AN EXAMINATION OF TRIAL-BASED FUNCTIONAL ANALYSIS WITH INTERVENTION IN THE HOME FOR YOUNG CHILDREN WITH OR AT RISK FOR AUTISM SPECTRUM DISORDER

By

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To my mom and dad for their unconditional love and support
To my husband Eric for standing by me on this journey
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<td>ABC</td>
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<td><strong>Applied behavior analysis</strong></td>
<td>The scientific discipline that promotes the use of analytic and systematic approaches to examine socially significant behaviors (Baer, Wolf, &amp; Risley, 1968)</td>
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<tr>
<td><strong>Autism and Developmental Disabilities Monitoring Network</strong></td>
<td>A group of CDC funded programs whose primary purpose is to describe the population of children with autism and identify the changes in the population over time (CDC, 2016)</td>
</tr>
<tr>
<td><strong>Autism Spectrum Disorder</strong></td>
<td>A developmental disability defined by impairments in social communication and behaviors and by the presence of restricted and/or repetitive behaviors (American Psychiatric Association, 2013)</td>
</tr>
<tr>
<td><strong>Alternating treatment design</strong></td>
<td>A research design that allows a researcher to test two or more different conditions simultaneously within the individual within the same phase over time (Barlow &amp; Hayes, 1979; Kazdin, 2011)</td>
</tr>
<tr>
<td><strong>Brief functional analysis</strong></td>
<td>A commonly used procedural variations for functional analysis (FA) and was developed to increase the overall utility of FA procedures in natural environments by shortening the time spent conducting the analysis (Northup et al., 1991)</td>
</tr>
<tr>
<td><strong>Centers for Disease Control and Prevention</strong></td>
<td>A federally funded agency with a primary goal of improving overall public health (CDC, 2018). The CDC funds the ADDM and helps to provide information on autism spectrum disorders including identifying risk factors and possible causes of the condition</td>
</tr>
<tr>
<td><strong>Component</strong></td>
<td>Used to describe the two steps completed in the first study: (1) pre-assessment and (2) trial-based functional analysis</td>
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<td><strong>Condition</strong></td>
<td>Refers to the overall trial type (e.g., attention, tangible, escape) of the TBFA. Each condition was designed to test a specific hypothesis about function of behavior. In the intervention, condition refers to the experimental conditions including: (1) baseline, (2) FCT + EXT, and (3) FCT + EXT + Delay to reinforcement or FCT + EXT + response chaining</td>
</tr>
<tr>
<td><strong>Discriminative stimulus (S^D)</strong></td>
<td>Discriminative stimulus signals the availability of a reinforcer and affects subsequent responding. The S^D can either evoke an increase or decrease in the momentary occurrence of a behavior because of a history the individual has with the availability of a reinforcer (Michael, 1993)</td>
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<tr>
<td>Term</td>
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<tr>
<td>Establishing operation</td>
<td>Refers to environmental events or stimuli that meet two conditions: (a) alters the momentary value of the reinforcer or punisher; and (b) alters the frequency of the behaviors associated with these events (Michael, 1982, 1993)</td>
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<tr>
<td>Extinction</td>
<td>A procedure for which reinforcement that is typically provided for a behavior is no longer delivered. This procedure is used to decrease problem behaviors</td>
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<tr>
<td>Functional communication</td>
<td>A procedure where reinforcement is provided for an alternative communication response to replace problem behavior for gaining access to a functional reinforcer (Carr &amp; Durand, 1985)</td>
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<tr>
<td>Latency functional analysis</td>
<td>A procedural variation of FA where latency (i.e., time from presentation of an event to the onset of the behavior) is used to determine the maintaining consequence in each FA condition as an alternative to measuring frequency of problem behaviors (Call, Pabico, &amp; Lomas, 2009; Thomason-Sassi, Iwata, Neidert, &amp; Roscoe, 2011)</td>
</tr>
<tr>
<td>Motivating operation</td>
<td>The overall term that includes both (a) establishing operations which have an evocative effect and increases the value of a given consequence, and (b) abolishing operations which have an abative effect and decreases the value of a given consequence (Laraway et al., 2003)</td>
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<tr>
<td>Phase</td>
<td>The experimental conditions consisted of multiple phases. A phase change was made within a condition when the intervention did not change, but the delay or number of steps was systematically increased</td>
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<td>Precursor functional analysis</td>
<td>A variation of FA procedures in which the FA conditions are applied to mild problem behaviors that consistently occur before the severe target problem behavior (Lalli, Mace, Wohn, &amp; Livezey, 1995)</td>
</tr>
<tr>
<td>Trial-based functional analysis</td>
<td>A variation of FA procedures in which the analysis is presented in brief trials that are embedded into a natural setting (Sigafoos &amp; Saggers, 1995)</td>
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<td>Trial/Segment</td>
<td>Trial refers to the combined presentation of the absence of the EO (control) followed by the presence of the EO (test). Segment refers to the two separate parts of the trial: a control segment (EO is absent) and a test segment (EO is present)</td>
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<td>Trial/Session</td>
<td>The arrangement of the EO followed by 30 s of access to the reinforcer during intervention. During baseline, the EO was presented and the delivery of the reinforcer was contingent upon problem behavior (similar to the test condition of the TBFA). During intervention, the EO was presented and delivery of the reinforcer was contingent upon functional communication. A session was comprised of 5 trials</td>
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<tr>
<td>Single case research design</td>
<td>A research design where participants serve as their own control and the target behavior is repeatedly measured using a design that controls for threats to internal validity (Sidman, 1960)</td>
</tr>
<tr>
<td>Self-injurious behavior</td>
<td>Self-injurious behavior is defined as movements made by the individual that results in injury to his/her own self using a part of their body, an object, or other surfaces to cause the injury including head banging, hand biting, face slapping, or any other self-inflicted violent behavior (Carr, 1977)</td>
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<tr>
<td>Young children</td>
<td>Refers to children 8-years-old and younger</td>
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Young children with autism spectrum disorders (ASD) are likely to demonstrate severe problem behaviors due to core deficits in social communication and the presence of repetitive and/or restrictive behaviors. Problem behaviors in young children, including those with ASD, are often a result of exposure to environmental variables (i.e., antecedents and consequences) that serve to set the stage for the occurrence of behavior and maintain behaviors after they occur. Thus, identification of these environmental variables using experimental procedures such as functional analysis (FA) can be used to develop effective interventions. Trial-based functional analysis (TBFA) is a variation of traditional FA procedures where the analysis is embedded into natural settings. A small body of literature using TBFA has emerged, however, few studies have examined the application of TBFA in the home setting. The purpose of this study was to examine the use of TBFA in home settings to determine the function of problem behavior in four young children (age 3-5) with or at risk for ASD. The results of the TBFA were then used to develop a functional communication training intervention to replace problem behavior with functional communication.
For all four participants, function of the problem behavior was determined using TBFA in the home. For two of the participants, a single function (i.e., access to tangible) was determined and a multiple baseline across tangible items was implemented for one of these participants. For the other two participants, multiple functions were identified (i.e., access to tangible and escape from demand) and a multiple baseline across demands was implemented.

The results of the study suggest that TBFA can be implemented in a home setting as at least one function of behavior was identified for each participant. Moreover, the interventions developed based on the TBFA decreased problem behavior to 0% and increased functional communication. Social validity reports from caregivers indicate that the procedures to analyze and intervene on the problem behaviors in the home are acceptable and effective ways to handle their child’s problem behaviors. Implications for research and practice are discussed and suggestions for future research studies are presented.
CHAPTER 1
INTRODUCTION

Autism spectrum disorder (ASD) is a developmental disability defined by impairments in social communication and behaviors and by the presence of restricted or repetitive behaviors (American Psychiatric Association, 2013). According to the most recent data from the Autism and Developmental Disabilities Monitoring Network (ADDM) and the Center for Disease Control (CDC), 1 in 59 or 1.7% of 8-year-old children are identified with ASD (CDC, 2018). Although its prevalence is wide-spread, ASD is a heterogeneous disorder with varying effects on the severity of the core ASD symptomology among individuals with the diagnosis (Ben-Itzchak & Zachor, 2007).

Young children with ASD are at risk for developing problem behaviors such as aggression, destruction, disruption, and self-injurious behavior (SIB) given the core ASD symptomology described above (Horner, Carr, Strain, Todd, & Reed, 2002; Machalicek et al., 2016). For example, findings from numerous research studies indicate a relationship between communication deficits and the development of problem behavior (e.g., Bott, Farmer, & Rhode, 1997; Carr & Durand, 1985; Sigafoos, 2000). Although problem behavior often emerges in early childhood for children with or without disabilities, children with ASD demonstrate these behaviors with increased intensity and frequency (Machalicek et al., 2016). Green, O'Reilly, Itchon and Sigafoos (2005) found evidence that moderate to severe problem behaviors present at the age of four in children with developmental disabilities such as ASD are not likely to decrease due to the passage of time. As such, if problem behaviors are not ameliorated during early childhood, children with ASD are also at risk for limited access to educational and social opportunities (Machalicek et al., 2016; National Research Council, 2001). Thus, findings
from the research support the need for explicit intervention to prevent and reduce
problem behaviors during the preschool years for children with or at risk for ASD (Green
et al. 2005).

From a behavioral perspective, problem behaviors in young children, including
those with or at risk for ASD, are often a response to environmental variables, such as
antecedents and consequences. For example, antecedents are stimuli that might serve
as a cue to the child that reinforcement for a specific behavior is available due to a
history of reinforcement (Wolery, 2000). Moreover, problem behaviors maintained by
their functional effect on the environment are not likely to decrease without altering the
value or availability of the maintaining consequences (Horner, Carr, Strain, Todd, &
Reed, 2002). Thus, identification of these environmental variables can be used to
develop effective interventions aimed at decreasing problem behavior. To do so,
functional analysis (FA), a procedure to identify causal relationships between the
behavior and the environment, is often used (Iwata, Dorsey, Slifer, Bauman, &

Functional analysis is a practice of experimentally manipulating environmental
variables to determine what evokes and maintains behavior (Iwata et al., 1982/1994).
Since the conception of FA, the procedures as described by Iwata and colleagues have
become known as traditional practice, however, several practical constraints of FA have
been identified (Iwata & Dozier, 2008). In response, behavioral researchers have
modified and varied traditional FA procedures to increase the applicability of FA to a
variety of behaviors and settings (Lydon, Healy, O’Reiley, & Lang 2012). One such
varied procedure, trial-based functional analysis (TBFA), has been used to apply FAs to natural environments (Rispoli, Ninci, Neely, & Zaini, 2014; Sigafoos & Saggers, 1995). The TBFA exposes the individual to experimental conditions similar to the traditional FA (e.g., attention, tangible, escape), but in contrast with traditional FA procedures, the conditions are delivered in short trials during typically occurring routines in a natural environment (Sigafoos & Saggers, 1995). Data are then summarized via a bar graph that indicate the percentage of trials in which problem behavior occurred. To date, TBFA has been primarily conducted with individuals with developmental disabilities, including ASD, in schools and residential settings and its use is increasing in the behavioral research literature (Rispoli et al., 2014).

The purpose of this chapter is to provide the context for the present study and a statement of the problem leading to the examination of the use of TBFA to assess the problem behaviors of young children with or at risk for ASD in the home setting. The purpose of the study, along with the study’s specific research questions will be presented. Next, the significance of the study will be discussed to highlight specific contributions this study makes to both research and practice in early childhood. Finally, delimitations and limitations for the present study will be stated.

**Context for the Study**

**Theoretical Context**

The present study is guided by a behavioral framework (Bijou, 1957). Within this framework, analysis of complex behaviors can be broken down into basic behavioral units and summarized through the application of behavioral principles (Catania, 1998). These behavioral principles are used to explain the functional relation between observable behavior and its environmental variables (Cooper, Heron, & Heward, 2007).
In relation to young children, the assumption is that a child’s behavior might result in a probable consequence that impacts the likelihood that the behavior will occur again in the future. Moreover, the child’s behavior might also serve to produce adult behaviors that impact the likelihood that the adult behavior will occur again in the future. The relationship between observable behaviors and environmental variables and the relationship between children and adult (e.g., caregiver, teacher) behavior provides a description of how problematic behaviors might be established and maintained (Wolery, 2000).

A notable characteristic of the behavioral framework is the distinction between the structural and functional aspects of a behavior. While a descriptive account of the structure of the behavior (i.e., topography) is essential for observation and monitoring, it is even more imperative to identify units of behavior by their functional effects on one another (Cooper et al., 2007). A function-altering effect occurs when an environmental event (e.g., antecedents and consequences) modifies future behavior when similar conditions are presented (Michael, 1993). Also, often viewed as a structural entity within other frameworks (e.g., people, setting), a behavioral perspective of the environment includes the analysis of stimuli and motivational factors that have a functional relation to the behavior (Schlinger, 1992). For example, during intervention the environment should be structured to increase the likelihood that behaviors occur with predictable consequences that reinforce desirable behaviors (Wolery, 2000).

Applied behavior analysis (ABA) is the scientific discipline that promotes the use of analytic and systematic approaches to examine socially significant behaviors such as identifying the environmental variables that influence problem behavior (Baer, Wolf, &
Research that is analytic demonstrates both the application of behavioral principles and the evaluation of whether this application can be attributed to changes in the behavior (Baer et al.). Research that is applied demonstrates that the targeted behaviors are socially significant and of immediate importance to the participant of the study. Although the assumption might be that applied studies are conducted in a typical environment, much of the research takes place in clinical settings (Baer et al.). While examining socially significant behaviors in clinical settings allows for the precise experimental control of relevant variables, the setting where these behaviors typically occur is often not as easily controlled (Baer et al.).

An important component of the theoretical context for this present study is that the analytic procedures take into account the social setting in which problem behaviors typically occur creating a balance between conducting research that is analytic and applied (Leaf et al., 2016). Ensuring that both of these dimensions (i.e., analytic and applied) are adhered to might result in increased levels of consumer satisfaction, consistent use of behavioral procedures, and the development of effective interventions (Leaf et al., 2016). Consequently, researchers that use both applied and analytic procedures are likely to improve behaviors that are socially significant (Baer et al., 1968; Leaf et al., 2016; Wolf, 1978).

Functional Analysis

Although not intended to describe a specific set of experimental procedures, Skinner (1938), an influential researcher in the science of human behavior, first used the term *functional analysis* to acknowledge that the environment might potentially control behavior. Years later, Carr (1977) described multiple hypotheses of function to explain the purpose of the behavior and inform the development of an effective
intervention matching the function. These hypotheses included: (a) social positive reinforcement; (b) social negative reinforcement, and (c) automatic reinforcement.

Based on Carr’s (1977) conceptualization of behavioral functions, Iwata and colleagues (1982/1994) developed a FA methodology that repeatedly measured potential functions of SIB across four conditions (i.e., each designed to test a specific potential reinforcer) using a multi-element single case research design (SCRD). These experimental analogue conditions included (a) social disapproval, (b) academic demand, (c) unstructured play, and (d) alone. A fifth condition, access to tangible, was later added by researchers (Mace & West, 1986), who determined that some behaviors were maintained by positive reinforcement, but in the form of tangible items or preferred activities rather than the attention of another person.

Since the inception of FA, hundreds of studies have been conducted using FA and adaptations or extensions of FA to determine the functions of a wide range of problem behaviors and populations (for reviews, see Beavers, Iwata, & Lerman, 2013; Hanley, Iwata, & McCord, 2003). The FA procedures as described by Iwata and colleagues (1982/1994) demonstrate strong experimental control, however, researchers have found that when FAs are conducted in natural environments obtaining strong experimental control may be more difficult when compared to those conducted in contrived settings. As such, researchers have examined the need to expand or modify to increase FA applicability to certain populations, behaviors, and settings (Hanley, 2012). For example, Iwata and Dozier (2008) outlined several practical constraints to FA methodology including the (a) time available for conducting the FA using the original procedure, (b) potential to reinforce severe problem behaviors that increase risk of
injury, and (c) inability to control the environment enough to isolate the variables associated with the problem behavior. More recently, Hanley (2012) added issues related to the (a) complexity of the procedures, (b) difficulty obtaining buy-in from constituents (e.g., caregivers, teachers), and (c) analysis of multiple topographies of problem behavior. Thus, consideration of these constraints is important when designing FA procedures, especially in the natural environment.

**Early Intervention, Problem Behavior, and ASD**

Researchers from multiple disciplines such as developmental neuroscience, psychiatry, special education, and ABA have contributed to the scientific literature on identifying and intervening on the symptoms of ASD in young children. Although different in approach, all confirm the importance of early identification and intervention for young children with ASD (Dawson, 2008; Woods & Wetherby, 2003). While not a diagnostic criterion for ASD, the propensity for individuals with ASD to demonstrate problem behaviors, such as aggression and destruction, is common and concerning (Herzinger & Campbell, 2007). Although behavior can be observed in many forms and can change due to the influence of environmental variables, problem behavior for individuals with ASD are likely to be higher in intensity when compared to other developmental disabilities (Lanovaz, Rapp, Gendron, Prefontaine, & Turgeon, 2017). Intervention, especially at a young age, is essential for the possible prevention or treatment of problem behaviors (Horner et al., 2002).

Specific to the field of ABA, the importance of early intervention for young children with or at risk for ASD is well documented (Hume, Bellini, & Pratt, 2005; Lovaas, 1987; Perry, Blacklock, & Geier, 2013; Reichow, 2012; Rogers, 1996). The underlying rationale is that intervening early and teaching replacement behaviors before
problem behaviors have become a part of an established repertoire might prevent other severe behaviors from developing (Dawson, 2008; Perry et al., 2013). Use of FA to identify the environmental determinants associated with problem behaviors allows for the development of an effective intervention to decrease the likelihood of the behavior occurring in the future. To that end, the focus of this study is on young children (age 3-5) with or at risk for ASD who are already exhibiting problem behaviors that have the potential to increase in severity if not treated.

**Statement of the Problem**

Given the likelihood of young children with or at risk for ASD to develop problem behaviors due to their core deficits in communication and social competence and the importance of high quality early intervention for ameliorating these behaviors, researchers have placed increasingly more attention on effective analysis and intervention (National Research Council, 2001). Moreover, while it might be useful to assess behaviors in controlled clinical settings, the reality is that the behaviors might not occur as they do in a natural environment when assessed in more controlled conditions. Thus, questions of the effectiveness of interventions developed based on a highly controlled FA are relevant.

Conducting FAs in authentic settings (e.g., home, school) is increasing (Beavers et al., 2013). One reason for the increase is that contrived settings might not always include the idiosyncratic variables present in natural environments that evoke the problem behavior. Researchers have shown that problem behaviors could potentially have multiple functions and those functions might vary from one setting to another based on contextual factors (Conroy, Fox, Crain, Jenkins, & Belcher, 1996; Derby et al., 1992) In fact, it is unclear if analogue assessment procedures in a highly controlled
clinical setting (i.e., traditional FA) might overlook environmental determinants of behaviors that might be applicable to the conditions where intervention would take place (Conroy et al., 1996; Lloyd et al., 2015). Researchers need to explore how to determine what settings can result in an accurate assessment of function and in what ways FA procedures can be adapted to maintain the intended experimental control (Lang et al., 2008; Lang, Sigafoos, Lancioni, Didden, & Rispoli, 2010).

Trial-based functional analysis (TBFA) offers one option for embedding the analysis of problem behavior into a natural environment. In contrast to the traditional FA, conditions are presented in brief trials where they might naturally occur. In other words, instead of contriving a setting where the conditions are presented in a pre-specified schedule, TBFA includes the use of natural antecedents and consequences in the environment within the analysis (Rispoli et al., 2014). Although several researchers have examined its use in school settings, research examining the applicability of TBFA to the home setting is limited (Rispoli et al., 2014). In fact, there are only two known studies that used TBFA in a home setting (Gerow, Rispoli, Ninci, Gregori, & Hagan-Burke, 2017; Gerow, Rispoli, Gregori, & Sanchez, 2018). Although Gerow et al. (2017) used the procedures to assess function in the home, the focus of the study was not on the TBFA, but rather the intervention following the TBFA. More applications of the procedures would provide an in-depth examination of the use of TBFA in a family’s home as opposed to a classroom or other settings. Further, Gerow et al. (2018) indicate that the number of trials per condition was based on the literature, but less trials might be useful (i.e., shortened duration of the analysis) especially when considering the social validity of the procedures to the caregivers. Finally, Gerow et al. recognized the
need for TBFA procedures to be overseen by individuals experienced in ABA and reported that five to seven hours of behavioral consulting was needed to train parents in the TBFA procedures in addition to the time needed to conduct the procedures. To that end, an examination of a TBFA procedures that lead to an identification of function without the need to train parents (i.e., conducted by a novel person) might shortened the assessment time in the home.

Taken together, TBFA offers an opportunity to embed an analysis of behavior into the natural environments where behavior commonly occurs for young children. As supported by research, home-based interventions might be essential given that problem behaviors can emerge in young children with developmental disabilities, such as ASD, as early as age four, if not earlier (Green et al., 2005). A TBFA would use variables in the home that might be excluded from a highly control clinical version of the FA that might influence the problem behavior. Moreover, the intervention for the problem behavior could then be implemented in the same setting in which the FA was conducted, possibly increasing its social validity. The need exists to further examine the TBFA and its utility in the home, especially for young children with ASD who are demonstrating problem behaviors.

**Purpose of the Present Study**

The purpose of this study was to examine the use TBFA in a home setting to identify functions of problem behaviors for young children with or at risk for ASD and use the results of the TBFA to develop a function-based intervention aimed at decreasing the problem behaviors.

This study will address the following research questions:
• Can TBFA conducted in the home identify the function of problem behaviors in young children with or at risk for ASD?

• Does a functional communication training intervention based on the results of the TBFA conducted in the home produce a decrease in the occurrence of problem behavior in young children with or at risk for ASD and an increase in the occurrence of functional communicative responses?

• What are the caregiver’s perception of the utility and feasibility (i.e., social validity) of TBFA in the home?

**Significance of the Present Study**

Problem behaviors can have a negative impact on both children with or at risk for ASD and their families (Horner et al., 2002; National Research Council, 2001). Children who demonstrate problem behaviors are at a disadvantage for engaging in positive social interactions and receiving necessary academic and adaptive interventions (Powell et al. 2006). Moreover, families living with a child who demonstrates problem behaviors may experience an increase in stress, which impacts their overall quality of life (Tudor & Lerner, 2015). Early intervention for problem behaviors is important, and thus, analysis of behavior that is authentic and accurate is vital (Horner et al., 2002).

Traditional methods of FA systematically alter environmental variables in highly controlled settings, which may not account for the idiosyncratic variables present in a natural environment that could influence problem behavior and its function (Carr, Yarbrough, & Langdon, 1997; Sigafoos & Saggers, 1995). Therefore, it is important to examine the use of an adaptation to FA procedures to determine function of behavior in different natural environments. Researchers have shown that using TBFA is one way to embed FA procedures within ongoing, natural routines (Sigafoos & Saggers, 1995). The use of TBFA has been demonstrated primarily in a school setting by comparing the outcomes of a traditional FA to the outcomes of the TBFA (Rispoli et al., 2014). While
TBFA have been successfully employed in a school setting, a home setting offers unique circumstances that warrant additional research (Gerow et al. 2017; Standish, 2014). The present study is of significance because few studies have demonstrated the effectiveness of using TBFA in a home setting. When successful in identifying the function using everyday routines and decreasing problem behavior within that setting, TBFA and its subsequent intervention has the potential to increase the child’s communicative competence and quality of life.

This study contributes to the research literature and practice in several ways. First, the study examined the utility of the TBFA to identify the function of problem behavior to further contribute to a small, albeit increasing, current literature base. Second, the study provides a systematic replication of TBFA procedures in the home setting. By expanding the use of TBFA methodology, which has typically been used in school settings, the study examined factors, such as routines and materials, that might influence its implementation in a different natural environment common to young children. Thus, this study provides an examination of the ecological and social validity of conducting TBFA in the home for young children with or at risk for ASD. Finally, the results of the TBFA were used to design and implement a function-based intervention. The usefulness of the TBFA to identify the function of behavior and inform an effective intervention in the home setting is important for furthering the research literature.

**Delimitations**

To feasibly address the research questions, the study was implemented within specific parameters. First, the study was delimited to a researcher-implemented TBFA in the home setting for young children with or at risk for ASD. As this was an examination of the TBFA procedures to ensure its ability to identify function of problem
behaviors in the home setting, the caregiver was not trained or responsible for the implementation of the TBFA or intervention. Next, the study was delimited to children between the age of three and five with or at risk for ASD and does not include examination of the applicability of the procedures children beyond the defined age range or with other conditions. Finally, for practicality of the study, data collection was delimited to one to two hour sessions. This is in contrast to studies using TBFA in other studies whereas data collection occurred across the full day.

**Limitations**

A number of limitations to the present study are noted. First, a restricted age range (i.e., ages 3-5) was used for the participants in this study. Although this allows the focus of the procedures to be on a critical time period during early childhood when problem behaviors are likely to evolve, specifically to the preschool age range, this restriction limits the applicability of the findings to a small population of children with or at risk for ASD. Second, the TBFA was conducted by a researcher and not the primary natural change agent in the home setting. The researcher is not a typical person in the child’s environment, thus, behaviors maintained by the presence of a specific person (e.g., caregiver, sibling) might have been missing from the analysis. Moreover, the social validity data on the TBFA and intervention procedures is limited to the extent of which the caregiver was aware of the procedures that were being implemented. Next, data collection was limited to one to two hours during the day and did not occur across all possible routines and activities typically occurring in the home. Although maintaining this schedule of data collection was chosen for practicality (e.g., children were typically in school during the day, availability of the families), this limits the generalizability of the results to other activities or settings in which the behaviors might occur.
CHAPTER 2
REVIEW OF THE LITERATURE

The purpose of this chapter is to (1) define problem behavior and its specific impact on individuals with autism spectrum disorder (ASD); (2) provide an overview of functional analysis (FA) situated in a behavioral framework including a description of the methodology, discussion of common constraints, and recommended practices; (3) offer a conceptual framework that informed the development of the current study; (4) present two systematic reviews of relevant bodies of literature including literature using FA in the natural environment specific to young children with ASD and literature using trial based functional analysis (TBFA); and (5) present a critical review of the literature to identify directions for future research and provide a rationale for the current study.

Autism Spectrum Disorder and Problem Behavior

Autism spectrum disorder (ASD) is a developmental disability defined by impairments in social communication and by the presence of restricted and/or repetitive behaviors (American Psychiatric Association, 2013). According to the most recent data from the Autism and Developmental Disabilities Monitoring Network (ADDM) and the Center for Disease Control and Prevention (CDC), 1 in 59 or 1.7% of 8-year-old children are identified with ASD (CDC, 2018). Often described as a spectrum, ASD affects individuals in a variety of ways as symptoms can range from mild to severe (APA, 2013) and ASD often co-occurs with other behavioral or medical conditions (Wiggins et al., 2015). Young children with ASD are at risk for developing problem behaviors that emerge early in childhood due to delays in communication and social skills repertoires (Machalicek et al., 2016).
Defining Problem Behavior

Problem behavior is defined in a variety of ways across the literature. Although the specific definitions vary, a general definition of problem behavior includes behaviors that are: (1) operationally defined by their intensity, frequency and duration; (2) socially or culturally unacceptable (Machalicek et al., 2016); (3) potentially a physical danger or threat to the safety of self and others (Jang, Dixon, Tarbox, & Granpeesheh, 2011; Machalicek et al., 2016); and (4) negatively impacts daily activities (Hartley, Sikora, & McCoy, 2008). Moreover, Smith and Fox (2003) define problem behavior as a repeated pattern of behavior that interferes, or has the potential to interfere, with learning and positive social interactions. Despite the variation in definition, the overall consensus is that young children who demonstrate problem behaviors are at risk for poor social development and negative educational outcomes (Horner et al., 2002; Jang et al., 2011). Problem behavior often emerges in early childhood, for children with or without disabilities; however, children with ASD demonstrate these behaviors with increased intensity and frequency (Machalicek et al., 2016).

Prevalence and Description of Problem Behaviors in Individuals with ASD

The prevalence of problem behavior in individuals with ASD has been examined in several studies. For example, Hartley and colleagues (2008) found of 169 young children (age 1.5 – 5.8 yrs) with ASD, one third had clinically significant problem behaviors at a level that potentially impacted their daily functioning. Moreover, in a study to examine the prevalence and types of problem behavior exhibited by children with ASD, Jang et al. (2012) found that of the 84 children in their study (mean age = 94 mos), 94% exhibited some form of problem behavior. Finally, other researchers have examined the association between problem behaviors, intellectual functioning, and
ASD. Holden and Gitlesen (2006) found that the severity of problem behavior was associated with the presence of an intellectual disability and behaviors occurred more frequently in individuals with ASD when compared to other developmental disabilities (e.g., Down’s syndrome). Consequently, without intensive, specialized intervention, problem behaviors in children with ASD are not likely to decrease and can impact the long-term quality of life of the child and their family (Horner et al., 2002).

Children with ASD can display a variety of problem behaviors that are operationally defined by the research under several general topographical categories including: aggression, destruction, disruption, self-injurious behavior (SIB), and stereotypy (Horner et al., 2002). Aggression, one of the most frequently reported problem behaviors for young children with ASD (Horner et al., 2002), is commonly defined as any behavior that results in or has the potential to cause injury to another person including kicking, punching, pinching, and hitting (Pelios, Morren, Tesch, & Axelrod, 1999). Destruction is defined as any behavior that results in or has the potential to cause damage to items or property including banging surfaces, breaking, tearing or throwing objects (Didden et al., 1997; Kuhn, Hardesty, & Sweeney, 2009). Disruption is defined as behaviors that cause a disturbance of social norms and impact daily functioning including noncompliance (e.g., refusal to follow directions), tantrums, inappropriate vocalizations, crying, and screaming (Horner et al., 2002). Self-injurious behavior is defined as movements made by the individual that results in injury to his/her own self using a part of their body, an object, or other surfaces to cause the injury including head banging, hand biting, face slapping, or any other self-inflicted violent behavior (Carr, 1977). Finally, stereotypies often described as repetitive behavior which
is a core symptom of ASD (APA, 2013), are defined as a broad class of behaviors described as repeated motor actions such as the repetitive movements or manipulations of items (Boyd, McDonough, & Bodfish, 2012).

Topography of behavior provides little information about the environmental variables maintaining the behavior, which are critical features to identify to develop effective interventions (Carr, 1977). As described in Chapter 1, Carr (1977) provided several hypotheses regarding the function of behavior including: a) social positive reinforcement; (b) social negative reinforcement; or (c) automatic reinforcement. The underlying assumption of these functional hypotheses is that topographically similar behaviors can serve different functions across people or within an individual. To develop effective interventions, it is important to identify the consequences that are maintaining problem behaviors (Dunlap & Fox, 2011; Iwata et al., 1982/1994).

Socially mediated behaviors (i.e., behaviors for which a consequence is provided by another people) can serve two functions: social positive or social negative (Carr, 1977). The hypothesis for behaviors associated with a social positive function states that the problem behavior can be maintained by the delivery of different forms of attention, tangible items, and/or access to preferred activities (Carr, 1977). If problem behavior were maintained by positive reinforcement, then one would assume the behavior would stop when the access to the preferred item or activity is presented (Carr, 1977).

Alternately, behaviors that have a social negative function are maintained by the termination or avoidance of an aversive stimulus (e.g., demand) that is applied following the occurrence of the behavior (Carr, 1977). In this situation, problem behavior is
maintained by the opportunity to escape an undesirable situation, activity, or person. If problem behaviors are maintained by negative reinforcement, then one would assume the behaviors would stop when the stimulus associated with the ending of an aversive situation is presented (Carr, 1977). Behaviors can also be maintained by consequences that are independent of the social environment (Lloyd & Kennedy, 2014); thus, the delivery of the reinforcement is not dependent on another individual. Behaviors can be maintained either by automatic positive reinforcement (e.g., providing sensory stimulation) or automatic negative reinforcement (e.g., removing of an aversive stimulus; Rapp & Vollmer, 2005).

**Summary**

Problem behaviors often emerge during early childhood and can vary in topography. Although it is not uncommon for young children to engage in problem behaviors, these behaviors often occur at a higher frequency or intensity for children with ASD due to limitations in communication and social skills. Problem behaviors are operationally defined and categorized by their topography, or the physical description of the behavior observed. While defining problem behavior by description is appropriate for monitoring and data collection, these descriptions do not provide information about the maintaining contingencies surrounding the behaviors, which can help to inform effective interventions. Although behaviors may be similar in topography, behaviors might differ in function, or the maintaining contingencies surrounding the behavior. The following section provides an overview of FA and the development of procedures that focus on identifying the function of behavior.
Overview of Functional Analysis

Functional analysis (FA), both conceptually and procedurally, can be placed in the historical context of the science of human behavior (Iwata et al., 1982/1994). Applied behavior analysis (ABA), a discipline based on the conceptual foundation of operant conditioning, has influenced not only the development of functional analysis, but the refinement and modification of the practice as well (Baer et al., 1968; Dixon et al., 2012). This section provides a: (a) brief history of the experimental analysis of behavior and its contributions to the development of the ABA discipline, (b) description of FA as described in Iwata et al.’s (1982/1994) seminal study that presented the first set of standardized experimental procedures for examining the function of behavior; and (c) description of some common constraints to FA methods and suggestions for best practice.

History of Experimental Analysis of Behavior

Early psychology was focused on mental processes such as feelings and emotions rather than observable events (Dixon et al., 2012). John Watson (1913) laid the scientific groundwork for the analysis of behavior by studying the relationship between the environment and observable behaviors. He described behavior in terms of a stimulus-response (S-R) relationship and asserted the study of behavior should be on par with other natural sciences (e.g., biology). Although researchers expanded Watson’s S-R theory, Watson’s initial shift in thinking about behavior as a science was instrumental in the development of the discipline of ABA (Cooper et al., 2007).

B.F. Skinner (1938) extended Watson’s S-R theory by incorporating the stimulus condition that followed a behavior as the third variable in the behavioral contingency. Skinner believed that not all behavior could be explained by the stimuli that preceded
the behavior and that it was necessary to examine stimuli that followed the behavior as well. Thus, Skinner’s experimental analysis of behavior included an analysis of operant behavior, defined as behavior whose probability of occurrence is influenced by the history of consequences (Cooper et al., 2007). Skinner’s initial use of the term *functional analysis*, description of the antecedent, behavior, consequence (ABC) contingency, and examination of operant behaviors led to an increase in the application of behavior analysis to explain and change human behavior in the 1950s and 1960s (Dixon et al., 2012).

The early work of Bijou in the 1950s helped to extend and apply the experimental analysis of behavior to humans (Bijou, 1957). Bijou was instrumental in the field for developing a systematic approach for analyzing child behavior. He refined procedures to maximize control over independent variables by studying behavior in a well-controlled environment (Dixon et al., 2012). Some of Bijou’s most notable contributions to the science of behavior include the application of behavioral principles to the classroom learning environment (i.e., a natural environment), the examination of patterns of reinforcement and extinction in young children, and the development of a descriptive analysis to identify the environmental variables maintaining behavior (Mendres & Frank-Crawford, 2009).

In 1968, the inaugural issue of the *Journal of Applied Behavior Analysis (JABA)* was published making it the first major journal dedicated to research on the applied application of behavioral theory (Cooper et al., 2007). A seminal paper published in that issue by Baer, Wolf, and Risley (1968) outlined the defining components of ABA, which included a focus on using the methodology to target socially significant behaviors.
Seven dimensions of ABA are described in this landmark paper including that the science be applied, behavioral, analytic, technological, conceptually systematic, effective and generalizable (Baer et al., 1968).

Research within this field illustrates that both the antecedent, that indicates a connection between a discriminating stimulus and the consequent event, and the consequences on the environment produced by the behavior affects a behavioral response. Describing behavior within the three-term contingency (i.e., ABC) acknowledges the interdependency of the components (Cooper et al., 2007). Thus, research using behavioral procedures involves the manipulation of one or more of these components (Cooper et al., 2007).

**Discriminative stimulus.** Some antecedent variables may set the occasion or signal availability of reinforcement for a particular problem behavior (Smith & Iwata, 1997). Antecedents that signal the availability of a reinforcer are called a discriminative stimulus ($S^D$) and affect subsequent responding. The $S^D$ can either evoke an increase or decrease in the momentary occurrence of a behavior because of a history the individual has with the availability of a reinforcer (Michael, 1993). In other words, a behavior occurred in the presence of the $S^D$ in the past and was previously followed by reinforcement. Conversely, in the absence of the $S^D$, that same behavior is associated over time with lesser availability or no availability of the reinforcer (Michael, 1993). A $S^D$ does not only describe the condition in which a response is reinforced, but also the evocative effect it might have on a behavior. Thus, the motivating conditions are also of importance in determining the strength of the $S^D$ (Michael, 1993).
Consequences and the environment. A behavioral consequence is defined as any event that follows a behavior in a temporal sequence that affects the probability that behavior will occur again in the future (Cooper et al., 2007). Consequences are either in the form of a stimulus that is added or removed from the environment. Moreover, consequences are classified by their effect on future occurrences of the behavior. Specifically, if the likelihood of a behavior increases after the presentation or removal of a stimulus, reinforcement has occurred. If the likelihood of a behavior decreases after the presentation or removal of a stimulus, punishment has occurred (Cooper et al.). Responses that differ slightly in their form, but result in the same consequences are considered to be a part of the same response class (Cooper et al.) For example, behaviors that are topographically different might result in the same reinforcer. Alternatively, responses may occur in hierarchical order within the response class whereas slightly less severe behaviors occur prior to more severe behaviors in an effort to produce a similar consequence (Smith & Churchill, 2002).

Four-term contingency. As described earlier, behavior can be explained by its function in three general classes of reinforcement: positive, negative, and automatic. In most instances, there are particular aspects of those broad functions that could determine how strong that reinforcer is for the particular behavior of interest (Carr, Yarborough, & Langdon, 1997). Although behavior is often described as a three-term contingency, the motivating variables that resulted in the consequence functioning as reinforcement should be identified and considered (Michael, 1993). Extending beyond the theory of operant conditioning described by Skinner (1953), the conceptualization of a fourth-term in the contingency that describes additional factors influencing the
antecedent, behavior, and consequence has emerged within two theoretical models in the research literature (Kantor, 1953; Michael, 1982). One model uses the term *setting factor* to describe the immediate conditions that function to strengthen a \( S^D \), behavioral response, and reinforcer (Bijou, 1978; Kantor, 1953). A second model, described by Michael (1982), uses the term *motivating operation* to describe the fourth-term’s influence over the momentary value of the available reinforcers.

