treatment comparison; 98.8% (range, 96.3% to 100%) and 100% during the extinction and reinforcement components of the extinction plus competing stimuli condition in the treatment comparison; 77.8% (range, 50% to 100%) and 80.6% (range, 50 to 100%) for

interest and happiness during the extinction-only condition of the treatment comparison; 91.7% (range, 83.3% to 100%) and 88.9% (range, 66.7% to 100%) for interest and happiness, respectively, during the extinction plus competing stimulus condition of the treatment comparison. IOA were not collected for preference assessments with Albert.

For Albert's FCRs, IOA was 99% (range, 90% to 100%) during the FCT phase of the FCT evaluation; 96.7% (range, 93% to 100%) and 99% (range, 97% to 100%) during extinction and reinforcement components, respectively, of discrimination training; 99.5% (range, 98.1% to 100%) and 100% for extinction and reinforcement components, respectively, during the extinction-only condition of the treatment comparison; and 100% for extinction and reinforcement components during the extinction plus competing stimuli condition of the treatment comparison. IOA for stimulus engagement was 88.9% (range, 72% to 100%) during the extinction plus competing stimulus condition of the treatment comparison.

Treatment Integrity

Experimenters. The experimenter for all of Steve's sessions was a doctoral candidate in school psychology. The experimenter held a master's degree in school psychology and had six years of experience working with children and adolescents with intellectual and developmental disabilities. Albert's functional analysis was conducted by an Associate Professor in Special Education with 19 years of experience working with individuals with developmental disabilities and was certified as a behavior analyst at the doctoral level. A doctoral student of special education conducted all of Albert's remaining sessions; she held a master's degree in special education, was a certified

behavior analyst, and had eight years of experience working with individuals with developmental disabilities.

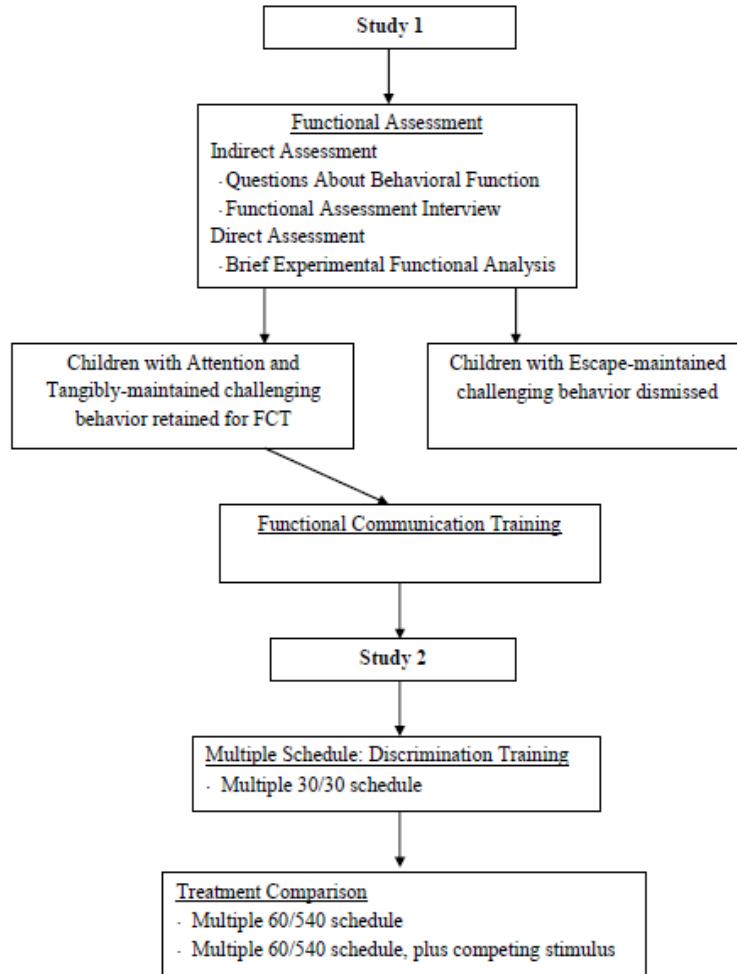
Percentage of Sessions Examined. In the experimental functional analysis, a data collector rated the extent to which the experimenter carried out all procedures correctly during 90% of the control and tangible sessions with Steve, and during 50% and 18.2% of the control and tangible sessions with Albert, respectively. For FCT, treatment integrity was collected for 80% of baseline sessions and 55.6% of FCT sessions for Steve, and during 54% and 50% of baseline and FCT sessions with Albert, respectively. For discrimination training, treatment integrity was collected for 38.5% and 37.5% of sessions for Steve and Albert, respectively. In the treatment comparison, treatment integrity was assessed for 25% and 58.3% of the extinction only and extinction plus competing stimuli conditions, respectively, for Steve. For Albert, treatment integrity was assessed for 66.7% of extinction only conditions, and 50% of extinction plus competing stimuli conditions.

Percentage of Treatment Integrity. For Steve, the mean level of treatment integrity was 100% for control and tangible conditions during the functional analysis, 98.9% (range, 97% to 100%) during baseline and 100% during the FCT phases of functional communication training, 99.4% (range, 97% to 100%) and 100% during extinction and reinforcement components of discrimination training, 100% during reinforcement and extinction components of the extinction only condition of the treatment comparison, and 100% and 99.7% (range, 98% to 100%) during the reinforcement and extinction components of the extinction plus competing stimuli condition in the treatment comparison.

For Albert, mean level of treatment integrity was 100% for control and tangible conditions of the functional analysis, 100% and 85.7% (range, 50% to 100%) during FCT and baseline conditions during functional communication training, 100% during extinction and reinforcement components of discrimination training, 100% and 99.5% (range, 98.1% to 100%) during reinforcement and extinction components of the extinction only condition in the treatment comparison, and 100% and 96.3% (range, 96.3% to 98.1%) during reinforcement and extinction components of the extinction plus competing stimulus condition of the treatment comparison. The experimenter's low percentage of treatment integrity during FCT was due to withholding the card from the participant until the tablet was restricted. In other words, the experimenter restricted the tablet, then offered Albert the card, which was then exchanged for the tablet. The faculty supervisor provided immediate feedback and the primary author reviewed the protocol with the experimenter to increase adherence to the treatment protocol.

Experimental Phases

This investigation comprised two studies, as depicted in the model below.



Study 1 included two phases: functional assessment (Phase 1) and functional communication training (FCT) intervention (Phase 2). Functional assessment included both indirect (i.e., *Questions about Behavioral Function* and *Functional Assessment Interview Form*) and direct measures (i.e., brief experimental functional analysis). Two participants engaged in challenging behavior maintained by access to tangible stimuli based on the functional assessment were then trained alternative and socially appropriate functional communication responses (FCRs) using FCT.

Study 2 also included two phases: discrimination training (Phase 1) and treatment comparison (Phase 2). Discrimination training involved bringing participants' responding

(i.e., FCRs) under the control of schedule-correlated stimuli based on a multiple schedule paradigm. Specifically, a stimulus (i.e., wrist sweatband or FitBit™) signaled the availability of the tangible item, and a different stimulus (i.e., alternate-colored wristband or FitBit™) signaled the unavailability of the tangible item. After participants independently met a criterion level of performance during this training (described later), a fixed-lean schedule of reinforcement was employed to evaluate whether participants would display lower levels of challenging behavior during the extinction component when a competing stimulus was presented.

Study 1: Functional Assessment and Functional Communication Training

This study comprised two phases. In Phase 1, a multi-method functional assessment approach was employed to identify both participants' operant function of challenging behavior. After completing the assessment, each participant was taught an alternative and socially appropriate communication response to use in place of challenging behavior during Phase 2.

Research Questions

1. What is the operant function of each participant's challenging behavior?
(Phase 1)
2. Is there a functional relation between reinforcement for FCRs plus extinction for challenging behavior and increases for FCRs with concomitant decreases in challenging behavior? (Phase 2)

Phase 1 Procedures

Functional Assessment. The function of each participant's challenging behavior was partly identified through indirect assessments and confirmed using experimental functional analysis.

Indirect Functional Assessment. Caregivers were administered the *Questions About Behavioral Function* (QABF; Matson & Vollmer, 1995) and *Functional Assessment Interview Form* (FAI; O'Neill et al., 1997) to identify each child's putative function of challenging behavior. Both questionnaires were administered to caregivers during the first scheduled appointment as semi-structured interviews (see Form 1 and Form 2).

Functional Analysis. Experimental functional analyses (Iwata et al., 1982/1994), including test and control conditions, were conducted for both participants using reversal designs (ABABA for Steve, ABAB for Albert). For Steve, sessions were conducted in trial format using response latency as the metric based on the severity and topography of his targeted challenging behavior. Thus, sessions were terminated following the first instance of challenging behavior. For Albert, the duration of each session was 5 minutes. Between two and seven sessions were conducted per appointment.

Toy Play. The environmental condition that was most unlikely to evoke challenging behavior, identified through the FAI and QABF, was conducted. For Steve and Albert, caregivers reported each child was least likely to engage in challenging behavior when they had access to a phone and tablet, respectively. The experimenter also delivered vocal praise approximately every 30 s.

Tangible. The environmental condition that was most likely to evoke challenging behavior for both participants was employed. Caregivers reported in the FAI and QABF

that each participant was most likely to engage in challenging behavior when a phone or tablet were restricted from Steve and Albert, respectively. Thus, each participant had one minute of unrestricted access to the relevant tangible stimulus (i.e., phone for Steve, tablet for Albert) before the session was initiated. When the session began, the therapist restricted the tangible item from the child. For Steve, the therapist delivered the phone following the first instance of challenging behavior and terminated the session. For Albert, the therapist delivered the tablet for 30-s following the first instance of challenging behavior and then restricted his access to the tablet again. This sequence continued for the duration of the 5-minute session.

Phase 2 Procedures

Functional Communication Training (FCT). Each participant was trained to use an FCR, which was individually determined based primarily on his communicative repertoire, intensity of challenging behavior, response effort associated with each topography, and caregivers' agreement. Information about each participant's communication skills was obtained through caregiver report on the FAI. Steve was taught to use a microswitch (i.e., a button that emitted an audible sound "Phone, please") and Albert was taught to exchange a picture card with the therapist. The duration of each session was 5 minutes and between two and five sessions were conducted per appointment.

Tangible. The same procedures employed in the test condition of the functional analysis were presented during this phase, with one exception. The duration of each session for Steve were fixed at 5 minutes (i.e., sessions were not terminated following the first instance of challenging behavior). Instead, Steve had 30 s of access to the phone

contingent upon challenging behavior. Thereafter, the phone was restricted again until he engaged in another instance of challenging behavior.

Pretraining. Both participants were taught to use an alternative, more appropriate communication response (i.e., a functional communication response) to obtain the phone or tablet. Sessions comprised 10 trials. A 0-s time delay procedure was employed during the first instructional session by providing an immediate physical prompt to use the FCR and delivering the phone or tablet immediately for 30 s. Thereafter, every session was conducted using a 5-s prompt delay during which the child had 5 s to engage in an independent response. Correct unprompted responses were followed by the reinforcer for 30 s, while incorrect or no responses were followed by a physical prompt and verbal statement (e.g., “that’s how you ask for the phone”); however, prompted responses during this condition did not produce access to the reinforcer. The mastery criterion for pretraining was two consecutive sessions with correct unprompted responding at or above 80% (see Form 5).

FCT+EXT. Both participants had access to the reinforcer for 60 s prior to each session. The experimenter then restricted the reinforcer when the session was initiated. The experimenter delivered the reinforcer for 30 s contingent upon each instance of the FCR. All instances of challenging behavior were ignored.

Measures

Questions About Behavioral Function (QABF; Matson & Vollmer, 1995).

The QABF is a 25-item questionnaire that helps identify the function of challenging behavior. Paclawskyj et al. (2000) reported that this measure is technically adequate

based on test-retest reliability ranges from 0.80 to 0.99, and inter-rater reliability ranges from 0.43 to 0.92. Internal consistency reliability is reported at 0.60.

Functional Assessment Interview Form (O’Neill et al., 1997). This measure is a structured survey that identifies information pertaining to the function of challenging behavior, as well as antecedents, routines, communication skills, among others.

Variables

Challenging Behavior. Challenging behavior was examined for each participant within the context of experimental functional analyses and FCT, according to the specific topographies reported by caregivers and directly observed by interventionists.

Challenging behavior was measured as a frequency for Steve and displayed as a rate (response per minute) for each session on a line graph. Albert’s challenging behavior was examined using 10-s partial-interval recording.

Functional Communication Response. Study 1 examined the frequency of each participant’s FCRs. Data on FCRs were collected during FCT and presented as a rate.

Research Design and Data Analysis

For both participants, scores on the QABF and relevant qualitative information were obtained from indirect assessments to create test-specific conditions for the experimental functional analyses. Functional analyses (Phase 1) and FCT (Phase 2) were conducted in ABAB reversal format (Baer et al., 1968). Functional communication training was conducted using an independent ABAB reversal design.

Data obtained from functional analyses and FCT were depicted using graphical displays and analyzed using visual analysis, as described by Horner, Carr, Halle, McGee, Odom, et al. (2005). Specifically, the level, trend, variability, immediacy of effects

following phase changes, consistency of responding across similar phases or conditions, and/or degree of overlap across adjacent phases were examined.

Study 2: Discrimination Training Plus Treatment Comparison

This study comprised two phases. In Phase 1, participants were trained to discriminate between periods of reinforcement and extinction using a multiple schedule. After participants engaged in discriminated FCRs across reinforcement and extinction components, a treatment comparison evaluating the effects of noncontingent delivery of alternative items during a fixed-lean multiple schedule was conducted in Phase 2.

Research Questions

1. Is there a functional relation between reinforcement of FCRs plus extinction for challenging behavior and increases for FCRs and decreases in challenging behavior during the reinforcement component of the multiple schedule?
2. Is there a functional relation between noncontingent delivery of a competing stimulus and decreases in challenging behavior during the extinction component of the fixed-lean multiple schedule?
3. Will the extinction component during the fixed-lean multiple schedule with competing stimuli be associated with high levels of item interaction?
4. Is there a functional relation between noncontingent delivery of a competing stimulus and elevated levels of participant affect during the extinction component of the fixed-lean multiple schedule?

Phase 1 Procedures

Discrimination Training (Multiple Schedule 60/60). Discrimination training was conducted to train participants to engage in FCRs during the reinforcement component of the multiple schedule and to withhold FCRs during the extinction component of the multiple schedule. The duration of each session was 10 min. The experimenter wore a green wrist sweatband (Steve) or FitBit™ (Albert) during the reinforcement component of the multiple schedule and a red wrist sweatband (Steve) or FitBit™ (Albert) during the extinction component of the multiple schedule. Prior to each session, the adult stated the contingency that was associated with each condition (e.g., "When I am wearing the green wristband, you can ask for the phone and I will give it to you. If I am wearing the red wristband, you can ask for the phone, but I will not give it to you,") to facilitate discrimination across the conditions for each participant (Tiger & Hanley, 2004). All sessions began with a 60-s extinction component followed by a 60-s extinction component. Thereafter, each component was randomly alternated and presented an equal number of times within each session (see Form 6).

During the reinforcement component, FCRs produced 30 s of access to the reinforcer. However, the reinforcement interval was truncated if the response occurred when less than 30 s remained in the reinforcement component and the extinction component was scheduled to occur next. During the extinction component, FCRs did not produce access to the reinforcer. Instead, the experimenter tapped on his or her wristband four times to signal that the phone or tablet was not available. Challenging behavior did not produce any programmed consequence during either component. Sessions for discrimination training were terminated when high and stable rates of alternative

communication responses occurred in the reinforcement component, and near-zero rates occurred in the extinction component (Fisher et al., 1998).