**Setting factors.** Kantor (1953) originally situated the term *setting factor* within an interbehavioral framework in which he posited that the interactions between a stimulus and a response had a bi-directional reciprocal relationship. Within this framework, Kantor’s conceptualization of the setting factor encouraged researchers to look beyond the immediate antecedents to temporally remote and distal events that may also have stimulus properties for the behavior (Smith & Iwata, 1997). Bijou and Baer (1961) extended the term setting factor to the child development literature outlining two types of antecedent events; the setting factor and the more discrete stimulus event. These authors categorized setting factors into three groups including 1) physical (e.g., contextual conditions such as the level of noise, temperature), 2) physiological (e.g., satiation or deprivation of needs such as food and water, biological factors such as illness and fatigue), and 3) sociocultural (e.g., contexts such as home, school, presence of particular people). Thus, setting factors could either precede or occur concurrently with the interaction between a particular \( S^D \) and its related consequence to influence the behavioral response (Whaler & Fox, 1981).

**Motivating operations.** First described as an *establishing operation* (EO), motivating operations (MO) refers to environmental events or stimuli that meet two
conditions: (a) alters the momentary value of the reinforcer or punisher; and (b) alters the frequency of the behaviors associated with these events (Michael, 1982, 1993). Michael (2000) later refined the term (i.e., EO) by coining *motivating operation (MO)* as an omnibus term to explain that there is not always an increase in the value of a reinforcer, which might have been implied by the use of the term “establishing.” In fact, the value might also be decreased (Laraway, Snycerski, Michael, & Poling, 2003). To that end, a MO is considered the overall term that includes both (a) establishing operations which have an evocative effect and increases the value of a given consequence, and (b) abolishing operations which have an abative effect and decreases the value of a given consequence (Laraway et al., 2003). To clarify, a SD signals the chance of one accessing the reinforcer, whereas the MO affects one’s motivation to obtain it (McGill, 1999).

**Summary.** The pioneering work of early researchers laid the groundwork for the current application of behavioral research to socially significant behaviors and for the systematic and analytic examination of the effect of environmental variables on behavior. Scientists such as Watson, Skinner, and Bijou were responsible for the development of a behavioral science that analyzed observable behaviors in a systematic way to identify contingencies that maintain behavior. Skinner (1938) described functional analysis initially as a conceptual framework for examining contingencies maintaining operant behaviors. Applied behavior analysis emerged as a discipline where researchers applied the principles of operant behavior to socially significant behaviors in systematic and analytic ways (Baer et al., 1968). Within this framework, behavior is described by the three-term contingency that includes the
antecedent, behavioral response, and consequence. Additionally, researchers have explored a fourth-term that described the environmental factors that influence motivational factors associated with the response. In conclusion, the application of these theories and principles were instrumental in the development of functional analysis as a practice of experimentally identifying the variables that maintain problem behavior.

**Functional Analysis (FA)**

Based on the conceptualization of behavior function described by Carr (1977), Iwata and colleagues (1982/1994) developed a methodology that repeatedly measured SIB using a multi-element single case research design (SCRD) across multiple conditions designed to test a specific potential reinforcer (i.e., identify function). They originally described the FA procedures with four experimental conditions, each presented for 15 min sessions. The first condition, social disapproval, required that the experimenter provide attention to the participant contingent upon any occurrence of problem behavior (i.e., self-injury). The rationale for this condition was that it mirrored the natural environment where severe problem behaviors may be more likely to gain attention (e.g., in the form of disapproval) from caregivers and, thus, attention could function as positive reinforcement for the behavior (Iwata et al., 1982/1994). Next, the academic demand condition required the experimenter to present learning trials to the participant using prompting procedures. When problem behavior was observed, the demand was terminated and the experimenter moved away. The purpose of this condition was to examine if removing demand situations and allowing the participant to escape or avoid the demand would provide negative reinforcement for the problem behavior (Iwata et al., 1982/1994). Finally, two control conditions were described.
including unstructured play and alone. Unstructured play served as a control condition for the presence of the experimenter. During this condition, the participant was presented with preferred stimuli, attention was delivered every 30 s in the form of social praise, and no demands were presented. The second control condition was the alone condition, where the participant was in the room with no materials or other persons. The rationale for this condition was to test the hypothesis that problem behavior such as SIB may be automatically reinforced. While these were the original conditions presented in the FA, researchers later determined that some behaviors were maintained by positive reinforcement, but in the form of access to tangible items or preferred activities rather than the attention of another person (Mace & West, 1987). Thus, a tangible condition was developed and has been common practice in most of the FA literature (Beavers et al., 2013; Day, Rea, Schussler, Larsen, & Johnson, 1988; Hanley et al., 2003). The results of the Iwata et al., (1982/1994) study indicated that specific topographies do not necessarily relate to a specific function and that learned behaviors might differ in their relationship to environmental events.

The use of FA procedures allows a researcher to observe if elevated levels of problem behavior occur in one or more of the test (or analogue probe) conditions to identify if the behavior is being maintained by positive, negative, or automatic reinforcement (Iwata et al., 1982/1994). Hundreds of studies have since applied and extended FA to a wide range of problem behaviors and populations (for reviews, see Beavers et al., 2013; Hanley et al., 2003). The reviews conducted by Hanley et al. (2003), and later updated by Beavers and colleagues (2013), of the FA literature provided a status of the practice within the research literature and summary data about
the use of FA across populations and settings. Across the two reviews, 435 studies were identified. There was a rapid increase in the number of studies using FA between the years of 1986 – 2000, but this number has since stabilized. Beavers et al. reported the publication of studies using FA in journals outside of *JABA* increased from 35.1% to 53.8% from the original review (Hanley et al., 2003) indicating a more widespread publication of studies outside psychology using the practice.

Overall, the majority of the research has been conducted with individuals with developmental disabilities (87.8%) and more specifically, those with ASD (26.9%). Beavers et al. (2013) report that FA was most commonly used with children (defined as age 1 -18 years). Although FAs have been mostly used in hospital inpatient settings (41.2% of studies) there was an increase from 7.6% to 15.8% in FA use in homes from 2000 - 2013. Beavers et al. suggest changes to service settings, expansion of research methods to nonresidential settings or the expansion of the FA practice beyond traditional clinical research settings, might be attributed to this increase.

**Constraints of FA and recommendations for practice.** Although the FA procedures described by Iwata and colleagues (1982/1994) demonstrate a level of control over the events surrounding the occurrence and nonoccurrence of the behavior, in natural environments (e.g., home, school, community) obtaining this level of control may be more difficult. Iwata and Dozier (2008) posit that control needs to be demonstrated over the measurement of the dependent variable, application of the treatment, and other possible sources of confounding variables. For example, Iwata and Dozier (2008) outlined several practical constraints to FA methodology including the: (a) time available for conducting the FA using the original procedures; (b) potential to
reinforce severe problem behaviors that increase risk of injury, and (c) inability to control
the environment enough to isolate the variables associated with the problem behavior.
More recently, Hanley (2012) echoed these constraints and added issues related to the
(a) complexity of the procedures, (b) difficulty obtaining buy-in from constituents (e.g.,
parents, teachers), and (c) analysis of multiple topographies of problem behavior.

Although the procedures described by Iwata and colleagues (1982/1994) are
commonly thought to be traditional methodology for conducting a FA, researchers have
examined the need to expand or modify the procedures to be applicable to certain
populations, behaviors, and settings (Hanley, 2012). As the practice has become more
common in the natural environment, variations or combination of variations to the
methodology have emerged including: (a) brief FA (BFA); (b) latency-based FA (LFA);
(c) TBFA; and (d) precursor FA (PFA). See Lydon et al (2012) for a detailed review of
these FA variations. The BFA, one of the most commonly used procedural variations,
was developed to increase the overall utility of FA procedures in natural environments
by shortening the time spent conducting the analysis (Northup et al., 1991). Researchers
using the BFA have identified a differentiated function of behavior in over
85% of the studies and increased the utility of the FA practice in different settings
(Lydon et al., 2012). The LFA was developed to provide an alternative measurement
approach for the FA (Call, Pabico, & Lomas, 2009; Thomason-Sassi, Iwata, Neidert, &
Roscoe, 2011). Latency (i.e., time from presentation of an event to the onset of the
behavior) is used to determine the maintaining consequence in each FA condition as an
alternative to measuring frequency of problem behaviors (Lydon et al., 2012). Latency
as a measure of response strength (i.e., high frequency behaviors have shorter latency
to onset) might be useful when it is either impractical (e.g., elopement) or undesirable (e.g., SIB) to set up multiple opportunities to observe the behavior (Thomason-Sassi et al., 2011). The TBFA was developed to facilitate use of FA during naturally occurring activities in authentic settings. Conditions in the TBFA are presented in discrete trials and data are reported in number of trials the problem behaviors were present (Sigafoos & Saggars, 1995). Since TBFA allows the analysis to be embedded into ongoing routines, the disruptive nature of the FA is reduced, as well as the time needed to conduct the procedures (Rispoli et al., 2014). Finally, PFA is based on the hypothesis that behaviors that are topographically different might be members of the same functional response class (Fahmie & Iwata, 2013, Lalli, Mace, Wohn, Livezey, 1995). During PFA, behaviors that occur in a predictable, temporal order to the problem behavior (i.e., precursor behaviors) are identified through indirect and descriptive methods. Conditions in the FA are applied to those precursor behaviors instead of to severe behaviors (e.g., Fritz, Iwata, Hammond, & Bloom, 2013; Harding et al., 2001; Langdon, Carr, & Owen-DeSchryver, 2008; Najdowski, Wallace, Ellsworth, MacAleese, & Cleveland, 2008; Smith & Churchill, 2002).

In addition to procedural variations, the influence of idiosyncratic variables (i.e., variables that influence a specific individual's behavior) has emerged in the FA research literature (Lloyd et al., 2015; Rooker et al., 2015; Schlichenmeyer et al., 2013). Although more often than not FA results in the identification of the function(s) of behavior, some researchers have found undifferentiated findings where a function cannot be determined from the results (e.g., see Hagopian, Rooker, Jessel, & DeLeon, 2013). One possible explanation for an undifferentiated FA might be that relevant antecedents and
consequences (i.e., idiosyncratic variables) were not included in the traditional FA conditions (Carr et al., 1997; Hagopian et al., 2013). Schlichenmeyer et al. (2013) conducted a review of published research from 2001 to 2010 and identified 30 idiosyncratic variables that influenced responding during an FA. Moreover, the assumption that variables included in the FA in one setting (e.g., clinic) influence behaviors similarly in another setting (e.g., natural environment) may be incorrect (Lang et al., 2009). Thus, the specificity of the reinforcer might be an important consideration for designing FA conditions to avoid misleading or undifferentiated results (Carr et al., 1997). The utility of using idiosyncratic variables in FA procedures then relies on the ability to identify these variables prior to conducting the procedures especially in complex, natural environments (Carr et al., 1997).

Although Iwata and colleagues (1982/1994) provided replicable procedures for conducting FA, the refinement of the methodology has occurred to continuously identify analytic procedures that are generalizable in a socially significant way (Baer et al., 1968). Some researchers have provided suggestions and guidelines for using the practice to address some of the common constraints or to limit the possibility of undifferentiated results (Hanley, 2012; Rooker et al., 2015). Rooker and colleagues (2015) suggest: (a) ruling out medical causes of the behavior; (b) conducting the FA on only one topography of behavior; (c) setting a criteria for the period of time without the occurrence of problem behaviors before beginning the next FA session, and (d) using multiple pre-assessments (e.g., preference assessment, descriptive assessments) to determine which conditions and subsequent modifications should be included in the FA (See Rooker et al. 2015 for specific research related to each of these guidelines).
Overall, examining socially significant behaviors is a cornerstone for the discipline of ABA and has resulted in the ongoing refinement and extension of FA methodology (Beavers et al., 2013).

In addition to these general guidelines provided by Rooker et al. (2015), Hanley (2012) offered specific practical solutions to the time, complexity and safety constraints when an FA occurs in a natural environment. These include: (a) shortening the test conditions to 5 minutes or less to reduce extensive exposure to potential reinforcers; (b) increasing use of open-ended interviews to help refine FA procedures to individualize (e.g., adapt the traditional conditions by incorporating idiosyncratic variables); (c) reducing the number of conditions presented by developing and testing a hypothesis using pre-assessment measures; or (d) employing one of the common practical variations described in the previous section. Additionally, other practical concerns can be addressed by maintaining a safe environment within the natural environment, providing clearly signaled contingencies, and using continuous schedules of reinforcement during the FA (Hanley et al., 2013; Lloyd et al., 2015). Incorporating modifications and variations to traditional FA procedures may be more appropriate for use within authentic settings where problem behaviors naturally occur and increase the social validity of the outcomes.

Summary

Functional analysis of problem behavior is situated in the historical context of the science of human behavior with ties to early researchers such as Watson, Skinner, and Bijou. These early researchers laid the conceptual framework for the analysis of operant behavior, which became the basis for ABA. The seminal article published by Baer et al. (1968) described the dimensions for ABA that have since guided behavioral researchers
to produce research focused on socially significant behaviors. While topography describes the form of a behavior, identifying the function provides information about the environmental variables influencing the behaviors. Iwata and colleagues (1982/1994) provided the initial procedures for systematically identifying multiple sources of reinforcement including social positive (e.g., attention, tangible), social negative (e.g., demand), and automatic reinforcement. Since its conceptualization, FA has been extended to multiple behaviors, populations, and settings, but modification or variations to FA practice have been recommended to address some common constraints when conducted in the natural environment. Given the previous described recommendations for addressing constraints of FA procedures, the following section will provide a systematic examination of the use of FA specifically in the natural environment for young children with ASD, highlighting any modifications or variations that were used.

**Functional Analysis in the Natural Environment for Young Children with ASD: Literature Review**

Traditional FAs, as described by Iwata et al. (1982/1994), are most often conducted in a highly controlled setting. The advantage of the controlled setting is the ability to maintain the procedural fidelity of the experimental procedures (Lang et al., 2008) and to minimize the influence of other variables. Nonetheless, Martens, Gertz, de Lacy Werder, and Rymanowski (2010) posit that several assumptions are made when the FA is conducted in a controlled setting as opposed to the natural setting in which the behavior naturally occurs. First, the experimenter assumes that high levels of problem behavior will be observed in the controlled test conditions when a reinforcer that is stable across time and settings is presented. In other words, the individual should have a history with the reinforcer and this reinforcer is associated with the occurrence of
problem behavior across all settings. Next, the experimenter assumes that the stimuli included in the FA (e.g., setting, therapist) that differ from the natural setting where behaviors typically occur must either not influence behavior, be similar enough to those in the natural environment, or be irrelevant to the individual. Finally, the experimenter assumes that the reinforcer being tested in the FA represents a general class of reinforcers and any variations from how it typically occurs are functionally equivalent (Martens et al., 2010). Thus, it is important to recognize that the context (i.e., setting) in which the FA is conducted might possibly influence the outcome if these previous assumptions are not met.

A series of studies (Lang et al. 2008; Lang et al., 2009; Lang et al., 2010) have been conducted to examine the influence setting has on behavior. For example, Lang et al. (2009) examined the differences in outcomes of FAs conducted on the playground and those conducted in the classroom. Although behaviors were similar in rate in both settings, the FA results suggest that behavior on the playground was maintained by adult attention whereas behavior in the classroom was maintained by access to tangible items (Lang et al., 2009). The researchers also suggest that a FA that is not conducted where intervention takes place might potentially lead to an ineffective intervention because the maintaining consequence in the settings might differ. (Lang et al., 2010).

As discussed, an abundance of research showing the utility of FA methodology for identifying the function of behaviors has been conducted across various populations and settings (Beavers et al., 2013; Hanley et al., 2003). Although extensive reviews of the FA literature provide broad information about the use of FAs, it is also important to examine the implementation of FA for the specific populations and settings to support
refinement of the methodology and the development of recommended practice guidelines. The increasing research using variations of the FA (Lydon et al., 2012) and the consideration of practical implementation barriers of the FA in natural environments (Hanley, 2012) both warrant an in-depth look at a more specific literature base. The purpose of this comprehensive literature review is to identify and describe functional analysis approaches conducted in natural environments to analyze the problem behaviors of young children with ASD. The specific research questions for this review are:

- What FA approaches have been used in the natural environment for young children with ASD?
- To what extent have these approaches identified one or more functional relations and informed a function-based intervention?
- To what extent have these FA approaches aligned with previous recommendations to address barriers of implementation in a natural environment?

**Method**

To identify relevant literature, an electronic database search was conducted in March 2017 of four databases (PsycINFO, ERIC, Medline, and CINAHL) using various combinations of the following terms: *autism spectrum disorders, developmental disabilities, functional analysis, and problem behavior* (see Appendix A for the literature review coding manual containing the complete electronic database search strategy). To identify additional studies that were not located in the electronic database searches, reference lists from key reviews and included studies were also examined.

This literature review was conducted in three phases. First, the author screened the titles and abstracts of all articles that were located by the electronic search to exclude articles that were clearly irrelevant to the review and to remove duplicate
records. Articles identified by searching reviews were also screened in this manner. Second, the remaining articles from the first phase underwent a full text review by the author to confirm which articles met the inclusion criteria. Finally, data from the included articles were extracted based on the variable definitions provided below.

**Inclusion criteria.** Studies were included that met the following inclusion criteria: (a) empirically based and employed a SCRD; (b) at least one participant was a young child defined as 8-years-old or under with a diagnosis of ASD; (c) the dependent measure was problem behavior that fits a definition of at least one of the following: aggression, destruction, disruption, SIB, or restricted and/or repetitive behaviors (RRB) described previously; (d) a FA of the behavior was conducted; and (e) the FA was conducted within a natural environment (e.g., home, school, day care, community). Additionally, limits were set for the search to only include studies published in English in peer-reviewed journals from 1982 to present. The limit on the date was determined from the date FA methodology was first described by Iwata and colleagues (1982). Excluded from this review were participants ages 9 or older and those solely with disabilities other than ASD. Additionally, a study was excluded if the function of the behavior was determined solely through indirect or descriptive methods. Finally, a study was excluded if the description of the setting indicated the FA was conducted in a natural environment (e.g., home or school), but was conducted in a separate, isolated area (e.g., room free of other variables typically present in the environment) within that setting.

**Variables definitions and coding.** A coding manual was developed to provide standardized definitions of the variables that were coded via an Excel spreadsheet (see Appendix A). Coding variable definitions were adapted and modified to fit the purpose of
this review from a previous review conducted by Lloyd et al. (2015) that addressed the use of functional analysis approaches in school settings. Some of the variables were coded on the study level, while others were coded on the individual participant level. For each of the studies, the publication year and journal name, experimental design of the functional analysis and intervention (where applicable), and the number of participants that met the inclusion criteria were recorded. That is, it was possible for only one of the participants in the study to meet all criteria, thus, only data on that participant was used.

**Participants and settings.** For each participant, general characteristics were coded including age, additional disabilities (i.e., other than ASD), level of intellectual functioning, and targeted problem behavior(s). Targeted behaviors are defined as one of the following general categories. Aggression is defined as any behavior that results in or has the potential to cause injury to another person including kicking, punching, pinching, and hitting (Pelios, Morren, Tesch, & Axelrod, 1999). Destruction is defined as any behavior that results in or has the potential to cause damage to items or property including banging surfaces, breaking, tearing or throwing objects (Didden et al., 1997; Kuhn, Hardesty, & Sweeney, 2009). Disruption is defined as behaviors that cause a disturbance of social norms and impact daily functioning including noncompliance (i.e. refusal to follow directions), tantrums, inappropriate vocalizations, crying, and screaming (Horner et al., 2002). SIB is defined as movements made by the individual that results in injury to his/her own self using a part of their body, an object, or other surfaces to cause the injury including head banging, hand biting, face slapping, or any other self-inflicted violent behavior (Carr, 1977). The setting of the FA was indicated along with the agent responsible for carrying out the FA procedures.
**Supplemental assessments.** Supplemental assessments used in the study to inform the FA were recorded. For each participant, the use of an indirect (e.g., interview), descriptive (e.g., direct observation), or preference assessment was indicated and defined. If the authors clearly indicated how the supplemental assessments were used in the development of the FA (e.g., define the behavior, develop a hypothesis) this was also coded. The use of these assessments was not mutually exclusive; thus, the authors could report that it was used in multiple ways.

**FA approach.** Several variables associated with the FA approach were coded per participant. First, the FA approach was confirmed as an ABC model and included in this review if experimental manipulation occurred for all aspects of both the antecedent and consequence across test conditions (Iwata et al., 1982/1994). Next, any variation of the procedures from the traditional procedures set forth by Iwata and colleagues (1982/1994) was coded. These variations were described previously in this paper and defined in the coding manual. Finally, any additional analyses (e.g., demand assessment, choice assessment) that were conducted were recorded.

**FA characteristics.** For the specific FA procedures, the following variables were coded: (a) number of conditions, (b) total number of FA sessions (e.g., as per graph if not reported directly in the article); (c) condition duration; (d) estimated FA duration in minutes (i.e., defined as the total number of sessions multiplied by session duration), and (e) specific conditions included in the FA defined as standard or adapted.

**FA results.** For each participant, it was recorded if the FA produced conclusive results and if the participant’s behavior was being maintained by multiple functions. Specific function(s) of the behavior was recorded. Additionally, if an intervention was
included in the study, type of intervention, development of the intervention, and connections between the results of the FA were coded. The results of the function-based intervention were not recorded, as this would be beyond the scope of the literature review.

**Quality indicators.** Included studies were evaluated on methodological quality based on indicators adapted from Reichow and colleagues (2008) for research in ASD. Adapted indicators for SCRD were used because all studies included in this review did not include an intervention making some indicators not be applicable to the studies. Each study was examined on two levels (1) primary quality indicators and (2) secondary quality indicators. Primary indicators are components of the study are considered critical to establish the validity of the study (Reichow et al., 2008). Secondary indicators are important components but are not considered critical (e.g., interobserver agreement, fidelity). All indicators were rated on a dichotomous scale of whether they are present or not (Reichow et al., 2008). Definitions for all indicators are described in Table 2-4.

For all studies, primary indicators include criteria related to (a) participant description; (b) baseline (FA procedures); (c) dependent variable, and (d) visual analysis. Criteria for the independent variable was only evaluated if the study included a subsequent intervention. Secondary indicators include criteria related to (a) interobserver agreement; (b) implementation fidelity; and (c) social validity. Generalization and maintenance were only evaluated if the study included an intervention.

**Alignment with the practical recommendations for FA.** Based on the recommendations of Hanley (2012) and modeled from the review of Lloyd et al. (2015),
several variables were coded to identify the extent to which these natural environment FA aligned with the practical recommendations described previously. Specifically, the studies were coded “yes” or “no” to the following criteria: (a) use of brief 5 min or less sessions; (b) included no more than 2 conditions in the FA; (c) conducted open-ended interviews as part of the pre-assessment procedures; (d) adapted or individualized at least one of the test conditions; (e) used a variation of the traditional FA methodology (e.g., BFA, TBFA, LFA, PFA); (f) indicated that the FA was conducted in an environment that allowed the problem behavior to occur safely; (g) included clearly signaled contingencies in the test condition (e.g., salient clues for the conditions were indicated by vocal phrase, gestural prompts, different therapist), and (f) continuous schedules of reinforcement were used during the FA (e.g., the study did not use an A-B model or an intermittent schedule of reinforcement).

Results

The results of the electronic search and reference list review yielded a total of 3,036 studies for screening after deduplication. After the initial title and abstract screening, 348 studies were included in the full text screening to determine eligibility for the review. A total of 32 studies, describing use of FA for 61 participants meeting inclusion criteria, were included in this review. Reasons for exclusions are provided in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA; Moher, Liberati, Titled, & Altman, 2009) flow diagram provided in Figure 2-1. The largest number of studies ($n = 107$) were excluded due to the setting (i.e., not in a natural environment) where the FA took place. An additional 71 studies were excluded because although the FA was technically in a natural environment, the FA was conducted is
isolated areas (e.g., areas in which typical and relevant variables were removed) within that setting.

**Participant characteristics.** A summary of the participant characteristics is provided in Table 2-1. The average age of the 61 participants was 5.2 yrs ($SD = 1.7$) and the majority of the participants were male ($n = 48, 78.7\%$). Beyond the ASD diagnosis, close to one half of the participants were also described as having another disability; the most common co-morbid disability was an intellectual disability ($n = 19, 31.1\%$). Topographies of problem behavior included all of the following general categories: with aggression (e.g., hitting, kicking) as the most commonly targeted category ($n = 40, 65.6\%$). More than half of the participants demonstrated a behavior in multiple topographical categories ($n = 34, 55.7\%$). Despite being a diagnostic criterion for ASD, repetitive/restricted behaviors (i.e., ones identified as problematic) were the least targeted topography and only included in the natural environment FA for 10 (16.4\%) participants.

**FA approaches.** A summary of the approaches and components of the FA across participants are included in Table 2-2. Variations of the traditional FA model were implemented for 20 of 61 (32.8\%) of the participants. Notably, the most common variation used with these participants was the TBFA ($n = 14$ of 20, 23.0\%). Other variations that were identified were the brief FA ($n = 4$ of 20, 6.6\%), and precursor FA ($n = 1, 1.6\%$). Additionally, although some identified studies did not use a variation of the procedures, adapted or conditions including idiosyncratic variables were included. Attention and demand conditions were adapted to included specific types of each (e.g.,
high/low demands, attention from a specific person) while tangible conditions were adapted to test the influence of high or low preference toys.

Figure 2-2 shows a graphic representation of the number of studies that included a variation or adapted condition by setting (i.e., home and school). Across young children with ASD, the majority of the FAs were conducted in the home \((n = 38, 62.3\%)\), while 23 \((37.7\%)\) were conducted in schools. Only 2 of 23 \((8.5\%)\) school-based FAs were conducted using the traditional procedures. Conditions were adapted for 10 participants in schools compared to the 5 in the home. Additionally, variations were implemented in 13 school-based FAs compared to 4 in the home. Notably, at the time this review was conducted, the most common variation (TBFA) has only been implemented with young children with ASD in schools.

**FA characteristics.** Across the participants, the most common procedures for implementing a FA included the use of four conditions \((n = 45, 73.8\%)\) with a session length of 5 min \((n = 33, 54.1\%)\). There was, however, some variation in the number of conditions. Only a few studies included three conditions in the FA \((n = 8, 13.1\%)\), while some used five \((n = 5, 9.2\%)\) and even fewer used six or more \((n = 3, 4.9\%)\). The duration of the sessions for these participants also ranged from short trials (i.e., TBFA) that lasted for 1-2 min to the traditional FA procedural use of 15 min \((n = 7, 11.5\%)\). Overall, the average number of sessions needed to complete the FA was 24.1 \((SD = 19.2)\). Of the studies that reported length of sessions and number of conditions, the average overall time needed to complete the FA was 110 min \((SD = 88.2)\).

Supplemental assessments were included in the FA process in numerous studies. An indirect assessment (e.g., interviews, caregiver/teacher reports) was
included for just under half of the participants ($n = 30, 49.2\%$). Of these indirect assessments, only one stated an open-ended interview (i.e., the interview allows free response as opposed to responding to ratings or closed-ended questions) was used. A descriptive assessment (e.g., direct observation of behaviors) was included for 25 (42.6\%) of the participants. A formal preference assessment to identify preferred and non-preferred objects/toys was included for 14 (23\%) of the participants. The authors described the use of the supplemental assessments in some, but not all studies. The most common use of these additional assessments as reported by the authors were to develop a hypothesis about the function of the behavior, although some stated the assessments were used to operationally define the target behaviors. As noted earlier, these were not mutually exclusive and some authors used the assessments for multiple purposes.

**FA results.** According to the authors, a function of behavior was determined for the majority of the participants ($n = 52, 85.2\%$). For 26 of 61 participants (42.6\%), the authors determined that the problem behavior was maintained by multiple functions. Included studies showed examples of problem behaviors for young children with ASD maintained by one or more of all of the described functions. Most children demonstrated behaviors with a tangible function ($n = 32, 52.5\%$) followed by escape ($n = 29, 46.5\%$) and attention ($n = 10, 16.4\%$). The results of the FA were connected to a function-based intervention for 37 of the participants (60.7\%), with the most common treatment being functional communication training (FCT; Carr & Durand, 1985). The other studies did not link their findings from the FA to an intervention or did not report intervention data in their published research.
Critical Analysis of the Literature Review

The purpose of this literature review was to identify and describe the current published studies that used FA approaches to target the problem behaviors of young children with ASD in natural environments and to provide a critical analysis of the state of the research. To that end, data were extracted from 32 studies published between 1982 and 2017 based on the inclusion criteria for the review. Collectively, the literature provides evidence of a slight shift towards a more ecologically valid process of identifying variables maintaining problem behaviors in the natural environment. As outlined by previous reviews of FAs in the natural environment (Lloyd et al., 2015), some practical recommendations have been provided that might increase the utility and ecologically validity of the process. To examine the literature for young children with ASD, those recommendations were applied to the studies identified in this review to determine the extent to which they align. Additionally, quality indicators (adapted from Reichow et al. [2008]) were applied to this body of research to assess methodological quality. This discussion provides a closer look at the literature with a focus on procedural variations and modifications used for FAs in a natural environment and the current alignment with recommendations for recommended practice for FAs.

Alignment with the practical recommendations for FA. Hanley et al. (2002) recommended limiting the number of conditions included in the FA by using pre-assessments (e.g., open-ended interviews) to only address relative hypotheses and to potentially shortened the analysis. In this review, none of the studies identified included only two conditions and only one study identified the indirect assessment as an open-ended interview. McComas, Hoch, Paone, and El-Roy (2000) examined idiosyncratic EOs related to escape behavior in academic tasks for an 8-year-old male. These
authors used an open-ended interview with teachers and caregivers to identify specific methods of instruction that might influence destructive behavior. The interview was used to both develop a hypothesis about function and develop an appropriate intervention.

**Adaptations and variations.** Another approach for improving the ecological validity of the FA was to include an adapted condition (e.g., changes to specific features of the reinforcer or a unique condition) or use one of the common variations of the traditional procedures (Hanley, 2012). For young children with ASD, individualized or adapted conditions and variations in the FA procedures were included in 10 studies (31.3%) each. Some examples of the modifications include types of attention delivered (Rispoli et al., 2013; Robertson et al., 2013) or types of demands presented (Arndorfer et al., 1994; Tarbox et al., 2009). The low number of studies that were modifying the conditions to reflect more nuanced sources of reinforcement is reflective of the use of pre-assessments prior to designing the FA.

Ten of the 32 (31.3%) reviewed studies were conducted using some variation of traditional FA procedures (described earlier in this chapter). Not surprisingly, the most common variation used was the TBFA (n = 14; 23.0%), a variation that was originally designed for use during natural, ongoing routines (Sigafoos & Saggers, 1995). Although TBFA appears to be the most used variation, the number of studies that used a BFA might not have been captured by this review. A limitation of the coding manual is that BFA was only coded if the author identified their FA as a BFA in their methods. As such, the most common session length for the FAs included in this review was 5 min, which indicates that some may have used BFA without formally acknowledging it. No study included in this review employed a LFA to determine function, although some included
the latency measure as a secondary analysis. The use of alternative measures of behavior (e.g., latency) might be explored further to determine if it is useful for identifying function or informing the development of function-based interventions.

An examination of the literature revealed interesting relationships between the use of adapted FA conditions (i.e., conditions that were individualized beyond those described in traditional FAs) or variations (e.g., BFA, TBFA, PFA) and the setting of the FA. For young children with ASD, there were more studies that used FA implemented in the home compared to the school. This is not surprising given the age restriction of children in the review; however, the review also revealed that a traditional FA was more likely to be used in the home. On the other hand, school-based FAs were almost all conducted using a modification or variation to the FA procedures. Although the most commonly used variation in the included studies was TBFA, this variation was exclusively used in school settings. Given the differences between home and school settings (e.g., structured activities, peers), the procedures for conducting TBFA in the home would need to be examined so that the FA is both applicable and effective for determining the function of the behavior in that setting.

There is a standard procedure (i.e., number of conditions and length of sessions) that was used by an overwhelming number of FAs conducted with young children with ASD. As noted earlier, the most common session length was 5 min which differs from the most current review of FAs conducted by Beavers and colleagues (2013) where the most common length of the conditions was 10 min. Nonetheless, Beavers et al. did note an increase in the use of 5 min sessions, which is reflected in this review. There were not many differences in the descriptions of the FA procedures when compared to typical
procedures identified in other reviews (Hanley et al., 2003; Beavers et al., 2013). One of the limitations in the literature, however, is that all data are not reported on specific number of sessions that are conducted (i.e., at times this is reported as a percentage) or the duration of each session. To that end, it is difficult to determine if any of the variations or adaptations to the procedures succeeded in shortening the length of the analysis.

Quality of literature. A series of primary and secondary quality indicators were applied to this research to assess the methodological quality of the included studies (see Table 2-5). Descriptions of the participants were generally sufficient across the studies, however, a lack of description of the implementer was noticed in multiple studies. There was little information about the qualifications or descriptive characteristics of the person conducting the FA in the natural environment in these studies. This information is important as it addresses whether extensive training is needed to conduct an FA or if natural agents in the environment might be able to conduct the procedures. An adapted indicator was used to assess the authors’ descriptions of the FA procedures (e.g., conditions) and providing sufficient detail for replication. Generally, the authors described these procedures with detail and provided enough data to make decisions via visual analysis. A strength of this research is the extent to which the authors describe the dependent and independent (when applicable) variables in the studies. Consistently, all authors described the target behaviors and subsequent interventions with replicable details. If an intervention was included, the majority of the studies provided a direct connection between the results of the FA and
the design of the intervention. Additionally, all studies reported IOA appropriately and maintained high, adequate levels (>80%) of this measure.

As far as methodological quality, one missing component in this research is the reporting of fidelity measures for the implementation of the functional analysis. Across the 32 studies, only 9 studies (23%) reported fidelity data related to the FA. It is concerning that with the movement of procedures to free operant environments (i.e., all studies included in this review) that measures that indicate the FA is being conducted with fidelity are not reported. Moreover, while the social validity of the procedures is increased by implementation in a natural environment and typically with natural agents, the studies that report formalized assessment of acceptability are limited.

**Future research directions.** Although there is an abundance of research supporting the utility of the FA to identify the function of problem behaviors, broad reviews of the FA literature do not specify how the practice is being used with specific populations and in certain settings. This purpose of this review was to evaluate the current research specifically to young children with ASD to identify the FA approaches used in the natural environment. While the studies align with some of the practical recommendations to reduce common barriers of implementation, there is still opportunity for more research.

Future research using FA in the natural environment for this population should be conducted with some considerations. First, it is recommended that research continue to use shortened sessions (i.e., 5 min or less) to lessen the time young children are exposed to conditions that potentially reinforce problem behavior. It was not possible to gather consistent information about number of sessions included in the FA. Future
research should ensure to report the number of sessions so that reasonable conclusions can be made about the length of time needed to determine a function in the natural environment.

Additionally, consideration should be made to further explore the use of TBFA, an alternative to traditional conditions, which offers a practical solution for shortening sessions, while still maintaining the experimental integrity of the practice. Despite its demonstrated utility in school settings, the use of TBFA in the home has not been fully examined for this, or any, populations. Procedural considerations for the most effective and efficient TBFA should be examined. To that end, inclusion of fidelity measures should be increased to ensure that the FA is being conducted in the manner in which it was intended.

Next, consideration should be made for ways in which idiosyncratic variables unique to an individual and the setting can be incorporated into the FA. The growing research base on the influence of these variables on behavior (Hagopian et al., 2013; Lloyd et al., 2015; Rooker et al., 2013; Schlichenmeyer et al., 2013) warrants more exploration on how these variables might influence the problem behaviors of young children with ASD. One way is to expand the use of pre-assessments to help design and adapt the FA conditions specifically to the participant. Although it may occur more frequently in practice, the research literature does not always report the use of these procedures or accurately explain how the assessments have been connected to the design of the FA. Future research should expand and report the process of using pre-assessment information and how it has contributed to determining the function of the
behavior. Inclusion of social validity measure might assist in determining if the FA conducted captured all necessary variables that might influence the problem behavior.

Finally, while it is not surprising that more than half of the studies included in this review connected the results of the FA to a subsequent function-based intervention, there continues to be a need to expand the use of intervention following the FA. Future research can use the information gathered through pre-assessments and the FA to design contextually relevant and appropriate interventions for young children with ASD. Additionally, the inclusion of social validity measures for both the FA and intervention help to assess both the acceptability (e.g., extent to which caregivers are comfortable with the analysis and treatment) and the authenticity (e.g., extent to which the analysis and treatment reflects the typical occurrence of the behavior in that setting). Researchers should use findings from such measures to continue to explore the ecological and social validity of conducting FAs in the natural environment.

**Trial-Based Functional Analysis Literature Review**

Based on the above review of FA use in the natural environment for young children with ASD, the most common variation of FA used is the TBFA. The benefits of using the TBFA procedures (e.g., shortened control and test segments, embedded within ongoing routines) makes the TBFA a viable alternative to traditional FA procedures, especially for young children. Thus, a closer look at the literature using TBFA is relevant to this discussion. Trial-based functional analysis was first developed by Sigafoos and Saggers (1995) as a variation of the traditional FA procedures to identify the function of behavior within the natural environment (e.g., school). A second purpose of the TBFA was to minimize repeated exposure to traditional FA conditions that potentially reinforce severe or dangerous problem behavior. During the TBFA,
conditions are presented in a discrete trial format, trials end on the occurrence of
problem behavior or the lapse of 1-2 minutes, and data are reported in number of trials
the problem behaviors was present (Sigafoos & Saggers, 1995). The following section
will present a systematic review of the TBFA literature, independent of age, setting, and
disability, to provide a detailed examination of the state of the TBFA literature. The
specific research questions for this review are:

- What are the characteristics of the participants with whom TBFA has been
  conducted?
- What are the characteristics of TBFA (e.g., implementer, setting, conditions, trial
duration) in the literature?
- What are the gaps in the TBFA literature that should be examined in future
  research?

Method

To identify relevant literature, an electronic database search was conducted in
Spring 2018 of three databases (PsycINFO, ERIC, and Academic Search Premier)
using the terms: trial-based, trial based, and discrete trial combined with the term
functional analysis (see Appendix B for the literature review coding manual containing
the complete electronic search strategy). To identify other possible studies that were not
included in the electronic searches, a snowball method (Greenhalgh & Peackock, 2006)
was used. Specifically, reference lists from key reviews were also examined and a
Google Scholar search was conducted for studies that cited the initial TBFA study,

This literature review was conducted in three phases. First, the author screened
the titles and abstracts of all articles that were located by the electronic search to
exclude articles that were clearly irrelevant to the review and to remove duplicate
records. Articles identified by searching reviews were also screened in this manner. Second, the remaining articles from the first phase underwent a full text review by the author to confirm which relevant articles met the inclusion criteria. Finally, data from the included articles were extracted based on the variable definitions provided below.