Phase 2 Procedures

Preference Assessment. A multiple-stimulus without replacement (MSWO; Steve) or a multiple-stimulus with replacement (MSWR; Albert) preference assessment (DeLeon & Iwata, 1996) procedure was conducted to identify the tangible stimulus item to use during the treatment comparison. For Steve, the MSWO occurred one time at the beginning of each scheduled appointment. For Albert, the MSWR occurred only once before starting the treatment comparison. During this assessment, an array of approximately six edible and/or toy items were presented to each participant and they were instructed to select one. The participant had access to the item for 30 s. For Steve, the experimenter removed the tangible item and rearranged the remaining items in the array. Steve was then instructed to select another item. The procedure continued until no items remained in the array (see Form 7). For Albert, any item selected was placed back into the array and he was instructed to select an item again. The item selected first for both participants during the preference assessment(s) was used as the competing stimulus during the relevant condition in the treatment comparison.

Treatment Comparison. This portion of the study was conducted to evaluate whether noncontingent delivery of a tangible stimulus was associated with lower levels of challenging behavior when a fixed-lean schedule of reinforcement is employed following discrimination training (see Form 8). The reinforcement component began when the experimenter put on the wristband for 60 s to signal the availability of reinforcement. Immediately after the reinforcement component, a 540 s extinction component was

presented during which FCRs did not produce access to the reinforcer. Instead, the experimenter tapped on the wristband to signal the unavailability of the phone or tablet. No differential consequences were employed for challenging behavior.

Fixed-lean Multiple Schedule, Extinction Only (FL MS 60/540 – EXT only).

Sessions were identical to discrimination training with the exception that the duration of the extinction component was extended to 540 s. FCRs produced access to the reinforcer for 30 s during the reinforcement component. The experimenter tapped on his or her wristband when the child emitted FCRs during the extinction component.

Fixed-lean Multiple Schedule, Extinction plus Competing Stimulus (FL MS 60/540 – EXT+CS). Sessions were identical to the extinction-only condition above, with the exception that the child had unrestricted access to the item selected first during the MSWO or MSWR during the entire 540-s extinction component.

Social Validity. This study examined whether there were differences in the acceptability of using competing stimuli during the extinction component of the multiple schedule based on behavioral indicators of interest and happiness. Caregivers' acceptability of the treatment was examined using a self-report measure. Procedures are described below.

Child Participants' Acceptability. Independent observers who were blind to the study's procedures rated participants' "interest" and "happiness" during the treatment comparison, specifically the extinction period, using a modified version of the Rating Scale for Child Affect (Dunlap & Koegel, 1980). The scores were combined to form a composite; this score was depicted using the experimental design employed for each participant (see Form 9).

Caregivers' Acceptability. Caregivers were asked to rate the acceptability of the procedures at two time points: (1) before conducting the functional analysis, and (2) after conducting the treatment comparison, using an adapted version of the Treatment Acceptability Rating Form - Revised (Reimers & Wacker, 1988). Caregiver ratings for each item are presented in a table to illustrate change, if any, in treatment acceptability at the start and completion of the study (see Form 10).

Measures

Rating Scale for Child Affect (Dunlap & Koegel, 1980). Dunlap and Koegel (1980) demonstrated the utility of the Rating Scale for Child Affect by examining within child differences in affect when presented with two different instructional formats. Raters scored participants' interest and happiness based on a Likert scale from 0 to 5 with behavior descriptors for some ratings (e.g., "Smiles, laughs, seems to be enjoying self. Score 4 or 5 depending on extent of enjoyment."). Interest and happiness scores for each participant were compared based on sessions with and without the use of a competing stimulus during the extinction component of the multiple schedule of reinforcement.

Treatment Acceptability Rating Form – Revised (Reimer & Wacker, 1988). The Treatment Acceptability Rating Form (TARF-R) is comprised of nine items (e.g., "How clear is your understanding of the procedures?") rated on a 7-point Likert-type scale (1 = *not at all clear*, 4 = *neutral*, 7 = *very clear*). The Treatment Acceptability Rating Form-Revised has acceptable internal consistency reliability (range, 0.65 to 0.95; Finn & Sladeczek, 2001).

Variables

During Study 2, four variables were examined using direct observation. Variables included challenging behavior, functional communication responses, stimulus engagement, and participants' affect. Examining these variables helped determine the impact of treatment for both participants.

Challenging Behavior. Study 2 examined each participant's challenging behavior during discrimination training and the treatment comparison. The definition of challenging behavior for each participant was consistent with those described above for both participants in Study 1. In addition, challenging behavior was measured as a frequency (and depicted as a rate) for Steve and using partial-interval recording (depicted as a percentage for each session) for Albert on a line graph.

Functional Communication Response. Study 2 examined each participant's FCRs during discrimination training for the reinforcement and extinction components of discrimination training and the treatment comparison based on the multiple schedule. FCRs were consistent for each participant across both studies.

Item Interaction. Study 2 examined each participant's engagement with a competing stimulus that was identified during the MSWO or MSWR preference assessment. Stimulus engagement was defined as approaching, touching, or looking at the competing stimulus during or at the end of each 10-s interval during the extinction plus competing stimulus condition for Albert and Steve, respectively. Item interaction will be quantified as a percentage of intervals per session, and charted on a secondary y-axis during the treatment comparison.

Affect. Ratings of participants' affect, using an adapted version of the Rating Scale for Child Affect (Dunlap & Koegel, 1980), during the treatment comparison were

obtained from observers who were blind to the study's procedures. The interest and happiness measures will be combined and depicted on a line graph as a composite score per session.

Research Design and Data Analysis

Discrimination training for both participants was evaluated using independent multielement designs (Ulman & Sulzer-Azaroff, 1975). A reversal ABAB design (Baer et al., 1968) was initially attempted with Steve; however, the treatment comparison was terminated prematurely due to unanticipated results. Albert's treatment comparison was evaluated using an alternating treatments design (Barlow & Hayes, 1979). Child participants' affect, with aggregated scores for interest and happiness, was also depicted on a line graph. All data presented in graphical format (i.e., discrimination training, treatment comparison, and affect ratings) were analyzed using visual analysis (Horner et al., 2005), as described above. Scores on the TARF-R were presented in a table.

CHAPTER III

RESULTS

This section will describe the results of Study 1, including assessment (i.e., indirect and experimental measures) and functional communication training, for Steve and Albert. Then, the results of discrimination training and the treatment comparison during Study 2 will be described for both participants. Finally, the results of both social validity measures (i.e., pre and post TARF-R and ratings of child affect) will be presented.

Study 1 Phase 1: What is the operant function of each participant's challenging behavior?

Steve. Results from the interview with Steve's caregivers using the QABF are presented in Table 2. Based on caregiver report, Steve obtained elevated scores in the attention, escape, non-social, and tangible domains. Based on his caregivers' report, challenging behavior was relatively less likely to occur when somatic symptoms arose compared to when the other situations, identified in the domains above, occurred (e.g., when he was presented with task demands or when his access to tangible items was restricted). The FAI provided additional context surrounding the factors that evoked challenging behavior for Steve. Steve's caregivers reported that, when at home, Steve typically spent all of his waking hours engaged with his mother's smartphone and that challenging behavior occurred daily when caregivers had to temporarily restrict his access to the phone (e.g., when they need to answer a phone call) or when the battery ran out. In addition, although task demands (e.g., putting on his clothing) were reported to evoke challenging behavior for Steve, he was reported to be more likely to engage in

challenging behavior when his access to other items (e.g., phone) or activities was restricted when task demands were placed.

Steve's latency-based functional analysis is depicted in Figure 1. During the first toy play session Steve did not engage in challenging behavior. Sessions in which challenging behavior were not observed are denoted by an asterisk. In the tangible session that followed, there was an immediate decrease in latency to challenging behavior. With the exception of one session, most instances of challenging behavior occurred within the first 10 s of initiating the session. On average, Steve's latency to challenging behavior during this phase was 22.5 s (range, 1 s to 120 s). The next toy play phase was marked by an immediate increase in Steve's latency to challenging behavior. The average latency to challenging behavior in this toy play phase was 256 s (range, 101 s to 300 s); he did not engage in challenging behavior during three out of six sessions. In the second test phase with the tangible condition, Steve's average latency to challenging behavior was 1.25 s (range, 1 s to 2 s). Finally, Steve's average latency to challenging behavior in the last toy play phase was 243 s (range, 145 s to 300). Overall, the differences in Steve's responding were marked with short latencies to challenging behavior when his access to the phone was restricted in the tangible condition. He consistently showed a short latency to challenging behavior in the tangible condition and often did not engage in challenging behavior in the control condition. This pattern of responding was consistent across phases in which the same test and control conditions were employed. Thus, the assessment results, including indirect and experimental measures, indicated that Steve's challenging behavior within this context was maintained by positive reinforcement in the form of access to the smartphone.

Albert. Albert's scores on the QABF are presented in Table 2. Based on the interview with his parents, challenging behavior was likely to occur in a demand context as well as when his parents restricted his access to an Internet-enabled tablet. Albert was reported to engage with the tablet as soon as he arrived home from school and on weekends he was reported to engage with the table for many hours at a time. Caregivers did not report that Albert engaged in challenging behavior during periods of limited or no attention from others, when he was alone, or when he experienced somatic complaints. Like Steve, Albert's caregivers also reported in the FAI that challenging behavior often occurred when demands (e.g., putting his clothes on or academic tasks at school) were placed, which required brief periods of restricted access from preferred items (e.g., tablet) or activities.

Albert's reversal functional analysis is depicted in Figure 2. During the first phase (i.e., toy play), Albert did not engage in any challenging behavior when he had access to a moderately preferred item and adult attention. When the first tangible condition was initiated, Albert's challenging behavior immediately increased to 20%. The rest of the tangible phase was marked by an increasing trend, and he engaged in challenging behavior for as much as 70% of all 10-s intervals in one session. There was an immediate reduction in challenging behavior during the next toy play session and, consistent with his behavior during the initial toy play phase, Albert did not engage in any challenging behavior during this condition. The final tangible phase was marked by a higher percentage of challenging behavior compared to toy play, although there was some variability across sessions. Overall, the results of this functional assessment indicated that

restricting Albert's access to an Internet-enabled tablet reliably evoked challenging behavior for Albert.

Thus, the operant function of challenging behavior for both participants was identified.

Study 1 Phase 2: Is there a functional relation between reinforcement for FCRs plus extinction for challenging behavior and increases in FCRs with concomitant decreases in challenging behavior?

Steve's FCT results are depicted in Figure 3. During baseline, Steve engaged in high levels of challenging behavior. On average, Steve engaged in 1.57 responses per minute (RPM; range, 0.4 RPM to 2.4 RPM) during baseline. Next, Steve was taught to engage in an alternative, socially appropriate communication response to access the phone in place of challenging behavior during pretraining. In the FCT phase that followed, an immediate reduction of challenging behavior was observed, with an average of 0.05 RPM (range, 0 RPM to 0.2 RPM); Steve's FCRs were elevated and stable during this phase and he presented an average of 1.85 RPM (range, 1.6 RPM to 2 RPM) across these sessions. Thus, a functional relation was observed between reinforcement of FCRs plus extinction for challenging behavior and increases in FCRs plus decreases in challenging behavior during the FCT evaluation for Steve.

Albert's FCT results are depicted in Figure 4. Albert engaged in challenging behavior during an average of 52.9% (range, 40% to 66.7%) of sessions during baseline. After pretraining, Albert's percentage of challenging behavior was reduced to an average of 2.42% (range, 0% to 6.7%); Albert engaged in an average of 1.27 FCRs per minute (range, 1.2 RPM to 1.4 RPM). When treatment was removed and baseline procedures

were employed a second time, Albert showed an increasing trend in challenging behavior; he engaged in challenging behavior for an average of 38.67% (range, 13.3% to 50%) during this phase. When FCT treatment was reinstated, challenging behavior was immediately reduced. Albert engaged in challenging behavior for an average of 1.85% (range, 0% to 10%) of sessions and 1.50 FCRs per minute (range, 1.4 RPM to 1.9 RPM). Thus, FCT was also demonstrated to be an effective treatment for Albert to reduce challenging behavior and increase his use of a socially acceptable communication response to gain access to a tablet.

These results confirm the hypothesis that both participants will engage in higher rates of the FCR and negligible levels of challenging behavior during functional communication training.

Study 2 Phase 1: Is there a functional relation between reinforcement of FCRs plus extinction for challenging behavior and increases for FCRs and decreases in challenging behavior during the reinforcement component of the multiple schedule?

Steve. Steve's results from discrimination training are depicted in the top and bottom panels in Figure 5. Steve engaged in slightly more FCRs in the extinction component compared to the reinforcement component of the multiple schedule during the first nine sessions (Figure 5, top panel). Specifically, he engaged in more FCRs when the phone was not available compared to when it was available. Steve's average rate of FCRs in the extinction component was 2.60 RPM (range, 0.8 RPM to 6 RPM); in the reinforcement component Steve engaged in 1.73 RPM (range, 0.8 RPM to 3 RPM). However, when the location of the switch was moved to the other side of the room, Steve withheld all FCRs during the extinction component and engaged in elevated and stable

rates of FCRs during the reinforcement component. For challenging behavior, Steve engaged in discriminated responding across reinforcement and extinction components throughout discrimination training. In the reinforcement component, Steve engaged in an average of 1.22 RPM (range, 0 RPM to 5 RPM). In the extinction component, Steve engaged in an average of 4.86 RPM (range, 2.2 RPM to 9.2 RPM). Overall, the reinforcement component of discrimination training was associated with elevated and relatively stable FCRs with mostly low rates of challenging behavior compared to the extinction component; thus, confirming the hypothesis for this participant.

Albert. Albert's results from discrimination training are depicted in Figure 6. Albert's FCRs in the reinforcement component remained elevated and stable with an average of 2.08 RPM (range, 2 RPM to 2.2 RPM). With the exception of the first three sessions, Albert's FCRs were low and stable in the extinction component. During the last five sessions of discrimination training, Albert engaged in 0.52 RPM (range, 0.2 RPM to 0.8 RPM) during extinction. Albert's challenging behavior was lower in the reinforcement component compared to extinction, although the differences were less pronounced. Albert engaged in challenging behavior during 4.17% (range, 0% to 11.7%) and 10.63% (range, 1.7% to 18.3%) of intervals during the reinforcement and extinction components across sessions, respectively. Thus, the reinforcement component during discrimination training was associated with elevated and stable rates of FCRs, overall, and lower percentages of challenging behavior. Thus, Albert's results during discrimination training were also consistent with the hypothesis.

Study 2 Phase 2: Is there a functional relation between the noncontingent delivery of a competing stimulus and decreases in challenging behavior during the extinction component of the fixed-lean multiple schedule?

Steve. Steve's results from the treatment comparison are depicted in the top and bottom panels in Figure 6. When the FL MS (EXT+CS) condition was employed (i.e., a 1-min reinforcement component followed by a 9-min period of extinction), Steve continued to engage in discriminated FCRs across components. In the reinforcement component (top panel, second phase), Steve's average rate of FCRs was 1.9 RPM (range, 1 RPM to 2 RPM) compared to an average of 0.03 RPM (range, 0 RPM to 3 RPM) during the extinction component. When the FL MS (EXT-only) condition was employed (top panel, third phase), Steve continued to engage in stable FCRs during the reinforcement component (i.e., 2 RPM) and no FCRs during the extinction component (i.e., 0 RPM).