**Inclusion criteria.** Studies were included that met the following inclusion criteria: (1) the study was peer-reviewed, empirical, and experimental, (2) TBFA was used to determine a function of a behavior, and (3) outcomes (e.g., function determined, comparison to traditional FA) were reported.

**Variables definitions and coding.** A coding manual was developed to provide standardized definitions of the variables that were coded via an Excel spreadsheet. Some of the variables were coded cumulatively on study level. For each of the studies, the publication year, journal name, and the experimental design of the FA and intervention (where applicable) were recorded.

**Participants.** An overall number of participants were recorded per study. For each participant, general characteristics were coded including age, disabilities (if applicable), gender, and targeted problem behavior(s).

**TBFA characteristics.** The setting of the TBFA was indicated along with the agent responsible for carrying out the TBFA procedures. Specific procedures were also coded including: (a) number and type of conditions; (b) duration of each segment (i.e., test and control); and (c) dependent variable.

**Outcomes and Intervention.** The outcome of the study was reported based on the dependent variable. For studies that examined the use of TBFA to identify a function, outcomes were the identification of function per participant. For studies that
examined training agents to implement the procedures, outcomes were the fidelity of
the agent. Studies that included a subsequent intervention were noted.

Results

Twenty-eight studies were identified for inclusion in this review. Table 2-6
provides a summary of each of the studies including (a) participant characteristics, (b)
primary dependent measure of the study, (c) TBFA characteristics including setting,
agent implementing the analysis, conditions, and descriptions of the trials, and (d)
outcomes. Across the studies, 63 individuals with disabilities were included in TBFA
studies. Eleven (39.3%) of these studies focused on training different agents to
implement TBFA and included 61 adult participants. Of the 28 studies, 18 studies
(64.3%) included at least one individual with ASD representing the majority of the
included studies. Other diagnoses included intellectual disabilities ($n = 8; 28.6\%$),
developmental disabilities ($n = 5; 17.9\%$), and emotional/behavioral disorders ($n = 2,$
$7.1\%$).

The setting of TBFA studies was primarily in classrooms ($n = 20; 71.4\%$); and
specific settings ranged from pre-school classrooms to public middle schools. Other
settings included residential settings, vocational facilities, homes, and behavioral clinics.
Being that the primary setting for these studies was the classroom, it is not surprising
the primary agent conducting the TBFA was the classroom teacher or paraprofessional
($n = 15; 57.7\%$).

Of the 28 studies reviewed, the TBFA typically included three (i.e., attention,
tangible, escape; $n = 12$) or four conditions (i.e., attention, tangible, escape, control; $n =$
$11$). Three studies ($11.5\%$) included modified versions of traditional conditions (Austin et
al., 2014; Flanagan & Debar, 2017; Lambert et al., 2017; Lloyd et al., 2015). The
number of trials conducted per condition ranged from 3 \((n = 1; \text{McDonald et al., 2012})\) to 20 \((n = 6; 21.4\%)\). It was most common for researchers to conduct 10 trials per condition \((n = 12; 42.9\%)\). It was not common for researchers to provide a rationale for the number of trials per condition. One study, Lloyd et al. (2015), provided response differentiation criteria and varied the number of trials across conditions based on these criteria.

**Seminal studies.** Sigafoos and Saggers (1995) conducted the first study using TBFA. This study was conducted in a special education school and the classroom teacher conducted the analysis of aggression for two males with ASD aged 10 and 12. These researchers included three conditions (i.e., attention, tangible, and escape) with a test segment followed by a control segment. Each of the segments lasted up to 1 min in duration with an entire condition lasting up to 2 min. These authors found clear results for both participants and concluded that the TBFA was effective in isolating influencing variables maintaining the aggressive behavior in the classroom (Sigafoos & Saggers, 1995). Similarly, Sigafoos and Meikle (1996) applied the same procedures to target the multiple problem behaviors of two 8-year-old males with autism in a special education classroom. Function of behavior was identified using TBFA for both participants.

Following these initial studies, there was not another published application of TBFA for 14 years. Regardless of this gap in its use, studies using TBFA began to increase in 2010 with a renewed interest in this specific variation of FA methodology.

Following the initial studies that applied these procedures, three primary themes were identified in the TBFA literature including: (1) comparison studies between the TBFA procedures and traditional FAs as described by Iwata and colleagues
(1982/1994); (2) studies that examined the utility of TBFA to inform function-based intervention; and (3) studies that examined training natural change agents (e.g., teachers, paraprofessionals) to conduct the TBFA (Austin et al., 2015). Therefore, the descriptive summary of a sample of these studies will be provided based on these themes following a brief description of the seminal study that initially examined the use of TBFA.

**Comparison studies between TBFA and traditional FA.** The purpose of the comparison studies was to examine if the results of the TBFA were comparable to the results of a traditional FA. LaRue et al. (2010) conducted a comparison study with five males (age range from 4 yrs to 29 yrs) with developmental disabilities (DD) in classrooms and vocational settings. The typical staff of these settings implemented procedures that included four conditions (i.e., attention, tangible, escape, and play) lasting up to 2 min (e.g., 1 min in each test and control segment). Data were taken on both the occurrence and latency to problem behavior within each condition. These authors found exact correspondence of the results between the TBFA and traditional FAs in four of five participants. In addition, an analysis of the time needed to conduct each FA showed the TBFA took 84.8% less time than the traditional FA. La Rue et al. concluded that there was a correspondence between the TBFA and the traditional FA and the TBFA reduced time needed to complete the analysis.

Bloom, Iwata, Fritz, Roscoe, and Carreau (2011) extended the TBFA research by conducting a comparison to a traditional FA, while also examining modifications to the procedures. The TBFA was conducted with children with DD ranging in age from 8 to 18 years old in a special education school. Bloom et al. made two significant modifications
to the TBFA including extending the length of each segment to 2 min and testing the reversal of the test and control segments. The rationale for the reversal was to limit any carryover behaviors from the test segment to the control segment. Bloom et al. found correspondence between the TBFA and the traditional FA procedures for 6 of the 10 participants.

Rispoli, Davis, Goodwyn, and Camargo (2013) conducted a comparison of TBFA to traditional FA procedures in elementary school classrooms with two children ages five and fifteen. These two analyses (i.e., traditional FA and TBFA) were both implemented by the teacher or paraprofessional. Clear behavioral functions were identified for both of the participants using TBFA, where inconclusive results were found using the traditional FA. These researchers speculate setting might have influenced the motivation to engage in the behaviors (i.e., traditional FA took place in a corner of the room or outside the classroom, whereas TBFA took place within the naturally occurring routines in the classroom). Variables that might have influenced the results include the presence of other children, noise levels, or physical aspects of the classroom (Rispoli et al., 2013).

The overall conclusion from the comparison studies is that TBFA can produce similar outcomes when compared to traditional FA procedures. In some cases (e.g., Rispoli et al., 2013), the TBFA was more efficient in capturing variables that contribute to the identification of function in the natural environment when compared to the traditional FA. Comparison studies were a natural first step in the TBFA development to examine if similar results might be produced using varied procedures.
Use of TBFA to inform intervention. Other researchers have expanded the TBFA research by using the results of a TBFA to inform the development of a function-based intervention. Lambert, Bloom, and Irvin (2012) examined the utility of TBFA in early childhood settings with three children with developmental delays. The special education teacher conducted the TBFA using modified procedures (i.e., 2 min segments and reversed control and test) similar to Bloom et al. (2011). A clear function was determined for all participants and results of the TBFA informed the implementation of a successful FCT intervention. Also conducted with young children, Bloom, Lambert, Dayton, and Samaha (2013) taught classroom teachers to implement the TBFA with three young children with developmental delays. These pre-school teachers successfully conducted the TBFA and identified the function of the behavior to inform an intervention (e.g., differential reinforcement, non-contingent reinforcement) for all participants.

Lloyd et al. (2015) extended the literature by evaluating the utility of TBFA in public elementary school classrooms and validating the results using contingency reversals in that same setting. Additionally, these researchers used extensive pre-assessment procedures (e.g., indirect and direct methods) to develop of hypothesis of the function and design individualized conditions for the TBFA. The use of pre-assessments helped limit the number of conditions needed for the analysis (i.e., only relevant conditions were presented) and examined the utility of combined conditions (e.g., escape to tangible). Lloyd et al. (2015) successfully identified at least one function for each of the participants and validated the procedures through contingency reversal trials. Flanagan and Debar (2017) used a similar procedure for increasing the specificity
of the reinforcer during the TBFA by modifying the conditions based on pre-assessment measures. These authors extended the research by completing a TBFA with 10-year-old male with an emotional and behavioral disorder in a public school classroom. Flanagan and Debar (2017) used multiple indirect (e.g., interviews, questionnaires, self-report) and direct (e.g., descriptive measure) to inform the TBFA. Additionally, a demand and preference assessment were used to further define the conditions. This resulted in the inclusion of three specific attention conditions (i.e., attention, divided attention [peer], divided attention [adult]), two specific demand conditions (i.e., high-probability [tasks associated with high levels of problem behavior], and low-probability [tasks associated with low levels of problem behavior], and two specific tangible conditions (i.e., tangible, tangible transferred to another peer). These authors identified attention and escape functions for the participant and noted the specificity of the conditions helped identify function that traditional conditions may have masked (Flanagan & Debar, 2017).

**Training natural change agents to conduct TBFA.** There is also an increasing line of research examining procedures for training teachers and other staff members to conduct TBFA. In these studies, rather than measuring the occurrence of problem behavior, the dependent measure was fidelity of implementation. These studies used training methods such as a modified pyramid training model (Kunnavatana, Bloom, Samaha, & Dayton, 2013; Alnemary, Wallace, Alnermary, Gharapetian, & Yassine, 2017), automated training presentations (Lambert, Lloyd, Staubitz, Weaver, & Jennings, 2014), and coaching (Rispoli et al., 2015; Rispoli, Neely, Healy, & Gregori, 2016) to train natural change agents to conduct the TBFA. For example, Kunnavatana and colleagues
(2013) trained special education coordinators in the implementation, data collection and analysis of the data for a TBFA using a modified pyramid approach. The coordinators in turn, provided the training to the classroom teachers who would implement the TBFA. Rispoli et al. (2016) used a coaching model that included didactic instruction, role-playing, and corrective feedback to train teachers to implement TBFA in Head Start classrooms. The researchers found that the teachers were trained quickly in simulated settings were able to transfer the skills to implementation of the TBFA in the classroom. Overall, regardless of training approach, the studies that included training a natural change agent to conduct TBFA were successful.

**Critical Analysis of the Literature Review**

Albeit small, the use of TBFA to assess problem behavior across populations and settings is increasing in the literature. Figure 2-3 shows the dearth of studies published between 1996 – 2009, however, an increased interest began in 2010 and continues to the present. Notably, although the research increased in the last eight years, there is little variability in the number of different research groups conducting TBFA research.

The most recent published review of TBFA conducted by Rispoli et al. (2014) concluded that while TBFA produces comparable results to a traditional FA, more research is needed to support its utility across different populations and settings. As evidenced by this update on the research, applications of the TBFA have expanded to other populations such as middle school students with emotional/behavior disorders (Flynn & Lo, 2015), adults in residential settings (Chezan, Drasgow, & Martin, 2014; Lambert et al., 2013), and typically developing elementary school students (Austin et al., 2014). Similar to the review conducted by Rispoli et al., findings from this present review show variable methodology when designing the conditions (e.g., order of conditions,
duration of segments, number of trials per condition). Replications of previous studies and refinements to the TBFA procedures might help increase the use of FA procedures in the natural environment and develop a more consistent procedure.

Since previous research primarily focused on schools, it is notable that of the published, peer-reviewed studies included in this review, there are only two experimental tests in the home environment (Gerow et al., 2017; 2018). Gerow et al. (2017) included TBFA in a study that examined coaching parents to implement an FCT intervention in the home. While the purpose of this study was not to examine the use of TBFA but rather the coaching of parents for the intervention, this study is the first to successfully report identifying the function of the participant’s behaviors using TBFA in a home setting.

While the successful implementation of TBFA in schools is promising, the home offers further challenges to the analysis of behavior such as the presence of alternative influential variables, potential occurrence of different topographies of behavior, or fluctuating structure of home routines (Johnson & Hastings, 2002). Moreover, as mentioned previously, early intervention on problem behavior is essential and the home setting offers a place to intervene early before there is a long history of reinforcement. When embedded into a family’s routine, the TBFA is conducted in the same context in which the intervention will be implemented, allowing for the identification of idiosyncratic variables in the home that might influence behavior and the integration of the intervention into the larger family ecology (Lucyshun, Albin, & Nixon, 1997). Additionally, conducting the FA within short trials sets the occasion for behavior to be immediately abolished, which minimizes the length of time the behavior is reinforced in the FA.
These reasons would make the TBFA more practical and socially acceptable in the home setting, but feasible procedures still need to be tested.

**Quality of the literature.** A series of primary and secondary quality indicators were applied to this research to assess the methodological quality of the included studies (see Table 2-7). Descriptions of the participants were generally sufficient across the studies, however, similar to the review of FAs in the natural environment previously described, a lack of description of the implementer was noticed in multiple studies. There was often little information about the qualifications or descriptive characteristics of the person conducting the TBFA. This is especially pertinent information for the studies examining the training procedures of natural change agents.

An adapted quality indicator was used to assess the authors’ descriptions of the TBFA procedures (e.g., conditions) to provide sufficient detail for replication. Generally, the authors described the procedures for each of the TBFA conditions with enough detail to be replicable and to make decisions on the function of the problem behavior via visual analysis. A strength of this research is the extent to which the authors describe the dependent and independent (when applicable) variables in the studies. Consistently, all authors described the target behaviors and subsequent interventions with replicable details. Additionally, all studies reported IOA appropriately and maintained high, adequate levels (>80%) of this measure.

Across the 28 studies, only seven studies (25.0%) reported fidelity data related to the TBFA. Nonetheless, there is a series of studies that used TBFA that are primarily focused on the fidelity of the natural change agent in conducting the procedures accurately. Since individuals who are not primarily trained in ABA are responsible for
conducting the TBFA in those studies, the examination of a fidelity measure is vital. Moreover, while increasing in more recently published studies, a measure of social validity is often not included in the manuscript or focused only on the social validity of the intervention (if included in the study). It is important to continue to assess the acceptability of the TBFA procedures especially since its primarily purpose is to assess function of behavior in natural settings.

Summary. Since 2010, the research using TBFA has increased in number of studies and seems to be continuing to gain momentum in the literature. Over the last several years, TBFA has been conducted with different populations such as individuals with ASD, students with emotional and behavioral disorders, and individuals without a specific diagnosis. Additionally, several themes in the research are notable, especially the increased focus on training procedures for individuals in the natural environment to conduct the TBFA. There does not, however, seem to be a consistent method for conducting the TBFA and thus, more research including replications of existing studies would be helpful in developing best practice recommendations. Finally, while the number of studies that used TBFA has been increasing, there are very few replications of the procedure in the home setting.

Summary of the Chapter

Children with ASD often engage in a variety of problem behaviors due to the core deficits of the disorder and increased probability of co-morbid conditions. Without intensive intervention, these behaviors are not likely to decrease and will likely impact academic and social opportunities (Horner et al., 2002). Problem behaviors can be defined by their topographical features and by the relationship to environmental contingencies (Carr, 1977). Procedures for the experimental analysis of function of
behavior were developed by Iwata and colleagues (1982/1994) and have been replicated across multiple behaviors and populations. The empirical evidence of the utility of FA to determine the function of problem behavior is well documented (Beavers et al., 2013). The application of the FA to natural environments is increasing, but some constraints of the practice such as evoking potentially severe behaviors and not including all relative stimuli in the analysis have been discussed. The evolving nature of behavioral practices within behavior analysis to further examine socially significant behaviors has led to the refinement of FA to address some of these constraints. There is a small body of literature that represents the utility of FA in the natural environment for young children with ASD, but further research is needed. The research would benefit from an increased precision in reporting important critical components such as integrity and social validity measures to further evaluate any modifications or variations that are being examined. Notably, the most common variation, TBFA, designed to reduce constraints of conducting an FA in the natural environment has a small, yet increasing body of research overall. Nevertheless, there is limited empirical guidance on TBFA in a home setting even though this is an environment that many young children spend the majority of their time and often receive services.

**Purpose of the Present Study**

This section will (a) describe the conceptual framework for the current study, (b) identify the purpose of the study and (c) state the specific research questions.

**Conceptual Framework**

The conceptual framework for this study is situated in the science of human behavior (Bijou & Baer, 1978). As described earlier, FA of variables that can reliably predict and maintain problem behavior were developed from the contributions of early
behavioral researchers who laid the groundwork for the discipline of ABA (Dixon et al., 2012). This current study retains the theories and principles of a behavioral framework with emphasis on the importance of using FA to identify the function of problem behaviors demonstrated by young children with ASD. A visual representation of the conceptual framework is provided in Figure 2-4. The driving components of the conceptual framework are focused on the influence of the 4th term in the behavior contingency whereas both setting factors (Whaler & Fox, 1981) and MOs (Michael, 2000) might affect the overall occurrence and subsequent maintenance of problem behavior. For the purpose of this study, the setting factor is the home setting and its direct effects on the ABC contingency and potential indirect effects on the MO.

In home settings, routines can be defined as specific activities that serve the function of organizing a family’s daily living (Bernheimer & Keogh, 1995). These activities vary from home to home and often represent some of the constraints and available resources in the immediate environment for the family and child. Assessment of behavior within typical home routines might give clues to the feasibility and overall practicality of a specific intervention for a young child with ASD (Bernheimer & Keogh, 1995). In other words, situating assessment into typical routines might help to ensure that the subsequent intervention is compatible with ongoing family activities and routines for the young child with ASD (Moes & Frea, 2000). To that end, more research is needed to develop and refine procedures that preserve the ecological validity of the FA by matching the context of the assessment with the context of the intervention (Lloyd & Kennedy, 2014).
Acknowledging the home setting might potentially impact the behavioral contingency, this framework posits that the context (e.g., setting factor) might also indirectly influence the motivating operations that are available in that particular setting. Thus, in addition to conducting the FA in the setting where behaviors naturally occur, the use of pre-assessment measures might also be important to identify which environmental stimuli within that particular setting are more likely to alter the momentary effectiveness of a specific reinforcer. This current study incorporates modifications and variations to the FA practice that might be necessary for it to be more efficient and effective in a home setting for young children with ASD. Specifically, conducting the FA in the home setting requires consideration of the procedural variation to reduce the time spent evoking severe problem behavior and account for stimuli in the environment that is difficult to experimentally control. Additionally, use of pre-assessments focused on identifying idiosyncratic variables that might potentially influence problem behavior will inform any modifications to components of the FA such as the S⁰ and the consequence. This present study focuses on maintaining the procedural integrity of the scientific practice while aiming to increase the ecological validity.

**Purpose**

The purpose of this study was to examine the use TBFA in a home setting for young children with or at risk for ASD in identifying function of behaviors and use the results of the TBFA to develop an individualized function-based intervention aimed at decreasing the problem behaviors. This study will address the following research questions:

- Can TBFA conducted in the home identify the function of problem behaviors in young children with or at risk for ASD?
• Does functional communication training based on the results of the TBFA produce a decrease in the occurrence of problem behavior in young children with or at risk for ASD in the home?

• What are the parent’s perception of the utility and feasibility (i.e., social validity) of TBFA in the home?
Table 2-1. Summary of participant characteristics and setting across studies.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of total children</td>
<td>61</td>
</tr>
<tr>
<td>Average age</td>
<td>5.2 years (SD = 1.7)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>48 (78.7)</td>
</tr>
<tr>
<td>Female</td>
<td>13 (21.3)</td>
</tr>
<tr>
<td>Disability</td>
<td></td>
</tr>
<tr>
<td>Multiple disability</td>
<td>25 (41)</td>
</tr>
<tr>
<td>Intellectual disability</td>
<td>19 (31.1)</td>
</tr>
<tr>
<td>Other</td>
<td>5 (8.2)</td>
</tr>
<tr>
<td>Developmental disability</td>
<td>4 (6.6)</td>
</tr>
<tr>
<td>Problem behavior</td>
<td></td>
</tr>
<tr>
<td>Aggression</td>
<td>40 (65.6)</td>
</tr>
<tr>
<td>Multiple problem behaviors</td>
<td>34 (55.7)</td>
</tr>
<tr>
<td>Disruption</td>
<td>26 (42.6)</td>
</tr>
<tr>
<td>Destruction</td>
<td>25 (41.0)</td>
</tr>
<tr>
<td>Self-injurious behavior</td>
<td>18 (29.5)</td>
</tr>
<tr>
<td>Repetitive/restricted behavior</td>
<td>10 (16.4)</td>
</tr>
<tr>
<td>Setting</td>
<td></td>
</tr>
<tr>
<td>Home</td>
<td>38 (62.3)</td>
</tr>
<tr>
<td>School</td>
<td>23 (37.7)</td>
</tr>
<tr>
<td>Functional analysis agent</td>
<td></td>
</tr>
<tr>
<td>Caregiver</td>
<td>25 (41.0)</td>
</tr>
<tr>
<td>Researcher/Graduate student</td>
<td>18 (29.5)</td>
</tr>
<tr>
<td>Teacher</td>
<td>13 (21.3)</td>
</tr>
<tr>
<td>Therapist</td>
<td>5 (8.2)</td>
</tr>
</tbody>
</table>
Table 2-2. Summary of functional analysis approaches and components across all participants (n = 61).

<table>
<thead>
<tr>
<th>Approach or Component</th>
<th>N</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trial-based functional analysis</td>
<td>14</td>
<td>(23.0)</td>
</tr>
<tr>
<td>Brief functional analysis</td>
<td>4</td>
<td>(6.6)</td>
</tr>
<tr>
<td>Precursor functional analysis</td>
<td>1</td>
<td>(1.6)</td>
</tr>
<tr>
<td>Number of conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>(13.1)</td>
</tr>
<tr>
<td>4</td>
<td>45</td>
<td>(73.8)</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>(9.2)</td>
</tr>
<tr>
<td>6+</td>
<td>3</td>
<td>(4.9)</td>
</tr>
<tr>
<td>Average number of conditions</td>
<td>4.1</td>
<td>(SD = 0.8)</td>
</tr>
<tr>
<td>Duration of condition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 min</td>
<td>4</td>
<td>(6.6)</td>
</tr>
<tr>
<td>2 min</td>
<td>2</td>
<td>(3.3)</td>
</tr>
<tr>
<td>5 min</td>
<td>33</td>
<td>(54.1)</td>
</tr>
<tr>
<td>10 min</td>
<td>7</td>
<td>(11.5)</td>
</tr>
<tr>
<td>15 min</td>
<td>6</td>
<td>(9.8)</td>
</tr>
<tr>
<td>Average total time (min) of analysis</td>
<td>110</td>
<td>(SD = 88.2)</td>
</tr>
<tr>
<td>Supplemental assessments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indirect</td>
<td>30</td>
<td>(49.2)</td>
</tr>
<tr>
<td>Descriptive</td>
<td>26</td>
<td>(42.6)</td>
</tr>
<tr>
<td>Preference assessment</td>
<td>14</td>
<td>(23.0)</td>
</tr>
</tbody>
</table>
Table 2-3. Summary of alignment with practical recommendations (Hanley, 2012) across studies.

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Number of studies (%)</th>
<th>Number of participants (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brief 5 min or less FA sessions</td>
<td>22 (68.8)</td>
<td>40 (65.6)</td>
</tr>
<tr>
<td>Included only 2 conditions</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Conducted open-ended interviews</td>
<td>1 (3.1)</td>
<td>1 (1.6)</td>
</tr>
<tr>
<td>Individualized (adapted) conditions</td>
<td>10 (31.3)</td>
<td>16 (26.2)</td>
</tr>
<tr>
<td>Conducted variations of the FA approach</td>
<td>10 (31.3)</td>
<td>18 (29.5)</td>
</tr>
<tr>
<td>Brief</td>
<td>2 (6.3)</td>
<td>4 (6.6)</td>
</tr>
<tr>
<td>Latency-based</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Trial-based</td>
<td>7 (21.9)</td>
<td>14 (23.0)</td>
</tr>
<tr>
<td>Precursor</td>
<td>1 (3.1)</td>
<td>1 (1.6)</td>
</tr>
<tr>
<td>Ensured a safe environment</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Included clearly signaled contingencies</td>
<td>2 (6.3)</td>
<td>4 (6.6)</td>
</tr>
<tr>
<td>Included continuous schedule of consequences</td>
<td>32 (100.0)</td>
<td>61 (100.0)</td>
</tr>
</tbody>
</table>
Table 2-4. Quality Indicators Definitions for single subject research designs (adapted from Reichow et al., 2008).

<table>
<thead>
<tr>
<th>Quality indicators</th>
<th>Definition</th>
<th>Acceptable (Yes)</th>
<th>Unacceptable (No)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary indicators</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participant characteristics (PC)</td>
<td>Description of participant includes; (a) age and gender; (b) diagnosis or operational definition of behaviors/symptoms; (c) characteristics of the agent (e.g., person conducting the FA); (d) description of standardized tests if used</td>
<td>All except for (b)</td>
<td>Does not meet (a), (c), or (d)</td>
</tr>
<tr>
<td>Baseline condition (BL)*</td>
<td>FA procedures are described to include: (a) at least three measurement points; (b) appear to be visually stable; (c) conditions do not show a counter-therapeutic trend (e.g., no problem behavior is observed); (c) conditions are operationally described with replicable precision</td>
<td>Only one of these criteria are not met</td>
<td>Two or more of the criteria are not met</td>
</tr>
<tr>
<td>Dependent variable (DV)</td>
<td>Description of the dependent variable includes; (a) variables are operationally defined; (b) details are provided for replication; (c) measures are linked to dependent variables; (d) data are collected at appropriate times</td>
<td>Meets 3/4 criteria</td>
<td>Fewer than 3/4</td>
</tr>
<tr>
<td>Independent variable (IV)* if intervention is included</td>
<td>Interventions are (a) connected to the results of the FA and (b) described with replicable precision</td>
<td>Meets 2/2</td>
<td>Does not meet</td>
</tr>
</tbody>
</table>

* BL: Baseline condition, IV: Independent variable, DV: Dependent variable.
<table>
<thead>
<tr>
<th>Quality indicators</th>
<th>Definition</th>
<th>Acceptable (Yes)</th>
<th>Unacceptable (No)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual analysis (VA)*</td>
<td>Description of the analysis of the FA includes; (a) function of the behavior is indicated through clear differentiation of conditions; (b) if undifferentiated, description of additional analysis was conducted to interpret the analysis</td>
<td>Meets both criteria</td>
<td>Does not meet</td>
</tr>
</tbody>
</table>

**Secondary indicators**

| Interobserver agreement (IOA) | IOA is collected across all conditions, raters, and participants with a reliability of >.80 | Yes | No |
| Implementation fidelity (IF) | Implementation fidelity of the FA procedures is assessed across participants and conditions. If applicable, measures are >.80 | Yes | No |
| Generalization/maintenance (G/M) if intervention is included | If intervention is included, the authors report data assess either generalization or maintenance | Yes | No |
| Social validity (SV)* | Social validity of the FA procedures was (a) socially important DV; (b) time and cost effective; (c) consumers were satisfied with the procedures; (d) natural change agent; (e) conducted in the natural environment | Meets 4/5 | Fewer than 4/5 |

* indicates criteria that were adapted from Reichow et al. (2008) to fit the purpose of this review
Table 2-5. Application of the quality indicators (adapted from Reichow, 2008) to the research using functional analysis in the natural environment for young children with ASD.

<table>
<thead>
<tr>
<th>Study</th>
<th>Primary Indicators</th>
<th>Secondary Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PC</td>
<td>BL</td>
</tr>
<tr>
<td>Arndorfer et al. (1994)</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Bloom et al. (2011)</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Borrero et al. (2005)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Brown et al. (2000)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Camacho et al. (2014)</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Cummings et al. (2005)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Harding et al. (2001)</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Harding et al. (2002)</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Kodak et al. (2013)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Lang et al. (2009)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Larkin et al. (2016)</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Study</td>
<td>Primary Indicators</td>
<td>Secondary Indicators</td>
</tr>
<tr>
<td>------------------------------</td>
<td>--------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td></td>
<td>PC</td>
<td>BL</td>
</tr>
<tr>
<td>LaRue et al. (2010)</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Mace et al. (1998)</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Machalicek et al. (2016)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Mancil et al. (2006)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Mancil et al. (2016)</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Martens et al. (2011)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>McComas et al. (2000)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Moes et al. (2002)</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Mueller et al. (2005)</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Rispoli et al. (2013)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Rispoli et al. (2014)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Robertson et al. (2013)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Study</td>
<td>Primary Indicators</td>
<td>Secondary Indicators</td>
</tr>
<tr>
<td>------------------------</td>
<td>--------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td></td>
<td>PC</td>
<td>BL</td>
</tr>
<tr>
<td>Sasso et al. (1992)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Schieltz et al. (2010)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Sidener et al. (2005)</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Sigafoos et al. (1996)</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Suess et al. (2014)</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Tarbox et al. (2009)</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Wacker et al. (2005)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Wacker et al. (2011)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Wilder et al. (2010)</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Study</td>
<td>Participant Characteristics</td>
<td>TBFA Characteristics</td>
</tr>
<tr>
<td>------------------------------</td>
<td>-----------------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>G</td>
</tr>
<tr>
<td>Alnemary et al. (2017)</td>
<td>8</td>
<td>NR</td>
</tr>
<tr>
<td>Austin et al. (2014)</td>
<td>3</td>
<td>M</td>
</tr>
<tr>
<td>Bloom et al. (2011)</td>
<td>10</td>
<td>M</td>
</tr>
<tr>
<td>Bloom et al. (2013)</td>
<td>3</td>
<td>M</td>
</tr>
<tr>
<td>Study</td>
<td>N</td>
<td>G</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-----</td>
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</tr>
<tr>
<td>Chezan et al. (2014)</td>
<td>3</td>
<td>2 M, 1 F</td>
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<tr>
<td>Flanagan et al. (2017)</td>
<td>1</td>
<td>M</td>
</tr>
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</table>
Table 2-6. Continued.

<table>
<thead>
<tr>
<th>Study</th>
<th>N</th>
<th>G</th>
<th>Age (yrs.)</th>
<th>Disability</th>
<th>Dependent Variable</th>
<th>Setting</th>
<th>Implementer</th>
<th>Condition</th>
<th>Trials</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flynn &amp; Yo (2016)</td>
<td>6</td>
<td>(C)</td>
<td>5 M,</td>
<td>ASD, EBD</td>
<td>Fidelity of</td>
<td>Middle school classroom</td>
<td>Teacher</td>
<td>ATT, TAN,</td>
<td>10 trials</td>
<td>Function was determined for all participants, all teachers increased fidelity; 2/3 could correctly identify function</td>
</tr>
<tr>
<td></td>
<td>(C)</td>
<td>1 F</td>
<td>11,11,</td>
<td></td>
<td>implementation,</td>
<td></td>
<td></td>
<td>ESC, Ignore</td>
<td>per condition</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>11,12,</td>
<td></td>
<td>Occurrence or</td>
<td></td>
<td></td>
<td></td>
<td>1 min</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>12,</td>
<td></td>
<td>nonoccurrence of</td>
<td></td>
<td></td>
<td></td>
<td>Control, 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>target behavior</td>
<td></td>
<td></td>
<td></td>
<td>min Test</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>(A)</td>
<td>3 F,</td>
<td></td>
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<td></td>
<td></td>
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<td>12,</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Adult</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Gerow et al. (2017)</td>
<td>3</td>
<td>3 M</td>
<td>2, 2, 2</td>
<td>ASD, DD</td>
<td>Occurrence or</td>
<td>Home</td>
<td>Parent</td>
<td>ATT, TAN,</td>
<td>10 trials</td>
<td>Function was determined for all participants. Mother implemented with fidelity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>nonoccurrence of</td>
<td></td>
<td></td>
<td>ESC</td>
<td>per condition</td>
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</tr>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td>target behavior;</td>
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<td>1 min Control</td>
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</tr>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td>Fidelity of</td>
<td></td>
<td></td>
<td></td>
<td>1 min Test</td>
<td></td>
</tr>
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<td></td>
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<td>implementation</td>
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<tr>
<td>Gerow et al. (2018)</td>
<td>3</td>
<td>3 M</td>
<td>2, 2, 2</td>
<td>ASD</td>
<td>Occurrence or</td>
<td>Home</td>
<td>Parent</td>
<td>ATT, TAN,</td>
<td>10 trials</td>
<td>Function was determined for all participants. Mother implemented with fidelity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>nonoccurrence of</td>
<td></td>
<td></td>
<td>ESC, Ignore</td>
<td>per condition</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>target behavior;</td>
<td></td>
<td></td>
<td></td>
<td>1 min Control</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Fidelity of</td>
<td></td>
<td></td>
<td></td>
<td>1 min Test</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>implementation</td>
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</tbody>
</table>
### Table 2-6. Continued.

<table>
<thead>
<tr>
<th>Study</th>
<th>Gender</th>
<th>Age (yrs.)</th>
<th>Disability</th>
<th>Dependent Variable</th>
<th>Setting</th>
<th>Implementer</th>
<th>Condition</th>
<th>Trials</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kodak et al. (2013)</td>
<td>4 M, 1 F</td>
<td>4, 5, 7, 9</td>
<td>ASD</td>
<td>Occurrence or nonoccurrence of target behavior</td>
<td>University-based preschool, Self-contained elem. classroom</td>
<td>Therapists</td>
<td>ATT, TAN, ESC, Play</td>
<td>20 30s trials during 10 min sessions; Test &amp; Control were conducted separately</td>
<td>Function was determined for all participants</td>
</tr>
<tr>
<td>Kunnavatana et al. (2013)</td>
<td>8 F, 2 M</td>
<td>Adult</td>
<td>NA</td>
<td>Fidelity of implementation</td>
<td>Classroom</td>
<td>Teacher, Coordinators</td>
<td>ATT, TAN, ESC, Ignore</td>
<td>2 min trials</td>
<td>Teacher implemented the procedures with 100% fidelity</td>
</tr>
<tr>
<td>Kunnavatana et al. (2013a)</td>
<td>4 F</td>
<td>Adult</td>
<td>NA</td>
<td>Fidelity of implementation</td>
<td>Classroom</td>
<td>Teacher</td>
<td>ATT, TAN, ESC</td>
<td>2 min trials</td>
<td>Following feedback, teachers conducted the procedures with acceptable fidelity</td>
</tr>
<tr>
<td>Lambert et al. (2012)</td>
<td>1 M, 2 F</td>
<td>3-4</td>
<td>DD</td>
<td>Occurrence or nonoccurrence of target behavior</td>
<td>Special Ed Classroom</td>
<td>Teacher</td>
<td>ATT, TAN, ESC</td>
<td>10 trials per condition, 2 min segment</td>
<td>Function was determined for all participants</td>
</tr>
<tr>
<td>Study</td>
<td>N</td>
<td>G</td>
<td>Age (yrs.)</td>
<td>Disability</td>
<td>Dependent Variable</td>
<td>Setting</td>
<td>Implementer</td>
<td>Condition</td>
<td>Trials</td>
</tr>
<tr>
<td>-----------------------</td>
<td>----</td>
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<td>------------</td>
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<td>-----------------------------------------</td>
<td>------------------------</td>
<td>-----------------------</td>
<td>----------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>Lambert et al. (2013)</td>
<td>9</td>
<td>NR</td>
<td>Adult</td>
<td>DD</td>
<td>Fidelity of implementation</td>
<td>Residential facility</td>
<td>House managers</td>
<td>ATT, TAN, ESC, Ignore</td>
<td>2 min trials</td>
</tr>
<tr>
<td>Lambert et al. (2014)</td>
<td>10</td>
<td>NR</td>
<td>Adult</td>
<td>NA</td>
<td>Fidelity of implementation</td>
<td>University</td>
<td>Graduate students</td>
<td>ATT, TAN, ESC, Ignore</td>
<td>2 min trials</td>
</tr>
<tr>
<td>Lambert et al. (2017)</td>
<td>1</td>
<td>M</td>
<td>10</td>
<td>ASD</td>
<td>Occurrence or nonoccurrence of target behavior</td>
<td>University-based behavior clinic</td>
<td>Therapist</td>
<td>ATT, TAN, ESC, Ignore, Preferred Environ.</td>
<td>10 trials per condition, 2 min segments</td>
</tr>
<tr>
<td>Larkin et al., (2016)</td>
<td>3</td>
<td>3 M</td>
<td>4,5,7</td>
<td>ASD</td>
<td>Occurrence or nonoccurrence of target behavior</td>
<td>Private School</td>
<td>Graduate students, Agency staff</td>
<td>ATT, TAN, ESC</td>
<td>20 trials per condition, 1 min segments</td>
</tr>
<tr>
<td>Study</td>
<td>N</td>
<td>G</td>
<td>Age (yrs.)</td>
<td>Disability</td>
<td>Dependent Variable</td>
<td>Setting</td>
<td>Implementer</td>
<td>Condition</td>
<td>Trials</td>
</tr>
<tr>
<td>-----------------------</td>
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</tr>
<tr>
<td>LaRue et al., (2010)</td>
<td>5</td>
<td>M</td>
<td>4, 8, 9, 20, 29</td>
<td>ASD, ID</td>
<td>Occurrence or nonoccurrence of target behavior</td>
<td>Classroom, Vocational Setting</td>
<td>Classroom staff</td>
<td>ATT, TAN, ESC, Play</td>
<td>12 trials per condition, 1 min segments</td>
</tr>
<tr>
<td>Lloyd et al. (2015)</td>
<td>4</td>
<td>3 M, 1 F</td>
<td>5, 8, 9, 9</td>
<td>ASD, DD, ID, VI, DS, Speech</td>
<td>Occurrence or nonoccurrence of target behavior</td>
<td>Special Ed classroom</td>
<td>Paraprofessional</td>
<td>ATT, TAN, ESC</td>
<td>Number of trials varied by condition, 1 min segments</td>
</tr>
<tr>
<td>McDonald et al. (2012)</td>
<td>1</td>
<td>M</td>
<td>5</td>
<td>ASD</td>
<td>Occurrence or nonoccurrence of target behavior</td>
<td>Special Ed classroom</td>
<td>NR</td>
<td>ATT, ESC, TAN, Play</td>
<td>3 trials per condition, 1 min segments</td>
</tr>
<tr>
<td>Neidert et al. (2013)</td>
<td>2</td>
<td>M</td>
<td>21, 22</td>
<td>ID</td>
<td>Latency to target behavior</td>
<td>Special Ed classroom</td>
<td>Therapist</td>
<td>ATT, ESC, Ignore</td>
<td>5 min trials</td>
</tr>
</tbody>
</table>
### Table 2-6. Continued.