Steve engaged in different rates of challenging behavior across reinforcement and extinction components of the FL MS (EXT+CS) condition (Figure 7). In the reinforcement component, Steve engaged in an average of 0.02 RPM (range, 0 RPM to 0.2) RPM. In the extinction component, Steve engaged in an average of 0.57 RPM (range, 0 RPM to 3.3 RPM). During the extinction component of this condition, Steve engaged with the competing item during an average of 32.5% (range, 0% to 94.4%) of each session (Figure 8). With the exception of two out of 17 sessions during the FL MS (EXT only) condition (bottom panel, second phase), Steve showed negligible differences in challenging behavior across reinforcement and extinction components. Steve did not engage in any challenging behavior in the reinforcement component. In the extinction

component, Steve's average rate of challenging behavior was 0.67 RPM (range, 0 RPM to 6.6 RPM). Overall, there were no differences in challenging behavior during the extinction component of both conditions (i.e., EXT+CS and EXT only). The evaluation ended for Steve following the second phase due to minimal differences in challenging behavior across both conditions that occurred infrequently and at low rates. Thus, the effects of noncontingent access to competing stimuli on challenging behavior during fixed-lean multiple schedules could not be assessed for Steve. Although there were no differences in challenging behavior across both conditions for Steve, item interaction occurred at variable and elevated levels compared to challenging behavior; thus, confirming the hypothesis that Steve will interact with competing stimuli during extinction.

Albert. Albert's results from the treatment comparison are depicted in Figure 9. Albert continued to engage in discriminated FCRs across both conditions of the FL MS (Figure 9, top panel). Specifically, Albert engaged in 2.00 FCRs per min during the reinforcement component across both conditions of the FL MS (i.e., EXT+CS and EXT only). Albert engaged in an average of 0.02 FCRs per min (range, 0 RPM to 0.1 RPM) in the extinction component of the FL MS (EXT+CS); he engaged in an average of 0.04 FCRs per min (range, 0 RPM to 0.1 RPM) in the extinction component of the FL MS (EXT only) condition. With the exception of the first session in the treatment comparison (i.e., FL MS EXT only), Albert's challenging behavior was not differentiated during the treatment comparison (Figure 9, bottom panel). Albert engaged in challenging behavior during an average of 1.85% (range, 0% to 5.6%) in the extinction component of the FL MS (EXT+CS) compared to an average of 3.70% (range, 0% to 16.7%) in the extinction

component of the FL MS (EXT only) condition. Albert interacted with the competing stimulus during an average of 80.86% of the period in sessions during which the FL MS (EXT+CS) was employed (Figure 10). Overall, there were no differences in challenging behavior across EXT+CS and EXT only conditions; thus, rejecting the hypothesis that challenging behavior will occur at lower levels in the extinction plus competing stimulus condition compared to extinction only for Albert. However, Albert consistently interacted with the competing stimulus during extinction at elevated and stable levels; thus, confirming the hypothesis that he would engage with an alternative item during extinction.

Study 2 Child Participant Acceptability: Is there a functional relation between noncontingent delivery of a competing stimulus and elevated levels of participant affect during the extinction component of the fixed-lean multiple schedule?

Steve. Ratings for Steve's affect are depicted in Figure 11. Steve's interest in the extinction component of the FL MS 60/540 (EXT+CS) condition was rated to be an average of 2.5 (range, 0 to 5), and his interest in the extinction component of the FL MS 60/540 (EXT only) condition was rated to be an average of 2.4 (range, 1 to 3). Steve obtained an average rating of 2.7 (range, 0 to 4) during extinction in FL MS 60/540 (EXT+CS) compared to an average rating of 2.7 (range, 2 to 4) during extinction in FL MS 60/540 (EXT only) condition. Overall, Steve's affect composite yielded an average rating of 4.7 (range, 1 to 9) across sessions in the extinction component of the FL MS (EXT+CS) condition compared to an average rating of 5.1 (range, 3 to 7) in the extinction component of the FL MS (EXT only) condition. Thus, across both conditions there was much overlap in affect ratings and Steve obtained similar scores, overall.

Albert. Ratings for Albert's affect are depicted in Figure 8. For the interest measure in the FL MS (EXT+CS) condition, Albert obtained an average rating of 3.2 (range, 2 to 4). In comparison, Albert's average rating in the FL MS (EXT only) condition was 2.2 (range, 1 to 4); an average difference of 1 point per session across both conditions. For the happiness measure, Albert obtained an average rating of 3 (range, 2 to 4) in the FL MS (EXT+CS) condition compared to an average rating of 2.2 (range, 1 to 4) in the FL MS (EXT only) condition. Thus, Albert's overall ratings based on the affect composite were higher in the FL MS (EXT+CS) condition. Visual inspection of Albert's ratings across both conditions provides additional support that affect ratings were consistently higher in the FL MS 60/540 (EXT+CS) condition, although there was some overlap. Thus, the hypothesis that Albert would display higher levels of affect when he had access to a competing stimulus during extinction held true.

Study 2: Caregiver Acceptability

Ms. Smith. Based on scores obtained on the TARF-R Steve's mother, Mrs. Smith, reported overall satisfaction with the study. Ms. Smith's ratings improved on five out of nine items on the rating scale and none of her ratings worsened during the post assessment. On the post assessment, Ms. Smith rated the cost of the intervention as a 1 (*not at all costly*), the amount of disruption to her home as a 1 (*not at all disruptive*), and the level of discomfort Steve would experience as a result of the procedures as a 2 (between *no discomfort at all* and *neutral*); all of these items showed improved ratings by two points compared to pre-assessment. Ms. Smith also rated her understanding of the procedures as being a 7 (*very clear*) and the extent to which the procedures fit well within their home routine as a 7 (*very well*); thus, indicating that Ms. Smith's understanding of

the procedures and how well the procedures fit into her home slightly improved during the post assessment. In all, Ms. Smith assigned perfect scores to eight out of nine items on the post assessment, which suggests a high degree of acceptability for these procedures.

Ms. Adams. Albert's mother, Ms. Adams, also reported improvements on the TARF-R in comparison to baseline. Ms. Adams' ratings improved on six out of nine items and none of her ratings worsened during the post assessment. During the post assessment, Ms. Adams' rated her understanding of the procedures as a 7 (*very clear*), the amount of disruption to her home as a 1 (*not at all disruptive*), the extent to which she liked the procedures as a 7 (*like them very much*), and the amount of discomfort that Albert would experience as a result of the procedures as a 2 (between *no discomfort at all* and *neutral*); these items improved by two points or more during the post assessment. The following items showed improved scores by one point: acceptability of the procedures based on her concerns for her child was rated as a 7 (*very acceptable*), and the extent to which she found the procedures to be reasonable based on Albert's behavior issues as a 7 (*very reasonable*). Ms. Adams assigned perfect scores to eight out of nine items on the post assessment, suggesting a high degree of acceptability.

Summary of Results

The assessment results demonstrated for both participant that problem behavior was maintained by access to tangible stimuli. Functional communication training plus extinction was associated with immediate reductions in challenging behavior for both participants. Moreover, both participants acquired the discrimination between periods of reinforcement and extinction based on discriminated FCRs across both components of the

multiple schedule. Discriminated FCRs were maintained during the fixed-lean multiple schedule and challenging behavior reduced to negligible levels during both conditions for both participants. Thus, the data did not support the use of competing stimuli to minimize resurgence of challenging behavior during the fixed-lean multiple schedule for both participants. Finally, both participants displayed mostly neutral affect during both conditions, and caregivers rated the treatment package positively, suggesting that this was a socially valid treatment for both participants.

CHAPTER IV

DISCUSSION

Individuals with intellectual and developmental disabilities, including Autism Spectrum Disorder, often engage in challenging behavior that can severely impact life outcomes; thus, intervention for this population crucial. Functional assessments help (a) identify the operant function of targeted behavior, such as those that are maladaptive, and (b) increase the likelihood of successful treatment (Carr et al., 1999). Although functional communication training (i.e., teaching the individual an alternative and socially acceptable response in place of challenging behavior) has been demonstrated to be an effective intervention (Carr & Durand, 1985; Fisher et al., 2000; Hagopian et al., 2008; Kuhn et al., 2010; Sprague & Horner, 1992), it is necessary to identify strategies that promote its feasibility. Multiple schedules of reinforcement, which involve schedule-correlated stimuli which signal the availability or unavailability of reinforcement, have demonstrated great promise to promote the feasibility of FCT (Fisher et al., 1998; Hanley et al., 2001); however, the process of schedule thinning (i.e., gradually and systematically increasing the duration of extinction) may pose challenges based on the length of time it could take to reach a terminal criterion of extinction (Hagopian et al., 2004). An alternate strategy, namely, fixed-lean multiple schedules, have received comparably little attention in the research literature despite its reported efficacy to maintain discriminated mands across reinforcement and extinction components (Betz et al., 2013; Fisher et al., 2015; Greer et al., 2016) and relatively efficient attainment of clinical outcomes (Hagopian et al., 2004). This may be due to reports that fixed-lean schedules may be associated with initially elevated levels of challenging behavior when it is initially employed (Hagopian

et al., 2004; Volkert et al., 2009). Thus, the purpose of this study was to evaluate a strategy to reduce the likelihood of challenging behavior within the context of a fixed-lean multiple schedule for individuals with intellectual and developmental disabilities.

This study comprised a multi-method functional assessment to identify the operant function of participants' challenging behavior, FCT to teach individuals that an alternative response—not challenging behavior—would produce access to reinforcement, a multiple schedule to teach participants to identify periods when reinforcement was available, and a treatment comparison evaluating whether noncontingent access to alternative items would decrease the likelihood of challenging behavior when fixed-lean multiple schedules were initially employed. This study sought to address the following: the operant function of each participant's challenging behavior, whether FCT plus extinction would result in reduced levels of challenging behavior and concomitant increases in functional communication responses, whether participants would engage in mands and reductions in challenging behavior during the reinforcement component of a multiple schedule, and whether alternative items would effectively compete with challenging behavior within the context of a fixed-lean multiple schedule. This study also sought to address issues of social validity, such as whether participants would display more positive affect when they had access to alternative items when preferred stimuli were not available and treatment acceptability based on caregiver report.

Main Findings

What is the operant function of each participant's challenging behavior? The results of the QABF for Steve produced elevated scores (i.e., 12+ points) for a total of four out of five possible functions (i.e., attention, escape, non-social, physical, and

tangible). However, the FAI and anecdotal observation provided additional information that was necessary to identify the context in which challenging behavior was most likely to occur for Steve. A latency-based experimental functional analysis confirmed caregiver reports that restricting Steve's access to the smart phone would reliably evoke challenging behavior based on short latencies to challenging behavior when the phone was restricted, and relatively lengthy, or no challenging behavior at all, when Steve had unrestricted access to the phone.

For Albert, the results of the QABF strongly suggested a tangible function for challenging behavior, but also that challenging behavior may have been partially maintained by escape. The FAI also provided additional clarification such that challenging behavior might have been likely to occur within a demand context which also co-occurred with the restriction of tangible stimuli. The experimental functional analysis confirmed the hypothesis based on indirect measures that challenging behavior reliably occurred when Albert's access to the tablet was restricted.

Is there a functional relation between reinforcement for functional communication responses (FCRs) plus extinction for challenging behavior and increases in FCRs with concomitant decreases in challenging behavior? Functional communication training (i.e., reinforcement of FCRs on an FR-1 schedule of reinforcement) in combination with extinction for challenging behavior produced immediate reductions of challenging behavior for both participants. Importantly, reductions in challenging behavior co-occurred with elevated and stable rates of FCRs; thus, indicating that both types of responses (i.e., FCR and challenging behavior) were functionally equivalent. However, because challenging behavior did not produce

reinforcement during FCT, thereby making it ineffective (Horner & Day, 1991), challenging behavior seldom occurred in this context. Thus, the hypothesized results for FCT were confirmed for both participants.

Is there a functional relation between reinforcement of FCRs plus extinction for challenging behavior and increases for FCRs and decreases in challenging behavior during the reinforcement component of the multiple schedule? Although there were slight differences in the number of sessions to mastery, discriminated FCRs occurred for both participants. Specifically, participants engaged in FCRs when the stimulus associated with reinforcement component was presented, and responding was suppressed when the stimulus signaling the unavailability of reinforcement was presented. Along with elevated and stable FCRs during the reinforcement component were concomitant reductions of challenging behavior for both participants. Similar to the results for both participants during FCT, this inverse relationship provides additional support that FCRs and challenging behavior were in the same response class. Thus, the hypothesized patterns of responding during discrimination training were confirmed for both participants.

Is there a functional relation between noncontingent delivery of a competing stimulus and decreases in challenging behavior during the extinction component of the fixed-lean multiple schedule? Although noncontingent access to a competing stimulus was associated with immediate reductions of challenging behavior for Steve when the fixed-lean multiple schedule was initially employed, there was insufficient evidence to support this strategy in this context, because challenging behavior remained low following the removal of the competing stimulus during the extinction only

condition. For Albert, there were no differences in challenging behavior across conditions, and he engaged in low levels of challenging behavior during the entire treatment comparison. Thus, the hypothesis that participants would engage in low levels of challenging behavior when they had access to a competing stimulus and elevated levels of challenging behavior during the extinction only condition was rejected for both participants.

Will the extinction component during the fixed-lean multiple schedule with competing stimuli be associated with high levels of item interaction? Both participants were observed to engage with competing stimuli to some extent, albeit to different degrees. Steve engaged with competing stimuli at variable durations, with moderate-to-high levels of interaction during the initial part of the phase, and low-to-moderate levels of interaction during the latter part of the phase. In contrast, Albert consistently engaged with the competing stimulus at moderate-to-high levels throughout the evaluation; this co-occurred with low levels of challenging behavior. Thus, the hypothesis was confirmed for Albert based on consistently elevated, and mostly stable, interaction with the competing item. For Steve, there was no consistent pattern between level of engagement with the competing item; thus, the hypothesis was rejected for Steve.

Is there a functional relation between noncontingent delivery of a competing stimulus and elevated levels of participant affect during the extinction component of the fixed-lean multiple schedule? For both participants, there was much overlap across conditions, thereby suggesting minimal differences in participant affect across conditions, overall. Nevertheless, Albert's mean score was slightly higher in the extinction plus competing stimulus condition based on more consistently elevated scores in this

condition. Thus, the hypothesis that participants would display more positive affect when they had access to a competing stimulus was partially confirmed with Albert, but rejected for Steve.

Implications for Practice

There are four primary implications for practice that emerge from this study. First, the results of prior research (i.e., Betz et al., 2013) were replicated based on discriminated mands and low levels of challenging behavior for both participants, regardless of access to competing stimuli, during the fixed-lean multiple schedule. Schedule thinning, which is commonly employed to promote the feasibility of FCT (Hagopian, Boelter, & Jarmolowicz, 2011), often entails a gradual and systematic process that could become the primary focus of intervention for individuals with challenging behavior. Given that prior research (e.g., Betz et al., 2013; Greer et al., 2015) has demonstrated that an abrupt shift to the terminal schedule (i.e., nine minutes of extinction) (a) has been associated with continued discrimination of mands across reinforcement and extinction components, and (b) not always been associated with elevated rates of challenging behavior, service providers should re-assess whether a gradual and systematic process of schedule thinning is necessary for participants to achieve clinical goals. Hagopian et al. (2011) described several strategies to promote the feasibility of FCT; service providers should consider alternate strategies (e.g., terminal probes) that could result in relatively more efficient services than would otherwise occur following a gradual process of schedule thinning.

Second, low levels of challenging behavior during the extinction only condition for both participants were unexpected based on elevated rates of challenging behavior displayed by other participants in prior research (Hagopian et al., 2004; Hoffman &

Falcomata, 2014; Volkert et al., 2009). However, it is possible that the participants in this study are more similar to participants in Betz et al. (2013) and Greer et al. (2015), in which challenging behavior occurred at low rates despite the absence of competing stimuli during an abrupt shift to a lean schedule of reinforcement. One similarity might be that the participants in these studies responded well to extinction; thus, obviating the need for noncontingent access to alternative items. However, for other children, FCT plus extinction might not be sufficient to reduce challenging behavior to criterion levels. For example, Rooker, Jessel, Kurtz, and Hagopian (2013) found in a consecutive case series analysis of 58 applications of FCT that alternative reinforcement resulted in $\geq 90\%$ reduction of challenging behavior with 71% of the cases for whom initial treatment was unsuccessful. Thus, extinction only may not be sufficient to maintain low rates of challenging behavior. As a result, the use of other treatment components, such as competing stimuli, may be required to facilitate attainment of treatment goals. Clinicians providing services for individuals with challenging behavior may find it useful to assess whether the use of competing stimuli are necessary based on how children respond to extinction.

Third, both participants in this study acquired the discrimination relatively quickly based on differentiated rates of FCRs during reinforcement and extinction components of the multiple schedule. This suggests that a relatively low intensity multiple schedule treatment, with colored, wrist sweatbands or FitBit™ that were worn by therapists along with contingency-specifying prompt, was effective during an initial step toward promoting the feasibility of FCT. That said, it may not be the case that every child who receives a multiple schedule as a treatment adjunct acquires a discrimination or

does not engage in some, albeit relatively fewer, FCRs during the extinction component as occurred with Albert. Responding during extinction may suggest that schedule-correlated stimuli did not have complete stimulus control over FCRs. As Grow, LeBlanc, and Carr (2010) noted, responding during the extinction component could be of concern if it is intermittently reinforced, thereby leading to undifferentiated FCRs that occur independent of schedule-correlated stimuli. Clinicians should be extra cautious about appropriately reinforcing mands when some responding persists during extinction.

Fourth, the initial nine sessions of discrimination training for Steve were associated with variable rates of FCRs across reinforcement and extinction components and would lead one to conclude that this participant did not acquire the discrimination across components sooner than the data demonstrated. It was hypothesized that Steve truly acquired the discrimination earlier than his responding across components suggested, but due to the low effort associated with pressing a button that was within arm's reach from him on the couch, FCRs continued during the extinction component. The effects of differing levels of response effort associated with alternative responses have been demonstrated in prior research to impact the efficacy of FCT (see Horner & Day, 1991). When the switch was shifted across the room, thereby increasing the effort associated with the communication response, Steve showed immediate reductions in FCRs during the extinction component but continued to respond during the reinforcement component. Clinicians should carefully consider the extent to which response effort influences individuals' response patterns when employing a multiple schedule.

Implications for Research

Findings from the present study yield 10 primary implications for research. First, consistent with prior research (Austin & Tiger, 2015; Hagopian et al., 2005; Hagopian et al., 2013), it is possible that Steve's noncontingent access to an alternative item facilitated his tolerance to extended periods of extinction. When the fixed-lean multiple schedule with a competing stimulus (i.e., FL MS 60/540 – EXT+CS) was introduced after discrimination training, Steve engaged in lower rates of challenging behavior, overall. Steve's average rate of challenging behavior during this treatment condition was 90% lower than his average rate of challenging behavior during the extinction component of discrimination training; his challenging behavior was marked by immediacy of effect, less variability, and a lower level, overall. By the end of the extinction plus competing stimulus phase his challenging behavior reduced to mostly zero rates. Nevertheless, the competing stimulus condition co-occurred with the introduction of the fixed-lean multiple schedule and it is unclear whether the introduction of the fixed-lean multiple schedule itself (i.e., without a competing stimulus) would have been sufficient to maintain low levels of challenging behavior, as had been demonstrated in prior research (Betz et al., 2013; Greer et al., 2015). Future research should evaluate the presentation of competing stimuli during extinction in a manner that does not involve more than one change simultaneously in order to assess the effects of each variable on challenging behavior.

The effects of functional communication training to produce immediate reductions of challenging behavior and elevated levels of an alternative communication response to obtain preferred items were evident for both participants; these results were consistent with prior research (e.g., Betz et al., 2013; Fisher et al., 2000; Hagopian et al., 2008; Kuhn et al., 2010; and Sprague & Horner, 1992). For Steve and Albert, FCT

resulted in a 94% and 95% reduction of challenging behavior, respectively, in Study 1. Importantly, low levels of challenging behavior co-occurred with an elevated and stable level of FCRs. Thus, FCRs and challenging behavior could be considered functionally equivalent responses that co-vary (Sprague & Horner, 1992), and challenging behavior may have been reduced for both participants, because it did not produce access to the reinforcer.

Second, based on the intensity of challenging behavior exhibited by Steve (i.e., rapid fist-to-head contact) and the context in which the experiment was conducted (i.e., home, as opposed to clinic or hospital), experimenters targeted a broad range of responses, including those that were lower intensity (e.g., negative vocalizations). Likely a result of negative vocalizations being a relatively more efficient response (see Horner & Day, 1991), Steve allocated responding to this topography specifically. Through informal observation, Steve's more intense topographies became less frequent over the course of the functional analysis and during the remainder of the study. Unfortunately, targeting topographies that were lower intensity could have resulted in fewer opportunities for higher intensity responses (e.g., rapid fist-to-head contact) to contact the contingencies in place during treatment (i.e., extinction). Steve may have become less likely to engage in precursor behavior and more likely to engage in high intensity responses when challenging behavior occurs in similar contexts in the future due to relatively fewer instances where high-intensity challenging behavior contacted the contingency (i.e., extinction; Hagopian et al., 2013). Nevertheless, data were not scored separately across response topographies, so the frequency of reinforcement for each type of response is unclear. Future research should evaluate whether the assessment and treatment of low-

intensity topographies results in collateral decreases of high-intensity topographies for individuals who engage in challenging behavior.

Third, both participants discriminated between periods of reinforcement and extinction based on FCRs that almost always occurred when the stimulus that was correlated with reinforcement was presented, and FCRs were withheld when the stimulus that was correlated with extinction was presented. Differentiated rates of FCRs continued to occur for both participants across reinforcement and extinction components during the treatment comparison despite employing a fixed-lean multiple schedule when elevated FCRs might otherwise be expected due to an extended period of deprivation. The fact that FCRs primarily occurred during the one-minute period of reinforcement and never (Steve) or rarely (Albert) occurred during the nine-minute period of extinction suggests that both schedule-correlated stimuli formed strong stimulus control over mands for reinforcement.

Nevertheless, the extent to which each stimulus exerted control over FCRs and challenging behavior is empirical. It is possible that challenging behavior would re-emerge if individuals other than the specific experimenter who conducted sessions for each child implemented intervention procedures. First, a response is rarely under the control of a single stimulus in the environment (e.g., a wrist sweatband); rather, a combination of stimuli, including the specific experimenters conducting the procedures, location of experimental sessions (e.g., family room and associated stimuli), the sequence of behaviors exhibited by experimenters that are associated with the intervention procedures, contingency-specifying prompt, etc., could act independently or in conjunction to form control over responding. Individuals with autism, such as those in the

present investigation, often fail to exhibit skills in the presence of other therapists, settings, or contexts (Koegel & Rincover, 1977), which may be an indication that responding has come under the stimulus control of irrelevant stimuli (Horner, Bellamy, & Colvin, 1984; Jones, Lerman, & Lechago, 2014). It is unclear whether discriminated FCRs would continue to occur if the factors mentioned above were systematically varied (e.g., initiating treatment in a different room in the house or have caregivers conduct treatment sessions) during assessments for generalization. Individuals receiving treatment for challenging behavior may require explicit training in alternative settings (Koegel & Rincover, 1977) or by using other strategies (e.g., programming common stimuli) described by Stokes and Baer (1977). Future research should evaluate which components of the treatment package form stimulus control over responding and incorporate strategies for generalization accordingly.

Fifth, the fact that elevated and stable rates of FCRs during the reinforcement component and near-zero FCRs and challenging behavior during the extinction component continued to occur when the fixed-lean multiple schedule was employed for both participants may be important for future research to explore. Differences in responding across both components of the multiple schedule may be attributed to (a) stimulus control (as described above), (b) an abolishing operation (AO) or satiation associated with access to the reinforcer first followed by not having access (Laraway et al., 2003), or (c) local positive behavioral contrast associated with the multiple schedule and putative stimulus habituation (McSweeney, 2004; McSweeney & Weatherly, 1998), among other factors. For instance, Lang, O'Reilly, Sigafos, Lancioni, Machalicek, Rispoli, and White (2009) reported that challenging behavior and stereotypy were

comparatively less likely to occur for a child who was given pre-session access to stereotypy prior to treatment sessions. Thus, pre-session access to stereotypy may have acted as an AO that temporarily decreased the frequency of stereotypy and the value of reinforcement associated with stereotypy. Similarly, both participants in the present study had one minute of access to the reinforcer at the beginning of the session; this could have created an abolishing effect for the remainder of the session, thereby making FCRs and challenging behavior less likely to occur. However, this study did not confirm behavioral indicators of satiation during the first component of the multiple schedule (i.e., one minute). In fact, both participants consistently engaged with their respective device during the first component of the multiple schedule.

Conversely, brief access to a reinforcer has been reported to increase the likelihood of responses that produce access to reinforcement (e.g., O'Reilly, Lang, Davis, Rispoli, Machalicek, et al., 2009). As a result, brief pre-session access could also create an establishing operation (EO) that temporarily increases the frequency of challenging behavior and the value of the reinforcer. This seemingly contradictory evidence may be better explained by the theory of habituation and sensitization (Grove & Thompson, 1970; McSweeney, 2004; McSweeney & Weatherly, 1998) than through motivating operations (Laraway et al., 2003). Habituation is a decrease in the rate of responding following repeated presentations of a stimulus (i.e., reinforcer) and sensitization is an increase in responding following the presentation of a stimulus. The effects of habituation may have been evident when FCRs were reduced for both participants during the nine-minute period of the S^d . Sensitization may have been implicated if challenging behavior increased during extinction following brief access to reinforcement. Future research

should consider whether the duration of the reinforcement component would impact the likelihood of challenging behavior during lengthy periods of extinction.

Sixth, the potential of effects of dishabituation should also be considered in future research. Specifically, when potentially less preferred, alternative items were introduced during the extinction plus competing stimulus condition for Steve, slight increases in challenging behavior were observed. Dishabituation is an increase in responding after an extra stimulus is presented (Murphy, McSweeney, Smith, & McComas, 2003). Future research could evaluate whether the type of competing stimuli introduced during extinction impacts the likelihood of challenging behavior.

Seventh, behavioral contrast is a change in the rate of responding during one component of a multiple schedule based on a change in the rate of reinforcement in the alternate component (Reynolds, 1961). During both components, challenging behavior did not produce access to reinforcement, and FCRs only produced reinforcement during the first component of the multiple schedule (S^D). Although the duration of the second component of the multiple schedule (S^A) was extended and the first component of the multiple schedule (S^D) was shortened, a change in the rate of FCRs was not observed. This was presumably a result of the 30-s reinforcement interval following mands for reinforcement; thereby, only allowing a total of two communication responses per minute. Although additional FCRs technically could have occurred, an increased rate of FCRs was not expected because it would not produce more access to the reinforcer. It may be useful for future research to evaluate the effect of local positive behavior contrast when reinforcement is delivered based on quantity and not duration.

Eighth, findings related to acceptability yield implications for research. Ms. Adams reported a high degree of treatment acceptability from the outset and indicated a clear understanding of the procedures. Although she found the procedures to be acceptable, Ms. Adams reported that Albert would experience much discomfort as a result of the procedures and she assigned the highest score possible for this item (7). Also, Ms. Adams assigned a score on the lower end of the scale (3) for how much she liked the procedures. These scores may be an indication that she was not completely bought in to treatment, although she did not explicitly state this was the case. During the post assessment, Ms. Adams rated Albert's discomfort as being low (2) and her acceptability of the approach as high (7). Thus, her acceptability of procedures and her perception of Albert's discomfort associated with the procedures appear to have been inversely related. A similar pattern of responses was observed for Ms. Smith with perceived high discomfort (7) for Steve and relatively low acceptability (3) during pre-assessment, and low discomfort (2) and high acceptability (7) during post assessment. Future research should investigate the factors associated with these procedures, such as child affect and behavioral outcomes, that contribute to caregivers' perceptions of child discomfort and acceptability of treatment.

Ninth, for measures of participant acceptability, Albert mostly showed consistently levels of elevated affect when he was given access to an alternative item; his affect was mostly on the lower end of the neutral range during the extinction only condition. Even with minimal differences in challenging behavior across the treatment comparison, the extinction plus competing stimulus condition may be a more socially valid approach, based on his comparably elevated affect, when teaching Albert to tolerate

lengthy periods when his tablet is not available. Relatively elevated child affect might also influence caregiver buy-in, which may promote the acceptability of this treatment package with all stakeholders. Future research should investigate the effects of child affect on caregiver buy-in during treatment.

Tenth, Steve exhibited mostly neutral affect, overall, with a slightly increasing trend during the latter half of the treatment comparison. His affect was more variable and on a decreasing trend during the initial part of the treatment comparison in the extinction plus competing stimulus phase. As noted earlier, it is possible that this pattern may be a result of the effects of satiation. Alternately, it is possible that individuals with ASD do not present the same behavioral indicators of interest or happiness as typically developing individuals, as an associated characteristic of their difficulties with social communication. When his most preferred snacks were consistently included in treatment, Steve continued to select the same edible item (i.e., fruit snacks) at the beginning of each appointment during brief preference assessments yet his affect scores were on a decreasing trend. Future research should investigate the utility of a participant-specific affect rating scale that is tailored to indicators of interest and happiness for individual participants.

Limitations and Future Research Directions

Findings from the present study must be considered within a set of important limitations. These limitations inform future research directions. Steve engaged in low rates of challenging behavior when the extinction plus competing stimuli condition was employed, and his challenging behavior was reduced to near-zero rates during the latter half of this treatment phase. With the exception of a few sessions, challenging behavior did not re-emerge during the extinction only condition. Nevertheless, it is possible that

competing stimuli mitigated the any potential effects of the extended period of extinction only on challenging behavior, but challenging behavior reduced to zero due to a learning history associated with the previous condition. Future researchers should employ strategies, such as reversing to baseline conditions, to regain experimental control and re-evaluate any potential effects of both conditions.

Despite caregiver reports of intense topographies of challenging behavior (e.g., slamming his body on the couch or floor, hair pulling, high-pitched screaming, hitting leg with closed fist), Albert consistently engaged in relatively minor forms of challenging behavior within the context of this study (e.g., persistently grabbing the tablet, whining and crying, and occasional kicking). It is possible that caregivers, in particular, have a stronger evocative effect for high intensity topographies of challenging behavior. This is an indication that certain topographies of challenging behavior (e.g., whining and crying) may be under multiple sources of control, while other topographies (e.g., self-injury) are under the control of specific stimuli in the environment (e.g., caregivers). Future research should investigate whether certain response topographies are more likely to be emitted in the presence of specific stimuli and evaluate whether this impacts the efficacy of treatment.

This study was conducted with individuals for whom the use of competing stimuli during extended periods of extinction may not have been necessary to maintain low levels of challenging behavior, such as the participants in Betz et al. (2013). In other words, the fixed-lean schedule of reinforcement may have been sufficient to maintain discriminated FCRs and low levels of challenging behavior. However, this study did not allow for the measurement of challenging behavior during the extinction only condition

before participants were exposed to the extinction plus competing stimulus condition (except one session with Albert). Had participants been introduced to the fixed-lean multiple schedule 60/540 (EXT only) condition for an extended period prior to the introduction of the EXT+CS condition, as conducted with Stephen in Hagopian et al. (2004), it would have allowed for the opportunity to observe whether a competing stimulus was necessary for the Steve and Albert. Future research might consider employing the extinction only condition first as part of a fixed-lean multiple schedule, and then introducing competing stimuli only if clinically indicated for specific participants.

Although most of the procedures for Steve and Albert were associated with a high degree of experimental control, the treatment comparison for both participants did not support the use of competing stimuli. For Steve, elevated rates of challenging behavior were not observed for the majority of sessions during the treatment comparison. It is possible that Steve would have otherwise engaged in challenging behavior when the fixed-lean multiple schedule was initially employed but competing stimuli suppressed challenging behavior. Future research should consider a research design sensitive to the potential effects of a fixed-lean multiple schedule (e.g., an alternating treatments design). This may allow for measurement of challenging behavior when the individual is initially introduced to lean schedules of reinforcement.