<table>
<thead>
<tr>
<th>Study</th>
<th>Participants</th>
<th>N</th>
<th>G</th>
<th>Age (yrs.)</th>
<th>Disability</th>
<th>Dependent Variable</th>
<th>Setting</th>
<th>Implementer</th>
<th>Condition</th>
<th>Trials</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rispoli et al. (2012)</td>
<td>2</td>
<td>1 M, 1 F</td>
<td>5, 15</td>
<td>ASD, DS, ID</td>
<td>Occurrence or nonoccurrence of target behavior</td>
<td>Classroom</td>
<td>Teacher, Paraprofessional</td>
<td>ATT, TAN, ESC</td>
<td>20 trials per condition, 2 min segments</td>
<td>Function determined for both participants; TFA was inconclusive while TBFA detected function</td>
<td></td>
</tr>
<tr>
<td>Rispoli et al. (2015a)</td>
<td>3 (C), 3 (A)</td>
<td>2 M, 1 F (C); 3 F (A)</td>
<td>3, 4, 4</td>
<td>NR</td>
<td>Occurrence or nonoccurrence of target behavior; Fidelity of implementation</td>
<td>Head Start classroom</td>
<td>Teacher</td>
<td>ATT, TAN, ESC</td>
<td>10 trials per condition, 1 min segments</td>
<td>Function determined for all participants; Teachers could implement with 100% fidelity</td>
<td></td>
</tr>
<tr>
<td>Rispoli et al. (2015)</td>
<td>3</td>
<td>3 F</td>
<td>Adult</td>
<td>NA</td>
<td>Fidelity of implementation</td>
<td>Head Start classroom</td>
<td>Teacher</td>
<td>ATT, TAN, ESC</td>
<td>1 min segments</td>
<td>Teachers were able to implement procedures with fidelity following training</td>
<td></td>
</tr>
<tr>
<td>Study</td>
<td>Participant Characteristics</td>
<td>TBFA Characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>N</td>
<td>G</td>
<td>Age (yrs.)</td>
<td>Disability</td>
<td>Dependent Variable</td>
<td>Setting</td>
<td>Implementer</td>
<td>Condition</td>
<td>Trials</td>
<td>Outcomes</td>
<td></td>
</tr>
<tr>
<td>Rispoli et al. (2016)</td>
<td>6</td>
<td>F</td>
<td>Adult</td>
<td>NA</td>
<td>Fidelity of implementation</td>
<td>Special Ed classroom</td>
<td>Teacher</td>
<td>ATT, TAN, ESC</td>
<td>1 min segments</td>
<td>Teachers were able to implement procedures with fidelity following training</td>
<td></td>
</tr>
<tr>
<td>Schmidt et al. (2014)</td>
<td>3</td>
<td>M</td>
<td>9, 10, 15</td>
<td>ASD, ID, Depressive Disorder – NOS</td>
<td>Occurrence or nonoccurrence of target behavior</td>
<td>Residential facility</td>
<td>Behavior Staff, Researcher</td>
<td>ATT, TAN, ESC</td>
<td>10 trials per condition, Variable segments (1 – 3 min)</td>
<td>Function was determined for all participants</td>
<td></td>
</tr>
<tr>
<td>Sigafoos &amp; Meikle (1995)</td>
<td>2</td>
<td>M</td>
<td>8</td>
<td>ASD</td>
<td>Occurrence or nonoccurrence of target behavior</td>
<td>Special Ed School</td>
<td>Teacher</td>
<td>ATT, TAN ESC</td>
<td>20 trials per condition, 1 min segments</td>
<td>Function determined for all participants</td>
<td></td>
</tr>
<tr>
<td>Sigafoos &amp; Saggers (1995)</td>
<td>2</td>
<td>M</td>
<td>10, 12</td>
<td>ASD</td>
<td>Occurrence or nonoccurrence of target behavior</td>
<td>Special Ed School</td>
<td>Teacher</td>
<td>ATT, TAN ESC</td>
<td>20 trials per conditions, 1 min segments</td>
<td>Function determined for all participants</td>
<td></td>
</tr>
</tbody>
</table>

Note: NR not reported; NA not applicable; Disability: ASD autism spectrum disorder; ID intellectual disability; DS Downs Syndrome; HI hearing impairment; SLD speech and language disorder; Conditions: ATT attention, TAN tangible, ESC escape; Trials: segment each trial consists of test and control segments
Table 2-7. Application of the quality indicators (adapted from Reichow, 2008) to the research using trial-based functional analysis

<table>
<thead>
<tr>
<th>Study</th>
<th>Primary Indicators</th>
<th>Secondary Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PC</td>
<td>BL</td>
</tr>
<tr>
<td>TBFA with intervention</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Austin et al. (2014)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Bloom et al. (2013)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Chezan et al. (2014)</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Gerow et al. (2017)</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Gerow et al. (2018)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Lambert et al. (2012)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Lambert et al. (2017)</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Larkin et al., (2016)</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Lloyd et al. (2015)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Rispoli et al. (2015a)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Schmidt et al. (2014)</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Sigafous &amp; Meikle (1996)</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Comparison studies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bloom et al. (2011)</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>LaRue et al., (2010)</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Rispoli et al. (2012)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Rispoli et al. (2016)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Training natural change agents (no intervention)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alnemary et al. (2017)</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Flynn &amp; Yo (2016)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Kunnavatana et al. (2013)*</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Kunnavatana et al. (2013a)*</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Lambert et al. (2014)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Lambert et al. (2013)*</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Rispoli et al. (2015)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Implementation of TBFA (No intervention or comparison)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kodak et al. (2013)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Flanagan et al. (2017)</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>McDonald et al. (2012)</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Sigafous &amp; Saggers (1995)</td>
<td>N</td>
<td>Y</td>
</tr>
</tbody>
</table>

Note: PC= participant characteristics, BL = baseline condition, DV = dependent variables, IV = independent variables, VA = visual analysis, IOA = interobserver agreement, IF = implementation fidelity, G/M = generalization/maintenance, SV = social validity. A (*) indicates that social validity measures were included in the study but only for the intervention and not the TBFA.
Figure 2-1. PRISMA diagram showing inclusion decisions
Figure 2-2. A comparison of home and school natural environment functional analysis approaches. Total indicates the number of study in each setting. Standard = the number of studies that used procedures that did not include adapted conditions or variations in procedures (Iwata et al., 1982/1994); Adapted = one or more of the conditions were adapted or individualized; Variation = the type of approach was a variation from the standard procedures.
Figure 2-3. Number of studies published using trial-based functional analysis per year from 1995 – 2017.
Figure 2-4. Conceptual Framework

Concurrent Setting Factors
Factors that occur concurrently with the interaction between a particular $S^D$ and its related consequence to influence the behavioral response (Whaler & Fox, 1981)

Motivating Operation

$S^D$
- Evoke an increase or decrease in the momentary frequency of a behavior because of a history with the availability of a reinforcer (Michael, 1993)

Observed behavior

Response

Consequence
- Classified by their effect on future occurrences of the behavior (Cooper et al., 2007)

Environmental events or stimuli that meet two conditions: (a) alters the momentary value of the reinforcer or punisher; and (b) alters the frequency of the behaviors associated with these events (Michael, 2000).
CHAPTER 3
METHOD

The purpose of this chapter is to describe the methods that were used to conduct two studies: (1) trial-based functional analysis (TBFA) in home settings and (2) functional communication training (FCT) intervention linked to the results of the TBFA to reduce problem behavior and increase communication skills in young children with autism spectrum disorder (ASD). The participants, settings, and materials used in each study are presented. Next, the experimental procedures, dependent measures, study design and data analysis are described. Finally, procedures for obtaining interobserver agreement, procedural fidelity, and social validity are provided.

Study 1: TBFA in Home Settings

Participants

The following section describes the eligibility characteristics for the participants, recruitment procedures, and the screening process to determine eligibility. Participant characteristics are described and provided in Table 3-1.

Focal child characteristics. Participants were young children with or at-risk for ASD who demonstrated socially mediated problem behaviors in their home settings. The following criteria were used for inclusion in the study:

- A chronological age between 2.0-5.0 years old and English as the primary language spoken in the home.
- Eligible for special education services under the category of autism or developmental delay according to the state board of education criteria for special education OR receiving or eligible for early intervention services.
- A minimum score of 30 or higher on the researcher-administered Childhood Autism Rating Scale -2nd Edition (CARS-2; Schopler, Van Bourgondien, Wellman, & Love, 2010). This cutoff score indicates mild-to-moderate symptoms of ASD.
Demonstration of problem behavior that appear to be mediated by social variables (i.e., consequences are provided by other people; Carr, 1977)

Caregiver reported that the problem behavior occurs at a high frequency and was observed during the initial observation.

At least one primary caregiver (i.e., defined as residing with the child and being responsible for the care of the child during every day routines) agreed to be the primary contact throughout the study and provide relevant information to assist in the development of the individualized TBFA conditions.

The caregiver verbally agreed to the timeline of home visits consisting of a minimum of once a week for approximately one hour per visit until the completion of the study. These visits were to be consistent (i.e., same time/day) unless other arrangements are made with the primary investigator (PI).

Recruitment. Four children with or at-risk for ASD between the ages of two and five years old were selected to participate in this study. Prior to beginning the study, Institutional Review Board (IRB) approval was obtained from the University of Florida (IRB 201700212). Upon IRB approval, recruitment for the study was conducted through University of Florida related or community organizations (e.g., Center for Autism and Related Disabilities, Florida Autism Center), surrounding area school districts and early intervention organizations to identify families with children that meet the inclusion criteria. These organizations/schools identified potential families made initial contact with the caregivers and distributed a flyer with a description of the study and PI contact information. In response to the flyer, interested families contacted the PI via phone or email to begin the screening procedures for eligibility.

Screening and eligibility confirmation. Once contact was made, screening took place in two phases: (1) initial child and family screening; and (2) confirmation of eligibility. The initial screening was conducted via telephone (see Appendix B for protocol and screening form). The purpose of the screening form was to provide guidance on whether the child was eligible for inclusion based on the criteria described
If the child met these criteria, the caregiver signed a consent form (see Appendix C) for participation in the study, child assent was sought, and confirmation of eligibility was conducted.

The confirmation of eligibility took place once the initial screening was conducted and the caregiver signed consent for participation. This phase of the screening process included two steps: (1) informal observation and (2) researcher-administered CARS-2 (Schopler et al., 2010). An informal observation was conducted in the home to determine the frequency of problem behaviors and develop operational definitions for target behaviors. This observation included situations set up by the caregiver where problem behavior is more likely to occur, followed by a brief (i.e., 5-10 min) observation of the child alone (i.e., no other stimuli present) to screen for behaviors that were automatically reinforced (i.e., not socially mediated behavior; Querim et al., 2013). The CARS-2 (Schopler et al. 2010) was administered to confirm risk or symptoms of ASD for each child participant. The CARS-2 is a 15-item rating scale completed by the researcher based on observations of the child and input from the caregivers. Scores from the CARS-2 are used to identify the level of severity of autism-related behaviors comparable to other individuals with ASD. Scores on the CARS-2 of 30 or above indicated the presence of risk factors associated with ASD.

Ryan. Ryan, a Caucasian male, was 3 years and 9 months at the start of the study. Ryan was diagnosed with moderate ASD using the *Autism Diagnostic Observation Schedule, 2nd Edition* (ADOS-2; Lord et al., 2012) by a licensed clinical psychologist. His CARS-2 score was 42, indicating a severe degree of ASD. Ryan was receiving special education services and attended a self-contained pre-school special
education classroom in rural north central Florida. He resided in rural north central Florida with his mother, father and younger brother. According to the caregiver interview, Ryan primarily communicates using gestures and idiosyncratic vocalizations with occasional use of short one-syllable words (e.g., “yes,” “no”). Ryan’s problem behaviors were aggression and destruction. Aggression was defined as any action that resulted in or any attempt to harm through the use of physical contact between a part of his body (e.g., hand, foot) or object and the body of another person. Ryan’s aggression was in the form of hitting, grabbing, kicking, or throwing an object at another person. Destruction was defined as any action or attempt to cause damage to items or property. Ryan’s destructive behaviors were primarily in the form of throwing or attempting to throw an object, but not in the direction of another person. Other forms of destruction included forcefully pushing and pulling on an object or swiping objects from a surface (e.g., table).

James. James, a Caucasian male, was 4 years and 5 months at the start of the study. James was receiving services special education services and attended a self-contained pre-school classroom in suburban north central Florida. James was receiving services under the category of Developmental Delay and was awaiting additional clinical testing to determine a specific diagnosis. His CARS-2 score was 34, indicating a mild to moderate degree of ASD. He resided in suburban north central Florida with his mother, father and younger brother. According to caregiver interview, James communicates using complete phrases and sentences. James’ problem behaviors were destruction, disruption, and aggression. James’ destruction was primarily in the form of throwing or attempting to throw items, breaking or attempting to break items, slamming doors with
excessive force, kicking objects, and swiping objects from the table or couch using his
hand. James’ disruption was primarily in the form of screaming defined as a high-
pitched vocalization. Finally, James’ aggression was primarily in the form of pushing or
hitting using his hands to make contact with another person.

Kaleb. Kaleb, a Caucasian/Hispanic male, was 5 years and 4 months at the start
of the study. Kaleb was receiving special education services and attended a general
education kindergarten classroom in rural north central Florida. Kaleb was receiving
services under the category of Developmental Delay and had a diagnosis of ASD from a
licensed clinical psychiatrist. His CARS-2 score was 32.5, indicating mild to moderate
degree of ASD. He resided in rural north central Florida with his mother, father and
younger sister. According to the parent interview, Kaleb communicated using phrases or
full sentences. Kaleb’s problem behaviors were disruption and aggression. Disruption
was primarily in the form of noncompliance, screaming, whining or crying, and tantrum
behaviors. Aggression was primarily in the form of kicking, hitting or pushing.

Jacob. Jacob, a Caucasian male was 3 years and 8 months at the start of the
study. Jacob was receiving special education services under the category of
Developmental Delay and attended a self-contained preschool classroom in suburban
north central Florida. Jacob was diagnosed with ASD using the ADOS-2 (Lord et al.,
2012) from a licensed clinical psychologist. His CARS-2 score was 38, indicating a
severe degree of ASD. He resided in suburban north central Florida with his mother,
father, older brother, and younger sister. According to the parent interview, Jacob
communicated using some phrases or single word vocalizations. Jacob’s problem
behaviors were disruption and aggression. Disruption was primarily in the form of
noncompliance, screaming, whining or crying, and tantrum behaviors. Aggression was primarily in the form of hitting or pushing.

Setting

This study was conducted with two components: (1) pre-assessment and (2) TBFA. Both components of the study were conducted in the child’s home. The pre-assessment component consisted of two interviews with the caregiver(s) and one direct observation. These assessments were used to identify problem behaviors and environmental settings and variables related to the behaviors. Direct observations for all participants were conducted during play routines in the living room of the home. The TBFA component of the study was implemented in the home in rooms that were identified during the pre-assessment component. For Ryan, TBFA trials were conducted in the bedroom, living room, and kitchen. For James, TBFA trials were conducted in the living room. For Kaleb, TBFA trials were conducted in the living room, kitchen, and dining area. For Jacob, TBFA trials were conducted in the living room and outside in the backyard.

Materials

During the pre-assessment component, structured interview forms and a direct observation data collection sheet (Antecedent-Behavior-Consequence [ABC] form) were completed to collect information about the participant’s problem behaviors. Trained graduate students used a digital video camera to record the direct observation. Descriptions and purposes of the forms are described in the experimental procedures section. During the TBFA phase, relative stimuli from the home (e.g., preferred items) that were identified during the pre-assessment phase were used. A digital video camera was used during the TBFA to record the behaviors for data collection. A digital timer on
the videographer’s smartphone was used to monitor the duration of the trials. Specific materials for each participant are described in the experimental procedures section.

**Change Agent**

The PI, a doctoral candidate in the Special Education program in the School of Special Education, School Psychology, and Early Childhood Studies at the University of Florida conducted all components of this study. The PI sought the input of the primary caregiver to plan the conditions for the TBFA, but the PI remained the primary change agent for the assessment components of this study.

**Study Design**

This section describes the single case research design (SCRD) used for conducting the TBFA. An alternating treatment design (ATD; Barlow & Hayes, 1979) was used to evaluate the effects of the conditions during the TBFA. An ATD allows a researcher to test two or more different conditions simultaneously within the individual within the same phase over time (Barlow & Hayes, 1979; Kazdin, 2011). Specific to this study, one trial consisted of the comparison of two distinct segments (i.e., control and test) comparable to a comparison between baseline (i.e., no treatment) and treatment (Barlow & Hayes, 1979). As in other variations of study design in SCRDs, level of responding in each condition were visually analyzed to identify differentiation between the control and test segments (Kazdin, 2011).

**Experimental Procedures**

The experimental procedures section outlines the steps that were implemented to complete the two components of the study: (1) pre-assessment and (2) TBFA.
Component 1: Pre-assessment

The pre-assessment component was conducted to gather information about the child’s behavior and the home setting to inform the TBFA and to develop a hypothesis of the function of the problem behaviors. Data from two interviews are reported including the *Open-ended Functional Assessment Interview* (Hanley, 2012) and the *Caregiver Preference Assessment Interview* (Conroy, 2008). A descriptive observation was video recorded and ranged from 7-10 minutes for each participant. These observations were descriptively analyzed to identify potential antecedents, behaviors, and consequences. Finally, a brief meeting with the caregiver occurred prior to the TBFA to outline the TBFA procedures. All forms for the pre-assessment phase are included in Appendix D. Specific procedures are described below.

**Indirect assessment.** The interviews were conducted with the participant’s primary caregiver(s). Responses were used to generate a hypothesis of function of the problem behavior and to inform the conditions tested during the TBFA. The purpose of the *Open-ended Functional Assessment Interview* (Hanley, 2012) was to collect descriptive information relative to the problem behavior, including identifying contexts where the behavior might occur and idiosyncratic variables that might influence the occurrence of the behaviors. Specifically, the PI used the *Open-ended Functional Assessment Interview* (Hanley, 2012) to decide which of the conditions might be most relative to the problem behaviors. The interview was also used to determine all materials needed for the conditions which were then outlined on the *TBFA Planning Form* (see Appendix D). The purpose of the *Caregiver Preference Assessment Interview* (Conroy, 2008) was to identify preferred items and activities in the home and to determine the form of communication the child typically uses to express needs or
wants. Specifically, this form was used to identify communicative responses currently in the child’s repertoire (e.g., gestures, vocalizations) to ensure that the chosen communicative responses for the analysis and intervention were appropriate for that child.

**Descriptive observation.** This section will describe the steps taken to complete a descriptive observation of the participant. First, a routine identified as typically problematic (i.e., likely to evoke problem behavior) during the indirect assessment was chosen for the descriptive observation. Next, the descriptive observation was video recorded for a minimum of 5 min for each participant. The videographer was instructed to remain as unobtrusive in the routine as possible and ensure the video frames all relative people and materials. If the problem behaviors were not observed so that a precise operational definition could be developed (i.e., as was the case for Jacob), the PI asked the caregiver to set up some specific situations where the behaviors might be directly observed (e.g., taking away a preferred item, diverting their attention to someone else). Finally, the observations were descriptively analyzed using pencil and paper via the video by the PI to identify potential antecedents, behaviors, and consequences.

**Caregiver meeting.** Following the interview and direct observation, the PI completed the *Trial-based Functional Analysis Planning Form* prior to the caregiver meeting specifying the context, materials, people, and test/control segment procedures for each condition. The PI then met with the caregiver before the first session of the TBFA to explain the results of the pre-assessments and the TBFA procedures. The form was modified, if needed, in collaboration with the caregiver. A specific operational
definition of behaviors that were being tested in the TBFA was developed and confirmed with the caregiver for accuracy.

**Component 2: TBFA**

A TBFA is a systematic process of manipulating environmental variables by embedding trials into a natural routine (Sigafoos & Saggers, 1995). The PI implemented the TBFA procedures in the home. Based on the pre-assessments, a minimum of three traditional conditions (e.g., attention, escape, tangible) were included in every TBFA. A combined condition (i.e., escape to tangible) was used for all participants because pre-assessment data indicated its relevance to the problem behavior (e.g., clean up from a preferred activity was problematic). The order of the conditions was determined based on the routines that were occurring during the home visit. No more than three of the same condition were presented in a row and a 2 – 5 min break was given between each trial. For the purpose of this study, **condition** refers to the overall trial type (e.g., attention, tangible, escape), **trial** refers to the combination of control and test, and **segment** refers to either the test or control portion of that trial. A protocol for the TBFA is provided in Appendix E.

Each trial of the TBFA was divided into two segments: control and test. Control segments were conducted before the test segments to limit the carryover effects (Bloom et al., 2011). The control segment was conducted for the first minute of the trial. During this segment, the hypothesized reinforcer was freely available (i.e., EO for problem behavior was not present). If problem behavior occurred during the control segment, the control segment was terminated and the test segment began. If no problem behavior occurred after the passage of 1 min, the PI initiated the test segment by removing the hypothesized reinforcer from the participant (i.e., EO for problem behavior was present)
and re-setting the digital timer for 1 min. Occurrence of problem behavior resulted in the delivery of the reinforcer and ended the test segment. If problem behavior did not occur, the test segment ended when the timer signaled the passage of 1 min. Each trial lasted up to 2 min depending on when and if problem behavior occurred during the control or test segments.

If problem behavior occurred during the trial, there was at least a 5 min break after problem behavior ceased for a minimum of 1 min before the presentation of the next trial to reduce carry over of behaviors from each condition. During that time, the child was able to access moderately preferred items and attention was delivered. If no problem behavior occurred during the previous condition, the wait time was shortened to 2 min as the next condition was arranged. If problem behavior was persistent and would potentially interfere with data collection (e.g., problem behavior was not ceasing long enough to set up a control condition without problem behavior), a decision was made to discontinue the presentation of trials and terminate that session.

Conditions were presented for a minimum of 5 trials; but, as per procedures described by Lloyd et al. (2015), continued until response differentiation could be determined between test and control segments. In other words, trials were presented until there was a differentiated pattern between the occurrence of problem behavior in the test segment and non-occurrence of problem behavior in control segment and could vary across participants or conditions. Response differentiation is described in more detail in the data analysis section. General descriptions of the conditions are provided below followed by the specific conditions that were conducted with each participant.
Table 3-3 provides additional details of the conditions presented to each of the participants including context, setting and materials.

**Attention.** The control segment began with the PI engaging with the child in a natural occurring routine and providing attention to the child. Attention was freely available and delivered to the child for the entire 1 min during the control segment. Moderately preferred toys were available during the attention condition and designated highly preferred toys were removed from the setting. All non-target problem behaviors were ignored. The control segment ended at 1 min or occurrence of problem behavior. At the beginning of the test segment, the PI told the child “I am going to play over there” and turned away. The PI ignored all child communicative behaviors and non-targeted problem behaviors. If targeted problem behavior occurred, the PI immediately provided attention for the problem behavior (e.g., “Don’t do that”). The form of attention was varied across participants based on pre-assessment results (e.g., diverting attention to other family members, reprimands). Problem behavior ended the test segment and data collection continued on the problem behaviors until behaviors ceased for 5 s following the end of the test segment.

**Tangible.** The control segment began by providing the child exposure to a highly preferred item or activity (i.e., item/activity that was identified in the *Caregiver Preference Assessment Interview*; Conroy, 2008) during the chosen routine. During the control segment, the child had continuous (i.e., uninterrupted) access to the preferred tangible with intermittent (e.g., every 30 s) quality attention from the PI (e.g., “This is fun!” or “Looks like you really like this toy”). All non-target problem behavior was ignored. The control segment ended after 1 min or occurrence of problem behavior.
Following the control condition, the PI removed the item and began to manipulate the item (e.g., “All done” or “My turn”). The PI ignored all child communicative behaviors and non-targeted problem behaviors and did not allow access to the item or activity. If problem behavior occurred, the tangible item was returned to the child accompanied by a verbal statement (e.g., “Ok, you can have it.”). Problem behavior ended the test segment and data collection continued on the problem behaviors until behaviors ceased for 5 s following the end of the test segment.

**Escape.** The control segment began with the PI remaining in close proximity but turned away from the participant giving no demands or prompts. Neutral materials (e.g., objects that were not identified as highly preferred in the pre-assessments or no materials were present. The PI responded to appropriate bids for communication but did not respond by giving a demand (e.g., asking a question). The control segment ended after 1 min or occurrence of problem behavior. The test segment began with the PI giving a demand to the child to engage in a non-preferred task or activity identified during the pre-assessments. Prompts were delivered to complete the task using least-to-most prompting (i.e., prompting began with a vocal prompt, followed by a gestural, and physical, if needed). Demands were delivered approximately every 10-15 s during the test condition. The PI ignored all child communicative behaviors and non-targeted problem behaviors and did not allow the child to avoid the task (i.e., escape). If problem behavior occurred, PI discontinued prompting accompanied by a verbal statement (e.g., “Ok let’s take a break” or “Ok, you don’t have to”) and the child was allowed to cease from completing the demand. In this condition, the child did not have access to a highly preferred item upon escape from demands. Problem behavior ended the test segment.
and data collection continued on the problem behaviors until behaviors ceased for 5 s following the end of the test segment.

**Escape to tangible.** A combined condition was implemented since all caregivers reported that the child engaged in problem behavior to both escape a demand and access a highly preferred tangible. This typically occurred in the context of a transition (e.g., child is asked to clean up a preferred item to come to dinner). Since combined conditions were included in the analysis, the isolated conditions (e.g., escape, tangible) were also included.

During the control segment, the PI remained in close proximity to the child and delivered intermittent attention. The child had continuous (i.e., uninterrupted) access to the preferred item and PI delivered non-specific demands (e.g., “We should go to the table soon”) every 15 s with no additional prompts for completion. The PI responded to appropriate bids for communication, but did not respond in demand form (e.g., making a demand). The control segment ended at 1 min or the occurrence of problem behavior. During the test segment, the PI removed the tangible and simultaneously gave a vocal demand (e.g., “Playtime is over, time to go eat dinner” or “All done playing, we are cleaning up now”). Prompts were delivered to complete the task using least-to-most prompting (i.e., started with a vocal prompt, if no response a gestural prompt was delivered, followed by physical guidance when needed). Demands were delivered approximately every 10-15 s during the test condition. The PI ignored all child communicative behaviors and non-targeted problem behaviors and did not allow the child to avoid the task (i.e., escape). If problem behavior occurred, the PI discontinued prompting accompanied by a verbal statement (e.g., “Ok, you can go play”) and
simultaneously delivered the preferred tangible item. Problem behavior ended the test segment and data collection continued on the problem behaviors until behaviors ceased for 5 s following the end of the trial.

Based on the results of the pre-assessments, conditions were developed for each of the participants specific to the settings within the home, materials, and routines that were determined to be relevant to the problem behaviors. General descriptions are provided below and detailed descriptions (i.e., setting, materials) of the conditions for each participant are found in Table 3-3.

**Ryan.** According to the pre-assessment interviews, Ryan’s problem behavior typically occurred within playtime and transition activities. The assessment trials included in Ryan’s TBFA were: (a) attention; (b) tangible; (c) escape; and (d) escape to tangible. Attention, tangible and escape to tangible trials were embedded into typical playtime activities in the living room and bedroom (i.e. location of toys and where typical play occurs) of his house. Escape trials began in the living room or bedroom, but demands were specific to movement towards the kitchen and to the table.

**James.** James’ problem behaviors typically occurred within playtime and transition activities. The assessment trials included in James’ TBFA were: (a) attention; (b) tangible; (c) escape; and (d) escape to tangible. All of these trials were embedded into typical playtime activities in the family’s living room. The demand for the escape and escape to tangible conditions was to clean up.

**Kaleb.** Kaleb’s problem behavior typically occurred within playtime and transition activities. The assessment trials included in Kaleb’s TBFA were: (a) attention; (b) tangible; (c) escape; and (d) escape to tangible. All of these trials were embedded into
typical playtime activities in the family’s living room, kitchen, and dining room. The attention condition included Kaleb’s younger sister and attention was diverted to her during the test segment. The demand for the escape and escape to tangible conditions was to clean up or do academic work (e.g., read words, complete homework worksheet).

Jacob. Jacob’s problem behavior typically occurred within playtime and transition activities. The assessment trials included in Jacob’s TBFA were: (a) attention; (b) tangible; (c) escape; and (d) escape to tangible. All of these trials were embedded into typical playtime activities in the family’s living room, kitchen, dining room, and outside in the backyard. The demand for the escape and escape to tangible conditions was to go inside (e.g., if outside), clean up, or complete a neutral task such as placing blocks together or into a bin.

**Dependent Measures**

The primary dependent measure for this study was problem behavior. Prior to beginning the TBFA, problem behaviors were operationally defined per individual participant based on the pre-assessment interviews and observed behaviors. Data were collected on the occurrence and non-occurrence of problem behavior during each segment (i.e. test and control) and reported as the cumulative frequency of trials with problem behavior for the analysis.

Rate of problem behavior was also reported per condition during the TBFA sessions. Data were collected on rate of problem behavior for two purposes: (1) to examine the pattern of behavior for differences in rate of behavior across conditions (e.g., measure the potential differences in the problem behavior following the delivery of a specific reinforcer) and (2) to examine the pattern of behavior for changes in the rate
of behavior as additional trials of the same condition were presented. Rate was determined by recording the frequency of the problem behavior, defined as a count of behavior occurring from the first instance of problem behavior (e.g., behavior that ends the trial) until the problem behavior ceased for at least 5 s following the end of the test segment. This was calculated by dividing the number of behaviors emitted during the recorded duration of the trial (i.e., test and control segments) plus the duration of time until behavior ceased.

Data Collection

Procedures. All TBFA trials were video recorded. A trained data collector recorded the occurrence of problem behavior using pencil and paper on the TBFA Data Collection Form (see Appendix F) from the video recording. Occurrence or non-occurrence of target problem behaviors for each segment was recorded by circling the plus (i.e., occurrence) or minus (i.e., non-occurrence) sign on the data collection form. Within session graphs were constructed using the occurrence or non-occurrence of problem behavior in the control and test segment of each trial. A second data collector (PI) recorded data using pencil and paper via video recording on 100% of the sessions. Data collection was also completed via video on the frequency of problem behavior following the occurrence of problem behavior in the test segment until behaviors ceased for at least 5 s. All data collection forms are included in Appendix F.

Data collector training. Data collectors were graduate students in the College of Education at the University of Florida. All data collectors were students in the special education, school psychology or early childhood studies programs and had previously experience working with children and families. Prior to data collection, data collectors were trained on general TBFA procedures, behavioral definitions and data collection
procedures. Initial training included a didactic training (adapted from Lambert et al., 2014) on the general procedures for attention, tangible, and escape conditions. This training included a PowerPoint® presentation of video clips showing correct and incorrect demonstrations of the trials for each condition, as well as multiple-choice questions to check knowledge about the procedures. Although the data collectors did not implement the procedures, the purpose of the training was to teach them to recognize the correct procedures and code the trials appropriately. During this TBFA training, the specific protocol for this study, behavioral responses, and the data collection forms were used to code the video samples. Data collectors met once a week for the duration of the study. Data collectors met to review behavioral definitions, protocol procedures and codes, assign coding videos, and discuss questions that arose as the study progressed. Recorded descriptive assessments were shown to data collectors to identify specific behavior per participant. Interobserver agreement (IOA) was assessed on two measures: (a) occurrences of target behavior and (b) procedural fidelity data. Data collectors coded 10 sample trials (i.e., control and test segments) to a criterion of 80% or higher before study data could be coded. If data collectors were not in agreement on the codes prior to collecting data, additional training was conducted and included watching videos and conducting discrepancy talks to clarify behavioral definitions until the criterion was met.

**Data storage.** Upon recruitment to the study, each child participant was given an ID number, which was used on all forms in lieu of the child’s name. If child was found to be eligible, all signed consent forms were stored in a locked cabinet in the Anita Zucker Center for Excellence in Early Childhood Studies in the College of Education at the
University of Florida separated from study data to maintain the confidentiality of the raw data. All raw data (i.e., assessments, data collection forms) were returned to the College of Education immediately after collection and stored in a locked cabinet. Videos were uploaded to a file on the secure, password protected College of Education server. Only data collectors and investigators for this study had access to these files on the server. Data from the TBFA were transferred to an Excel® file and were graphed. Additional procedures for data labeling and storage are provided in Appendix G.

Data Analysis

Trial-by-trial occurrence of problem behavior was analyzed to determine response differentiation and to identify behavior function. Response differentiation during an FA is defined as a pattern of responding that shows higher occurrences of problem behavior in the test condition relative to that of the control condition (Hagopian et al., 1997). Thus, function was evaluated by the differences in level between the control and test segments for each condition.

A cumulative frequency graph was developed to show the total number of responses (i.e., occurrence of target behavior) during all previous observations (i.e., trials). Specifically, each consecutive data point represents the accumulated total of problem behavior for that trial and all previous trials in the test and control segments. The use of a cumulative frequency graph is appropriate when target behavior can only occur one time during an observation and offers the opportunity to analyze temporal patterns in data that might otherwise be presented in summary form (Cooper et al., 2007; Johnston & Pennypacker, 1980). In the research literature, data for TBFAs have been summarized using bar graphs to depict percentage of trials with target behavior (Sigafoos & Saggers, 1995), but this form does not allow for analysis of trial by trial
patterns that might occur during the TBFA. To that end, a separate cumulative frequency graph was developed for each TBFA condition.

Following a minimum of 5 trials presented in a condition, visual analysis of the cumulative frequency graph was used to confirm response differentiation between the test and control segments of each condition. In a cumulative frequency graph, response rates are compared by examining the slope of the data path, whereas a steeper slope indicates a higher response rate (Cooper et al., 2007). A horizontal line in a cumulative graph indicates no responding (i.e., the target behavior did not occur). Cumulative occurrence of problem behavior was evaluated to determine the function of the target behaviors. Determination of function was made per condition and comparisons were made across the conditions.

**Interobserver Agreement**

As previously described, graduate students were the primary data collectors for all participants. The PI served as a secondary data collector and scored IOA to ensure that data were consistently recorded across all phases of the study (Kazdin, 2011). High levels of agreement (i.e., 80% or above) indicated that all observers were measuring the dependent measures consistently according to the behavioral definitions (Kazdin, 2011; Gast, 2009). If IOA was below 80% for any given session, a discrepancy talk was conducted between the two data collectors and additional training was provided during the weekly meeting.

All TBFA sessions were coded so that IOA was calculated on 100% of all observed trials per condition across all participants. During the TBFA session, an agreement was defined as both observers recording the occurrence of the targeted problem behavior within each test and control segment. To be considered an
agreement, the data collectors needed to agree on the occurrence or nonoccurrence of problem behavior for the entire condition (i.e., both segments). Acceptable agreement criteria were 80% or above across all phases on the occurrence of problem behavior and was calculated by dividing the number of agreements by agreements plus disagreements and multiplying by 100 (Kazdin, 2011). IOA data was calculated and stored in an Excel spreadsheet on the secure server.

**Procedural Fidelity**

Procedural fidelity refers to the extent to which the study procedures were implemented as designed. Procedural fidelity measures ensure that the study adheres to specific guidelines across all phases and increases the internal validity of the study (Ledford & Wolery, 2013). It was especially important to ensure fidelity to the TBFA procedures to confirm that function of behavior was identified in a scientific and systematic manner.

Procedural fidelity was measured using behavioral observation to determine if the PI implemented the TBFA procedures as intended. These data were embedded on the *TBFA Data Collection Form* and were analyzed on a trial-by-trial basis during the TBFA. Each trial consisted of 5 possible steps that needed to be completed to achieve adequate fidelity. Data collectors indicated on the data collection form if these were implemented appropriately and scored as a percentage of correct steps (i.e., number of correct steps out of 5). Adequate fidelity was 80% or above per trial. Any trial that was not implemented with adequate fidelity was considered invalid and was repeated. Two data collectors viewed the videos from the server and completed the fidelity measure while recording data on the target behavior. A protocol outlining each step in the TBFA process, as well as all relevant forms, is provided in Appendices E and F.
To be considered a correct trial, the PI: (1) set up the control segment so that access to the designated reinforcer was available; (2) provided reinforcement only for targeted problem behaviors; (3) transitioned from the control to test segment within 5 s of the occurrence of problem behavior or after the 1 min has completed; (4) removed access to the designated reinforcer during test segments; and (5) delivered the relevant consequence in the test segment or ended the session with the passage of 1 min. The relative behavioral definitions for fidelity for setting up each segment are provided below. Fidelity was calculated as percentage of the steps correctly implemented during all complete trials (i.e., control and test) per participant. Mean percentage and range across all trials per participant are reported. Agreement between the primary data collector and the PI was also calculated for 100% of the trials.

Operational definitions for the implementation of the TBFA control and test segments were adapted from Lloyd et al. (2015) and included: (a) attention delivery; (b) attention removal; (c) tangible delivery; (d) tangible restriction; (e) instruction delivery; and (f) instruction removal. *Attention delivery* was defined as any vocal or physical interaction directed towards the child (e.g., vocal statements or questions, physical touches, prompting). *Attention removal* was defined as the change agent delivering attention (e.g., vocal or physical interaction) to any other person, item, or activity other than the focal child. *Tangible delivery* was defined as providing access or following through with a child’s request for a preferred item or activity either by direct contact with the change agent (e.g., change agent hands the item to the child) or in a manner that was not initiated by the change agent (e.g., child runs into the kitchen and takes more cereal from the box). *Tangible restriction* was defined as the active removal or denial of
a preferred item or activity from the child (e.g., placing a toy out of reach). *Instruction delivery* was defined as any prompt to complete an action or activity (e.g., “Time to clean up the toys”). To be coded as an instruction, the prompt needed to specify an action that can be observed. *Instruction removal* was defined as the active removal of an instruction via a vocal prompt (e.g., “Ok you don’t have to do it”) or physical removal of the items away from the child.

**Social Validity**

Social validity refers to the extent to which the goals of the study are socially significant and the procedures employed are socially appropriate (Wolf, 1978). A social validity rating scale, adapted from Lloyd et al. (2015), was administered following the completion of the TBFA to assess the caregiver’s acceptability of the TBFA procedures (see Appendix H). All responses were rated on a Likert scale of 1-6 and corresponded to questions about the acceptability (i.e., how comfortable the caregiver felt with the procedures of the TBFA) and authenticity (i.e., how closely the caregiver feels the TBFA reflected a typical occurrence of problem behavior in the home) of the procedures for analyzing problem behavior in the natural home setting.