Regardless of whether competing stimuli will effectively suppress challenging behavior during fixed-lean schedules of reinforcement, it is important to consider whether the results in this study would generalize to other populations. Although FCT and the multiple schedule was demonstrated to be an effective intervention for both participants

this study and Betz et al. (2013), these children were both individuals of the same age, diagnosed with Autism Spectrum Disorder (ASD), and had limited functional communication skills. Although one might reasonably expect this treatment package to be effective for other individuals with ASD, the extent to which this treatment package would be effective for individuals within the broader category of intellectual and developmental disability who do not have ASD is suspect. Future research should evaluate the efficacy of fixed-lean multiple schedules with individuals who have other diagnoses.

A final limitation relates to the experimental functional analysis procedures that were employed for Steve and Albert. Specifically, hypothesis-driven methods were employed, based on caregiver reports and descriptive observations, such that only a test and control condition were included during experimental analyses. Although there may have been other factors that contributed to challenging behavior for each participant, this study was designed to only address challenging behavior maintained by access to social-positive reinforcers (i.e., tangibles or attention), which was clearly demonstrated for both participants. Future research should incorporate more thorough, experimental functional analysis procedures to identify whether the complexity of behavioral function for specific individuals impacts the efficacy of this treatment package.

Summary

Individuals with intellectual and developmental disabilities, including children with autism spectrum disorder, often engage in challenging behavior maintained by access to tangible stimuli. This study demonstrated that teaching individuals to engage in an alternative, socially acceptable communication response in place of challenging

behavior can be an effective treatment for challenging behavior. Further, multiple schedules of reinforcement (i.e., the use of schedule-correlated stimuli) can be an effective strategy to help individuals discriminate when preferred items are available. Treatment packages comprising a fixed-lean multiple schedule with noncontingent access to alternative items may facilitate tolerance to extended periods when reinforcement is not available, although additional research in this area is needed. This treatment package is not only a socially valid approach based on caregiver report, but also based on ratings of participant affect from observers who were blind to the study's procedures. Future research should continue to investigate ways to reduce challenging behavior during periods when resurgence of challenging behavior is otherwise likely to occur.

APPENDICES

QUESTIONS ABOUT BEHAVIORAL FUNCTION (QABF)

Client's name and residence: _____

Name of person completing QABF: _____ Date: _____

Rate how often the CLIENT demonstrates the behaviors in situations they might occur.
Be sure to rate how often each behavior occurs, not what you think a good answer would be.

X	0	1	2	3
Does Not Apply	Never	Rarely	Some	Often

- _____ 1. Engages in the behavior to get attention.
- _____ 2. Engages in the behavior to escape work or learning situations
- _____ 3. Engages in the behavior as a form of "self stimulation."
- _____ 4. Engages in the behavior because he/she is in pain.
- _____ 5. Engages in the behavior to get access to items such as preferred toys, food, or beverages.
- _____ 6. Engages in the behavior because he/she likes to be reprimanded.
- _____ 7. Engages in the behavior when asked to do something (get dressed, brush teeth, work, etc.)
- _____ 8. Engages in the behavior even if he/she thinks no one is in the room.
- _____ 9. Engages in the behavior more frequently when he/she is ill.
- _____ 10. Engages in the behavior when you take something away from him/her.
- _____ 11. Engages in the behavior to draw attention to him/herself.
- _____ 12. Engages in the behavior when he/she does not want to do something.
- _____ 13. Engages in the behavior because there is nothing else to do.
- _____ 14. Engages in the behavior when there is something bothering him/her physically.
- _____ 15. Engages in the behavior when you have something he/she wants.
- _____ 16. Engages in the behavior to try to get a reaction from you.
- _____ 17. Engages in the behavior to try to get people to leave him/her alone.
- _____ 18. Engages in the behavior in a highly repetitive manner, ignoring his/her surroundings.
- _____ 19. Engages in the behavior because he/she is physically uncomfortable.
- _____ 20. Engages in the behavior when a peer has something he/she wants.
- _____ 21. Does he/she seem to be saying, "come see me" or "look at me" when engaging in this behavior?
- _____ 22. Does he/she seem to be saying "leave me alone" or stop asking me to do this" when engaging in the behavior?
- _____ 23. Does he/she seem to enjoy the behavior, even if no one is around?
- _____ 24. Does the behavior seem to indicate to you that he/she is not feeling well?
- _____ 25. Does he/she seem to be saying, "give me that (toy item, food item)" when engaging in the behavior?

Form 1. Questions about Behavioral Function questionnaire.

Adapted from: O'Neill, R. E., Homer, R. H., Albin, R. W., Sprague, J. R., Storey, K., & Newton, J. S. (1997). *Functional Assessment and Program Development for Problem Behavior*. Pacific Grove, CA: Brooks/Cole Publishing.

FUNCTIONAL ASSESSMENT INTERVIEW FORM—YOUNG CHILD

Child with Challenging Behavior(s): _____

Date of Interview: _____

Age: _____ Yrs _____ Mos

Sex: M F

Interviewer: _____ Respondent(s): _____

A. DESCRIBE THE BEHAVIOR(S)

1. What are the behaviors of concern? For each, define how it is performed, how often it occurs per day, week, or month, how long it lasts when it occurs, and the intensity in which it occurs (low, medium, high).

	Behavior	How is it performed?	How often?	How long?	Intensity?
1.					
2.					
3.					
4.					
5.					

2. Which of the behaviors described above occur together (e.g., occur at the same time; occur in a predictable "chain"; occur in response to the same situation)?

B. IDENTIFY EVENTS THAT MAY AFFECT THE BEHAVIOR(S)

1. What medications does the child take, and how do you believe these may affect his/her behavior?

2. What medical complication (if any) does the child experience that may affect his/her behavior (e.g., asthma, allergies, rashes, sinus infections, seizures)?

3. Describe the *sleep cycles* of the child and the extent to which these cycles may affect his/her behavior.
4. Describe the *eating routines and diet* of the child and the extent to which these routines may affect his/her behavior.
5. Briefly list the child's typical daily schedule of activities and how well he/she does within each activity.

DAILY ACTIVITIES

Time	Activity	Child's Reaction

6. Describe the extent to which you believe activities that occur during the day are predictable for your child. To what extent does the child know what he/she will be doing and what will occur during the day (e.g., when to get up, when to eat breakfast, when to play outside)? How does your child know this?
7. What choices does the child get to make each day (e.g., food, toys, activities)?

C. DEFINE EVENTS AND SITUATIONS THAT MAY TRIGGER BEHAVIOR(S)

1. **Time of Day:** When are the behaviors most and least likely to happen?

Most likely:

Least likely:

2. **Settings:** Where are the behaviors most and least likely to happen?

Most likely:

Least likely:

3. **Social Control:** With whom are the behaviors most and least likely to happen?

Most likely:

Least likely:

4. **Activity:** What activities are most and least likely to produce the behaviors?

Most likely:

Least likely:

5. Are there particular situations, events, etc., that are not listed above that "set off" the behaviors that cause concern (particular demands, interruptions, transitions, delays, being ignored, etc.)?

6. What one thing could you do that would most likely make the challenging behavior occur?

7. What one thing could you do to make sure the challenging behavior did not occur?

D. DESCRIBE THE CHILD'S PLAY ABILITIES AND DIFFICULTIES

1. Describe how your child plays (With what? How often?).
2. Does your child have challenging behavior when playing? Describe.
3. Does your child play alone? What does he/she do?
4. Does your child play with adults? What toys or games?
5. Does your child play with other children his/her age? What toys or games?
6. How does your child react if you join in a play activity with him/her?
7. How does your child react if you stop playing with him/her?
8. How does your child react if you ask him/her to stop playing with a toy and switch to a different toy?

E. IDENTIFY THE "FUNCTION" OF THE CHALLENGING BEHAVIOR(S)

1. Think of each of the behaviors listed in Section A, and define the function(s) you believe the behavior serves for the child (i.e., what does he/she get and/or avoid by doing the behavior?)

Behavior	What does he/she get? Or what exactly does he/she avoid?
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

2. Describe the child's most typical response to the following situations:

- a. Are the above behavior(s) more likely, less likely, or unaffected if you present him/her with a difficult task?
- b. Are the above behavior(s) more likely, less likely, or unaffected if you interrupt a desired event (eating ice cream, watching a video)?
- c. Are the above behavior(s) more likely, less likely, or unaffected if you deliver a "stern" request/command/reprimand?
- d. Are the above behavior(s) more likely, less likely, or unaffected if you are present but do not interact with (ignore) the child for 15 minutes.
- e. Are the above behavior(s) more likely, less likely, or unaffected by changes in routine?
- f. Are the above behavior(s) more likely, less likely, or unaffected if something the child wants is present but he/she can't get it (i.e., a desired toy that is visible but out of reach)?
- g. Are the above behavior(s) more likely, less likely, or unaffected if he/she is alone (no one else is present)?

F. HOW WELL DOES THE BEHAVIOR WORK?

1. What amount of physical effort is involved in the behaviors (e.g., prolonged intense tantrums vs. simple verbal outbursts, etc.)?
2. Does engaging in the behaviors result in a "payoff" (getting attention, avoiding work) every time? Almost every time? Once in a while?
3. How much of a delay is there between the time the child engages in the behavior and gets the "payoff"? Is it immediate, a few seconds, longer?

G. HOW DOES THE CHILD COMMUNICATE?

1. What are the general expressive communication strategies used by or available to the child (e.g., vocal speech, signs/gestures, communication books/boards, electronic devices, etc.)? How consistently are the strategies used?
2. If your child is trying to tell you something or show you something and you don't understand, what will your child do? (repeat the action or vocalization? modify the action or vocalization?)

3. Tell me how your child expresses the following:

MEANS

FUNCTIONS	GRAB & REACH	GIVE	POINT	LEAD	GAZE SHIFT	MOVE TO YOU	MOVE AWAY FROM YOU	HEAD NOD/HEAD SHAKE	FACIAL EXPRESSION	VOCALIZE	IMMEDIATE ECHO	DELAYED ECHO	CREATIVE SINGLE WORD	CREATIVE MULTI WORD	SIMPLE SIGNS	COMPLEX SIGNS	SELF-INJURY	AGGRESSION	TANTRUM	CRY OR WHINE	OTHER	NONE	
Requests an Object																							
Requests an Action																							
Protests or Escapes																							
Requests Help																							
Requests a Social Routine																							
Requests Comfort																							
Indicates Illness																							
Shows You Something																							

4. With regard to receptive communication ability:

- a. Does the child follow verbal requests or instructions? If so, approximately how many? (List, if only a few).

- b. Is the child able to imitate someone demonstrating how to do a task or play with a toy?

- c. Does the child respond to sign language or gestures? If so, approximately how many? (List, if only a few.)

- d. How does the child tell you "yes" or "no" (if asked whether he/she wants to do something, go somewhere, etc.)?

H. EXPLAIN CHILD'S PREFERENCES AND PREVIOUS BEHAVIOR INTERVENTIONS

1. Describe the things that your child really enjoys. For example, what makes him/her happy? What might someone do or provide that makes your child happy?

2. What kinds of things have you or your child's care providers done to try and change the challenging behaviors?

I. DEVELOP SUMMARY STATEMENTS FOR EACH MAJOR TRIGGER AND/OR CONSEQUENCE

Distant Setting Event	Immediate Antecedent (Trigger)	Problem Behavior	Maintaining Consequences	Function

Form 2. Functional Assessment Interview Form - Young Child. (Adapted from O'Neill et al., 1997).

FUNCTIONAL ANALYSIS

Date: _____ Participant# _____ Condition: _____ Session # _____ DC: _____ Interventionist: _____	Date: _____ Participant# _____ Condition: _____ Session # _____ DC: _____ Interventionist: _____
--	--

	1 min	2 min	3 min	4 min	5 min	1 min	2 min	3 min	4 min	5 min
30s	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:
	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -
30s	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:
	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -
30s	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:
	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -
40s	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:
	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -
50s	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:
	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -
60s	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:
	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -

Directions: Tally each instance of challenging behavior (defined below) during each 10-s interval. Challenging behavior that differs by topography within each 10-s interval or have a duration of 1 second or more between instances count separately. Record whether the interventionist delivered the consequence appropriately given the condition (circle plus or minus).

Conditions

Play: Child has access to tangibles. Instances of challenging behavior are ignored.

Attention: Deliver attention for 30 s only if challenging behavior occurs.

Tangible: Deliver tangible item for 30 s only if challenging behavior occurs.

Demand: Use least to most prompts to guide task completion. Terminate demand for 30 s only if challenging behavior occurs.

Challenging behavior:

Aggression: hitting, kicking, pinching, grabbing, scratching, hair pulling, biting, throwing objects within 2 ft of others; includes attempts

Disruption: banging on surfaces, yelling, knocking over furniture, property destruction, throwing objects

Self-injury: hitting, kicking, pinching, scratching, hair pulling, or biting self

Form 3. Data collection sheet for brief experimental functional analysis.

FUNCTIONAL COMMUNICATION TRAINING

Date: _____ Participant# _____ Condition: _____ Session # _____ DC: _____ Interventionist: _____	Date: _____ Participant# _____ Condition: _____ Session # _____ DC: _____ Interventionist: _____
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	1 min	2 min	3 min	4 min	5 min	1 min	2 min	3 min	4 min	5 min
10.	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:
	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:
	Integrity: +	Integrity: +	Integrity: +	Integrity: +	Integrity: +	Integrity: +	Integrity: +	Integrity: +	Integrity: +	Integrity: +
20.	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:
	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:
	Integrity: +	Integrity: +	Integrity: +	Integrity: +	Integrity: +	Integrity: +	Integrity: +	Integrity: +	Integrity: +	Integrity: +
30.	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:
	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:
	Integrity: +	Integrity: +	Integrity: +	Integrity: +	Integrity: +	Integrity: +	Integrity: +	Integrity: +	Integrity: +	Integrity: +
40.	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:
	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:
	Integrity: +	Integrity: +	Integrity: +	Integrity: +	Integrity: +	Integrity: +	Integrity: +	Integrity: +	Integrity: +	Integrity: +
50.	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:
	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:
	Integrity: +	Integrity: +	Integrity: +	Integrity: +	Integrity: +	Integrity: +	Integrity: +	Integrity: +	Integrity: +	Integrity: +
60.	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:
	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:
	Integrity: +	Integrity: +	Integrity: +	Integrity: +	Integrity: +	Integrity: +	Integrity: +	Integrity: +	Integrity: +	Integrity: +

Directions: Tally each instance of challenging behavior (defined below) during each 10-s interval. Challenging behavior that differs by topography within each 10-s interval or have a duration of 1 second or more between instances count separately. Record whether the interventionist delivered the consequence appropriately given the condition (circle plus or minus).

Conditions: Baseline: CB will be reinforced; alternative responses will be ignored. DRA: CB will be ignored; alternative responses will be reinforced.

Challenging behavior:

Aggression: hitting, kicking, pinching, grabbing, scratching, hair pulling, biting, throwing objects within 2 ft of others; includes attempts

Disruption: banging on surfaces, yelling, knocking over furniture, property destruction, throwing objects

Self-injury: hitting, kicking, pinching, scratching, hair pulling, or biting self

Form 4. Data sheet for functional communication training.