**Study 2: Functional Communication Training**

The purpose of the second study was to examine the effects of functional communication training (FCT; Carr & Durand, 1985) interventions that were developed based on the results of the TBFA. Specifically, an intervention using FCT was developed for the participants to replace problem behavior with functionally equivalent communicative responses. The use of FCT as an intervention for problem behavior is well documented with young children with ASD (Durand & Moskowitz, 2015; Tiger, Hanley, & Bruzek, 2008; Mancil, 2006). Studies that employed TBFA have frequently
linked the results of the analysis to a FCT intervention (e.g., Chezan et al. 2014; Gerow et al. 2017; Lambert et al. 2012; Schmidt et al. 2014). Similar to the procedures of the TBFA, the development of the intervention was individualized to the child and family through the use of the pre-assessment measures and results of the TBFA.

**Participants**

Three of the four child participants from Study 1 also participated in Study 2. Participants were Ryan, James, and Kaleb. Due to time constraints, an intervention for Jacob is not included in this study. Consultation was provided to the family following the completion of the TBFA and a FCT intervention using one tangible item was employed.

**Setting**

The intervention was implemented during activities in the home as determined in the Study 1 and from input from the primary caregiver.

**Materials**

An *Intervention Data Collection Form* (adapted from Lloyd et al., 2015; see Appendix F), along with relative stimuli from the home (e.g., preferred items) that were identified during the pre-assessment for the TBFA was used. A digital video camera was used during all intervention sessions to record the behavior for data collection. A digital timer on the videographer's smartphone was used to monitor the duration of the sessions. For Ryan, the three preferred items used during the intervention were cars/trucks, a tablet, and a blanket. For both James and Kaleb, the Kindle® was used during the intervention. Specific demands for James and Kaleb warranted the use of other materials found in the home. For James, the materials used were blocks, cups and plates. For Kaleb, the materials used were toy trucks and a written list of spelling words.
Change Agent

The PI from Study 1 conducted all phases of the intervention. The PI worked in collaboration with the primary caregiver to choose contextually relevant routines and communicative responses, but the PI remained the primary change agent for the study.

Study Design

This section will describe the SCRD that was used to conduct the intervention. A multiple probe design (Horner & Baer, 1978) was used in the study to determine the effects of the intervention on the participant’s target behaviors. The traditional multiple baseline design demonstrates the effect by introducing the intervention across different baselines (e.g., participants, settings, behaviors) at different points in time (Kazdin & Kopel, 1975). The rationale for this design is that if the behavior changes when, and only when, the intervention is applied, the change can be attributed to the intervention (Kazdin, 2011). The multiple probe design variation allows for the elimination of the prolonged baseline while the intervention is being implemented (Horner & Baer, 1978). During the multiple probe design, baseline probes are collected systematically in all tiers that the intervention is not being implemented. The benefit of the multiple probe design is two-fold: (1) probes rather than continuous data collection might delay the risk of generalization across the tiers and (2) probes limit the amount of times the problem behaviors need to be reinforced during baseline conditions (Gast, 2009). This study employed three experimental conditions and the design of the study was an A (Baseline) – B (FCT + Extinction [EXT]) - B’ (FCT+ EXT + delay to reinforcement [Ryan] or response chaining [James & Kaleb]).

The intervention that was implemented with participants was based on the function of their problem behavior determined by the TBFA and differed slightly across
participants. Ryan’s intervention was a multiple probe across tangible items (i.e., tablet, trucks, and blanket). James' intervention was a multiple probe across demands (i.e., “clean up,” “put away dishes,” and “wash hands”). Kaleb’s intervention was a multiple probe across demands (i.e., “take turns,” “do work,” and “clean up”).

**Experimental Procedures**

Although the procedures varied based on the results of the TBFA and the individual child, this section outlines general steps that were implemented for the intervention. Following the intervention planning, this study employed three conditions: (1) baseline (A), (2) FCT plus EXT (B), and (3) delay to reinforcement (Ryan) or response chaining (James and Kaleb; B’). A protocol for the intervention procedure is included in Appendix F. Intervention sessions consisted of five consecutive trials each followed by 30 s access to the reinforcer contingent upon problem behavior (baseline) or communication (intervention).

After the completion of the TBFA, the PI conducted a meeting with the primary caregiver. The *Intervention Planning Form* was completed prior to this meeting. This form provided an outline of the specific routines that were used for intervention and was modified with the caregiver as needed. The PI ensured that the specific form of the communicative response was relevant and meaningful to the caregiver and that all materials needed for the routines were identified. Additionally, a crisis management plan was created with the caregiver to ensure the safety of the participant and all others in the environment in the event of severe problem behavior (see an example plan included in the *Intervention Planning Form, Appendix F*).
**Condition 1: Baseline (A)**

Pre-session access to the reinforcer was given to the participant for at least 30 s prior to beginning each baseline session. Each baseline session consisted of five trials using procedures similar to the test segment of the TBFA based on the determined function of the behavior. For example, the PI began each trial by removing the tangible item with no other prompt for communication. If the child needed to use a picture card or assistive technology device to communicate (i.e., Ryan), these were made available during baseline sessions, but prompting for use did not occur. Access to the tangible item was delivered for 30 s contingent upon problem behavior. After the passage of approximately 30 s (i.e., videographer indicated timing to the PI), the tangible item was removed and the trials were repeated until five were complete and the session was over. Baseline sessions were run until a stable baseline was observed.

**Condition 2: FCT + EXT (B)**

The trials were presented similar to baseline, except that an initial verbal instruction for the communicative response that describes the specific response expected (e.g., “If you want to play with me, touch my hand” or “If you would like to play with the car, hand me the picture of the car.”) was provided. To train the communicative response, a progressive prompt delay (Charlop, Scerbman, & Thibodeau, 1985; Fuhrman, Fisher, & Greer, 2016) was used. The purpose of the prompt delay procedure was to teach the response and then to transfer the stimulus control from a physical or verbal prompt to the natural opportunity to access reinforcement. Initially, a 0 s prompt delay was used (i.e., controlling prompt was delivered immediately upon presentation of the verbal instruction). The controlling prompt was different for each participant based on the child’s verbal skills. The prompt delay was increased to 1 s when a criterion of
three consecutive sessions (i.e., 5 trials each) without the occurrence of problem behavior was met and 100% of trials included prompted communication. Reinforcement was delivered immediately for approximately 30 s contingent upon all prompted or independent communicative responses. The terminal prompt delay for this condition was 3 s.

During intervention sessions, no programmed consequence for the problem behavior (i.e., extinction) was delivered. More specifically, every instance of problem behavior no longer resulted in access to the preferred reinforcer. Planned ignoring was used for disruptive behaviors (e.g., screaming, throwing objects that were not breakable or harmful to another person). Instances of aggression were also ignored, but a plan for moving people in the environment out of harm’s way and removing dangerous items was in place for these sessions. If problem behavior occurred after the verbal instruction, the reinforcer was withheld. The PI waited for a 3 s break in the problem behavior, and a verbal instruction for a communicative response was presented again.

Below are the specific procedures followed for FCT + EXT condition per participant.

**Ryan: FCT + EXT.** The intervention trials began when the PI engaged with Ryan in a play routine and provided him with access to one of the highly preferred tangibles (i.e., tablet, trucks, or blanket). After pre-session exposure (i.e., 30 s of access) the trial began. The PI removed the tangible item and simultaneously presented the verbal instruction for a communicative response (e.g., “All done” or “My turn” paired with “If you would like it back, put the picture of the car here” while pointing to the communication board). Using the progressive prompt delay described above (i.e., 0 s, 1 s, 3 s), the PI prompted the communicative response. If problem behavior occurred, PI did not provide
reinforcement, waited for a 3 s break in the behavior and presented the verbal instruction. The use of an independent or prompted communicative response resulted in the delivery of the tangible item for 30 s. After 30 s, the tangible was removed again and the next trial began until 5 trials were completed. A 3-5 min break was given between sessions.

James: FCT + EXT. The Kindle® was identified as the highly preferred tangible item for James’ intervention. Pre-session access to the Kindle® was available for a minimum of 30 s. After pre-session access, the PI removed the Kindle® and simultaneously presented a vocal demand paired with a verbal instruction for a communicative response. The demands were presented across three tiers: (1) “time to clean up” (2) “put away your dishes” and (3) “wash your hands.” Using the progressive prompt delay described above, the PI provided a vocal prompt for the communicative response “I want to play more.” If problem behavior occurred, the PI did not provide reinforcement, waited for a 3 s break in the behavior and presented the verbal prompt again. The use of a communicative response resulted in the delivery of the Kindle® for approximately 30 s.

Kaleb: FCT + EXT. The Kindle® was identified as the highly preferred tangible item for Kaleb’s intervention. Pre-session access to the Kindle® was available for a minimum of 30 s. After pre-session exposure, the PI removed the Kindle® and simultaneously gave a vocal demand paired with a verbal instruction for a communicative response. The demands were presented across three tiers: (1) “We are going to take turns” (2) “Time to do work” and (3) “Time to clean up.” Using the progressive prompt delay described above, the PI provided a vocal prompt for the
communicative response “I want to play more.” If problem behavior occurred, PI did not provide reinforcement, waited for a 3 s break in the behavior and presented the verbal instruction again. The use of a communicative response resulted in the delivery of the Kindle® for 30 s. A change was made to the prompting procedure in the second tier by shortening the prompt and removing the verbal instruction due to an increase of problem behavior. During the shortened prompt phase, the removal of the item was simultaneous with the demand and the verbal instruction was eliminated. The verbal prompt (i.e., “I want to play more”) was delivered based on the prompt delay procedures described above.

**Condition 3: Delay to reinforcement or response chaining (B’)**

**Delay to reinforcement.** Often when FCT is initially implemented, the reinforcer is delivered on a dense schedule whereas every instance of communication results in the immediate delivery of the reinforcer (Kuhn, Chirighin, & Zelenka, 2010). This dense schedule, however, can become problematic when the requesting of a reinforcer occurs at a high rate and the reinforcer is not always readily available which is often the case in authentic settings (Kuhn et al., 2010). To that end, researchers have programmed instruction to teach delay to reinforcement once the initial therapeutic effect of the FCT has been observed (Hagopian, Boelter, & Jarmolowicz, 2011). In Ryan’s intervention, the third condition included teaching Ryan to wait during a delay to reinforcement by systematically introducing a brief delay between the FCT response and the delivery of the tangible item. Specific procedures are described below.

**Ryan’s Intervention: FCT + EXT + Delay to reinforcement.** In Ryan’s intervention, he was initially taught to request his preferred tangible item using picture cards. The introduction of a delay to reinforcement (i.e., a waiting period before access
to the tangible item) was systematically applied across all tangible items after reaching criterion in the final prompt delay phase (i.e., 3 s prompt delay). The trials were conducted similar to the FCT + EXT condition, but systematically included trials where reinforcement is delivered immediately or a programmed delay was used.

Procedures were identical to the FCT + EXT condition described above where a verbal instruction was presented and the use of communication (i.e., moving the picture card to the end of the sentence “I want to play ___”) resulted in 30 s of access to the reinforcer. Initially, in one of five trials, a communication response was followed by an additional prompt to indicate that Ryan needed to wait for the reinforcer (e.g., “Ok, but you need to wait first”). The duration of the “wait” was systematically increased based on successful trials (i.e., sessions with no problem behavior and 100% independent communication) in the following sequence, 0 s, 1 s, 3 s, 10 s. During the delay, the PI withheld the reinforcer and all subsequent requests for the items were ignored during the wait time. After the passage of time for the delay, the reinforcer was delivered and access was granted for approximately 30 s.

The introduction of the delay was systematically applied by increasing (1) the number of delays presented in the session and (2) the length of the delay between the denial and the delivery of the reinforcer. In other words, the number of trials in a session that included delay and the length of the delay were both systematically increased across the phases. For example, once criterion was met for 10 s in one of the five trials, the number of trials with the delay was increased to two and then to three. Criteria for moving through the progression was 2 consecutive sessions defined as 100% independent communication and no demonstration of problem behavior. A change was
made to the intervention when problem behavior emerged during the delayed trial after the delay was increased from 3 s to 10 s. A visual timer was used to provide a continuous signal of the delay for the first tier only. The intervention was changed for the second tier to provide a 5 s delay phase in between the phases with a 3 s delay and a 10 s delay. The timer was not necessary for the other two tiers and the intervention was delivered as described.

**Response chaining.** James’ and Kaleb’s TBFA results indicated two functions of their problem behavior: tangible and escape. The second condition (FCT + EXT) was implemented to address the tangible function (i.e., use of functional communication in lieu of problem behavior to request access to a tangible item). The third condition was implemented to address the escape function. The purpose of this condition was to increase the response requirements before the participant could request access to the tangible item (Lalli, Casey, & Kates, 1995). The demands were broken down into two or three steps and access to the Kindle® was contingent upon completion of the designated step for each phase. When the Kindle® was removed, the demand for the current step was given and an opportunity to request the Kindle® was given following completion of the step. Prompting for compliance was used if needed. The following section outlines the specific procedures for James and Kaleb.

**James’ intervention: FCT+ EXT+ Response chaining.** James was initially taught to request his preferred tangible item (i.e., Kindle®) using the phrase “I want to play more” after the removal of the Kindle® and presentation of a demand. The introduction of compliance training was systematically applied across all demands after reaching criterion in the final prompt delay phase (i.e., 3 s prompt delay). The three
demands were broken down into multiple steps and introduced across phases of this condition.

Procedures were identical to the FCT + EXT condition described above where a verbal instruction was presented and the use of communication (i.e., vocal demonstration of the phase “I want to play more”) resulted in 30 s of access to the Kindle®. Each of the three demands (i.e., “clean up,” “put away dishes,” “wash hands”) was task analyzed into 2-3 specific steps. The first demand, “clean up,” was implemented in the following steps: (1) put one block into a bin, (2) put four to five blocks into a bin, and (3) put four to five blocks into the bin and move the bin to a shelf in the play area. The second demand, “put away dishes,” was implemented in the following steps: (1) pick up a cup off the table, (2) pick up two items (e.g., cup and plate) off the table, and (3) pick up two items off the table and bring to the kitchen. The third demand, “wash hands,” was implemented in the following steps: (1) go to the bathroom door and (2) go to the bathroom door and wash hands (i.e., turn on water, put hands under water, turn off water, dry hands).

Once the verbal demand was given, the first phase included the completion of one step of the demand and was prompted using least to most prompting. That is, James needed to initially complete only the first step of each demand to access the Kindle® for 30 s. After three successful sessions (i.e., 5 complete trials equal one session) with no problem behaviors and independent responding for the first step in the task analysis, the response requirement was increased to compliance with two steps of the demand before access to the Kindle® was delivered. After three successful
sessions with no problem behaviors and independent responding, the response requirements were increased to compliance with all steps in the demand.

**Kaleb’s intervention: FCT+ EXT+ Response chaining.** In Kaleb’s intervention, he was initially taught to request his preferred tangible item (i.e., Kindle®) using the phrase “I want to play more” after the removal of the Kindle® and presentation of a demand. The introduction of compliance training was systematically applied across all demands after reaching criterion in the final prompt delay phase (i.e., 3 s prompt delay). The three demands were broken down into multiple steps and introduced across phases of this condition.

Procedures were identical to the FCT + EXT condition described above where a verbal instruction was presented and the use of communication (i.e., vocal demonstration of the phase “I want to play more”) resulted in 30 s of access to the Kindle®. Each of the three demands (i.e., “take turns,” “do work,” and “clean up”) was task analyzed into 2-3 specific steps. The first demand, “take turns,” was implemented in the following steps: (1) hand the Kindle® to the PI with immediate return to child, (2) hand the Kindle® to PI and allow access for 5 s, and (3) hand the Kindle® to the PI and allow access for 10 s. The second demand, “do work,” was implemented in the following steps: (1) read three already mastered words, (2) read five words from a list of 10, and (3) read 10 words from a list. The third demand, “clean up,” was implemented in the following steps: (1) put one car into the basket, (2) put two to three cars into the basket and (3) put all the cars into the basket.

Once the verbal demand was given, the first phase included the completion of one step of the demand and was prompted using least to most prompting. That is,
Kaleb needed to initially complete the first step of each demand to access the Kindle® for 30 s. After three successful sessions (i.e., 5 complete trials equal one session) with no problem behaviors and independent responding for the first step in the task analysis, the response requirement was increased to compliance with two steps of the demand before access to the Kindle® was delivered. After three successful sessions with no problem behaviors and independent responding, the response requirements were increased to compliance with all steps in the demand. A change was made to Kaleb’s intervention when problem behavior emerged during the second step of the first tier (i.e., “take turns”). A visual timer was used to continuously signal the duration of time Kaleb needed to share his Kindle® before it would be returned. The timer was not necessary for the other two tiers and the intervention was delivered as described above.

**Dependent Measures**

The intervention targeted both problem behavior and communication. These behaviors were reported as percentage of trials based on the 5-trial sessions that were presented. Problem behaviors were operationally defined per participant and were the same as Study 1. A communicative behavior was defined as a child’s use of a vocal, gestural, or picture exchange to initiate (i.e., emit a response to gain the attention of another person, access an item or activity, or begin a social interaction) or respond (i.e., emit a response within 3 s of another’s bid for attention, items or activity, or social interaction). To be considered the target communicative response, the behavior met the following criteria: (a) socially appropriate form of communication that is currently in the child’s repertoire; (b) perceived as potentially efficient (i.e., the response takes just as much or does not take more effort to emit) as the identified problem behaviors; and (c) can potentially result in a functionally equivalent reinforcer to the problem behavior.
(Schindler & Horner, 2005). Communicative behavior was coded as either *prompted communication* (i.e., defined as occurring following a vocal, gestural, or physical prompt) or *independent communication* (i.e., defined as occurring without assistance from the change agent).

**Data Collection**

All intervention sessions were video recorded. Data collectors for Study 2 were the same as Study 1. A trained data collector recorded the data using pencil and paper on the Intervention Data Collection Form (see Appendix F) via video recording following each session. Occurrence or non-occurrence of target problem behaviors, prompted and independent communication for each trial was recorded by circling the plus (i.e., occurrence) or minus (i.e., non-occurrence) sign on the data collection form. Behaviors observed during each trial was converted to percentage of trials with communication or problem behavior by dividing the total number of trials with each behavior by the total number of trials presented and multiplying by 100. For example, if five trials were conducted and independent communication occurred in two trials, the percentage of independent communication would be 40% (i.e., \( \frac{2}{5} \times 100 \)). All data collection forms are included in Appendix F.

**Data Analysis**

Intervention data were graphed daily on a line graph and interpreted through visual analysis following procedures described by Kazdin (2011). A minimum of 3 baseline data points were collected for each participant in each tier and were visually analyzed to determine a stable pattern of behavior during this phase. Data were visually analyzed to determine if there were changes in the level and trend on the dependent measures (Kazdin, 2011). The immediacy (i.e., how quickly there were changes in the
behavior following implementation of the intervention) and variability (i.e., degree of overlap between baseline and intervention phases) were also analyzed (Kazdin, 2011). Phase changes were determined by a pre-determined criteria of consecutive sessions with zero instances of problem behavior and 100% of the trials with prompted or independent communication. For this study, an intervention effect was demonstrated if only after the intervention was implemented, there was an increase in communication and a subsequent decrease in problem behaviors. A functional relation was demonstrated if this effect was observed across the three tiers in each of the individual participant experiments (Kazdin, 2011).

**Interobserver Agreement**

The same trained data collectors from Study 1 conducted primary data collection and the PI conducted secondary data collection for baseline and intervention sessions. All sessions were coded and assessed for IOA. Secondary data collectors scored sessions using pencil and paper via video recording. An agreement was defined as both observers recording the occurrence of the targeted communication (i.e., prompted and independent) and problem behavior for each trial during a five-trial session. Acceptable agreement criteria were 80% or above across all phases on the occurrence of communication and problem behavior and was calculated by dividing the number of agreements by agreements plus disagreements and multiplying by 100 (Kazdin, 2011).

**Procedural Fidelity**

Procedural fidelity was assessed using behavioral observation embedded on the data collection form and analyzed on a trial-by-trial basis during the intervention. Operational definitions of change agent behavior are the same as ones used for Study 1. Data collectors (i.e., primary and the PI) viewed the videos from the server and
completed the data collection form. To be considered a correct trial, the PI: (1) removed access to the designated reinforcer; (2) provided an appropriate verbal instruction that identified the desired communicative response; (3) delivered the appropriate delay to reinforcement (i.e., 0 s was initially used for the FCT + EXT trials and increased throughout the intervention) or response chaining procedures and (4) delivered the relevant consequence for 30 s following communication. Procedural fidelity was calculated as a percentage of correctly implemented steps per trial and then added together to determine the percentage of correct steps for the session. Specifically, for each session there was a possibility of 20 correctly implemented steps (i.e., four steps for each of the five trials). The number of correct steps for each trial was added together, divided by 20 and multiplied by 100 to determine the percentage of correct steps in the session. Mean percentage and range across all sessions per participant was reported.

Social Validity

Social validity, in addition to identifying the extent to which the goals and procedures are socially significant and appropriate, it is also important to assess the extent to which the effects of a behavioral intervention is socially important (Wolf, 1978). Similar to the rating scale used in Study 1, a second social validity rating scale, adapted from Lloyd et al. (2015), was administered to assess the caregiver’s perceptions of the intervention (see Appendix H). All responses were rated on a Likert scale of 1-6 and corresponded to questions about the acceptability (i.e., how comfortable the caregiver felt with the procedures of the intervention), authenticity (i.e., how closely the caregiver feels the intervention reflected a typical occurrence of problem behavior in the home),
and importance (i.e., as the extent to which changes in child behavior were observed following the intervention) of the intervention.
Table 3.1. Participant characteristics.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Age</th>
<th>G</th>
<th>Race</th>
<th>Class</th>
<th>Diagnosis</th>
<th>CARS-2</th>
<th>Raw Score</th>
<th>T-Score</th>
<th>Percentile</th>
<th>Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ryan</td>
<td>3</td>
<td>M</td>
<td>Caucasian</td>
<td>ASD</td>
<td>ASD</td>
<td>CARS-2</td>
<td>42</td>
<td>55</td>
<td>69</td>
<td>Severe</td>
</tr>
<tr>
<td>Jacob</td>
<td>3</td>
<td>M</td>
<td>Caucasian</td>
<td>DD</td>
<td>ASD</td>
<td>CARS-2</td>
<td>38</td>
<td>50</td>
<td>50</td>
<td>Severe</td>
</tr>
<tr>
<td>James</td>
<td>4</td>
<td>M</td>
<td>Caucasian</td>
<td>DD</td>
<td>None</td>
<td>CARS-2</td>
<td>34</td>
<td>46</td>
<td>35</td>
<td>Mild/moderate</td>
</tr>
<tr>
<td>Kaleb</td>
<td>5</td>
<td>M</td>
<td>Caucasian/Latino</td>
<td>ASD</td>
<td>ASD</td>
<td>CARS-2</td>
<td>32.5</td>
<td>43</td>
<td>24</td>
<td>Mild/moderate</td>
</tr>
</tbody>
</table>

Note. G = Gender, M = male, Class = Educational classification, ASD = autism spectrum disorder, DD = developmentally delayed; CARS-2 = Childhood Autism Rating Scale – 2nd Edition (Schopler et al. 2010). The raw score is a summed total of ratings of all items on the assessment. Summed scores can range from 15-60 and represent the severity of symptoms of ASD. Severity is classified by the following criteria: Minimal to no symptoms < 30; Mild to moderate 30 – 36.5; Severe > 37. The raw score is converted to a standardized score (i.e., T-score) based on the child’s age to allow for comparison between the participant and other children of the same age.
Table 3-2. Description of trial-based functional analysis conditions per participant

<table>
<thead>
<tr>
<th>Ryan</th>
<th>Attention</th>
<th>Tangible</th>
<th>Escape</th>
<th>Escape + Tangible</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Context: Playtime</td>
<td>Setting: Bedroom</td>
<td>Materials: Only moderately preferred items (i.e., ball, books, puzzle). All highly-preferred items were removed from the setting.</td>
<td>Control: Continuous attention (proximity, orientation towards the activity) using vocal statements about the activity (e.g., “This is fun!”) and/or physical interactions (e.g., tickles).</td>
</tr>
<tr>
<td></td>
<td>Context: Playtime</td>
<td>Setting: Bedroom</td>
<td>Materials: Highly preferred item used for this condition was any toy truck or car.</td>
<td>Control: Continuous access to multiple trucks throughout the segment. Attention was delivered in the form of vocal statements (e.g., “This is fun!”).</td>
</tr>
<tr>
<td></td>
<td>Context: Transition to table for meals</td>
<td>Setting: Living room, kitchen</td>
<td>Materials: Only moderately preferred items. All highly-preferred items were removed from the setting.</td>
<td>Control: No demands were given to Ryan during the control segment. Attention was only provided if initiated but was available.</td>
</tr>
<tr>
<td></td>
<td>Context: Clean up</td>
<td>Setting: Living room, Bedroom</td>
<td>Materials: Highly preferred item used for this condition was any toy truck or car.</td>
<td>Control: Continuous access to multiple trucks throughout the segment. Attention was delivered in the form of vocal statements (e.g., “This is fun!”). No demands were presented during this segment.</td>
</tr>
<tr>
<td></td>
<td>Attention</td>
<td>Tangible</td>
<td>Escape</td>
<td>Escape + Tangible</td>
</tr>
<tr>
<td>----------------</td>
<td>--------------------</td>
<td>--------------------</td>
<td>-------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td></td>
<td>Setting: Living room</td>
<td>Setting: Living room</td>
<td>Setting: Living room</td>
<td>Setting: Living room</td>
</tr>
<tr>
<td></td>
<td>Materials: Only moderately preferred items (i.e., blocks, cars, books). All highly-preferred items were removed from the setting.</td>
<td>Materials: Highly preferred item used for this condition was a handheld game.</td>
<td>Materials: Only moderately preferred items (i.e., blocks, cars, books). All highly-preferred items were removed from the setting.</td>
<td>Materials: Highly preferred item used for this condition was the handheld game.</td>
</tr>
<tr>
<td>Control:</td>
<td>Continuous attention (proximity, orientation towards the activity) using vocal statements about the activity (e.g., “This is fun!”) and/or physical interactions (e.g., tickles).</td>
<td>Continuous access to the handheld game throughout the segment. Attention was delivered in the form of vocal statements (e.g., “This is fun!”).</td>
<td>Control: No demands were given to James during the control segment. Attention was only provided if initiated but was available.</td>
<td>Control: Continuous access to handheld game throughout the segment. Attention was delivered in the form of vocal statements (e.g., “This is fun!”). No demands were presented during this segment.</td>
</tr>
<tr>
<td>Test:</td>
<td>Attention is diverted withheld signaled by the verbal statement, “Ok, you can keep playing. I am going over here.” Physical removal from the activity and diverted eye contact. Mom was present in the room and instructed to not respond to bids for communication.</td>
<td>Handheld game was removed. The test segment was signaled by denying access to the handheld game along with the verbal statement, “Ok, all done. It is my turn to play.”</td>
<td>The demand varied depending on ongoing activity. Demands included “Let’s put this away,” or “Clean up.” The demand was presented followed by prompts (when needed). The prompts consisted of using full physical prompt to put items into a bin. Demands were continuous during segment.</td>
<td>Handheld game was removed and the demand to cleanup was presented. The test segment was signaled by denying access to game along with the verbal statement, “All done, put these away” and the physical prompt of handing James a neutral item that he was supposed to put away.</td>
</tr>
</tbody>
</table>
Table 3-2. Continued.

<table>
<thead>
<tr>
<th>Attention</th>
<th>Tangible</th>
<th>Escape</th>
<th>Escape + Tangible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials: Only moderately preferred items (i.e., puzzles and other toys besides the Kindle®). All highly-preferred items were removed from the setting.</td>
<td>Materials: Highly preferred item used for this condition was a Kindle® or TV show based on preference or ongoing activity.</td>
<td>Materials: Only moderately preferred items (i.e., puzzles and other toys besides the Kindle®). All highly-preferred items were removed from the setting.</td>
<td>Materials: Highly preferred item used for this condition was the Kindle® or TV depending on ongoing activities. Neutral item was a puzzle.</td>
</tr>
<tr>
<td>Control: Continuous attention (proximity, orientation towards the activity) using vocal statements about the activity (e.g., “This is fun!”) and/or physical interactions (e.g., tickles).</td>
<td>Control: Continuous access to the Kindle® or TV throughout the segment. PI gave time for a game to begin playing before starting the trial. Attention was delivered in the form of vocal statements (e.g., “This is fun!”).</td>
<td>Control: No demands were given to Kaleb during the control segment. Attention was only provided if initiated but was available.</td>
<td>Control: Continuous access to Kindle® throughout the segment. Attention was delivered in the form of vocal statements (e.g., “This is fun!”). No demands were presented during this segment.</td>
</tr>
<tr>
<td>Test: Attention was diverted and signaled by the verbal statement, “Ok, you can keep playing. I am going to play with [sister].” Physical removal from the activity and diverted eye contact. Mom was present in the room and instructed to not respond to bids for communication.</td>
<td>Test: Kindle® was removed. The test segment was signaled by denying access to the game along with the verbal statement, “Ok, all done. It is my turn to play with the Kindle®.”</td>
<td>Test: The demand varied depending on ongoing activity. Demands included “Let’s put this away,” “Time to do work,” or “Put the puzzle away.” The demand was presented followed by prompts (when needed). The prompts consisted of using full physical prompt to put items into a bin. Demands were continuous during segment.</td>
<td>Test: Kindle® was removed and the demand to clean up or go do work while being handed a neutral item simultaneously presented. The test segment was signaled by denying access to the Kindle® along with the verbal statement, “All done, go put this away” and the physical prompt of putting the item back on the shelf or table or guidance to go to complete a school work activity.</td>
</tr>
<tr>
<td>Attention</td>
<td>Tangible</td>
<td>Escape</td>
<td>Escape + Tangible</td>
</tr>
<tr>
<td>-----------</td>
<td>----------</td>
<td>--------</td>
<td>-------------------</td>
</tr>
<tr>
<td><strong>Jacob</strong></td>
<td>Context: Playtime</td>
<td>Context: Playtime</td>
<td>Context: Indoor or Outdoor play</td>
</tr>
<tr>
<td>Setting: Living room</td>
<td>Setting: Living room</td>
<td>Setting: Living room</td>
<td>Setting: Living room, Outside</td>
</tr>
<tr>
<td>Materials: Only moderately preferred items (i.e., puzzles, other toys besides the small car or toy he is holding). All highly-preferred items.</td>
<td>Materials: Highly preferred item used for this condition was small cars that he holds.</td>
<td>Materials: Only moderately preferred items (i.e., puzzles, other toys besides the small car or toy he is holding). All highly-preferred items were removed from the setting.</td>
<td>Materials: Highly preferred item used for this condition were the cars and sandbox.</td>
</tr>
<tr>
<td>Control: Continuous attention (proximity, orientation towards the activity) using vocal statements about the activity (e.g., “This is fun!”) and/or physical interactions (e.g., tickles).</td>
<td>Control: Continuous access to the cars throughout the segment. Attention was delivered in the form of vocal statements (e.g., “This is fun!”).</td>
<td>Control: No demands were given to Jacob during the control segment. Attention was only provided if initiated but was available.</td>
<td>Control: Continuous access to cars while playing in the sandbox throughout the segment. Attention was delivered in the form of vocal statements (e.g., “This is fun!”). No demands were presented during this segment.</td>
</tr>
<tr>
<td>Test: Attention is diverted withheld signaled by the verbal statement, “Ok, you can keep playing. I am going over here.” Physical removal from the activity and diverted eye contact. Mom was present in the room and instructed to not respond to bids for communication.</td>
<td>Test: Cars were removed. The test segment was signaled by denying access to the cars along with the verbal statement, “Ok, all done. It is my turn to play with the cars.”</td>
<td>Test: The demand varied depending on ongoing activity. Demands included “Let’s put this away,” or “Clean up.” The demand was presented followed by prompts (when needed). The prompts consisted of using full physical prompt to put items into a bin. Demands were continuous during segment.</td>
<td>Test: Cars were removed and the demand to go transition to inside (e.g., leave the sandbox) was presented. The test segment was signaled by denying access to game along with the verbal statement, “All done, we need to go inside now” and the physical prompt leaving the sandbox and walking into the house.</td>
</tr>
</tbody>
</table>
CHAPTER 4
RESULTS

The purpose of the first study was to examine the use of trial-based functional analysis (TBFA) implemented in a home setting to identify the function of problem behavior in four young children with or at risk for autism spectrum disorder (ASD). When TBFA was implemented in the home setting, function was identified for each participant during brief trials designed to test for the occurrence of problem behavior under multiple stimulus conditions. The purpose of the second study was to use the results of the TBFA to develop a functional communication training (FCT) intervention for decreasing problem behavior and increasing communication. The effects of the FCT intervention were determined by the occurrence of problem and communicative behaviors across tangible items or demands (depending on the function of each participant’s behavior). Interobserver agreement was conducted on both the occurrence of target behaviors and the fidelity of the experimental procedures for both studies. In addition, social validity data for the TBFA and the FCT intervention were collected.

The results of both studies are presented for the participants. For Study 1, the pre-assessment component is described and includes interview information provided by the caregivers about their child’s problem behaviors. Next, the results of the TBFA are presented and includes a within-condition analysis of problem behavior across the trials. Interobserver agreement, procedural fidelity, and TBFA social validity results also are presented. Study 2 presents results of the function-based intervention for three of the four participants. Visual analysis of the data, interobserver agreement, procedural fidelity, and FCT social validity results are presented.
Study 1: TBFA in Home Settings

This section includes the results of the first study, which had two components: pre-assessment and TBFA. First, the pre-assessment interview data (i.e., responses provided by the caregivers) are summarized and findings from the descriptive observations are reported. Next, the results of the TBFA are described. Finally, data are reported on interobserver agreement, procedural fidelity, and social validity.

The pre-assessment phase was conducted to gather information about the child’s behavior and the home setting to assist in developing the TBFA conditions, and to develop a hypothesis of the function of the problem behavior. Data from two interviews are reported including the Open-ended Functional Assessment Interview (Hanley, 2012) and the Caregiver Preference Assessment Interview (Conroy, 2008). The pre-assessment was conducted over one to two visits to the families’ homes. A descriptive observation was video recorded and ranged from 5-10 minutes for each participant. These observations were descriptively analyzed to identify potential antecedents, behaviors, and consequences.

Following pre-assessment, TBFA conditions were developed for each participant. Each TBFA condition was presented for a minimum of five trials and data are presented on a cumulative frequency graph. Each consecutive data point represents the accumulated total of problem behavior for that trial and all previous trials in the test and control segments. Differentiation of conditions was determined based on a change in level in the data of the test segments when compared to the control segments. Additionally, the rate of problem behavior per second during each trial was calculated and presented using a bar graph on the secondary axis. Rate of behavior was used solely as descriptive data to examine patterns in the occurrence of problem behavior.
during the TBFA conditions and did not contribute to the determination of function. The results of the TBFA for all four participants are presented below.

**Ryan**

**Pre-assessment.** Ryan’s mother was the respondent for the two pre-assessment interviews and was observed along with Ryan during the direct observation. According to responses to the *Open-ended Functional Assessment Interview* (Hanley, 2012), Ryan’s most problematic behaviors were aggression and destruction. Aggression was defined as attempting to bite, hitting, and throwing objects at another person. Destruction was defined as dumping objects out of bins, swiping objects off tables, forcefully pushing or pulling objects, and throwing objects (i.e., not in the direction of a person). Ryan’s mother reported that although tantrum behaviors (e.g., crying, throwing self to floor) occurred, the risk of injury to himself and others was greater when Ryan engaged in aggression or destruction. Problem behaviors primarily occurred during playtime activities and transitions. Prior ineffective interventions used included applying deep pressure, increasing social attention (e.g., talking, hugging), providing a time out in his room, and ignoring the behaviors.

According to responses to the *Caregiver Preference Assessment Interview* (Conroy, 2008), Ryan communicated primarily using gestures and limited vocalizations. Preferred tangibles included toy trucks, tablet, and two specific blankets. Moderately preferred tangibles (i.e., tangibles that he engages with occasionally) included books, paints, and puzzles. Ryan’s mother reported that to gain access to a preferred item, Ryan often escalated to aggression if the item was not delivered (e.g., item was not available or he was told to wait). To escape a demand or situation, Ryan’s mother reported that Ryan engaged in tantrum behaviors (e.g., crying or falling on the floor). To
gain attention from others, Ryan initiated by using vocalizations or physical contact, but these behaviors did not typically escalate to problem behavior if he was ignored. Ryan’s mother hypothesized that the function of Ryan’s aggression and destruction was to obtain access to preferred tangibles.

The PI completed an Antecedent – Behavior – Consequence (ABC) chart based on a 10 min observation conducted in the living room of the family’s home. Ryan’s mother was present during the observation and interacted with Ryan while they watched television. During the 10 min observation, nine instances of aggression or destruction were recorded. Behaviors observed included hitting, grabbing his mother on the arm or shirt, and throwing items around the room or in the direction of his mother. The antecedent that set the occasion for the initial observed behavior was the mother changing the channel on the television from Ryan’s preferred television program. Following Ryan’s initial display of problem behavior in response to the antecedent, the consequences (e.g., refusal to change the channel back, verbal reprimands and ignoring) became the antecedents for additional instances of problem behavior. Behaviors increased in intensity (e.g., from grabbing the mother by the shirt to hitting and throwing objects in her direction) throughout the observation.

Based on the pre-assessment data, if the preferred tangible was not delivered immediately following display of problem behavior, behaviors were more likely to increase in intensity. Although delivery of a demand was not observed during the descriptive observation, responses from Ryan’s mother during the interviews suggest delivery of a demand might occasion problem behavior if Ryan was transitioning from playing with a preferred tangible (e.g., clean up). Additionally, if problem behavior
occurred, Ryan’s mother was less likely to enforce compliance with a demand compared to times when problem behavior did not occur. Access to tangibles and escape from demands were hypothesized reinforcers for Ryan’s problem behavior (i.e., aggression and destruction). The TBFA planning form was completed based on information gathered from the interviews and descriptive observation and four conditions were included in the TBFA: (1) attention, (2) tangible, (3) escape, and (4) escape to tangible.

**TBFA.** Results of Ryan’s TBFA are displayed in Figure 4-1. The target behaviors for the TBFA were aggression and destruction as defined previously during pre-assessment. A total of 29 trials were presented across the four conditions. The TBFA was conducted during six visits to the home over a 14 day period. A summary of the number of trials per condition and duration of the TBFA is provided for all participants in Table 4-1.