FCT PRETRAINING

Date _____ Participant# _____ Condition _____ Session # _____ Data Collector _____

Trial #	Targets	Verbal prompt	Physical prompt	Integrity
1		+ E NR	+ E NR	+ -
2		+ E NR	+ E NR	+ -
3		+ E NR	+ E NR	+ -
4		+ E NR	+ E NR	+ -
5		+ E NR	+ E NR	+ -
6		+ E NR	+ E NR	+ -
7		+ E NR	+ E NR	+ -
8		+ E NR	+ E NR	+ -
9		+ E NR	+ E NR	+ -
10		+ E NR	+ E NR	+ -

Date _____ Participant# _____ Condition _____ Session # _____ Data Collector _____

Trial #	Targets	Verbal prompt	Physical prompt	Integrity
1		+ E NR	+ E NR	+ -
2		+ E NR	+ E NR	+ -
3		+ E NR	+ E NR	+ -
4		+ E NR	+ E NR	+ -
5		+ E NR	+ E NR	+ -
6		+ E NR	+ E NR	+ -
7		+ E NR	+ E NR	+ -
8		+ E NR	+ E NR	+ -
9		+ E NR	+ E NR	+ -
10		+ E NR	+ E NR	+ -

Date _____ Participant# _____ Condition _____ Session # _____ Data Collector _____

Trial #	Targets	Verbal prompt	Physical prompt	Integrity
1		+ E NR	+ E NR	+ -
2		+ E NR	+ E NR	+ -
3		+ E NR	+ E NR	+ -
4		+ E NR	+ E NR	+ -
5		+ E NR	+ E NR	+ -
6		+ E NR	+ E NR	+ -
7		+ E NR	+ E NR	+ -
8		+ E NR	+ E NR	+ -
9		+ E NR	+ E NR	+ -
10		+ E NR	+ E NR	+ -

Form 5. Data sheet for FCT pretraining.

DISCRIMINATION TRAINING

Date: _____		Participant# _____		Session # _____		DC: _____		Interventionist: _____		
Total CB _____		Total FCR _____								
	1 min	2 min	3 min	4 min	5 min	6 min	7 min	8 min	9 min	10 min
	EXT									
10*	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -
	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:
	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -
20*	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -
	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:
	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -
30*	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -
	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:
	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -
40*	SR+									
	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -
	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:
	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -
50*	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -
	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:
	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -
60*	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -	Tally CB: + -
	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:
	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -	Integrity: + -

Directions: Tally each instance of challenging behavior (defined below) during each 10-s interval. Record whether the interventionist delivered the consequence appropriately given the condition (circle plus or minus).

Conditions: Reinforcement: Wristband will be present, CB will be ignored, and FCRs will be reinforced.

Extinction: Wristband will not be present, and CB and FCRs will be ignored.

Potential challenging behavior defined:

Aggression: hitting, kicking, pinching, grabbing, scratching, hair pulling, biting, throwing objects within 2 ft of others; includes attempts; Disruption: banging on surfaces, yelling, knocking over furniture, property destruction, throwing objects; Self-injury: hitting, kicking, pinching, scratching, hair pulling, or biting self.

CB = challenging behavior; FCR = functional communication response; SR+ = reinforcement; EXT = extinction

Form 6. Data sheet for discrimination training in the multiple schedule.

MSWO Preference Assessment

	Trial					
Tangible item	1	2	3	4	5	6

Directions: During each trial, place an "X" in the row of the item selected

TREATMENT COMPARISON

Date: _____	Participant# _____	Condition: EXT + CS or EXT w/o CS	Session # _____
DC: _____		Interventionist: _____	

		Total FCR			Total CB	Total CS				
1 min SR+		1 min EXT	2 min EXT	3 min EXT	4 min EXT	5 min EXT	6 min EXT	7 min EXT	8 min EXT	9 min EXT
10.	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:
	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:
	Integrity:	CS Eng.:	CS Eng.:	CS Eng.:	Stim Eng.:	Stim Eng.:	Stim Eng.:	Stim Eng.:	Stim Eng.:	Stim Eng.:
	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -
20.	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:
	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:
	Integrity:	CS Eng.:	CS Eng.:	CS Eng.:	Stim Eng.:	Stim Eng.:	Stim Eng.:	Stim Eng.:	Stim Eng.:	Stim Eng.:
	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -
30.	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:
	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:
	Integrity:	CS Eng.:	CS Eng.:	CS Eng.:	Stim Eng.:	Stim Eng.:	Stim Eng.:	Stim Eng.:	Stim Eng.:	Stim Eng.:
	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -
40.	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:
	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:
	Integrity:	CS Eng.:	CS Eng.:	CS Eng.:	Stim Eng.:	Stim Eng.:	Stim Eng.:	Stim Eng.:	Stim Eng.:	Stim Eng.:
	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -
50.	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:
	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:
	Integrity:	CS Eng.:	CS Eng.:	CS Eng.:	Stim Eng.:	Stim Eng.:	Stim Eng.:	Stim Eng.:	Stim Eng.:	Stim Eng.:
	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -
60.	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:	Tally CB:
	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:	FCR:
	Integrity:	CS Eng.:	CS Eng.:	CS Eng.:	Stim Eng.:	Stim Eng.:	Stim Eng.:	Stim Eng.:	Stim Eng.:	Stim Eng.:
	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -

Reinforcement (SR+) component: Ensure wristband is present, only reinforce FCRs, CB is ignored. Extinction (EXT) component: Wristband is off, FCRs and CB are ignored, deliver competing stimulus (if relevant). Record whether stimulus engagement (Eng) occurs at the end of each 10-s interval (momentary time sample).

Form 8. Data sheet for treatment comparison.

Interest

Disinterested

Child looks bored, noninvolved
Not curious or eager to continue activity.
May yawn or try to avoid the situation.
Spends much time looking around and not attending to task. If child does respond may be long response latency.
(Score 0 or 1, depending on extent of disinterest)

Neutral Interest

Neither particularly interested nor disinterested. Child seems to passively accept situation. Doesn't rebel but is not eager to continue.
(Score 2 or 3 depending on extent of interest)

Interested

Attends readily to task: responds readily and willingly. Child is alert and involved in activity.
(Score 4 or 5, depending on level of alertness and involvement)

0

1

2

3

4

5

Happiness

Unhappy

Cries, pouts, tantrums, appears to be sad, angry or frustrated. Child seems not to be enjoying self.
(Score 0 or 1 depending on extent of unhappiness)

Neutral

Doesn't appear to be decidedly happy or particularly unhappy. May smile or frown occasionally but overall, seems rather neutral in this situation.
(Score 2 or 3 depending on extent of happiness)

Happy

Smiles, laughs, seems to be enjoying self.
(Score 4 or 5 depending on extent of enjoyment)

0

1

2

3

4

5

Adapted Treatment Acceptability Rating Form-Revised

1. How clear is your understanding of the suggested procedures?
_____ _____ _____ _____ _____ _____ _____
Not at all clear Neutral Very clear

2. How acceptable do you find the procedures to be regarding your concerns for your child?
_____ _____ _____ _____ _____ _____ _____
Not at all acceptable Neutral Very acceptable

3. Given your child's behavior issues, how reasonable do you find the suggested procedures?
_____ _____ _____ _____ _____ _____ _____
Not at all reasonable Neutral Very reasonable

4. How costly will it be to implement these strategies?
_____ _____ _____ _____ _____ _____ _____
Not at all costly Neutral Very costly

5. How disruptive will it be to your home to implement the suggested procedures?
_____ _____ _____ _____ _____ _____ _____
Not at all disruptive Neutral Very disruptive

6. How much do you like the suggested procedures?
_____ _____ _____ _____ _____ _____ _____
Do not like them at all Neutral Like them very much

7. How much discomfort is your child likely to experience as a result of these procedures?
_____ _____ _____ _____ _____ _____ _____
No discomfort at all Neutral Very much discomfort

8. How willing would you be to change your home routine to implement these procedures?
_____ _____ _____ _____ _____ _____ _____
Not at all willing Neutral Very much willing

9. How well will carrying out these procedures fit into your home routine?
_____ _____ _____ _____ _____ _____ _____
Not at all well Neutral Very well

Form 10. Adapted Treatment Acceptability Rating Form - Revised.

Fidelity Checklist for Pretraining

0-s Time Delay

1. Place picture card on table to initiate the trial
2. Immediately physically guide the communication response (i.e., hand the picture icon to the experimenter)
3. Deliver the relevant reinforcer immediately for a duration of 30 s

5-s Time Delay

1. Place the picture card on the table to initiate the trial
2. Wait 5 s for a response
3. If the child independently engages in a correct response, immediately deliver the reinforcer for 30 s
4. If the child does not engage in the response independently, provide a physical prompt and verbally state "That's how you do it." The experimenter will not provide access to the reinforcer if the child does not engage in the response independently.

Fidelity Checklist for Functional Communication Training

Baseline

1. The assessor will provide access to the maintaining consequence identified through the functional assessment for 30 s contingent upon occurrences of the target problem behavior. All other behavior will be ignored.

FCT

1. All instances of challenging behavior will be ignored.
2. The experimenter will deliver the maintaining consequence identified through the functional assessment for 30 s following each instance of the target FCR.

Fidelity Checklist for Preference Assessment

1. The experimenter will label and present an array of 5 stimuli in front of the participant.
2. The experimenter will tell the participant to select one item.
3. The participant will have 30 s of access to the selected item.
4. Following the reinforcement interval, the experimenter will remove the item, and re-arrange the array of stimuli by moving the right-most item to the extreme left of the array.
5. The experimenter will tell the participant to select one item.
6. The same procedures will be followed until no items remain in the array.

Fidelity Checklist for Discrimination Training

Each session will begin with the reinforcement component followed by the extinction component. Thereafter, each component will be presented in a semi-random order an equal number of times during the remainder of the session.

Reinforcement Component

1. The experimenter will deliver a contingency-specifying prompt immediately before beginning the session. The contingency specifying prompt will be the following, "When I am wearing the wristband, you can ask for (reinforcer) and I will give it to you. If I am not wearing the wristband, you can ask for the (reinforcer), but I will not give it to you."
2. The session will begin when the experimenter puts on the wristband.
3. All instances of challenging behavior will be ignored.
4. The experimenter will deliver the reinforcer for 30 s contingent upon each instance of the FCR. The experimenter will simply extend the time if two instances of the FCR occur within a 30 s reinforcement interval.

Extinction Component

1. The experimenter will begin the 60-s extinction component by removing the wristband.
2. All instances of challenging behavior and FCRs will be ignored.

Fidelity Checklist for Treatment Comparison

Multiple 60/540 schedule

1. The session will begin when the experimenter puts on the wristband.
2. All instances of challenging behavior will be ignored.
3. The experimenter will deliver the reinforcer for 30 s contingent upon each instance of the FCR. The experimenter will simply extend the time if two instances of the FCR occur within a 30 s reinforcement interval.
4. Following 60 s of the reinforcement component, the experimenter will begin the 540-s extinction component by removing the wristband.
5. During the extinction component, all instances of challenging behavior and FCRs will be ignored.

Multiple 60/540 schedule with competing stimuli

1. The same procedures described in the above condition will be implemented.
2. During the extinction component, a competing stimulus item (i.e., the first item selected in the preference assessment) will be delivered noncontingently. All instances of challenging behavior and FCRs will be ignored during this 540-s time period.

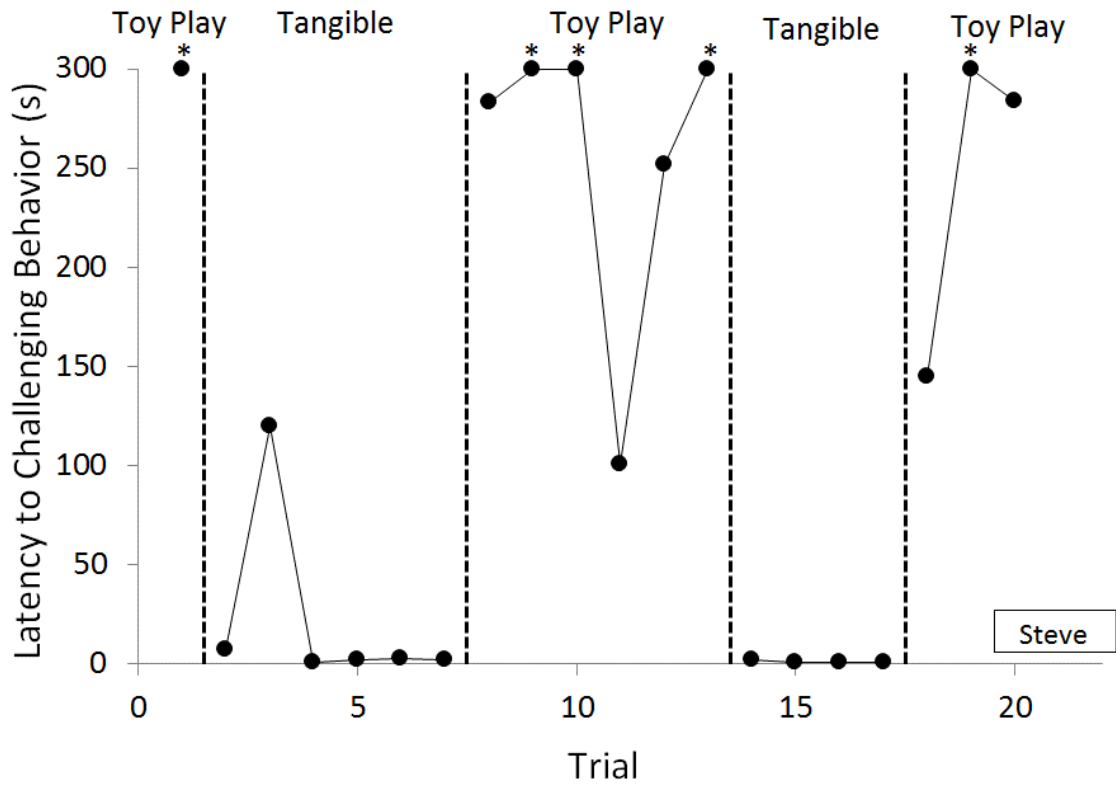


Figure 1. Results from Steve’s latency-based functional analysis. Asterisks indicate that challenging behavior did not occur.

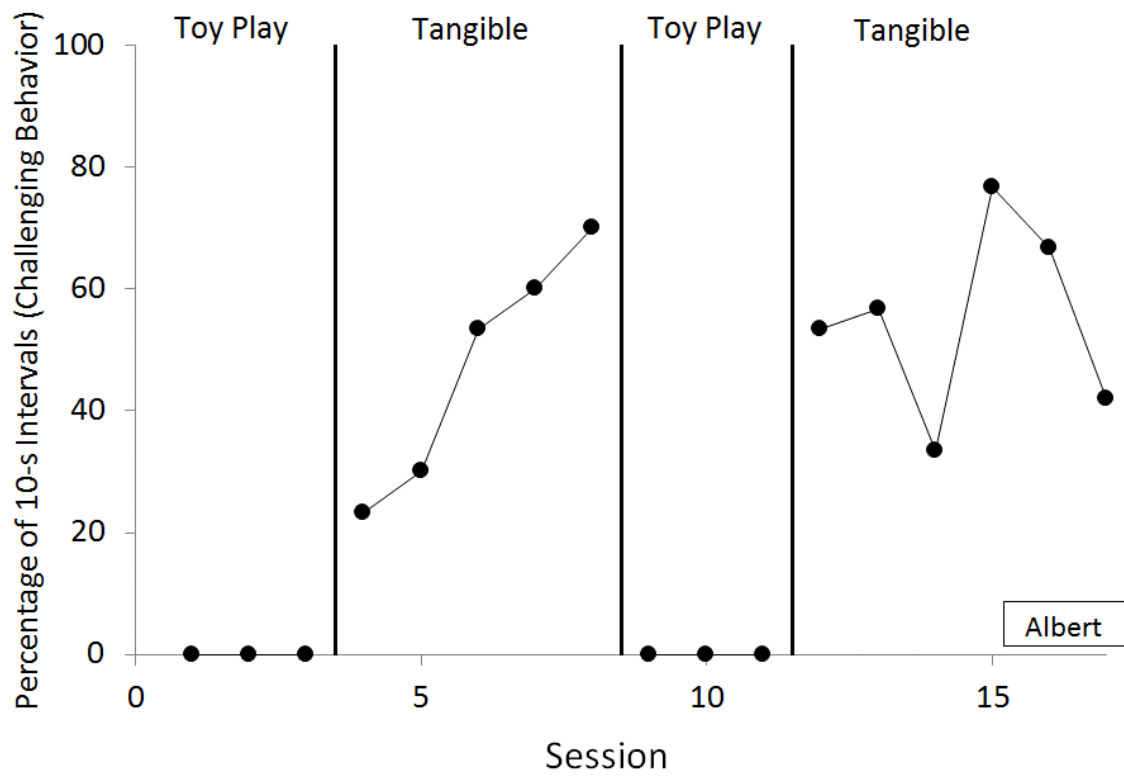


Figure 2. Results from Albert’s functional analysis indicating higher percentages of challenging behavior when the tablet was restricted.