In the attention condition, problem behavior was not observed in any trial and did not result in differentiation between the control or test segments. A similar pattern of responding was observed in the escape condition showing no differentiation between the test and control segments. In the tangible condition, no problem behavior was observed during the first five trials and did not result in differentiation between test and control segments. Problem behavior was observed in the test segment during the sixth trial which was followed by an increase in the cumulative occurrence of behavior over the remaining four trials. No problem behavior was observed in the control segments of all tangible trials. Finally, in the escape to tangible condition, no problem behavior was observed during the first three trials and did not result in differentiation between test and
control. Problem behavior was observed in the test segments during the fourth trial of the escape to tangible condition followed by an increase in the cumulative occurrence of behavior over the remaining three trials. No problem behavior was observed in the control segments of all escape to tangible trials.

The differentiation between the test and control segments in the tangible condition demonstrates a functional relation between Ryan’s problem behavior (i.e., aggression and destruction) and the removal of preferred tangibles. Thus, Ryan’s problem behavior is maintained by positive reinforcement in the form of access to tangibles. Although differentiation was observed in the combined condition, lack of differentiation in the escape only condition indicates that the presentation of a demand did not occasion the problem behavior. Hence, removal of the preferred tangible was a necessary component of the trial to elicit aggression or destruction.

In addition to the cumulative frequency graphs used to identify a function of problem behavior, a descriptive analysis of the rate of problem behavior per minute was conducted to examine patterns in the occurrence of problem behavior during the TBFA. Data on Ryan’s rate of problem behavior per trial are displayed in Figure 4-2. During Ryan’s TBFA, there was no notable differences in the rate of problem behavior across conditions. A decreasing pattern was found in the rate of Ryan’s problem behavior within conditions. Ryan demonstrated three instances of problem behavior during the first test segment with problem behavior and only one instance of problem behavior for each subsequent test segment in both the tangible and escape to tangible conditions. After Ryan was exposed to the contingency (i.e., problem behavior would result in the delivery of the consequence), the rate of problem behavior decreased in both condition.
The rate of problem behavior decreased from 1.91 occurrences per min to 0.91, 0.71, and 0.89 occurrences per min as the number of trials presented increased in the tangible condition. The rate of problem behavior decreased from 2.50 occurrences per min to 0.65 and 0.89 in the escape condition.

James

**Pre-assessment.** James’ mother and father were the respondents for the two pre-assessment interviews and were observed along with James in the direct observation. According to responses to the *Open-ended Functional Assessment Interview* (Hanley, 2012), James’ most problematic behaviors were aggression, destruction and disruption. Aggression was defined as attempting to bite, hitting, and throwing objects at another person. Destruction was defined as dumping objects out of bins, forcefully pushing or pulling objects, and throwing objects (i.e., not in the direction of a person). Disruption was defined as screaming, crying, and noncompliance. Problem behaviors primarily occurred during playtime activities and transitions. Prior ineffective interventions used included initiating physical contact (e.g., hugging, holding) and providing verbal reprimands.

According to responses to the *Caregiver Preference Assessment Interview* (Conroy, 2008), James communicated primarily using full sentences. James’ parents reported that James would initiate interactive play with them or his younger brother. Preferred tangibles included a handheld game, toy trucks and a tablet. Moderately preferred tangibles (i.e., tangibles that he will engage with occasionally) included blocks and bubbles.

James’ parents reported that to gain access to a preferred item, James often escalated to aggression if the item was not delivered (e.g., item was not available or he
was told to wait). To escape a demand or situation, James’ parents reported that James engaged in disruptive behaviors (e.g., screaming). To gain attention from others, James initiated by using full sentences or phrases, but these behaviors did not typically escalate to problem behavior if he was ignored. James’ parents hypothesized that the function of James’ aggression, destruction, and disruption was to escape demands.

The PI completed an ABC chart based on a 7 min 52 s observation conducted in the living room of the family’s home. James’ parents were present during the observation and primarily observed the researcher interactions with James. During the observation, seven instances of aggression, destruction, or disruption were recorded. Behaviors observed included screaming, kicking, throwing or pushing items. The antecedent that set the occasion for the initial observed behavior was the removal of a handheld game. Following James’ initial display of problem behavior in response to the antecedent, the consequences (e.g., verbal reprimands and ignoring) became the antecedents for additional instances of problem behavior.

Based on the pre-assessment data, if the preferred tangible was not delivered immediately following a display of problem behavior, behaviors were more likely to increase in intensity. James did not comply with simple demands during the observation and responses from James’ parents during the interviews suggest delivery of a demand might also occasion problem behavior. Additionally, if problem behavior occurred, James’ parents were less likely to enforce compliance with a demand compared to times when problem behavior did not occur. Access to tangibles and escape from demands were hypothesized reinforcers for James’ problem behavior (i.e., aggression, destruction, disruption). The TBFA planning form was completed based on information
gathered from the interviews and descriptive observation and four conditions were included in the TBFA: (1) attention, (2) tangible, (3) escape, and (4) escape to tangible.

**TBFA.** Results of James’ TBFA are displayed in Figure 4-3. The target behaviors for the TBFA were aggression, destruction, and disruption as defined previously during pre-assessment. A total of 20 trials were presented across the four conditions. The TBFA was conducted during four visits to the home over 15 days. A summary of the number of trials per condition and duration of the TBFA is provided for all participants in Table 4-1.

In the attention condition, problem behavior was not observed in any trial and did not result in differentiation between the control or test segments. In the tangible condition, problem behavior was observed in the test segment during all five trials which resulted in an increase in the cumulative occurrence of behavior over the five trials. No problem behavior was observed in the control segments of tangible trials. In the escape condition, problem behavior was observed in the test segment during all five trials which resulted in an increase in the cumulative occurrence of behavior over the five trials. No problem behavior was observed in the control segments of escape trials. Finally, in the escape to tangible condition, problem behavior was observed in the test segment during all five trials which resulted in an increase in the cumulative occurrence of behavior over the five trials. No problem behavior was observed in the control segments of all escape to tangible trials.

The differentiation between the test and control segments in the tangible condition demonstrates a functional relation between James’ problem behavior (i.e., aggression, destruction, disruption) and the removal of preferred tangibles. Thus,
James’ problem behavior is maintained by positive reinforcement in the form of access to tangibles. Additionally, the differentiation between the test and control segments in the escape condition demonstrates a functional relation between James’ problem behavior (i.e., aggression, destruction, disruption) and the presentation of a demand. James’ problem behavior is also maintained by negative reinforcement in the form of escape from demands. Although there was differentiation in between the test and control segments in the escape to tangible condition, differentiation in both single stimulus conditions (i.e., tangible and escape) indicates that both of these contribute to the maintenance of James’ problem behavior. Thus, these data show that James’ problem behaviors had two functions: access to tangibles and escape from demands.

In addition to the cumulative frequency graphs used to identify a function of problem behavior, a descriptive analysis of the rate of problem behavior per minute was conducted to examine patterns in the occurrence of problem behavior during the TBFA. Data on James’ rate of problem behavior per trial are displayed in Figure 4-4. During James’ TBFA, there were two different patterns observed across conditions. First, a decreasing pattern was found in escape and escape to tangible conditions. In these specific conditions, problem behavior occurred at a high rate during initial presentations and decreased as subsequent trials were presented. Conversely, there was variability in the rate of behavior during the tangible condition.

Similar to Ryan, a notable pattern in rate of problem behavior per min was found in two of the three conditions that resulted in the occurrence of problem behavior. In escape and escape to tangible, James engaged in higher rates of problem behavior in the first few trials and those rates decreased as the number of trials increased. For
example, during the first trial in the escape condition, James demonstrated problem behavior at a rate of 4.42 occurrences per min, but the rate decreased to 0.89 by the third trial where it remained stable. During the escape to tangible condition, the rate of problem behavior was stable at 3.64 occurrences per min for the first two trials before decreasing to 1.85 in the third and then to 0.93 by the last trial. As noted earlier, the rate of problem behavior in the tangible condition was variable and fluctuated with a maximum rate of 1.94 and minimum of 0.74 occurrences per min.

**Kaleb**

**Pre-assessment.** Kaleb’s mother and father were the respondents for the two pre-assessment interviews and his mother and sister were observed with Kaleb during the direct observation. According to responses to the *Open-ended Functional Assessment Interview* (Hanley, 2012), Kaleb’s most problematic behaviors were disruptions and noncompliance. Disruptions were defined as engaging in tantrum behaviors that included screaming, crying, and throwing self to floor. Noncompliance was defined as refusal to follow directions. Problem behaviors primarily occurred during playtime activities and transitions. Prior ineffective interventions used included initiating physical contact (e.g., holding, hugging), talking about the behavior, providing verbal reprimands, and providing a time out.

According to responses to the *Caregiver Preference Assessment Interview* (Conroy, 2008), Kaleb communicated primarily using full sentences and phrases. Kaleb’s parents reported that Kaleb typically preferred to play alone but would occasionally interact with them or his younger sister. Preferred tangibles included toy trucks, television, and the Kindle®. Moderately preferred tangibles (i.e., tangibles that he engages with occasionally) included books and puzzles.
Kaleb’s parents reported that to gain access to a preferred item, Kaleb often escalated to disruptive behaviors if the item was not delivered (e.g., item was not available or he was told to wait). To escape a demand or situation, Kaleb’s parents reported that Kaleb responded verbally with the word “no” and would run around the house. These behaviors often escalated to disruptive behaviors such as tantrums (e.g., crying and screaming). To gain attention from others, Kaleb initiated using vocalizations (i.e., phrases or sentences), but these behaviors did not typically escalate to problem behavior if he was ignored. Kaleb’s parents hypothesized that the function of Kaleb’s disruption and non-compliance was multiply maintained (i.e., access to tangible and escape).

The PI completed an ABC chart based on a 9 min 30 s observation conducted in the living room of the family’s home. Kaleb’s mother and younger sister were present during the observation and interacted with Kaleb during a play routine. During the observation, 11 instances of disruption or aggression were recorded. Behaviors observed screaming, crying, and forcefully pushing toys that his sister had in her hands. While not initially described as problematic during the interviews, aggression was recorded during the observation and was thus, included as a problem behavior in the analysis. Aggression was defined as making physical contact with another person using his hands (e.g., hitting) or feet (e.g., kicking). Antecedents that set the occasion for the observed behavior were the presentation of a demand, the presence of his sister in the play scenario, and denied access to the Kindle®. Following Kaleb’s initial display of problem behavior in response to the antecedent, the consequences (e.g., verbal reprimands and ignoring) became the antecedents for additional instances of problem
behavior. Behaviors increased in intensity (e.g., from talking to self and stomping feet to physically pushing his sister, louder screaming) throughout the observation.

Based on the pre-assessment data, if the preferred tangible was not delivered immediately following a display of problem behavior, behaviors were more likely to increase in intensity. Responses from Kaleb’s parents during the interviews suggest delivery of a demand occasioned problem behavior especially if Kaleb was transitioning from playing with a preferred tangible (e.g., clean up). Additionally, if problem behavior occurs, Kaleb’s parents were less likely to enforce compliance with a demand compared to times when problem behavior did not occur. Access to tangibles and escape from demands were hypothesized reinforcers for Kaleb’s problem behavior (i.e., aggression, destruction, disruption). The TBFA planning form was completed based on information gathered from the interviews and descriptive observation and four conditions were included in the TBFA: (1) attention, (2) tangible, (3) escape, and (4) escape to tangible.

**TBFA.** Results of Kaleb’s TBFA are displayed in Figure 4-5. The target behaviors for the TBFA were aggression, disruption and non-compliance as defined previously during pre-assessment. A total of 20 trials were presented across the four conditions. The TBFA was conducted during five visits to the home over a 32 day period. A summary of the number of trials per condition and duration of the TBFA is provided for all participants in Table 4-1.

In the attention condition, problem behavior was not observed in any trial and did not result in differentiation between the control or test segments. In the tangible condition, problem behavior was observed in the test segment of the first trial and was not observed in the second trial. Problem behavior was observed again during the third
trial and all subsequent trials which resulted in an increase in the cumulative occurrence of behavior over the remaining three trials. No problem behavior was observed in the control segments of all tangible trials. In the escape condition, problem behavior was observed in both the control and test segment in the first trial. No problem behavior was observed in either segment during the second trial and did not result in differentiation between test and control segments. Problem behavior was observed in the test segment during the third trial which was followed by an increase in the cumulative occurrence of behavior over the remaining three trials. No problem behavior was observed in the control segments of the remaining four escape trials following the first trial. Finally, in the escape to tangible condition, problem behavior was not observed in the first trial. Problem behavior was observed in the second trial, but not in the third trial. Problem behavior was observed in the fourth and fifth trials which resulted in an increase in the cumulative occurrence of behavior over the remaining two trials. No problem behavior was observed in the control segments of all escape to tangible trials.

The differentiation between the test and control segments in the tangible condition demonstrates a functional relation between Kaleb’s problem behavior (i.e., aggression, disruption, noncompliance) and the removal of preferred tangibles. Thus, Kaleb’s problem behavior is maintained by positive reinforcement in the form of access to tangibles. Additionally, the differentiation between the test and control segments in the escape condition demonstrates a functional relation between Kaleb’s problem behavior (i.e., aggression, destruction, noncompliance) and the presentation of a demand. Kaleb’s problem behavior is also maintained by negative reinforcement in the form of escape from demands. Although there was differentiation in between the test
and control segments in the escape to tangible condition, differentiation in both single stimulus conditions (i.e., tangible and escape) indicates that both of these contribute to the maintenance of Kaleb’s problem behavior. Thus, these data show that Kaleb’s behaviors have two functions: access to tangibles and escape from demands.

In addition to the cumulative frequency graphs used to identify a function of problem behavior, a descriptive analysis of the rate of problem behavior per minute was conducted to examine patterns in the occurrence of problem behavior during the TBFA. Data on Kaleb’s rate of problem behavior per trial are displayed in Figure 4-6. A decrease in rate of problem behavior per min was found in the escape condition. In this condition, Kaleb engaged in a high rate of problem behavior during the first trials and those rates decreased as more trials were presented. For example, during the first trial in the escape condition, Kaleb demonstrated problem behavior at a rate of 9.09 occurrences per min, but the rate decreased to 1.67 by the fifth trial. During the escape to tangible condition, the rate of problem behavior was stable at 0.87, 0.85, and 0.89 occurrences per min across the three trials where problem behavior occurred. The rate of problem behavior in the tangible condition was variable but decreased from 1.31 and 1.85 occurrences per min to 0.81 and 0.91 by the fourth and fifth trials similar to the other conditions when problem behavior occurred.

Jacob. Jacob’s mother was the respondent for the two pre-assessment interviews and was observed along with Jacob during the direct observation. According to responses to the Open-ended Functional Assessment Interview (Hanley, 2012), Jacob’s most problematic behaviors were aggression and disruption. Aggression was defined as hitting, pushing and throwing objects at another person. Disruption was
defined as screaming and crying (e.g., tantrum behaviors). Problem behaviors primarily occurred during playtime activities and daily living activities. Prior ineffective interventions used included providing vocal redirections, physically removing Jacob from the setting and ignoring problem behaviors. Access to videos or televisions shows have been used to distract from problem behavior.

According to responses to the Caregiver Preference Assessment Interview (Conroy, 2008), Jacob communicated primarily using gestures and some vocalizations (e.g., 1-2 word phrases). Jacob’s mother reported that Jacob primary preferred to play alone. Preferred tangibles included toy trucks, tablet, sandbox, and candy. Moderately preferred tangibles (i.e., tangibles that he engages with occasionally) included books, blocks, and playdoh. Jacob’s mother reports that preferences are variable and change daily.

Jacob’s mother reported that to gain access to a preferred item, Jacob’s behaviors often escalated to aggression if the item was not delivered (e.g., item was not available or he was told to wait). To escape a demand or situation, Jacob’s mother reported that Jacob engaged in tantrum behaviors (e.g., crying) and aggression (e.g., pushing). To gain attention from others, Jacob initiated by using some vocalizations or physical contact. These behaviors sometimes escalated to tantrums or aggression if attention was not delivered. Jacob’s mother hypothesized that the function of Jacobs aggression and disruption was to obtain access to preferred tangibles and to gain attention.

The PI completed an ABC chart based on a 5 min observation conducted in the living room of the family’s home. Jacob’s mother was present during the observation
and interacted with Jacob. During the 5 min observation, nine instances of disruption and noncompliance were recorded. Behaviors observed included whining, throwing items, screaming, and pulling on his mother. The antecedent that set the occasion for the initial observed behavior was the mother denying access to Jacob’s preferred television program. Following Jacob’s initial display of problem behavior in response to the antecedent, the consequences (e.g., redirection, ignoring, and attention) became the antecedents for additional instances of problem behavior.

Based on the pre-assessment data, if the preferred tangible was not delivered immediately following a display of problem behavior, behaviors were more likely to increase in intensity. Responses from Jacob’s mother during the interviews suggest delivery of a demand occasions problem behavior especially if Jacob was transitioning from playing with a preferred tangible (e.g., clean up). Additionally, if problem behavior occurred, Jacob’s parents were less likely to enforce compliance with a demand compared to times when problem behavior did not occur. Access to tangibles and escape from demands were hypothesized reinforcers for Jacob’s problem behavior (i.e., aggression, destruction, disruption). The TBFA planning form was completed based on information gathered from the interviews and descriptive observation and four conditions were included in the TBFA: (1) attention, (2) tangible, (3) escape, and (4) escape to tangible.

**TBFA.** Results of Jacob’s TBFA are displayed in Figure 4-7. The target behaviors for the TBFA were aggression and disruption as defined previously during pre-assessment. A total of 20 trials were presented across the four conditions. The TBFA was conducted during five visits to the home over a 50 day period. A summary of
the number of trials per condition and duration of the TBFA is provided for all participants in Table 4-1.

In the attention condition, problem behavior was observed in the first trial, but not observed again for the remaining four trials. Thus, there was not differentiation between the control or test segments in the attention condition. In the escape condition, problem behavior was not observed in any trial and did not result in differentiation between the control or test segments. In the tangible condition, problem behavior was observed in the test segment during the first trial but not in the second. Problem behavior was then observed again in the third trial which was followed by an increase in the cumulative occurrence of behavior over the remaining three trials. No problem behavior was observed in the control segments of all tangible trials. Finally, in the escape to tangible condition, problem behavior was observed in the test segments during the first three trials of the condition which resulted in an increase in the cumulative occurrence of behavior across the initial three trials. Problem behavior was not observed during trials four and five which remained stable for these two remaining trials. No problem behavior was observed in the control segments of all escape to tangible trials.

The differentiation between the test and control segments in the tangible condition demonstrates a functional relationship between Jacob’s problem behavior (i.e., aggression and disruption) and the removal of preferred tangibles. Thus, Jacob’s problem behavior is maintained by positive reinforcement in the form of access to tangibles. Although differentiation was observed in the combined condition, lack of differentiation in the escape only condition indicates that the presentation of a demand
did not occasion the problem behavior. Hence, removal of the preferred tangible was a necessary component of the trial to elicit aggression or destruction.

In addition to the cumulative frequency graphs used to identify a function of problem behavior, a descriptive analysis of the rate of problem behavior per minute was conducted to examine patterns in the occurrence of problem behavior during the TBFA. Data on Jacob’s rate of problem behavior per trial are displayed in Figure 4-8. During Jacob’s TBFA, a decreasing pattern was found in the rate of Jacob’s problem behavior in the escape to tangible condition. Jacob demonstrated two instances of problem behavior during the first test segment and only one instance of problem behavior for each of the following two trials in the escape to tangible condition. After Jacob was exposed to the contingency (i.e., problem behavior would result in the delivery of the consequence), the rate of problem behavior decreased in this condition (i.e., escape to tangible). The rate of problem behavior decreased from 0.97 occurrences per min to 0.79 occurrences per min as the number of trials presented increased. In the tangible condition, rate of behavior was stable at 0.93 occurrences per min in the 1st and 3rd trials, decreased to 0.72 for the next trial, before increasing to 1.85 in the final trial.

**Interobserver Agreement of TBFA**

All trials were coded by a primary data collector and the study PI to assess agreement on the occurrence of problem behavior. An agreement was defined as both observers recording the occurrence of the targeted problem behavior within each test and control segment. For Ryan, mean IOA across the conditions are as follows: (a) attention = 100%, (b) tangible = 100%; (c) escape = 85.7% ($SD=37.8$, range – 0% - 100%); and (d) escape to tangible = 100%. For James, mean IOA across the conditions are as follows: a) attention = 100%, (b) tangible = 100%; (c) escape = 100%; and (d)
escape to tangible = 100%. For Kaleb, mean IOA across the conditions are as follows: a) attention = 100%, (b) tangible = 100%; (c) escape = 80% ($SD = 44.7$; range - 0% - 100%); and (d) escape to tangible = 100%. For Jacob, mean IOA across the conditions are as follows: a) attention = 100%, (b) tangible = 100%; (c) escape = 100%; and (d) escape to tangible = 100%.

**Procedural Fidelity of TBFA**

Procedural fidelity was coded for each trial to measure whether the TBFA was implemented as intended. To assess agreement on the fidelity of the experimental procedures, all trials were coded by a primary data collector and the study PI. Procedural fidelity was assessed for five steps of the complete trial and included that the PI (1) set up an appropriate control segment, (2) provided reinforcement for the targeted behavior, if necessary, (3) transitioned to the test segment, (4) set up an appropriate test segment, and (5) ended the trial. For Ryan, mean procedural fidelity across the conditions was: (a) attention = 100%; (b) tangible = 100%; (c) escape = 97.1% ($SD = 7.6$, range – 80% to 100%); and (d) escape to tangible = 100%. For James, mean procedural fidelity across the conditions was: (a) attention = 100%; (b) tangible = 100%; (c) escape = 96% ($SD= 8.9$; range – 80% to 100%); and (d) escape to tangible = 100%. For Kaleb, mean procedural fidelity across the conditions was: (a) attention = 100%; (b) tangible = 100%; (c) escape = 96% ($SD =8.9$; range – 80% to 100%); and (d) escape to tangible = 100%. For Jacob, mean procedural fidelity across the conditions was: (a) attention = 100%; (b) tangible = 100%; (c) escape = 100%; and (d) escape to tangible = 100%.
Social Validity of TBFA

Social validity data for the TBFA were collected via a rating scale, adapted from Lloyd et al. (2015), from the caregivers after the completion of the TBFA. All responses were rated on a scale of 1-6 and corresponded to questions about the acceptability (i.e., how comfortable the caregiver felt with the procedures of the TBFA), authenticity (i.e., how closely the caregiver feels the TBFA reflected a typical occurrence of problem behavior in the home), and importance (i.e., the extent to which the benefits of the TBFA outweigh the risks). Results of the rating scale are presented in Table 4-3. All four caregivers strongly agreed that the TBFA was acceptable and beneficial, and that they felt positive about the TBFA as a method for analyzing their child’s problem behavior. All four also strongly agreed that their child’s behaviors were severe enough to warrant this type of analysis and that there were no negative side effects due to the TBFA. One item that were rated slightly lower was if they felt other caregivers would find the TBFA appropriate for their child’s problem behavior ($M = 5.5$). Responses were more variable to the question of whether the trials in the TBFA were similar to events that typically occur in the home setting. The attention trial had the lowest rating ($M = 4.3$) and ranged from 2 (i.e., less similar) to 6 (i.e., very similar). Tangible and escape had the highest rating ($M = 4.8$).

Study 2: Functional Communication Training

The results of the TBFA were used to develop a FCT intervention to decrease the problem behavior and increase functional communication for three of the participants. One participant (Ryan) behavior was maintained by access to tangible items, for which a multiple probe across tangible items was used. Two of the participants’ (James and Kaleb) behaviors were maintained by both tangible and
escape for which a multiple probe across demands was used. Due to time constraints, no intervention was implemented with Jacob.

Each datum point represents one session, which consisted of five consecutive trials each followed by 30 s access to the tangible item. Data were recorded on the occurrence of problem behavior and prompted or independent communication during each trial and reported as percentage of behavior per session. Sessions were graphed in the consecutive order in which they were conducted. The results of the intervention for each participant are presented below.

**Ryan**

Ryan’s intervention was conducted in three experimental conditions, each with multiple phases, across three tangible items: tablet, trucks, and blanket. First, a baseline (A) condition was conducted using similar procedures as the test segment of the TBFA. More specifically, an EO (i.e., removal of the tangible) was arranged and the delivery of the tangible during each trial was contingent on problem behavior. Next, during the FCT + EXT (B) condition, the EO was arranged and prompting was used to replace the problem behavior with functional communication. During this condition, three phases were conducted for each tier where the delay to the prompt was systematically increased (i.e., 0 s, 1 s, 3 s). Finally, during the FCT + EXT + delay to reinforcement (B’) condition, the intervention was conducted using the same procedures as the previous condition except that a verbal signal to wait was presented for one of the five trials and the delivery of the tangible was delayed during that trial. This condition was conducted using a variable number of phases across tiers. Across the phases, the length of time between the signal to wait and the delivery of the tangible during the wait
trial was systematically increased. After criterion was met for a 10 s delay to reinforcement for one of five trials, the number of trials with the delay was increased to two and three trials for the first and second tiers. The FCT + EXT + delay to reinforcement condition included six, five, and three phases for tablet, trucks, and blanket respectively. For tablet, the phases included a 0 s delay, 1 s delay, 3 s delay, 10 s delay, 10 s delay plus visual timer, and 20 s delay plus visual timer. For trucks, the phases included 0 s delay, 1 s delay, 3 s delay, 5 s delay, and 10 s delay. For blanket, the phases included 0 s delay, 1 s delay, and 3 s delay. The entire intervention (i.e., baseline, FCT + EXT, and FCT + EXT + delay to reinforcement conditions) was conducted in 21 home visits and 74 individual sessions ($M = 3.5$ sessions per visit, $SD = 1.7$) over three months. The results of Ryan’s intervention are shown in Figure 4-9 and are described below.

**Baseline**

Fourteen baseline sessions were conducted across the three tangible items. Picture cards (i.e., cards to be used during intervention) were made available during baseline sessions so Ryan had the opportunity to use the form of communication that was used in the intervention conditions. Across tangible items, Ryan demonstrated problem behavior in 100% of trials and functional communication (i.e., independent and prompted communication) in 0% of trials during all baseline sessions. Following a stable baseline of at least three data points, the intervention began in the first tier: tablet. Baseline probes continued in the other two tiers (i.e., trucks and blanket); data in these tiers remained stable with no change in level or trend for problem behavior and communication while the first tier was in the intervention condition. Introduction of the intervention was then staggered across the tiers.
**FCT + EXT**

Three phases (0 s, 1 s, 3 s prompt delay) were included in the FCT + EXT condition. Across tiers, the number of sessions for each tier (i.e., tangible item) was 10, 12, and 10 sessions for tablet, trucks, and blanket, respectively. In the first tier (i.e., tablet), three sessions were conducted with 0 s prompt delay, four sessions were conducted with a 1 s prompt delay, and three sessions were conducted with a 3 s prompt delay. In the second tier (i.e., trucks), four sessions were conducted with 0 s prompt delay, three sessions were conducted with a 1 s prompt delay, and five sessions were conducted with a 3 s prompt delay. In the third tier (i.e., blanket), four sessions were conducted with 0 s prompt delay, three sessions were conducted with a 1 s prompt delay, and three sessions were conducted with a 3 s prompt delay.

The intervention condition began with a 0 s prompt delay and included the presentation of a verbal prompting question to ask for the tangible item. This prompting question was followed immediately with a full physical prompt (i.e., hand over hand assistance) to move the picture of the tangible on the communication board to the end of the sentence “I want to play ____.” A progressive prompt delay was then implemented to systematically increase the time between the presentation of the verbal instruction and the availability of the prompt from 1 s to 3 s. Each phase change was made following three consecutive sessions with no problem behavior and 100% prompted or independent communication.

**Effects of FCT + EXT on problem behavior.** Introduction of the FCT + EXT with the 0 s prompt delay resulted in an immediate change in level of problem behavior from baseline across all three tiers (i.e., across all tangible items). During the 0 s prompt delay, problem behavior remained stable at 0% of trials for all sessions in the first and
third tier (i.e., tablet and blanket) and remained at a zero celerating trend for the remainder of the intervention phases (i.e., 1 s and 3 s prompt delays). In the second tier, there was an immediate change in level, from 100% of trials in baseline to 40% of trials in intervention. In the second session, there was a further decrease in problem behavior to 0% of trials, which remained stable for the remainder of intervention (i.e., 1 s and 3 s prompt delays). Thus, problem behavior was reduced to 0% across all tiers during the FCT + EXT condition.

**Effects of FCT + EXT on communication.** During the 0 s prompt delay phase in tiers one (i.e., tablet) and three (i.e., blanket), prompted communication was observed in all sessions. No independent communication occurred during these sessions. In the second tier, four of five sessions during the 0 s prompt delay contained only prompted communication and no independent communication. Independent communication was observed in one trial (20%) of the second session of that phase, whereas Ryan independently moved the picture card during the prompting question and the physical prompt was not needed.

After the prompt delay was increased from 0 s to 1 s prompt delay, there was an immediate change in level of independent communication from 0% to 60% of trials in the first tier (i.e., tablet), after which independent communication increased to 100% in the second and all subsequent sessions throughout the prompt delay phases. Prompted communication was not necessary for the remainder of the phases. There was an immediate change in level for independent communication from zero to 100% of trials in the second tier (i.e., trucks). Prompted communication occurred for 20% of the trials in the second session of the 3 s prompt delay phase, after which independent
communication returned to 100% for the remainder of this phase. There was an immediate change in level for independent communication from zero to 40% of trials in the third tier (blanket), after which independent communication increased to 100% for the remainder of this phase. Thus, independent use of functional communication was increased to 100% of sessions across all tiers during the FCT+EXT condition.

**FCT + EXT + delay to reinforcement**

The introduction of a delay to reinforcement (i.e., a waiting period before access to the tangible item) was systematically applied across all tangible items after reaching criterion in the final prompt delay phase (i.e., 3 s prompt delay). In addition to extending the delay to reinforcement, the number of trials in a session was systematically increased from 20% (one of five), to 40% (two of five), and finally to 60% (three of five) when Ryan met criterion for a minimum of a 10 s delay to reinforcement. Across tiers, the number of sessions during this condition for each tier (i.e., tangible item) was 16, 9 and 3 sessions for tablet, trucks, and blanket, respectively. A variable number of phases across the tangibles were conducted. For tablet, the number of sessions per phase was two sessions with 0 s delay, two sessions with 1 s delay, two sessions with 3 s delay, six sessions with 10 s delay, three sessions with 10 s delay plus visual timer (one with delay in 20% trials, one with delay in 40% trials, one with delay in 60% trial), and one session with 20 s delay plus visual timer in 60% of trials. For trucks, the number of sessions per phase was three sessions with 0 s delay, one session with 1 s delay, one session with 3 s delay, one session with 5 s delay, and three sessions with 10 s delay (one with delay in 20% trials, one with delay in 40% trials, one with delay in 60% trial). For blanket, the number of sessions per phase was one session with 0 s delay, one session with 1 s delay, and one session with 3 s delay.
Effects of FCT + EXT + delay to reinforcement on problem behavior. In the first tier (i.e., tablet), all phases with a 0 s, 1 s and 3 s delay to reinforcement resulted in no change in problem behaviors from the previous condition. That is, problem behavior remained stable at 0% of trials across three phases where the duration of the wait time was systematically increased. The first session of the 10 s delay did not result in a change in level of problem behavior, but problem behavior increased to 20% of trials for the subsequent five sessions in this phase. Because problem behavior only occurred during trials with the delay, a change was made to the intervention by adding a visual timer to signal the length of the delay to Ryan. After the timer was introduced, the percentage of trials with problem behavior returned to 0% and remained stable throughout the delay condition. After problem behavior decreased to 0% with a 10 s delay to reinforcement, the number of trials within each session that contained a delay increased from one trial (20%) to two trials (40% of trials) and to three trials (60% of trials). In this phase, problem behavior remained stable at 0% of trials despite the increase in the number of trials where a wait was signaled. A final session was conducted using a 20 s delay to reinforcement with a visual timer for 60% of the trials (i.e., three of five trials), in which 0% of trials contained problem behavior. Thus, a functional relation was found between the intervention (i.e., FCT + EXT + delay to reinforcement) and the occurrence of problem behaviors for Ryan.

Problem behavior occurred during the first session that included a delay to reinforcement (i.e., 0 s delay) in trucks, however, following this initial session problem behavior returned to 0%. Since problem behavior occurred when the 10 s delay to reinforcement was implemented in the first tier, a change was made for the intervention
for the delay to reinforcement in trucks to include a 5 s delay to reinforcement between the 3 s and 10 s delay to reinforcement. The original procedures were implemented (i.e., no timer) at the 10 s delay to reinforcement and problem behavior remained stable at zero. The systematic increase in number of trials that contained a delay was implemented and problem behavior remained at 0%. Three sessions were conducted that included a delay to reinforcement in the blanket tier, in which the level of problem behavior remained stable at 0% of trials. This phase was discontinued after the delay of 3 s with no problem behavior due to changes in preference for the tangible item.

**Effects of FCT + EXT + delay to reinforcement on communication.** Across the first and third tiers (i.e., tablet and blanket), independent communication remained stable at 100% of trials throughout all phases of the delay to reinforcement condition. In the first session of the second tier (i.e., trucks), there were two trials with prompted communication (40% of trials) and three trials with independent communication (60% of trials). Independent communication increased to 100% in the second session and was stable for the remaining sessions in the second tier. Thus, a functional relation was found between the intervention (i.e., FCT + EXT + delay to reinforcement) and the increase in independent communication for Ryan.

**James**

James’ intervention was conducted in three conditions, each with multiple phases, across three demands: “clean up,” “put dishes away,” and “wash hands.” First, a baseline (A) condition was conducted using similar procedures as the test segment of the TBFA. More specifically, an EO (i.e., removal of the tangible) was arranged and the delivery of the tangible item during each trial was contingent on problem behavior. Next, during the FCT + EXT (B) condition, the EO was arranged and prompting was used to
replace the problem behavior with functional communication. During this condition, three phases were conducted for each tier where the delay to the prompt was systematically increased (i.e., 0 s, 1 s, 3 s). Finally, during the FCT + EXT + response chaining (B‘) condition, the intervention was conducted using the same procedures as the previous condition except the response requirements were increased (i.e., compliance with some or all of the demand) before James could request access to the Kindle®. Across the phases, the number of steps that were required was systematically increased. This condition was conducted using a variable number of phases across tiers. The FCT + EXT + response chaining condition included three, three, and two phases for “clean up,” “put away dishes,” and “wash hands” respectively. For “clean up,” the phases included compliance with one step (i.e., put one block into a bin), two steps (i.e., put 4-5 blocks into a bin) and three steps (i.e., put 4-5 blocks into the bin and move the bin to a shelf in the play area). For “put away dishes,” the phases included compliance with one step (i.e., pick up a cup off the table), two steps (i.e., pick up two items off the table) and three steps (i.e., pick up two items off the table and bring to the kitchen). For “wash hands,” the phases included compliance with one step (i.e., go to the bathroom door) and two steps (i.e., go to the bathroom door and wash hands). The entire intervention (i.e., baseline, FCT + EXT, and FCT + EXT + response chaining conditions) was conducted in 23 home visits and 123 individual sessions (M = 5.6 sessions per visit, SD = 1.4) over three months. The results of James’ intervention are shown in Figure 4-10 and are described below.
Baseline

Nineteen baseline sessions were conducted across the three demands. The Kindle® was used as the reinforcer across all tiers. Across demands, James demonstrated problem behavior in 100% of trials and functional communication (i.e., independent and prompted communication) in 0% of trials during all baseline sessions for the first tier (i.e., “clean up”) and second tier (i.e., “put away dishes”). Following a stable baseline of at least three data points, the intervention began in the first tier: clean up. Probes continued in the other two tiers (i.e., “put away dishes” and “wash hands”); data in the second tier remained stable with no change in level or trend for problem behavior and communication while the first tier was in the intervention condition. Data in tier three remained stable with no change in level or trend for problem behavior while the first tier was in the intervention condition. Independent communication was observed in three sessions of the third tier during baseline. Independent communication then returned to 0% for the final two baseline sessions prior to implementing the intervention. Introduction of the intervention was then staggered across the tiers.

FCT + EXT

Three phases (0 s, 1 s, 3 s prompt delay) were included in the FCT + EXT condition. Across tiers, the number of sessions for each tier (i.e., demand) was 24, 13, and 15 sessions for “clean up,” “put dishes away,” and “wash hands,” respectively. In the first tier (i.e., “clean up”), seven sessions were conducted with 0 s prompt delay, eleven sessions were conducted with a 1 s prompt delay, and six sessions were conducted with a 3 s prompt delay. In the second tier (i.e., “put dishes away”), seven sessions were conducted with 0 s prompt delay, three sessions were conducted with a 1 s prompt delay, and thirteen sessions were conducted with a 3 s prompt delay. In the
third tier (i.e., “wash hands”), six sessions were conducted with 0 s prompt delay, six sessions were conducted with a 1 s prompt delay, and three sessions were conducted with a 3 s prompt delay.

The intervention condition began with a 0 s prompt delay and included the presentation of a verbal prompting question to ask for the tangible item. This prompting question was followed immediately with a vocal prompt to request more time to play (i.e., “I want to play more”). A progressive prompt delay was then implemented to systematically increase the time between the presentation of the verbal instruction and the availability of the prompt from 1 s to 3 s. Each phase change was made following three consecutive sessions with no problem behavior and 100% prompted or independent communication.

**Effects of FCT + EXT on problem behavior.** Introduction of the FCT + EXT with the 0 s prompt delay resulted in an immediate change in level of problem behavior from baseline across all three tiers (i.e., across all demands). In the first tier (i.e., “clean up”), there was an immediate change in level, from 100% of trials in baseline to 60% of trials in intervention. Data on problem behavior remained stable at 60% for the second session and increased to 80% for the third before returning to 60%. There was a decrease in problem behavior to 0% of the trials in the fifth session, which remained stable for the remainder of that phase. When the 1 s prompt delay was introduced, there was a change of level from 0% of trials to 40% of trials. Problem behavior then decreased to 20% for the next two sessions before increasing back to 40% in the fourth session. In the next session, a decrease to 0% problem behavior occurred but was followed by an increase to 60% before a decelerating trend in these data was observed.
Data returned to 20% of trials with problem behavior before reaching 0% for the remaining three sessions. When the 3 s prompt delay was introduced, a change of level of problem behavior from 0% of trials in the previous phase to 40% of trials was observed. Following this change in level, a variable data pattern was observed similar to the previous phase; however, problem behavior but returned to 0% and remained stable for the fourth through sixth sessions.

In the second tier (i.e., “put dishes away”), there was an immediate change in level from 100% of trials in baseline to 40% of trials when the intervention was introduced. Problem behavior then decreased to 0% followed by two sessions of 20% of trials before another decrease to 0% was observed. Problem behavior remained stable for the remaining three sessions of this phase. During the 1 s prompt delay, problem behavior remained stable at 0% of trials for all sessions and remained at a zero celerating trend for the remainder of the intervention phases (i.e., 3 s prompt delay).

In the third tier (i.e., wash hands), there was an immediate change in level of problem behavior from 100% of trials in baseline to 0% of trials in intervention. Problem behavior was observed in the second and third sessions (20% of trials per session) of this phase before returning to 0% for the remaining three sessions. Problem behavior remained at 0% when the 1 s prompt delay was introduced. One session with 20% trials with problem behavior occurred, before returning to 0%. These data remained stable for the remainder of intervention (i.e., 1 s and 3 s prompt delays). Thus, problem behavior was reduced to 0% across all tiers during the FCT + EXT condition.

**Effects of FCT + EXT on communication.** During the 0 s prompt delay phase in tier one (i.e., “clean up”), prompted communication was observed in all sessions. No
independent communication occurred during these sessions. After the prompt delay was increased from 0 s to 1 s prompt delay, there was a slight change in level from 0% of trials with independent communication to 20% of trials. During the second session in this phase, no independent communication was observed and all communication was prompted. Independent communication increased to 80% of trials in the following session, remained stable for one additional session before increasing to 100% of trials for the remaining seven sessions. Finally, when the 3 s prompt delay was introduced there was a change in level from 100% of trials during the previous phase to 60% of trials with independent communication (i.e., 40% of the trials in that session required prompting). Independent communication then increased to 100% of trials during the following session. Prompted communication was recorded for the third session for 20% of trials, after which independent communication returned to 100% for the remainder of this phase.

In the second tier (i.e., “put dishes away”), independent communication was observed before a prompt was delivered (i.e., emitted upon removal of the Kindle® and presentation of the demand). There was an immediate change in level for independent communication from 0% of trials during baseline to 60% of trials during the first session of the intervention. Prompted communication occurred in 40% of the trials in the first session. Independent communication then decreased to 80% of trials for two consecutive sessions, after which independent communication returned to 100% for the remainder of this phase. These data remained stable for the remainder of the intervention (i.e., 1 s and 3 s prompt delays). Prompted communication was not necessary for the remainder of the phases.
Independent communication was observed in the third tier (i.e., “wash hands”). There was an immediate change in level from 0% of trials of independent communication in baseline to 100% of trials in intervention. James emitted independent communication responses during the removal of the Kindle® and the presentation of the demand. In these trials, prompted communication was not needed. There was a descending trend in independent communication where prompted communication was used (i.e., sessions two and three). An increasing trend was then observed whereas independent communication returned to 100% of trials for the remainder of this phase. When the 1 s prompt delay was introduced, independent communication remained stable at 100% for the two sessions, decreased to 80% for one session before returning to 100% for the remainder of the phase. These data remained stable for the remainder of the intervention (i.e., 1 s and 3 s prompt delays). Thus, independent use of functional communication increased to 100% of sessions across all tiers during the FCT+EXT condition.

**FCT + EXT + response chaining**

The introduction of response chaining (i.e., gradual increase in response requirement before access to Kindle® was available) was systematically applied across all demands after reaching criterion in the final prompt delay phase (i.e., 3 s prompt delay). Across tiers, the number of sessions during this condition for each tier (i.e., demand) was 21, 13 and 16 sessions for “clean up,” “put dishes away,” and “wash hands”, respectively. A variable number of phases across the demands were conducted. For “clean up,” the number of sessions per phase was 11 sessions with one step, 5 sessions with two steps, and 3 sessions with 3 steps. For “put dishes away,” the number of sessions per phase was three sessions with one step, two sessions two
steps, and seven sessions with three steps. For “wash hands,” the number of sessions per phase was nine sessions with one step and seven sessions with two steps.

**Effects of FCT + EXT + response chaining on problem behavior.** In the first tier (i.e., “clean up”), there was an immediate increase in level from 0% of trials with problem behavior in the previous phase to 40% of trials with problem behavior. Problem behavior then decreased to 0% again for two consecutive sessions. In the third session of this phase, problem behavior occurred for 20% of trials before returning to 0% for two more consecutive sessions. Another increase to 40% of trials occurred and remained the same for two consecutive sessions. Problem behavior decreased to 0% and remained stable for the remainder of this phase. Of the five sessions in the second phase (i.e., two steps), there was only one session with problem behavior. There was an increase in problem behavior to 20% of trials in the second session before returning to 0% for the remainder of this phase. A similar pattern of responding was observed in the third phase (i.e., three steps). Of the five sessions, there was only one session with problem behavior. There was an increase in problem behavior to 20% of trials in the second sessions before returning to 0% for the remainder of this phase.

In the second tier (i.e., “put away dishes”), problem behavior remained stable at 0% through the first two phases. That is, there were no occurrences of problem behavior when implementing the first and second steps of the demand. There was a slight change in level in the third phase (i.e., three steps) and problem behavior increased to 20% of trials for the first two consecutive sessions. Problem behavior decreased to 0% for one session before returning to 20% of trials again. There was another decrease in problem behavior to 0% for the remainder of this phase.
In the third tier (i.e., “wash hands”), there was a variable trend in problem behavior before criterion was met with 0% of problem behavior for three consecutive sessions in the first phase. There was an initial increase in problem behavior from the previous phase from 0% of trials to 20% of trials. Problem behavior remained stable at 20% of trials for three consecutive sessions before returning to 0% for two consecutive sessions. There was another increase in problem behavior to 40% of trials before returning to 0% for the remainder of this phase. When the next phase (i.e., two steps) was implemented, there was a substantial increase in level from 0% of trials in the previous phase to 80% of trials in the first session of this phase. This initial increase was followed by a decelerating trend in problem behavior over the remaining sessions. Problem behavior was observed in 40% of trials for two consecutive sessions, 20% of trials and finally, 0% of trials where problem behavior remained stable for the remainder of this phase. Thus, problem behavior was reduced to 0% across all tiers during the FCT + EXT + response chaining condition. A functional relation was found between the intervention (i.e., FCT + EXT + response chaining) and the occurrence of problem behaviors for James.

**Effects of FCT + EXT + response chaining on communication.** In the first tier (i.e., “clean up”), there was an immediate change in level from 100% of trials with independent communication during the previous condition to 20% of trials in the first session. Prompted communication was needed in 80% of the trials during the first session of this condition. An accelerating trend was observed in the next two sessions where independent communication occurred for 60% of the trials and then returned to 100% of trials. In the fourth session of this phase, prompted communication was
needed for 20% of trials before returning to 0% for the remainder of the phase. Independent communication remained stable at 100% for the remainder of the intervention (i.e., one step, two steps, three steps). There were no changes in independent communication in the second tier when the condition was implemented. Independent communication remained stable at 100% of trials across all three phases for the demand “put away your dishes.” Of the 16 sessions conducted in the third tier (i.e., “wash hands”), only one session had prompted communication. The third session of the first phase in this tier had 20% of trials with prompted communication before returning to 0% for the remainder of the intervention. Following this one session, independent communication remained stable for the remainder of the intervention (i.e., one step, two steps). Thus, independent use of functional communication was increased to 100% of sessions across all tiers during the FCT+EXT + response chaining condition. A functional relation was found between the intervention (i.e., FCT + EXT + response chaining) and the increase in independent communication for James.

**Kaleb**

Kaleb’s intervention was conducted in three conditions, each with multiple phases, across three demands: “take turns,” “do work,” and “clean up.” First, a baseline (A) condition was conducted using similar procedures as the test segment of the TBFA. More specifically, an EO (i.e., removal of the tangible) was arranged and the delivery of the tangible item (i.e., Kindle®) during each trial was contingent on problem behavior. Next, during the FCT + EXT (B) condition, the EO was arranged and prompting was used to replace the problem behavior with functional communication. During this condition, three phases were conducted for each tier where the delay to the prompt was systematically increased (i.e., 0 s, 1 s, 3 s). Finally, during the FCT + EXT + response
chaining (B’) condition, the intervention was conducted using the same procedures as the previous condition except the response requirements were increased (i.e., compliance with some or all of the demand) before Kaleb could request access to the Kindle®. Across the phases, the number of steps that were required was systematically increased. This condition was conducted using a variable number of phases across tiers. The FCT + EXT + response chaining condition included four, three, and three phases for “take turns,” “do work,” and “clean up,” respectively. For “take turns,” the phases included compliance with one step (i.e., hand the Kindle® to the PI with immediate return), two steps (i.e., hand the Kindle® and allow access for 5 s), two steps with a visual timer (i.e., access for 5 s) and three steps with a visual timer (i.e., hand the Kindle® and allow access for 10 s). For “do work,” the phases included compliance with one step (i.e., read three words on the paper), two steps (i.e., read five words from an array of 10) and three steps (i.e., read all 10 words). For “clean up,” the phases included compliance with one step (i.e., place one car into the basket), two steps (i.e., place 4-5 cars into the basket), and three steps (i.e., place all cars into the basket) The entire intervention (i.e., baseline, FCT + EXT, and FCT + EXT + response chaining conditions) was conducted in 17 home visits and 91 individual sessions (\( M = 5.4 \) sessions per visit, \( SD = 2.0 \)) over two months. The results of Kaleb’s intervention are shown in Figure 4-11 and are described below.

**Baseline**

Seventeen baseline sessions were conducted across the three demands. The Kindle® was used as the reinforcer across all tiers. Across demands, Kaleb demonstrated problem behavior in 100% of trials and functional communication (i.e.,
independent and prompted communication) in 0% of trials during all baseline sessions for the first tier (i.e., “take turns”) and second tier (i.e., “do work”). Following a stable baseline of at least three data points, the intervention began in the first tier: “take turns.” Probes continued in the other two tiers (i.e., “do work” and “clean up”); data in the second tier remained stable with no change in level or trend for problem behavior and communication while the first tier was in the intervention condition. Data in tier three remained stable with no change in level or trend of problem behavior while the behaviors in the first tier was in the intervention condition. Independent communication was observed in one session of the third tier while intervention was conducted in tier one. Criterion for the phase changes was three consecutive sessions of no problem behavior. Introduction of the intervention was then staggered across the tiers.

FCT + EXT

Three phases (0 s, 1 s, 3 s prompt delay) were included in the FCT + EXT condition. Across tiers, the number of sessions for each tier (i.e., demand) was 21, 12, and 9 sessions for “take turns,” “do work,” and “clean up,” respectively. In the first tier (i.e., take turns), 13 sessions were conducted with 0 s prompt delay, 5 sessions were conducted with a 1 s prompt delay, and 3 sessions were conducted with a 3 s prompt delay. In the second tier (i.e., “do work”), six sessions were conducted with 0 s prompt delay, three sessions were conducted with a 1 s prompt delay, and three sessions were conducted with a 3 s prompt delay. In the third tier (i.e., “clean up”), three sessions were conducted with 0 s prompt delay, three sessions were conducted with a 1 s prompt delay, and three sessions were conducted with a 3 s prompt delay.

The intervention condition began with a 0 s prompt delay and included the presentation of a verbal prompting question to ask for the Kindle®. This prompting
question was followed immediately with vocal prompt to request more time to play (i.e., “I want to play more”). A progressive prompt delay was then implemented to systematically increase the time between the presentation of the verbal instruction and the availability of the prompt from 1 s to 3 s. Each phase change was made following three consecutive sessions of with no problem behavior.

**Effects of FCT + EXT on problem behavior.** Introduction of the FCT + EXT with the 0 s prompt delay resulted in an immediate change in level of problem behavior from baseline across all three tiers (i.e., across all demands). In the first tier (“take turns”), there was an immediate change in level, from 100% of trials in baseline to 60% of trials in intervention. Data on problem behavior increased to 80% for the second session before a decelerating trend was observed over the next two sessions to 40% and 0%, respectively. Problem behavior remained stable at 0% for two consecutive sessions. There was increase in the problem behavior over the next four sessions before returning to 0% where it was stable for the remainder of the phase. Problem behavior returned to 0% of trials where it remained stable for the remainder of the phases in this condition (i.e., 1 s and 3 s prompt delay). In the second tier, there was an immediate change in level, from 100% of trials in baseline to 80% of trials in intervention. Problem behavior increased to 100% of trials and then decreased to 80%. A change was made to the intervention to shorten the prompt by giving the demand while removing the Kindle® rather than removing the item first (i.e., remove the vocal instruction for communication) This allowed for the vocal demand and prompt to be presented before problem behavior could occur. There was a decrease in problem behavior to 0% of the trials in the first session of this phase, which remained stable for the remainder of the
phases in this condition (i.e., 1 s and 3 s prompt delay). In the third tier ("clean up"), there was an immediate change in level from 100% of trials in baseline to 0% of trials in intervention. Problem behavior remained stable at 0% for the remainder of intervention (i.e., 1 s and 3 s prompt delay). Thus, problem behavior was reduced to 0% across all tiers during the FCT + EXT condition.

**Effects of FCT + EXT on communication.** In the first tier (i.e., “take turns”), prompted communication was observed in 100% of the trials during the first session. Following this initial session, independent communication emerged as Kaleb would emit the communicative response while the demand was being delivered. More specifically, in some trials, Kaleb requested his Kindle® independently and simultaneously with the removal of the Kindle® and presentation of the demand. Independent communication was observed for 20% of the trials in the second session before returning to 0% (i.e., 100% prompted communication) for the next two consecutive sessions. During the fifth trial, independent communication increased to 40% of trials and remained stable for three sessions before returning to 0%. Another increase in independent communication occurred during the ninth session and remained stable at 20% for one more session. Independent communication increased to 100% for one session before decreasing to 60% and then to 20% for the remaining two sessions. When the 1 s prompt delay was introduced in tier one, there was an immediate change in level for independent communication from 20% of trials to 40% of trials. Independent communication then increased to 100% of trials where it remained stable for the remainder of this phase and the next phase (i.e., 3 s prompt delay). Prompted communication remained at 0% for the remainder of the phases.
During the 0 s prompt delay phase in tier two (i.e., “do work”), prompted communication was observed in all sessions. No independent communication occurred during these sessions. These data remained stable (i.e., all trials with prompted communication, no independent communication) throughout the phase with a shortened prompt. After the prompt delay was increased from 0 s to 1 s prompt delay, there was an immediate change in level from 0% of trials with independent communication to 100% of trials. These data remained stable at 100% independent communication for the remainder of this condition (i.e., 1 s prompt delay, 3 s prompt delay). No prompted communication was necessary in this tier.

During the 0 s prompt delay phase in tier three (i.e., “clean up”), prompted communication was observed in all sessions. No independent communication occurred during these sessions. After the prompt delay was increased from 0 s to 1 s prompt delay, there was an immediate change in level from 0% of trials with independent communication to 100% of trials. These data remained stable at 100% independent communication for the remainder of this condition (i.e., 1 s prompt delay, 3 s prompt delay). No prompted communication was necessary in this tier. Thus, independent use of functional communication was increased to 100% of sessions across all tiers during the FCT+EXT condition.

**FCT + EXT + response chaining**

The introduction of response chaining (i.e., gradual increase in response requirement before access to Kindle® was available) was systematically applied across all demands after reaching criterion in the final prompt delay phase (i.e., 3 s prompt delay). Across tiers, the number of sessions during this condition for each tier (i.e., demand) was 12, 11 and 9 sessions for “take turns,” “do work,” and “clean up”
respectively. A variable number of phases across the tangibles were conducted. For “take turns,” the number of sessions per phase was four sessions with one step, two sessions with two steps, three sessions with two steps plus a visual timer, and three sessions with three steps plus a visual timer. For “do work,” the number of sessions per phase was three sessions with one step, five sessions two steps, and three sessions with three steps. For “clean up,” the number of sessions per phase was three sessions with one step, three sessions with two steps, and three sessions with three steps.

**Effects of FCT + EXT + response chaining on problem behavior.** In the first tier (i.e., “take turns”), there was an immediate change in level from 0% of trials with problem behavior in the previous phase to 20% of trials with problem behavior. Problem behavior then decreased to 0% again for the remainder of this phase. Another change in level from 0% to 20% of trials occurred in the first session of the second phase of “take turns.” Problem behavior increased to 60% of trials in the next session. A change was made to the intervention by adding a visual timer to signal the length of the delay to Kaleb using a timer. Problem behavior immediately decreased to 20% of trials and then to 0% where it remained stable for the remainder of the interventions (i.e., two steps with visual and three steps with visual).

In the second tier (i.e., “do work”), problem behavior remained stable at 0% through the first phase. That is, there were no occurrences of problem behavior when implementing the first step of the demand (i.e., read three words). Problem behavior remained stable at zero for the first session of the second phase but increased to 40% during the second session. Problem behavior then returned to 0% and remained stable for the remainder of the intervention (i.e., two steps and three steps). In the third tier
(i.e., “clean up”) problem behavior remained stable at 0% for all sessions across all three phases. Thus, problem behavior was reduced to 0% across all tiers during the FCT + EXT + response chaining condition. A functional relation was found between the intervention (i.e., FCT + EXT + response chaining) and the occurrence of problem behaviors for Kaleb.

**Effects of FCT + EXT + response chaining on communication.** In the first tier (i.e., “take turns”), there was no immediate change in level from 100% of trials and data remained stable for the first phase (i.e., one step). Prompted communication was not needed during this phase. When two steps (i.e., take turn and allow access for 5 s) was implemented, independent communication decreased to 80% and prompted communication was needed for 20% of the trials during the first session. A further decrease in independent communication was observed in the following session to 60% of trials when problem behavior increased to 40% of trials. The change in the intervention (i.e., visual timer) resulted in an immediate increase of independent communication to 100% of trials and prompted communication decreased to 0%. These data remained stable for the remainder of the intervention (i.e., two steps + visual, three steps + visual). In the second and third tier (i.e., “do work” and “clean up”) independent communication remained stable at 100% of trials for all sessions across all three phases. Prompted communication was not needed in these tiers. Thus, independent communication was increased to 100% of all sessions across all tiers during the FCT + EXT + response chaining condition. A functional relation was found between the intervention (i.e., FCT + EXT + response chaining) and the increase in independent communication for Kaleb.
Interobserver Agreement

All sessions were coded and assessed for IOA. An agreement was defined as both observers recording the occurrence of the targeted communication (i.e., prompted and independent) and problem behavior for each trial during a five-trial session. Acceptable agreement criteria were 80% or above across all phases on the occurrence of communication and problem behavior and was calculated by dividing the number of agreements by agreements plus disagreements and multiplying by 100 (Kazdin, 2011). For Ryan, mean IOA across all conditions and tiers was (a) problem behavior = 99.6% ($SD = 0.9$; range = 98.4% to 100.0%); (b) independent communication = 99.6% ($SD = 0.9$; range = 98% to 100.0%); prompted communication = 99.6% ($SD = 0.9$; range = 98% to 100.0%). For James, mean IOA across all conditions and tiers was (a) problem behavior = 99.3% ($SD = 1.3$; range = 96.3% to 100.0%); (b) independent communication = 100.0%; prompted communication = 100%. For Kaleb, mean IOA across all conditions and tiers was (a) problem behavior = 98.1% ($SD = 2.7$; range = 91.7% to 100.0%); (b) independent communication = 99.9% ($SD = 0.2$; range = 99.9% to 100.0%); prompted communication = 100.0%. Interobserver agreement results are presented per condition across participants in Table 4-2.

Procedural Fidelity

Procedural fidelity was assessed using behavioral observation embedded on the data collection form and analyzed on a trial-by-trial basis during the intervention. To be considered a correct trial, the PI: (1) removed access to the designated reinforcer; (2) provided an appropriate verbal instruction that identified the desired communicative response; (3) delivered the appropriate delay to reinforcement (i.e., 0 s was used for the FCT + EXT trials and increased throughout the intervention) or response chaining
procedures; and (4) delivered the relevant consequence for 30 s following communication. Procedural fidelity was calculated as a percentage of correctly implemented steps per trial and then added together to determine the percentage of correct steps for the session. For Ryan, mean fidelity across all conditions and tiers was 97.7% ($SD = 2.6$; range = 92.0% to 100.0%). Agreement on fidelity was 98.7% ($SD = 1.1$; range = 97.5% to 100.0%). For James, mean fidelity across all conditions and tiers was 97.6% ($SD = 2.3$; range = 91.9% to 99.0%). Agreement on fidelity was 97.3% ($SD = 2.6$; range = 92.1% to 100.0%). For Kaleb, mean fidelity across all conditions and tiers was 98.6% ($SD = 1.3$; range = 97.0% to 100.0%). Agreement on fidelity was 98.1% ($SD = 1.2$; range = 97.3% to 100.0%). Procedural fidelity results are presented per condition per participant in Table 4-2.

**Social Validity**

Social validity data for the intervention were collected via a rating scale, adapted from Lloyd et al. (2015), from the caregivers after the completion of the study. All responses were rated on a scale of 1-6 and corresponded to questions about the acceptability (i.e., how comfortable the caregiver felt with the procedures of the intervention), authenticity (i.e., how closely the caregiver feels the intervention reflected a typical occurrence of problem behavior in the home), and importance (i.e., as the extent to which changes in child behavior were observed following the intervention). Results of the rating scale are presented in Table 4-3. All three caregivers strongly agreed that the intervention was acceptable and beneficial, and that they felt positive about the intervention for their child. All three also strongly agreed that their child’s behaviors were severe enough to warrant this type of intervention and that there were no negative side effects due to the intervention. Items that were rated slightly lower
included whether they would suggest this intervention to other caregivers \((M = 5.7)\) and if they felt other caregivers would find the intervention appropriate \((M = 4.7)\). James’ mother rated the intervention to be least like the a typical situation they would encounter in their home with a rating of 2 of 6, but the mean response across all three caregivers was 4.7 for this item.
Table 4-1. Summary of number of conditions and trials in the TBFA across participants

<table>
<thead>
<tr>
<th>Participant</th>
<th>Total # of trials</th>
<th>ATT</th>
<th>TAN</th>
<th>ESC</th>
<th>ESC/TAN</th>
<th>Total # of home visits</th>
<th>Total # of days</th>
<th>Total duration of TBFA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ryan</td>
<td>29</td>
<td>7</td>
<td>9</td>
<td>7</td>
<td>6</td>
<td>6</td>
<td>14</td>
<td>54 min 50 s</td>
</tr>
<tr>
<td>James</td>
<td>20</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>15</td>
<td>27 min 54 s</td>
</tr>
<tr>
<td>Kaleb</td>
<td>20</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>32</td>
<td>30 min 29 s</td>
</tr>
<tr>
<td>Jacob</td>
<td>20</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>50</td>
<td>34 min 7 s</td>
</tr>
</tbody>
</table>

Mean: 22.3 5.5 6 5.5 5.3 5 27.8 36 min 50 s  SD: 4.5 1.0 2.0 1.0 0.5 0.8 17.0 12 min 16 s

Note: ATT = attention; TAN = tangible; ESC = escape; ESC/TAN = escape to tangible
Table 4-2. Summary of IOA and fidelity across all phases and all participants during intervention.

<table>
<thead>
<tr>
<th>Material/Demand</th>
<th>Condition</th>
<th>Occurrence IOA (%)</th>
<th>Fidelity (%)</th>
<th>Fidelity Range</th>
<th>Fidelity IOA (%)</th>
<th>Average Session Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>PB</td>
<td>IND</td>
<td>PR</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ryan</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tablet</td>
<td>Baseline</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>96.7</td>
<td>95.0-100.0</td>
</tr>
<tr>
<td></td>
<td>FCT + EXT</td>
<td>100.0</td>
<td>98.0</td>
<td>98.0</td>
<td>100.0</td>
<td>95.0-100.0</td>
</tr>
<tr>
<td></td>
<td>FCT + EXT + Delay</td>
<td>98.4</td>
<td>100.0</td>
<td>100.0</td>
<td>98.4</td>
<td>90.0-100.0</td>
</tr>
<tr>
<td><strong>Trucks</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Baseline</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>92.0</td>
<td>85.0-100.0</td>
</tr>
<tr>
<td></td>
<td>FCT + EXT</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>99.2</td>
<td>95.0-100.0</td>
</tr>
<tr>
<td></td>
<td>FCT + EXT + Delay</td>
<td>97.8</td>
<td>100.0</td>
<td>100.0</td>
<td>98.9</td>
<td>90.0-100.0</td>
</tr>
<tr>
<td><strong>Blanket</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Baseline</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td></td>
<td>FCT + EXT</td>
<td>100.0</td>
<td>98.0</td>
<td>98.0</td>
<td>95.5</td>
<td>80.0-100.0</td>
</tr>
<tr>
<td></td>
<td>FCT + EXT + Delay</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>98.3</td>
<td>95.0-100.0</td>
</tr>
<tr>
<td><strong>James</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clean up</td>
<td>Baseline</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>96.7</td>
<td>95.0-100.0</td>
</tr>
<tr>
<td></td>
<td>FCT + EXT</td>
<td>99.2</td>
<td>100.0</td>
<td>100.0</td>
<td>98.5</td>
<td>80.0-100.0</td>
</tr>
<tr>
<td></td>
<td>FCT + RC</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>99.0</td>
<td>90.0-100.0</td>
</tr>
<tr>
<td><strong>Put away</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Baseline</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>98.6</td>
<td>90.0-100.0</td>
</tr>
<tr>
<td></td>
<td>FCT + EXT</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>97.7</td>
<td>85.0-100.0</td>
</tr>
<tr>
<td></td>
<td>FCT + RC</td>
<td>98.3</td>
<td>100.0</td>
<td>100.0</td>
<td>97.7</td>
<td>85.0-100.0</td>
</tr>
<tr>
<td><strong>Wash hands</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Baseline</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>98.9</td>
<td>90.0-100.0</td>
</tr>
<tr>
<td></td>
<td>FCT + EXT</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>99.0</td>
<td>95.0-100.0</td>
</tr>
<tr>
<td></td>
<td>FCT + RC</td>
<td>96.3</td>
<td>100.0</td>
<td>100.0</td>
<td>91.9</td>
<td>75.0-100.0</td>
</tr>
<tr>
<td><strong>Kaleb</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Take turns</td>
<td>Baseline</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td></td>
<td>FCT + EXT</td>
<td>96.7</td>
<td>100.0</td>
<td>100.0</td>
<td>98.1</td>
<td>80.0-100.0</td>
</tr>
<tr>
<td></td>
<td>FCT + RC</td>
<td>98.3</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Do work</td>
<td>Baseline</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>98.3</td>
<td>90.0-100.0</td>
</tr>
<tr>
<td></td>
<td>FCT + EXT</td>
<td>91.7</td>
<td>100.0</td>
<td>100.0</td>
<td>95.9</td>
<td>75.0-100.0</td>
</tr>
<tr>
<td></td>
<td>FCT + RC</td>
<td>98.2</td>
<td>100.0</td>
<td>100.0</td>
<td>98.6</td>
<td>95.0-100.0</td>
</tr>
<tr>
<td>Clean up</td>
<td>Baseline</td>
<td>100.0</td>
<td>99.4</td>
<td>100.0</td>
<td>98.8</td>
<td>95.0-100.0</td>
</tr>
<tr>
<td></td>
<td>FCT + EXT</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td></td>
<td>FCT + RC</td>
<td>97.8</td>
<td>100</td>
<td>100</td>
<td>97.8</td>
<td>90.0-100.0</td>
</tr>
</tbody>
</table>

*Note: IOA and fidelity were coded for 100% of all sessions. PB = Problem behavior; IND = Independent communicative response; PR = Prompted communicative response*
<table>
<thead>
<tr>
<th>Item</th>
<th>Ryan</th>
<th>James</th>
<th>Kaleb</th>
<th>Jacob</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>This was an acceptable assessment for my child.</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6.0</td>
</tr>
<tr>
<td>Most caregivers would find this assessment appropriate for their child's problem behaviors.</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>6</td>
<td>5.5</td>
</tr>
<tr>
<td>I would suggest the use of this assessment to other caregivers.</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6.0</td>
</tr>
<tr>
<td>My child's problem behavior is severe enough to warrant the use of this assessment.</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6.0</td>
</tr>
<tr>
<td>This assessment is NOT likely to result in negative side effects for my child.</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6.0</td>
</tr>
<tr>
<td>This assessment is a fair way to handle my child's problem behavior.</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6.0</td>
</tr>
<tr>
<td>I liked the procedures used in this assessment.</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6.0</td>
</tr>
<tr>
<td>Overall, this assessment was beneficial for my child.</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6.0</td>
</tr>
</tbody>
</table>

How similar was this trial to the event that your child typically encounters in your home setting?

- Attention trial 6 2 5 4 4.3
- Tangible trial 6 2 5 6 4.8
- Escape trial 6 2 6 5 4.8
- Escape to tangible 6 2 5 5 4.5
Table 4-4. Social validity results for the acceptability of the intervention.

<table>
<thead>
<tr>
<th>Item</th>
<th>Ryan</th>
<th>James</th>
<th>Kaleb</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>This was an acceptable intervention for my child.</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6.0</td>
</tr>
<tr>
<td>Most caregivers would find this intervention appropriate for their child’s problem behaviors.</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>4.7</td>
</tr>
<tr>
<td>I would suggest the use of this intervention to other caregivers.</td>
<td>5</td>
<td>6</td>
<td>6</td>
<td>5.7</td>
</tr>
<tr>
<td>My child’s problem behavior is severe enough to warrant the use of this intervention.</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6.0</td>
</tr>
<tr>
<td>This intervention is NOT likely to result in negative side effects for my child.</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6.0</td>
</tr>
<tr>
<td>This intervention is a fair way to handle my child’s problem behavior.</td>
<td>6</td>
<td>5</td>
<td>6</td>
<td>5.7</td>
</tr>
<tr>
<td>I liked the procedures used in this intervention.</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6.0</td>
</tr>
<tr>
<td>Overall, this intervention was beneficial for my child.</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6.0</td>
</tr>
<tr>
<td>I saw improvements in my child’s behavior after the intervention was used.</td>
<td>4</td>
<td>6</td>
<td>6</td>
<td>5.3</td>
</tr>
<tr>
<td>How similar was the trial component to the events that your child typically encounters in the home setting?</td>
<td>6</td>
<td>2</td>
<td>6</td>
<td>4.7</td>
</tr>
</tbody>
</table>
Figure 4-1. TBFA results for Ryan.
Figure 4-2. Rate of problem behavior for Ryan. Primary axis shows TBFA results. Secondary axis shows the rate of problem behavior per minute during each trial.
Figure 4-3. TBFA results for James.
Figure 4.4. Rate of problem behavior for James. Primary axis shows TBFA results. Secondary axis shows the rate of problem behavior per minute during each trial.
Figure 4-5. TBFA results for Kaleb.
Figure 4-6. Rate of problem behavior for Kaleb. Primary axis shows TBFA results. Secondary axis shows the rate of problem behavior per minute during each trial.
Table 4-7. TBFA results for Jacob.
Figure 4-8. Rate of problem behavior for Jacob. Primary axis shows TBFA results. Secondary axis shows the rate of problem behavior per minute during each trial.
Figure 4-9. Intervention results for Ryan.
Figure 4-10. Intervention results for James.
Figure 4-11. Intervention results for Kaleb.
CHAPTER 5
DISCUSSION

The purpose of this study was to examine the use of trial-based functional analysis (TBFA) in a home setting to determine the function of problem behavior in young children with or at risk for autism spectrum disorder (ASD). The occurrence of problem behavior during brief trials was recorded under multiple stimulus conditions. Function was determined using a within condition analysis of these trials to identify differentiation between the occurrence of problem behavior in test segments when compared to the control segments. The results of the TBFA were then used to develop and implement a functional communication training (FCT) intervention to decrease problem behavior and increase functional communication. This chapter includes an overview and interpretation of the findings, implications of the study for research and practice, limitations, and recommendations for future research.

Overview of the Findings

TBFA in a Home Setting

The first research question addresses whether function of problem behavior can be determined using a TBFA conducted in the home with young children with or at risk for ASD. In this current study, at least one function of problem behaviors across all four participants was determined using the TBFA in the home. Thus, presenting FA conditions (e.g., tangible, attention, escape) in brief trials (i.e., 60 s segments) of the control-test sequence in a home setting resulted in the clear differentiation between the segments to determine the function of problem behavior. For two of the participants, Ryan and Jacob, results of the TBFA indicate that problem behaviors were maintained by a tangible function. For the other two participants, James and Kaleb, results of the
TBFA indicate that problem behaviors were maintained by both tangible and escape functions.

The procedures of the TBFA and analysis of the data have some significant findings. First, the use of the pre-assessment component (i.e., two caregiver interviews and a descriptive observation) was an effective method for selecting TBFA conditions that could be feasibly implemented in the home to determine the function of problem behaviors for young children with or at risk for ASD. Second, the decision to vary the number of trials per condition based on response differentiation rather than a predetermined number of trials yielded important findings about how many trials are necessary to determine function. Function was determined for three of the four participants in five trials per condition which is half the number of trials typically included in a TBFA (Rispoli et al., 2014). For Ryan, additional trials were needed, however, no condition required more than nine trials which is still less than the ten that are typically used. Next, the within-condition analysis was a departure from traditional analysis of TBFA and offers a more specific analysis of how behaviors were occurring during the analysis. Finally, the inclusion of the measure of the rate of problem behavior during the TBFA offers some additional information about patterns of behaviors as they occurred during the TBFA.

**Functional Communication Training**

The second research question addressed whether using the results of the TBFA to develop a FCT intervention can produce a decrease in problem behavior and increase in functional communication. Specific interventions varied across participants relative to the function of behavior identified during the TBFA and to the tangible items or demands associated with problem behavior. Results of the intervention show all three
participants who received the intervention demonstrated a decrease in problem behavior from 100% of trials to 0% of trials and an increase in the use of functional communication. Thus, a functional relation between the FCT intervention developed based on the TBFA results and the decrease in problem behavior was found in each individual study (i.e., three tiers per participant) and replicated across the three participants. In addition, a correlation between the FCT intervention and an increase in the use of functional communication was found in each individual study and replicated across the three participants.

The interventions in this present study also expanded upon the FCT literature. First, Ryan’s intervention included a delay to reinforcement following the training of the functional communication response. The delays were implemented systematically and gradually to ensure success in tolerance of the delays. More specifically, instead of providing a delay in all of the trials, the design to systematically include the delays in 20, 40, or 60% of the trials was successful in training tolerance of the delay over time. In addition, the intervention implemented with James and Kaleb expanded upon the work of Lalli, Casey and Yates (1995) to develop an intervention that would address more than one function using FCT and response chaining. More specifically, while Lalli et al. focused on only escape behaviors, the intervention for both James and Kaleb included first an intervention to address the tangible function (i.e., how to request for a preferred tangible item) before implementing an intervention to increase compliance with demands. The findings from this study support the use of these procedures to target problem behaviors that are multiply maintained by tangible and escape functions.
Caregiver Social Validity

The third research question addressed the caregivers’ perception of the utility and feasibility of the TBFA procedures. Overall, social validity data show that the caregivers found the TBFA to be an acceptable method for analyzing their child’s problem behavior in the home. More importantly, the caregivers agree that their child’s problem behavior was severe enough to warrant the use of the TBFA, the TBFA did not result in negative side effects, and the TBFA proved to be beneficial to their child. These positive results for the acceptability of the TBFA support the findings from other research using TBFA in which individuals in the natural environment who either observed or conducted the TBFA found the procedures useful and appropriate for analyzing behaviors (e.g., Lloyd et al, 2014; Gerow et al., 2018).

Interpretation of the Findings

TBFA in a Home Setting

These results contribute to a small, albeit growing body of literature of studies using TBFA in natural settings. Unlike most of the TBFA literature that has been conducted in settings such as schools or residential placements (Rispoli et al., 2014), four applications of the TBFA were examined in home settings in this current study. Gerow et al. (2017; 2018) are the only published applications of the use of TBFA in a home and thus, additional examinations of TBFA in this setting was warranted. Although this finding supports the use of TBFA in the home, several additional factors are important to discuss. This section will provide a discussion of the findings within the context of the implementation of the TBFA and methodological considerations.

Number of trials. For this current study, a guideline for the minimum number of trials per condition in the TBFA and the potential for the total trials to vary across
participants and conditions was decided a priori. The number of trials conducted is significant since, based on previous research, one benefit of the TBFA is that it might potentially limit the time (e.g., duration of the analysis, number of visits needed) needed for implementing the procedures. More specifically, the number of sessions where a child is exposed to reinforcing contingencies for the problem behavior is limited (Bloom et al., 2011). To conduct a TBFA that was both accurate and efficient, for this present study the minimum number of trials per condition was set at five to allow for a pattern to be established within the data but limit the number of required trials. After five trials were presented, the data were examined for differentiation between test and control segments. For three of the four participants, only five trials were sufficient to establish a pattern of responding that included clear differentiation between the test and control segments.

Ryan’s TBFA required more than five trials due to non-responding in all conditions initially and warrants discussion. One explanation for Ryan’s initial non-responding might be that the agent implementing the procedures was a novel person (i.e., the PI), as researchers have found that outcomes of FAs might differ depending on if the agent is familiar to the participant (English & Anderson, 2004; Huete & Kurtz, 2010). While a novel person is a potential limitation to this present study, Ryan’s problem behavior did occur in the 10th and 11th trials and a pattern of differentiation was found in the tangible and escape to tangible conditions for all remaining trials. These findings are consistent with the findings of Thomason-Sassi, Iwata, and Fritz (2013) who found that after initial non-response in a therapist implemented FA, continued exposure to the FA contingencies resulted in a gradual emergence of problem behavior. Thus, in
Ryan’s TBFA, extended exposure was sufficient in determining function in a TBFA conducted by a novel person. In Ryan’s TBFA, the number of trials ranged from six (i.e., escape to tangible) to nine (i.e., tangible). To that end, while the TBFA required more trials than the minimum (i.e., five), less than 10 trials per condition were needed to identify the function of Ryan’s problem behavior.

These findings are significant because in the TBFA literature the most common number of trials per condition was 10, but variable across the studies (Rispoli et al., 2014). With the exception of Lloyd et al. (2015), researchers typically did not provide a rationale for the number of trials per condition and the number seems either arbitrary or based on previous studies. Lloyd et al. (2015) varied the number of trials across conditions and determined function based on criteria for differentiation between test and control segments. Hence, the findings of this study support Lloyd et al. (2015)’s use of varying numbers of trials per condition and response differentiation to determine function. Since function can be determined in as few as 5 trials, as it was in this present study, this would potentially lessen the time needed to conduct the analysis and expose children to reinforcement of problem behavior.