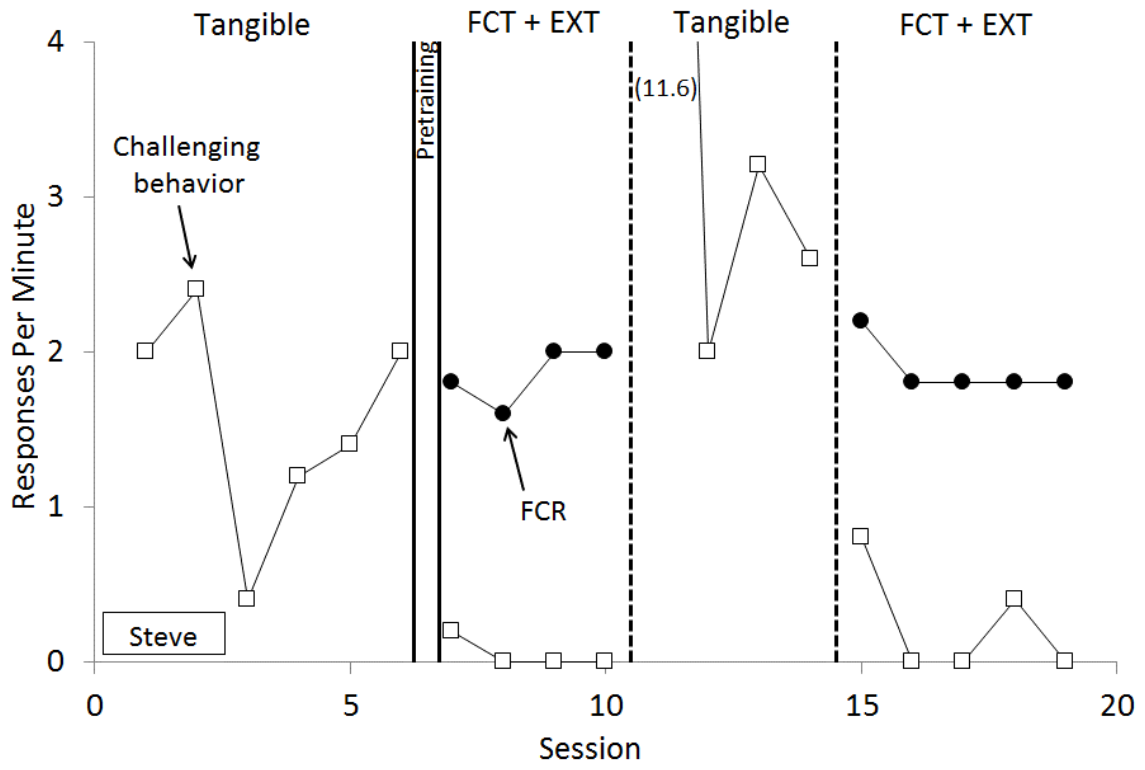


Figure 3. Results from FCT demonstrating Steve's increased rates of FCRs with concomitant decreases in challenging behavior.

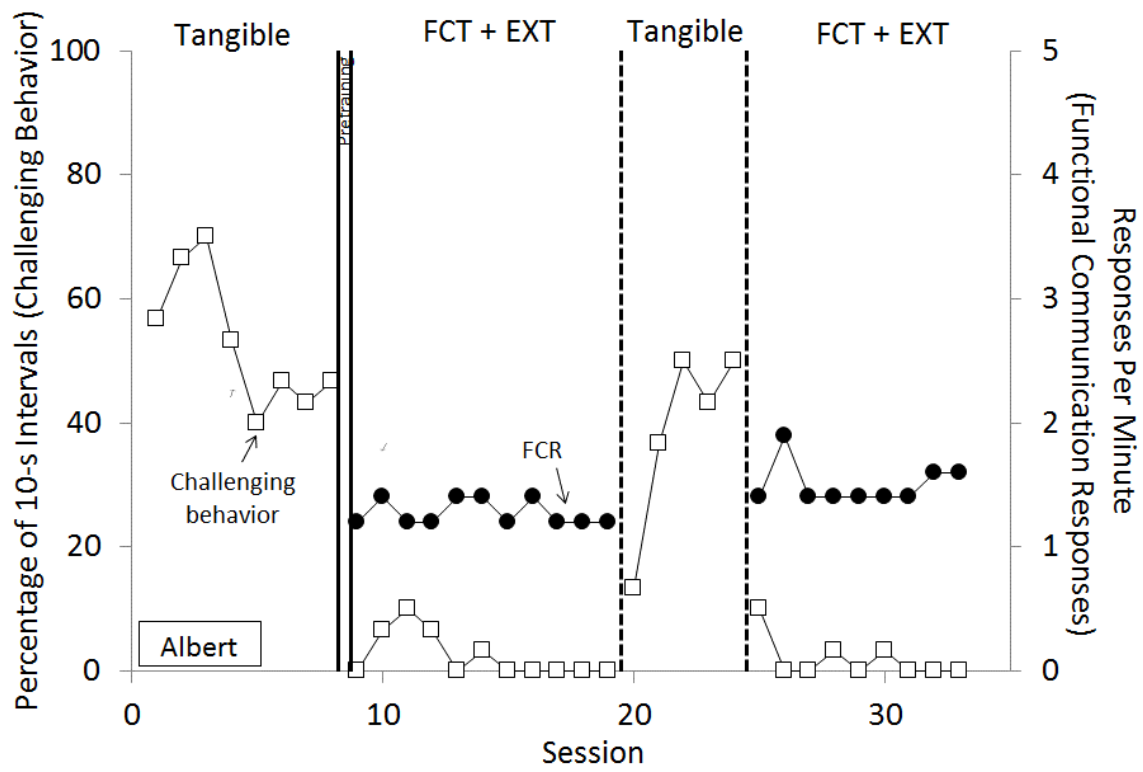


Figure 4. Results from FCT demonstrating Albert's increased rates of FCRs with concomitant decreases in challenging behavior.

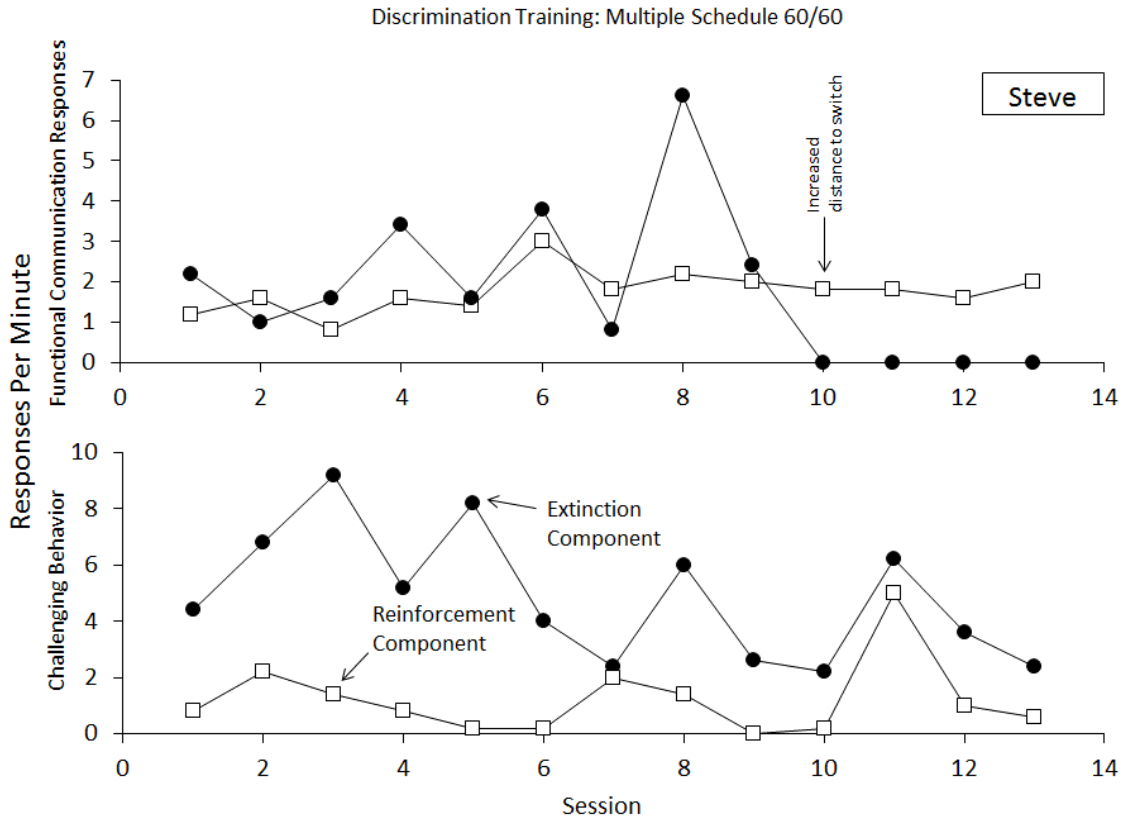


Figure 5. Results from discrimination training with Steve. Functional communication responses are depicted in the top panel and challenging behavior is depicted in the bottom panel.

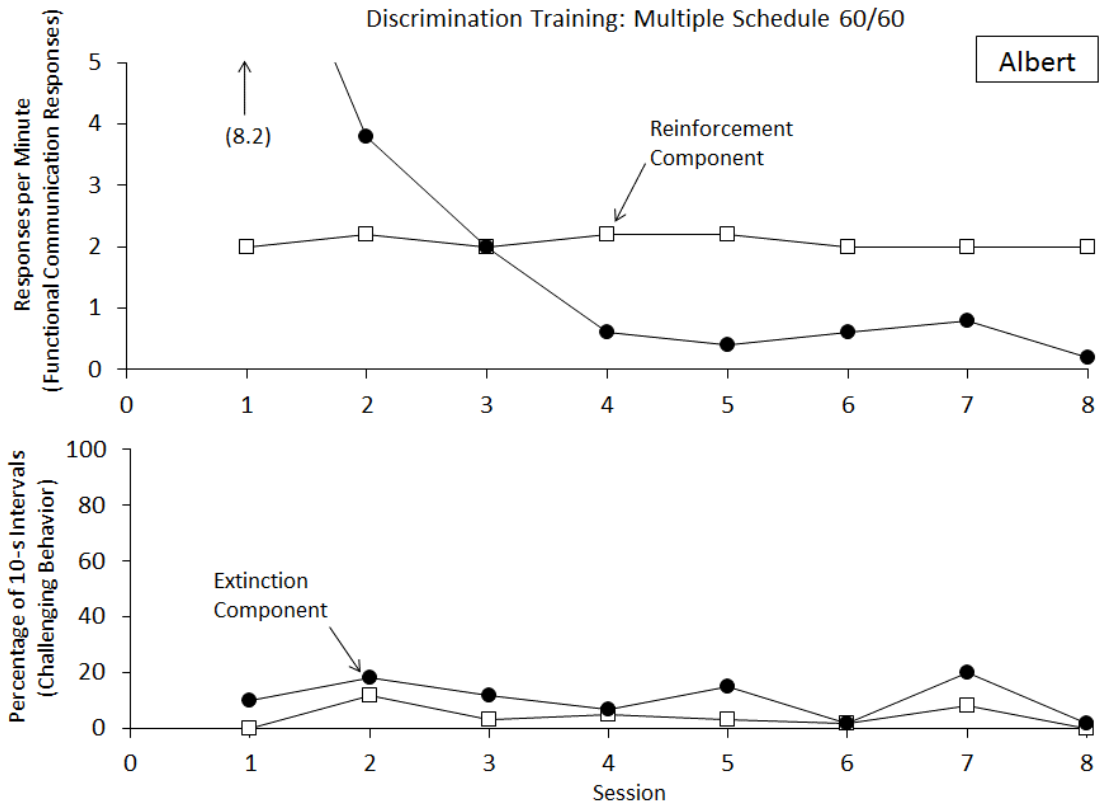


Figure 6. Results from discrimination training with Albert. Functional communication responses are depicted in the top panel and challenging behavior is depicted in the bottom panel.

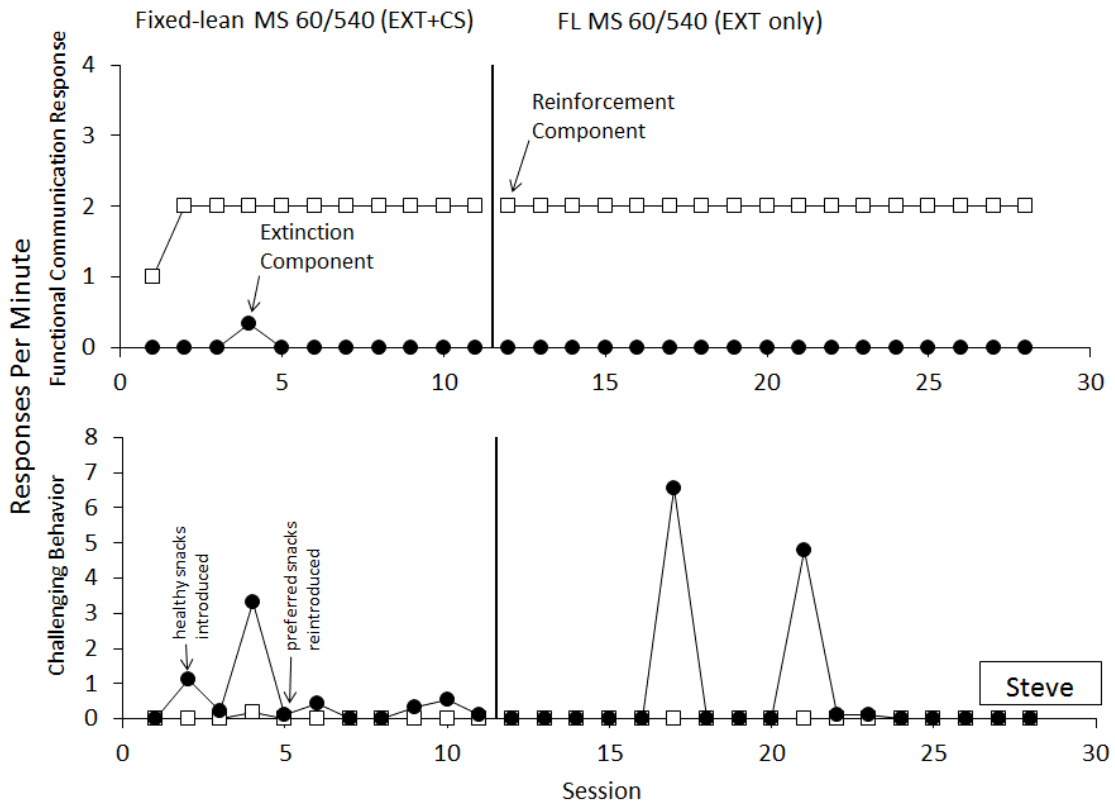


Figure 7. Results from the treatment comparison with Steve. Functional communication responses are depicted in the top panel and challenging behavior is depicted in the bottom panel.

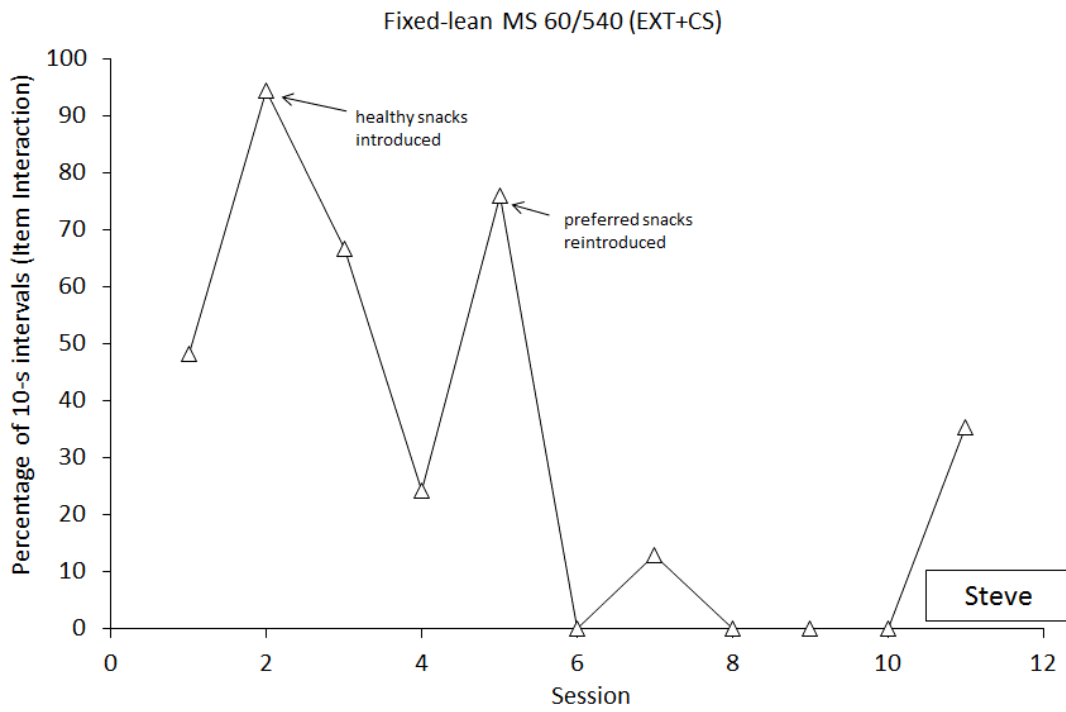


Figure 8. Steve interaction with competing stimuli during the fixed-lean multiple schedule, extinction plus competing stimulus condition.

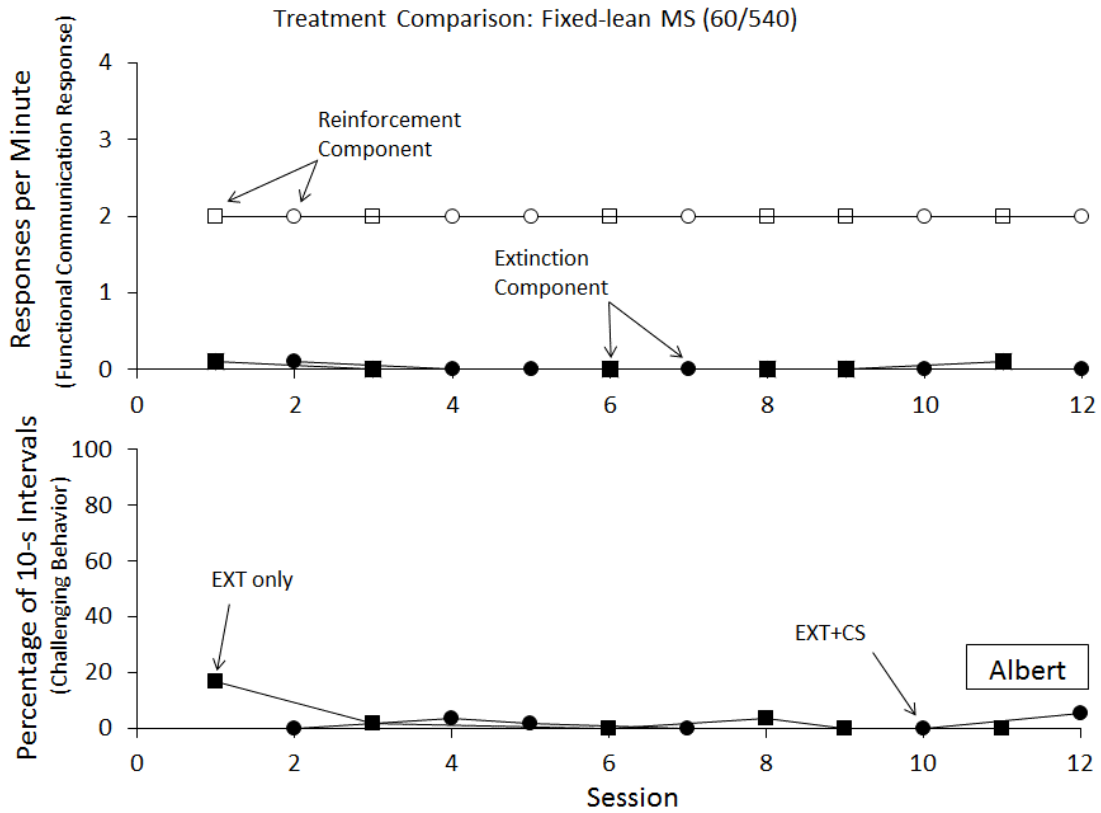


Figure 9. Results from the treatment comparison with Albert. Functional communication responses are depicted in the top panel and challenging behavior is depicted in the bottom panel.

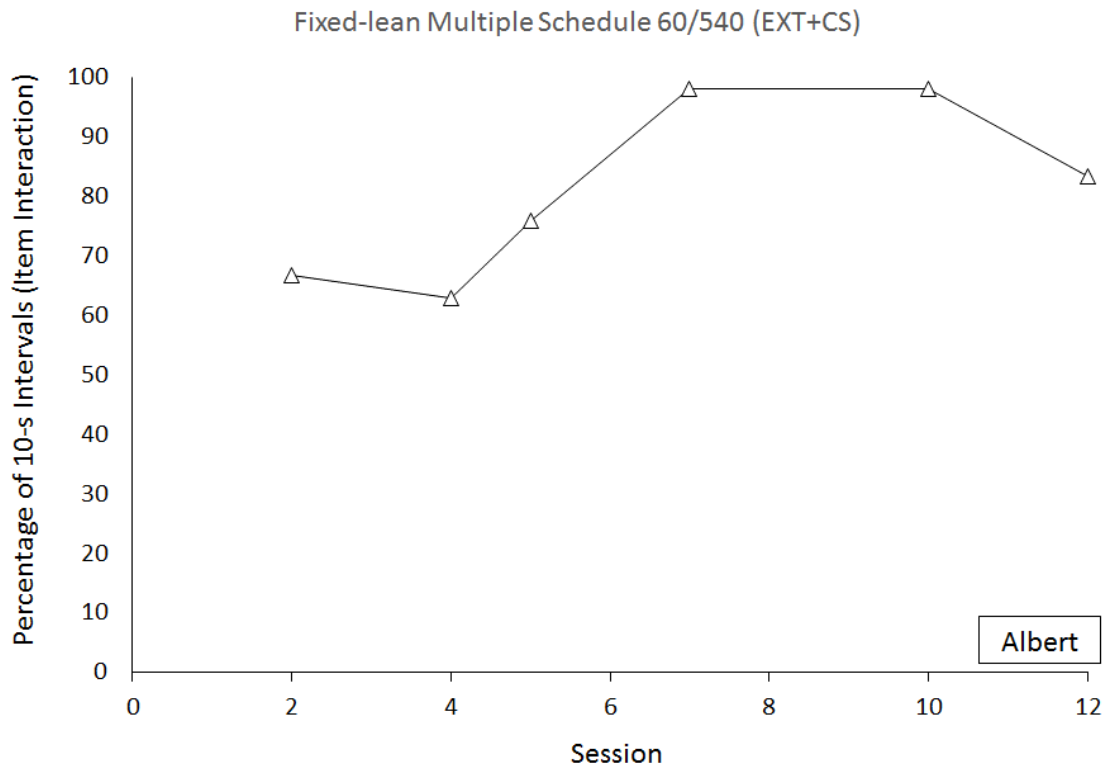


Figure 10. Albert's interaction with competing stimuli during the fixed-lean multiple schedule, extinction plus competing stimulus condition.

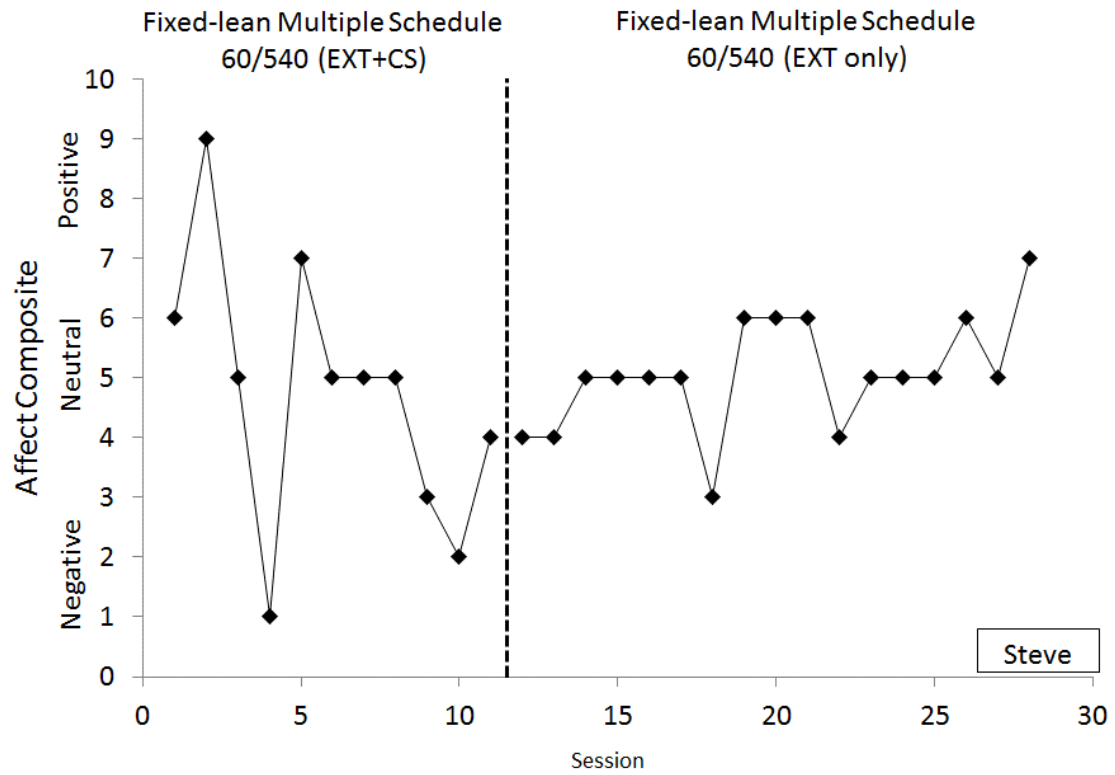


Figure 11. Ratings of Steve’s affect during the extinction component for both conditions in the fixed-lean multiple schedule.

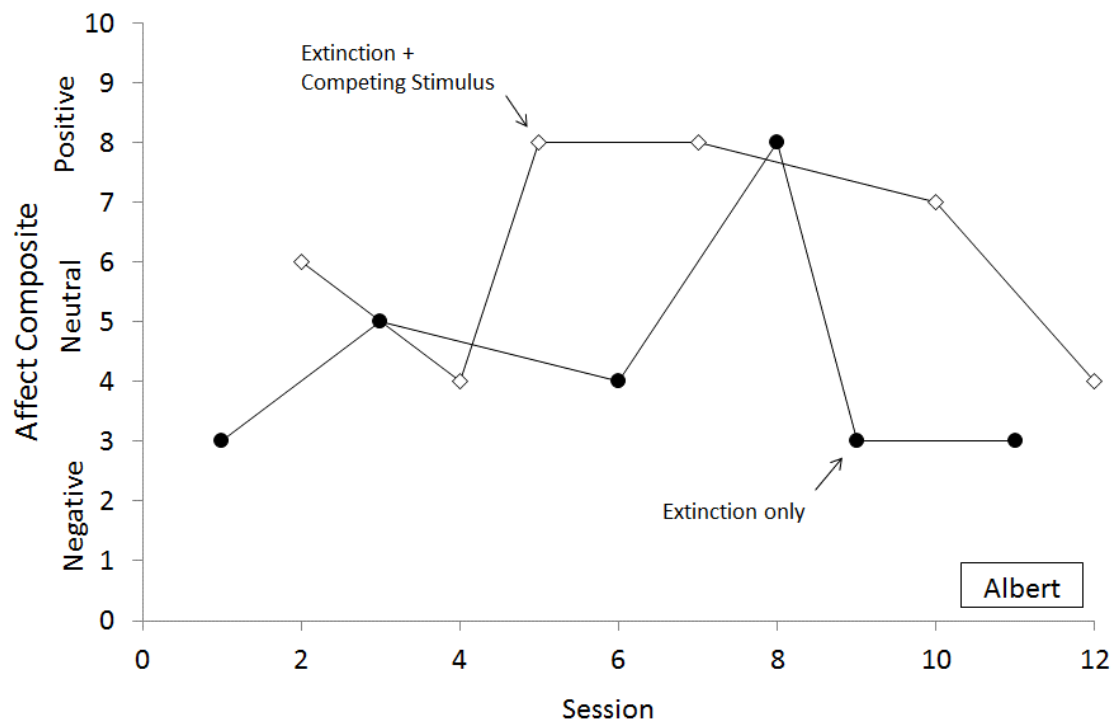


Figure 12. Ratings of Albert's affect during the extinction component for both conditions in the fixed-lean multiple schedule.

Table 1

Results from Questions About Behavioral Function interview with Steve and Albert's caregivers

Function	Steve	Albert
Attention	13	0
Escape	15	11
Non-social	12	0
Physical	9	0
Tangible	15	15

Table 2

*Results of Ms. Smith's agreeableness based on the Treatment Acceptability Rating Form
- Revised*

Item	Ms. Smith's pre-treatment rating	Ms. Smith's post-treatment rating
How clear is your understanding of the suggested procedures?	6	7
How acceptable do you find the procedures to be regarding your concerns for your child?	7	7
Given your child's behavior issues, how reasonable do you find the suggested procedures?	7	7
How costly will it be to implement these strategies?	3	1
How disruptive will it be to your home to implement the suggested procedures?	3	1
How much do you like the suggested procedures?	7	7
How much discomfort is your child likely to experience as a result of these procedures?	4	2
How willing would you be to change your home routine to implement these procedures?	7	7
How well will carrying out these procedures fit into your home routine?	6	7

Table 3

*Results of Ms. Adams' agreeableness based on the Treatment Acceptability Rating Form
- Revised*

Item	Ms. Adams' pre-treatment rating	Ms. Adams' post-treatment rating
How clear is your understanding of the suggested procedures?	5	7
How acceptable do you find the procedures to be regarding your concerns for your child?	6	7
Given your child's behavior issues, how reasonable do you find the suggested procedures?	6	7
How costly will it be to implement these strategies?	1	1
How disruptive will it be to your home to implement the suggested procedures?	3	1
How much do you like the suggested procedures?	3	7
How much discomfort is your child likely to experience as a result of these procedures?	7	2
How willing would you be to change your home routine to implement these procedures?	7	7
How well will carrying out these procedures fit into your home routine?	7	7

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