**Use of combined conditions.** Caregivers for all participants indicated during the pre-assessment interviews that giving their child the demand to “clean up” often evoked problem behavior. The specific demand of “cleaning up” involves two potential EOs for problem behavior: (1) presentation of a demand, and (2) removal of a highly preferred tangible item. Consequently, a decision was made to include a combined condition (i.e., escape to tangible) in all four participant’s TBFA to examine whether presenting both EOs is necessary to evoke problem behavior. A decision was made to ensure that both
single contingencies in the combined condition were also included in the TBFA. The rationale for this was to examine if one of them was influencing the problem behavior more than the other.

James and Kaleb both demonstrated problem behaviors in three of the conditions: tangible, escape, and escape to tangible. From these results, it was determined that the behaviors were multiply maintained by a tangible and escape function. In other words, the behavior is just as likely to occur when a highly preferred tangible is removed as it is when a demand is presented. The combination of the two conditions did, in fact, evoke problem behavior but results did not support that the presence of both EOs simultaneously was necessary. Ryan and Jacob both demonstrated problem behaviors in two conditions: tangible and escape to tangible. Neither of these participants demonstrated problem behavior in the escape condition. From these results, it was determined that the behaviors were maintained by a single tangible function. Since behaviors did not occur in the escape only condition, it could be determined that the removal of the tangible was essential for the occurrence of problem behavior.

Although the combined condition was perhaps more consistent to what might occur in the natural setting (e.g., a child typically escapes to something whether it be to a tangible or for attention when not complying with a demand), the use of the combined condition in the TBFA is not supported by the outcomes of this study for two reasons. First, the information about the function of the behavior for all four participants would have been the same had the combined condition not been included in the analysis. The only situation in which the combined condition might be advantageous, would be if
problem behavior was not observed in any of the single contingencies (i.e., tangible or escape). In this scenario, it might be determined that problem behavior is only evoked when the two conditions are presented simultaneously. Since this was not the case for the participants in this study, the use of the single contingencies would have been sufficient to determine function. Second, the TBFA could have been shortened if escape to tangible was not included. Given that one of the potential benefits of the TBFA is to shorten the FA process, the inclusion of an additional condition (i.e., escape to tangible) that did not lead to any further information about the function of the behavior only lengthened the analysis unnecessarily.

These results are support the findings of Fisher, Greer, Romani, Zangrillo and Owen (2016) in which comparisons were made between FAs using combined conditions and traditional FAs with single contingencies. In this study, four of the five participants showed response patterns in individual conditions consistent with the traditional FA. In fact, results from the analysis that used combined conditions included one functionally irrelevant condition for two participants and two functionally irrelevant conditions for the others (Fisher et al. 2016). In this present study, responding in both Ryan’s and Jacob’s TBFA might have resulted in erroneously identifying escape as a function had the single conditions not be included in the analysis.

**Rate of problem behavior.** The rate of problem behavior during the TBFA was reported as a descriptive analysis and did not inform the determination of the function of behavior. Nonetheless, findings from these data might offer insight into methodological considerations for the TBFA and to the examination of the development and maintenance of behavioral contingencies, especially in young children. The rate of
problem behavior across trials during the TBFA was analyzed for each of the participants. All participants had at least one condition where problem behavior decreased as more trials were presented. This pattern of responding might indicate that as exposure to the contingencies of the TBFA, the participants were becoming more efficient with their responding (e.g., one instance of problem behaviors will result in the desired reinforcer). Conversely, all patterns were observed in these data (i.e., accelerating, decelerating and stable) which does not lend itself to interpretation and implications.

Several studies have examined within-condition responding (Kahng & Iwata, 1998; Marcus, Vollmer, Swanson, Roane, & Ringdahl, 2001; Roane, Lerman, Kelley, & Van Camp, 1999; Vollmer, Iwata, Zarcone, Smith & Mazaleski, 1993). Rate of problem behavior might be a useful supplement to the FA. That is, higher rates of problem behavior in certain conditions might potentially indicate which specific EOs (i.e., conditions) result in increased motivation for problem behavior (Roane et al., 1999). In a study conducted by Marcus, Vollmer, Swanson, Roane, and Ringdahl (2001), rates of problem behavior (aggression) during a traditional FA actually increased within conditions. These researchers posited that the repeated exposure to the condition (i.e., repeatedly taking away the item) inflated the rate of problem behavior. While examining the effect of time in session on the rate of problem behavior, Smith, Iwata, Goh, and Shore (1995) found that it was possible to observe a variable pattern of responding over time even when the reinforcing contingencies are remaining constant. These variable findings are consistent with the findings of the present study. Examining data patterns using rate of problem behavior should be explored more in future research.
**Order of segments.** The trials of the TBFA in this study were presented in a control-test sequence whereas a test segment began following the completion of the control segment. The order of segments has been addressed in the TBFA literature since initial studies (e.g., Sigafoos & Saggers, 1995) presented the segments in the opposite order. Bloom and colleagues (2011) reversed the segments and examined the impact on behaviors that occurred in a pre-control and post-control segment. These researchers found that there was more responding (i.e., problem behavior) recorded in the post-control segments when compared to the pre-control segments for half of the participants. Since then, other studies that have used a control-test sequence (Austin et al., 2015; Bloom et al., 2013; Flynn & Lo, 2016; Lambert et al., 2012; Rispoli et al., 2015). Nevertheless, researchers have been conducting the TBFA using both approaches and the literature is not consistent with this methodological aspect of conducting the TBFA (Rispoli et al. 2014).

In this present study, rate of problem behavior was recorded following the initial occurrence in the trial (i.e., the occurrence of behavior that ended the segment) and continued until behaviors ceased for at least 5 s. In other words, for all participants, in some of the trials, problem behaviors did not immediately cease once the reinforcer was delivered during the test segments. This is significant because if a control segment were to follow the test segment, the potential for carryover behaviors could be problematic (e.g., there may be problem behavior in the control segment that was a result of carryover from the test). In this study, the number of trials with more than one instance of problem behavior during a test segment was two trials, seven trials, four trials, and five trials for Ryan, James, Kaleb and Jacob, respectively. More specifically, there could
have been potential to record problem behaviors in a post-control segment during these trials that would have been the result of carryover. Thus, examination of the rate of behavior during the TBFA provides additional support for the presentation of the control segment before the test segment.

**Summary.** In summary, the use of TBFA in the home setting is both a feasible and an acceptable variation to traditional FA procedures for identifying the function of problem behavior in young children with or at risk for ASD in a home. In addition to providing four applications of TBFA procedures in the home, the findings of this present study also offers additional information regarding procedural considerations that contribute to the TBFA literature. First, function was determined with fewer than ten trials per condition which supports the use of response differentiation rather than set numbers of trials. Second, the use of combined conditions in any FA is not supported by the findings of this study. Next, measurement of the rate of problem behavior might offer additional insight into the way in which behaviors are reinforced and maintained throughout analyses and interventions. Finally, examination of rate of behavior offers support for the implementation of a control-test sequence during TBFA to limit the possibility of carryover effects.

**Functional Communication Training**

The results of this present study lend themselves to an examination of several lines of behavioral research that might help in interpreting the findings. First, a discussion on the impact of delay to reinforcement is discussed. Second, responding during both experimental conditions (i.e., FCT + EXT and FCT+ EXT + delay to reinforcement [Ryan] or response chaining [James and Kaleb]) in all participants might be explained by the behavioral research on impulsivity and self-control. Third, a
discussion on the use of continuously signaled versus briefly signaled delays to reinforcement is relevant to the results of both Ryan and Kaleb. Next, the use of response chaining as a strategy for both delaying reinforcement and increasing compliance is discussed in regards to James and Kaleb’s results. Finally, the impact of preference and choice on the results of the intervention for all participants is presented.

**Delay to reinforcement.** As was the case for this present study, FCT interventions typically involve a continuous schedule of reinforcement where the reinforcer is delivered contingent upon every instance of functional communication (Carr & Durand, 1985). While necessary to establish the response-reinforcer contingency, the delivery of a reinforcer on this dense schedule is often problematic to caregivers in a natural setting when the functional communication response may not practically be reinforced. This might occur in situations where the reinforcer is simply unavailable, the reinforcer is not appropriate for the time or setting, or the request for a reinforcer occurs more often than a caregiver can feasibly deliver (Fisher, Thompson, Hagopian, Bowman, & Krug, 2000). Moreover, especially for young children, individuals in the natural environment might not necessarily have been taught to provide the reinforcer and resurgence of problem behavior might be observed during periods of nonreinforcement (Volkert, Lerman, Call, & Trosclair-Lasserre, 2009).

For Ryan, the delay to reinforcement was programmed by systematically increasing the time between the functional communication response and the delivery of the reinforcer. Results from Ryan’s intervention show that delays of 3 s to 20 s can be programmed with no occurrence of problem behaviors. For James and Kaleb, the delay to reinforcement was programmed by increasing the compliance requirements
necessary to gain access to the tangible item again. Results from this intervention show that in the case where problem behavior is maintained by both access to tangible items and escape from demands, by gradually increasing the number of required steps needed to complete a demand following the removal of a tangible item, problem behavior can be decreased to zero.

**Impulsivity and self-control.** Behavioral research on impulsivity and self-control might be helpful in interpreting the findings. Impulsivity is defined as a response that occurs to access a small, yet immediate reinforcer at the expense of access to a longer, yet delayed reinforcer (Vollmer, Borrero, Lalli, & Daniel, 1999). Conversely, self-control is defined as choosing to access a longer, yet delayed reinforcer over a smaller, immediate reinforcer (Dixon et al., 1998). The line of behavioral research investigating impulsivity and self-control spans both basic (i.e., laboratory experiments with non-human participants) and applied research (Dixon et al., 1998; Stromer, McComas, & Rehfeldt, 2000; Vollmer et al., 1999).

For James and Kaleb, initial onset of the FCT + EXT intervention still produced demonstrations of problem behavior as training of the functional communication response was implemented. Although an initial 0 s prompt delay was implemented (i.e., the prompt was delivered immediately following the removal of the tangible) and conceptually the prompt should eliminate the opportunity to engage in problem behavior, the occurrence warrants some explanation. For both of these participants, the removal of the tangible item alone was enough to evoke an immediate occurrence of problem behavior (e.g., screaming) before either the demand was presented or the prompt delivered. In James’ intervention, an initial high occurrence (60%-80% of trials)
of behavior in the first tier was observed before problem behaviors reduced to zero. In Kaleb’s intervention, a decision was made to combine the removal of the tangible and the presentation of the demand in the second tier in order to shorten the prompt for functional communication. This was done because the problem behavior was occurring on the onset of the trial (i.e., the removal of the tangible item) without allowing for the prompt to be delivered. This change in the intervention procedures was successful in both being able to deliver the prompt as intended and decreasing the occurrence of problem behavior.

The similarity between the characteristics of these two participants (James and Kaleb) and their responding in the initial phase of the FCT + EXT intervention is interesting. Both James and Kaleb demonstrated a similar topography of behavior (i.e., screaming) and initial levels of verbal behavior (i.e., use of phrases and sentences to communicate wants and needs). Conversely, in the initial FCT+ EXT phases for Ryan, prompted communication was delivered via a physical prompt of the picture communication card and problem behaviors were typically demonstrated using his arms and legs (i.e., aggression or destruction). A physical prompt for Ryan might have blocked the ability to engage in the problem behavior and the prompt was able to be delivered. Thus, results of this present study suggest that the propensity to initially engage in problem behavior rather than functional communication (i.e., impulsivity) for all of these participants might have been influenced by the topography of the behavior (e.g., vocally emitting a scream versus physical contact), history of reinforcement (Dixon et al. 1998; Ferster, 1958) or levels of verbal behavior (Schwietzer & Sulzer-Azaroff, 1988). Dixon and colleagues (1998) suggest two strategies that are supported in the
literature to decrease impulsivity and increase self-control: (1) programmed delays that are gradually introduced and (2) requirement of an individual to complete an activity (e.g., compliance with a demand) during the delay period.

**Continuously signaled versus briefly signaled delays.** As previously described, the need to thin the reinforcement schedule following an FCT intervention is important given the availability or non-availability of reinforcers in the natural setting (Fisher et al., 2000). Based on pre-assessment measures, Ryan’s mother indicated that problem behaviors often occurred when Ryan was told to wait for a preferred tangible item or activity. During the FCT + EXT + delay to reinforcement condition, results showed that Ryan tolerated a delay in the delivery of the tablet up to 3 s without engaging in problem behaviors. When the wait time increased to 10 s, however, there was an occurrence of problem behavior in every trial that contained the delay. Thus, the change in intervention was a shift from a briefly signaled delay (i.e., vocal prompt to “wait”) to a continuously signaled delay (i.e., use of visual timer) in the tablet tier. Introduction of the timer resulted in decrease in problem behaviors to 0% of trials for 10 s and 20 s. An interesting finding in Ryan’s intervention was that following the use of the continuously signaled delay in the first tier, shortening the gradual increases in delay (i.e., an increase from 3 s to 5 s rather than 3 s to 10 s), to reinforcement in the other two tiers was tolerated with only the briefly signaled delay. These results support previous assertions made by Vollmer et al. (1999) that specific parameters of the delay might be manipulated to produce impulsivity or self-control. Thus, in Ryan’s case, initial problem behavior in the 10 s delay may have been maintained by impulsive behavior and subsequent manipulation of the parameters of the delay (e.g., continuously
signaled, shorten the length of increases) were needed to decrease the problem behavior.

A similar pattern of responding was observed in the first tier of Kaleb’s intervention (i.e., “take turns”) when the second step of the response chain (i.e., share the Kindle® and allow access for 5 s) was implemented. Essentially, in requiring that Kaleb share the Kindle® for an extended time, a delay to the reinforcer was being instated. During initial sessions, the functional communication response was emitted but when not immediately reinforced, problem behavior was observed. A decision was made to change the intervention and use a continuously signaled delay during the “take turns” tier. Results indicated that problem behavior immediately returned to 0% of trials with the use of the timer and occurrence of problem behavior remained stable at 0% of trials during an increase in the length of the wait time. In Kaleb’s intervention, the nature of the demand (i.e., wait for his turn again) was problematic without the continuously signaled delay. Since the other two demands in his intervention required a response during the delay, it is not clear if similar patterns to Ryan (e.g., other tiers only need a briefly signaled delay) might have been observed. Future research might examine this further.

**Increasing compliance with response chaining.** Two of the participants, James and Kaleb, were first taught to request continued access to their preferred tangible item (i.e., Kindle®). The second condition of the intervention was focused on increasing the work requirements associated with the specific demand for that tier. These procedures were modified from those of Lalli et al. (1995) and provided two examples of how one might develop an intervention that addresses behaviors that are
multiply maintained by both escape and tangible functions. Although in both participants, there were increases in problem behaviors with the introduction of this condition, both interventions were successful in decreasing the problem behaviors of the two participants to 0% of trials.

**Preference and choice.** Preference and reinforcer value have been the focus of several conceptual frameworks (e.g., matching law, behavioral economics) and evidence from both applied and basic research indicate that preference is contextually dependent and does not retain constant properties of the stimuli (Hoffman, Samaha, Bloom, & Boyle, 2017). In fact, the value of a specific reinforcer can vary as a function of item type and duration of access (DeLeon et al., 2014; Hoffman et al., 2017). These two variables will be discussed as they relate to the results of this present study.

In Ryan’s intervention three tangible items were chosen based on the mother’s report of preference and behavioral observation of interactions with tangible items in the home setting. Although initially, all three items (tablet, trucks, and blanket) were highly reinforcing items, the preference for the tangible items changed over the course of the intervention. This was particularly true for the reinforcing value of the blanket as the intervention progressed. After the initial two baseline sessions in the blanket tier, four additional visits were made to the house where a baseline session with blanket could not be conducted because of a refusal to interact with the item. This pattern continued as most visits where multiple sessions could be run in the other tiers, only one session was possible with the blanket before Ryan would refuse the item when it was presented for the pre-session exposure. The decision to discontinue the FCT+EXT+ delay to
reinforcement was made due to preference changes and sessions were not run with longer than a 3 s delay to reinforcement.

One explanation for this change in preference might be attributed to the type of item. There are qualitative differences between items of different technological sophistication. More specifically, items that would be consider high-tech, such as computers or tablets, can be highly engaging and present changing stimuli (e.g., can choose a different game or activity). Conversely, items that would be considered low-tech, such as the trucks and blanket in Ryan’s intervention, are static in nature and can only change in predictable ways if they change at all (Hoffman et al., 2017). Findings from a study conducted by Hoffman and colleagues (2017) found that initial value of low-tech items might be considered high but that the value decreases the longer the tangible item is available (i.e., responding decreases). Conversely, the findings suggest that value of high-tech items might increase the longer the tangible item is available (i.e., as evidenced by increasing trends in responding).

The type of tangible (i.e., tablet) also might explain variability in the intervention data for James and Kaleb. As previously discussed, both participants demonstrated problem behaviors during the initial FCT + EXT sessions (i.e., first condition). James also demonstrated problem behavior in the first phase of the FCT + EXT + response chaining condition. All sessions for the intervention included removal of the item and brief access (approximately 30 s) contingent on functional communication. In this design, the continuity of the access might have contributed to the demonstrations of problem behavior when the intervention was first introduced. In other words, interrupting and reinstating a reinforcer such as a tablet requires the participant to reorient to the
tablet when it is returned (DeLeon et al., 2014). Interrupting the continuity of the reinforcer might potentially also alter the quality of the reinforcer and decrease its value (DeLeon et al., 2014).

**Implications of the Present Study**

The number of studies conducted using TBFA have been increasing since 2000; however, the body of literature is still relatively small compared to the overall FA literature. There continues to be a need for additional demonstrations of the procedures to refine the methodology. This present study contributes to the literature by demonstrating the feasibility of using TBFA to determine function of problem behavior of four young children with or at risk for ASD in a home setting. While there have been numerous studies that demonstrated the use of TBFA in schools, only two studies (Gerow et al. 2017; Gerow et al., 2018) have used TBFA in homes. This section will discuss the methodological implications and the practical implications.

**Methodological Implications**

This study contributes to the literature from a methodological perspective. First, several modifications to traditional TBFA procedures were needed to be made in order to maintain experimental control in the home setting. Decisions about the modifications were made a priori and contributed to the feasibility of using the procedures in a setting where some environmental stimuli might not be able to be controlled. Second, the visual analysis of the data was modified to provide a trial by trial analysis of behavior within a condition rather than analyzing across conditions. In the previous literature, TBFA data has been summarized using bar graphs depicting the percentage of trials with target behavior (Sigafoos & Saggers, 1995). While this method gives an overall picture of the occurrence of behavior during the TBFA, the focus is a comparison across conditions.
This present study was designed to shift the comparison to within conditions and allow for a closer examination of the differentiation between test and control segments within each condition. This nuanced approach to the interpretation offers more information about patterns of behaviors within the TBFA than would be obtained from analyzing using cumulative bar graphs. Finally, examining rate of behavior during the TBFA provides support for the control-test order of segments within a trial during the TBFA.

**Practical Implications**

Problem behaviors can have a negative impact on both children with ASD and their families (Horner et al., 2002; National Research Council, 2001). Children who demonstrate problem behaviors are at a disadvantage for engaging in positive social interactions and receiving necessary academic and adaptive interventions (Powell, Dunlap, & Fox, 2006). Early intervention is important since problem behaviors maintained by their functional effect on the environment are not likely to decrease without interventions that specifically target the function (Horner et al., 2002). Thus, this present study has practical implications as it provides evidence that the identification of the function of problem behaviors in young children with or at risk for ASD can be conducted in the natural home setting.

This present study was conducted within a behavioral framework in which analytic procedures (i.e., traditional FA) that are typically conducted in a controlled setting (i.e., clinic) were conducted in an applied setting (i.e., child’s home). The conceptual framework for this study posited that there might be contributions from two conceptual models of the fourth term in the behavioral contingency that influence behaviors: setting factors and motivating operations. More specifically, the setting for this study (i.e., home) could be considered a concurrent setting factor that influences
behavior by affecting the interaction between a particular SD and its related consequence (Whaler & Fox, 1981). This framework also suggested that the home setting might indirectly influence the MOs that are available in that particular setting.

Situating the assessment of problem behavior for young children with or at risk for ASD in their natural environment has several potential benefits. First, conducting an analysis in the home helps to identify any constraints or available resources which might impact the feasibility and practicality of an intervention (Bernheimer & Keogh, 1995). Second, it might also ensure that the subsequent intervention is compatible with ongoing family practices for the young child with ASD (Moes & Frea, 2000). Finally, conducting the TBFA in the home ensures that there are a sufficient number of stimuli components in common in both the analysis setting and the intervention setting, which in turn promotes generalization of the effects (Stokes & Baer, 1977).

Second, a key implication of the findings of this study is that function can be determined with as few as five trials per condition, limiting how much a behavior needs to be reinforced during the analysis. This is significant for practical reasons since children who demonstrate severe problem behaviors have been linked to increases in family stress (Tudor & Lerner, 2015) and evoking these behaviors more than is necessary in the home could be stressful for the family. Determining function with as few trials as possible might potentially increase the social validity of the procedures.

Third, some practical guidelines to the TBFA procedures were developed to aid in the implementation in the home setting. The home offers a unique setting whereas environmental factors might be more difficult to control when compared to a clinic or even a school (e.g., structured activities). Thus, the findings of this present study
indicate that some environmental arrangement might be necessary (e.g., restricted access, arranging of routines) in order to conduct the TBFA in the home. For example, the guidelines around implementing more than one trial in a row of a specific condition help to ensure that unnatural transitions in the home routines are not necessary. More specifically, if each TBFA condition requires different routines, allowing several trials to be conducted in one condition before transitioning might potentially reduce the time needed to conduct the TBFA and reduce the probability that a problem behavior might occur during the transition.

Next, although Gerow et al. (2018) provided evidence that caregivers can be trained to implement the TBFA with fidelity, findings from this present study suggest this might not be necessary. At least one function was determined for each of the participants in this study and a function-based intervention was successful in decreasing the problem behaviors of all those who received the intervention. Thus, a functional relation between the intervention developed from the results of a home-based TBFA implemented by a novel person and a decrease in problem behavior was found. It might be more important to train early interventionists in conducting the TBFA as these professionals would potentially have a background in behavior analytic procedures. As Hanley (2012) suggests, the process of conducting a complete functional assessment (e.g., interviews, observation, experimental design, data analysis) requires a skill set that people not trained in ABA (e.g., caregivers, family members) would possess. To eliminate the time it might take to train one caregiver to implement a TBFA, training early interventionists to conduct TBFAs would have benefits for all the children that the interventionist services. An early interventionist who delivers services in the home (e.g.,
typical for young children under the age of 5) might not have access to a controlled clinical setting. Conducting a TBFA in a home setting might be the best way to determine the function of the behavior experimentally while embedding the analysis into the setting where intervention will occur.

Finally, consideration should be made for the use of TBFA and its appropriateness for all children. Although the social validity results of this present study indicate an overall satisfaction for the TBFA process, extensive exposure to FA conditions might seem counterintuitive to a caregiver who does not have experience with the science behind the procedures (Hanley, 2012). For this particular study, especially in the case of Jacob, the length of time (i.e., calendar days) it took to conduct the analysis might seem excessive to a caregiver looking more for an intervention than an analysis. It is suggested that there might be some children for whom a traditional, clinical FA might be more appropriate and that future research should examine this more closely.

**Recommendations for Future Research**

Overall, the findings of this present study suggest that TBFA can be implemented in the home setting for young children with or at risk for ASD and thus, some recommendations for future research are proposed. First, additional replications of these procedures using the suggested modifications should be implemented. The use of TBFA in research is growing, but the small number of studies that have used the procedures in the home setting lends itself to further examination. To that end, it would be beneficial to conduct comparison studies between traditional FAs conducted in a clinic and TBFAs conducted in the home, similar to the comparison studies between clinics and schools (e.g., Bloom et al., 2011; LaRue et al., 2011; Rispoli et al., 2013).
these studies, the overall conclusion was that TBFA can produce similar outcomes when compared to traditional FA procedures. In some cases, researchers found that the TBFA was more efficient in capturing variables that contribute to the identification of function in the natural setting when compared to the traditional FA (Rispoli et al., 2013). Given these findings, comparison studies between clinic and home are necessary to examine the outcomes and the efficacy of the home-based TBFA.

Second, the practical implications of the findings indicate that the use of a familiar person might not be necessary to determine function of the behavior which would, in turn, limit the need to train family members to implement the procedures (e.g., shorten the time needed to conduct the TBFA by eliminating the training). Comparison studies, such as those described above, might be conducted that compare the TBFA conducted by a novel person to a TBFA conducted by a familiar person (e.g., caregiver, family member). Moreover, training early interventionists to implement the TBFA in the home would be beneficial. Practitioners trained in behavior analytic procedures would benefit from conducting assessments in the same environments in which they will implement interventions.

Third, future researchers should examine whether TBFA is an appropriate analysis for all young children or if there are certain characteristics (e.g., child, family, home) that might establish whether the TBFA would be successful in determining a function. To do this, additional replications across a larger sample might help identify characteristics of participants for whom TBFA would be appropriate and those for whom a traditional FA conducted in a clinic might be more efficient. Moreover, further
examination of family characteristics or environmental arrangements in the home might provide additional information about the efficacy of the TBFA procedures.

Next, further examination of the visual display for the TBFA should be conducted. The data in this present study was presented in an alternative format for reporting the results of the TBFA when compared to other TBFA studies (e.g., Sigafoos & Saggers, 1995; Bloom et al., 2011). Data from the trials of other TBFA studies have been presented in a cumulative bar graph that shows the percentage of trials with problem behavior per condition. The alternative use of a cumulative frequency graph in the present study shows patterns of response within the condition across trials. The utility of presenting data in this fashion should be explored.

Finally, future researchers should continue to examine the rate of problem behavior during TBFAs. For example, researchers can investigate patterns of problem behavior to identify if continued exposure to the conditions lead to an increase in the rate of problem behavior over the course of the TBFA. Alternatively, a child might become more efficient in responding the more the contingencies are presented and thus rate of behavior may decrease. Future studies could potentially identify if these patterns differ based on child characteristics (e.g., age, level of verbal behavior, intellectual ability) or topography of behavior.

**Limitations**

This study is not without limitations. First, the restricted age range (i.e., ages 3 – 5 yrs) restricts the applicability of the findings to a small population of individuals with or at risk for ASD. Generalizability to other ages and disabilities should be done so with caution. Second, some idiosyncratic variables might have been missing from the TBFA as the analysis was conducted by a researcher and not a typical person in the child’s
environment. For example, the attention of a specific person might have altered the outcome for the attention condition whereas none of the participants demonstrated behaviors in that condition. Third, to that end, the social validity reports are limited to the extent to which the caregiver was familiar with the procedures of the TBFA. While every effort was made to keep the caregivers informed (e.g., caregiver meetings prior to TBFA and intervention), there is a potential that caregivers not familiar with behavioral procedures were not aware of the significance. Social validity was also limited to the rating scale provided to the parents. An interview or anecdotal records might have been more beneficial to capturing the insights of the caregivers. Next, for the intervention, the criteria for moving to a new phase might have been too strict which resulted in extended time needed for the intervention. While requiring zero levels of behavior is ideal, it might not be able to maintained following the removal of the intensive intervention sessions. Finally, the absence of formal maintenance data is a limitation to this study.

**Conclusion**

Previous researches have examined the utility of TBFA as a variation to traditional FA procedures in the natural environment (Rispoli et al., 2014). The ability to embed short trials for the analysis into ongoing routines in the natural environment makes the TBFA a feasible alternative to conducting a FA in a highly controlled setting. To date, only two studies (e.g., Gerow et al., 2017; 2018) have examined the use of TBFA in home settings and further research was warranted. This current study offers four replications of the TBFA in home settings with young children with or at risk for ASD. At least one function was determined for each of the four participants using the TBFA making it an effective way to analyze problem behavior in that environment. Moreover, methodological considerations for TBFA are discussed and experimental
support is provided for considerations of number of trials needed per condition and the order of the control-test sequence. Moreover, a FCT intervention was implemented for three of the four participants based on the results of the TBFA. Functional relations were found between the intervention and the occurrence of problem behavior and communication in all participants. In other words, the FCT intervention developed based on the TBFA conducted in the home was responsible for a decrease in problem behavior and an increase in functional communication across participants.
Phase 1: Initial Search & Screening (Titles and Abstracts)

Research Questions

1) What functional analysis approaches have been evaluated in the natural environment for young children with autism spectrum disorders?
   a. To what extent have these approaches identified one or more functional relations and informed a function-based intervention?

2) To what extent have these approaches aligned with recommendations to address practical implementation barriers of the process in a natural environment?

Database search

The following databases are searched using the included search strategy that includes key words for participant, functional assessment, intervention, and outcomes: PsycInfo, ERIC, Academic Search Premier, and MEDLINE. The initial search is exported from the databases to EndNote. Titles and abstracts are screened through this program and sorted into a “possible inclusion” folder if they meet the initial criteria below.

The search is limited to peer-reviewed empirical articles from 1982 to present. The limit on the date was determined from the date the methodology was first described by Iwata and colleagues.

Screening Inclusion/Exclusion Criteria

Studies will be included if:

1) At least one participant is age 8 or under?
   - Does the student include at least one participant that is age 8 or under?
     - YES = Include
     - Unclear = Include
     - NO = Exclude

2) At least one participant with a developmental disability or intellectual disability
   - Does the study include at least one participant diagnosed with an autism spectrum disorder (i.e., ASD, PDD, PDD-NOS, Asperger’s), developmental delay/disability (i.e., Down syndrome, Fragile X, etc.) and/or intellectual disability (i.e., mental retardation)? (Note: DD can be defined by eligibility to
Part C/B Early Intervention and ASD will be included if the individual designated “at risk” for ASD using a screener or biological risk)
- YES = Include
- UNCLEAR = Include
- No = Exclude

1. Conducted a formalized assessment of function of behavior prior to the design of an intervention
   - Is it clear by reading title and abstract that the authors used formalized experimental assessment to determine the function of the aberrant behavior?
     - YES = Include
     - UNCLEAR = INCLUDE
     - NO = EXCLUDE

2. Outcome measure was effect on some form of problem behavior
   - Does the study assess the function of a problem behavior that fits into one of these broad categories: 1) aggression, 2) destructive, 3) disruptive, 4) self-injurious (SIB), 5) repetitive/restricted (i.e. stereotypy)?
     - YES = Include
     - UNCLEAR = INCLUDE
     - NO = EXCLUDE
Phase 2: Full Text Coding

Studies that are included during Phase 1 will move to Phase 2: Full text coding. Use the provided Excel workbook to respond “Yes” or “No” to all of these questions. These criteria are to be used as a hierarchy and the questions should be responded to until the first one that a “NO” is recorded. That reason will be recorded as the “Reason for Exclusion” on the PRISMA diagram.

Studies during this phase will be included if the answer is yes to all of the following:

1) Is the study empirical, experimental, and quantitative?

- **Definition**: Empirical studies use observation and/or experimental procedures to verify the research question. Experimental (not correlational or descriptive) methodology that allows the researcher to test a hypothesis between the independent and dependent variable.

- **Included Methodologies** (further designs within these categories will be described later in the data extraction section) are:
  - Single Case Design – allows for a within- and between- subjects comparison to control for threats to internal validity to demonstrate functional (i.e. causal) relationships between the independent and dependent variables (Horner et al., 2005).
  - Group Experimental (with random assignment): True experiment defined by randomization of experimental occasions, achieving a required balanced representation of highly likely sources of bias between both groups (Campbell & Stanley, 1963).
  - Group Quasi-Experimental: Researcher introduces experimental design into data collection procedures even though full experimental control (ability to randomize exposures) is not possible (Campbell & Stanley, 1963).

- **Excluded Methodologies**:
  - Correlational/Descriptive Design:
    - Comparison of one condition to another without a comparison (i.e., a single group compared at one time) or control for additional factors that would affect internal validity of the experiment (Campbell & Stanley, 1963).
  - Pre-Post Case Study Design
    - One group pre-post study design: A design in which other plausible explanations such as history could have influenced the outcome between pre and post-test (internal validity) (Campbell & Stanley, 1963).
  - Qualitative Design:
    - Observations in the field that are no analyzed using statistics, does not intend to manipulate a causal variable (Dooley, 2001).
  - Review Paper: (e.g. literature reviews, practice reviews, or systematic review without data, meta-analyses).
2) Does the study include at least one participant with a documented developmental disability (DD) and/or intellectual disability (ID)?

- Definition: “Developmental disabilities are a group of conditions due to an impairment in physical, learning, language, or behavior areas. These conditions begin during the developmental period, may impact day-to-day functioning, and usually last throughout a person’s lifetime” (CDC, 2010).
  - Specific conditions include:
    - *Autism spectrum disorder* (ASD) including pervasive developmental disorder (PDD), pervasive developmental disorder – not otherwise specified (PDD-NOS), Asperger’s syndrome.
    - *Developmental disability/delay* including Down Syndrome, and Fragile X.
    - *Intellectual disability* defined as impairments in mental abilities that have an impact on daily adaptive behaviors and functioning and includes participants classified as having mental retardation (varying from mild to severe/profound) (APA, 2013).
  - *Exclusions:* Emotional/Behavioral Disorders, Physical disability (without DD or ID), ADHD as the sole disability

3) Is the age of at least one participant 8 or under?

- Definition: Participant age is described as 8 years, 11 months or younger. There only needs to be ONE participant that meets this criterion for inclusion (e.g., there are two participants age 34 and 48 and one participant age 8, the study would be included). However, data will only be extracted for the participant that meets the age criterion.
  - *Exclusions:* All participant ages are described as 9 years and older.

4) Is there an experimental and systematic manipulation of variables (i.e., antecedent and/or consequence) to identify the function of the behavior?

- Definition: Assessment is conducted prior to intervention and seeks to determine the purpose or reason the behaviors are occurring and includes:
  - *Experimental:* Altering the environment in a purposeful way to determine the function of the behavior (Includes modifications to Iwata et al. 1982 procedures)
Exclusions: The determination of function based solely on descriptive data including indirect (i.e. interviews, questionnaires, surveys, rating scales) or direct (i.e., behavior observation). Only use of standardized testing prior to the intervention and/or does not seek “function” (i.e. seeks to determine level of communication/adaptive and/or academic skills)

5) Does the analysis address some form of aggression, destruction, or defiance?

- **Definition**: Behaviors that deviant from the social norms, impede on the quality of life of an individual and/or can result in harm to self-and/or others including:
  - Aggression (physical harm toward others), Destructive (physical harm to objects in environment), Defiance (noncompliance), Self-injurious (SIB) (physical harm to self)
  - Exclusions: Repetitive/restrictive (i.e. stereotypy) and/or Pica (i.e. ingesting non-foods that could potentially harm self), self-help behaviors, adaptive behaviors, academic skills.
  - Note: Behaviors that were found to be maintained by automatic reinforcement will be excluded from this review

6) Does the assessment occur in the natural environment?

- **Definition**: The assessment takes place in a setting where the child would normally be during their day.
  - Included settings: home, public school, child care setting, community
  - Exclusions: clinic, hospital, residential, secluded room in school where academic activities do not typically occur.
### Phase 3: Data Extraction

Data will be extracted from individual articles and recorded using an Excel workbook. Each article will be coded for participant and study characteristics, assessment components, intervention components, outcome, and study methodological quality. Each Excel column is defined below including response options and further definitions/clarifications.

<table>
<thead>
<tr>
<th>Column</th>
<th>Code</th>
<th>Response Options</th>
<th>Definition/Clarifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Year of Study</td>
<td>Record a four digit numerical response XXXX</td>
<td>Type in the year the study was published</td>
</tr>
<tr>
<td>C</td>
<td>First Author</td>
<td>Record one last name</td>
<td>Type only the first authors last name</td>
</tr>
<tr>
<td>D</td>
<td>APA Citation</td>
<td>Record the entire journal article citation as per the APA (201) guidelines</td>
<td>Author, A.A., Author, B.B., &amp; Author, C.C. (year). Title of article. <em>Title of Periodical</em>, X (X), pp-pp.</td>
</tr>
<tr>
<td>E</td>
<td>Journal</td>
<td>Record the name of the journal</td>
<td>Type the name of the journal</td>
</tr>
</tbody>
</table>
| F      | Experimental Design (Assessment) | Multi-element | Implementation of two or more interventions within the same phase with each intervention associated with distinct stimulus conditions to show that the behavior varies systematic as a function of that particular stimulus (Kazdin, 2011).

<p>| Alternating Treatment Design | Different treatment conditions are alternated across different stimulus conditions. This differs from a multi-element design as the interventions are purposely balanced and not connected from a specific stimulus (Kazdin, 2011). |
| Reversal | A design in which the experimental effect of the intervention is evaluated by alternating the baseline condition with the intervention condition and these phases are repeated (i.e. ABAB design) (Kazdin, 2011). |
| G      | Experimental Design (Intervention) | MBL = Multiple Baseline | Intervention is implemented to different baselines (persons, settings, or behavior) at different time points. Once an intervention is implemented, it does not need to be withdrawn and effects are demonstrated by |</p>
<table>
<thead>
<tr>
<th><strong>Withdrawal/Reversal</strong></th>
<th>A design in which the experimental effect of the intervention is evaluated by alternating the baseline condition with the intervention condition and these phases are repeated (i.e. ABAB design) (Kazdin, 2011).</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Multi-element</strong></td>
<td>Implementation of two or more interventions within the same phase with each intervention associated with distinct stimulus conditions to show that the behavior varies systematically as a function of that particular stimulus (Kazdin, 2011).</td>
</tr>
<tr>
<td><strong>Alternating Treatment</strong></td>
<td>Different treatment conditions are alternated across different stimulus conditions. This differs from a multi-element design as the interventions are purposely balanced and not connected from a specific stimulus (Kazdin, 2011).</td>
</tr>
<tr>
<td><strong>Changing Criterion</strong></td>
<td>Experimental effects are shown by demonstrating that the behavior changes gradually over time and improves in increments to match a specified criterion (Kazdin, 2011).</td>
</tr>
<tr>
<td><strong>2+ SCD used</strong></td>
<td>Two or more of the above designs were used in the intervention.</td>
</tr>
<tr>
<td><strong>Pre-test, post-test control group with random assignment (RA)</strong></td>
<td>Equivalent groups for treatment and control are determined through randomization in order to achieve balanced representation of sources of bias (e.g., regression, maturation, selection) (Campbell &amp; Stanley, 1963).</td>
</tr>
<tr>
<td><strong>Post-test only control group with RA</strong></td>
<td>Random assignment is sufficient (assuring the groups were “equal” prior to beginning the experiment) and pre-test is either not used or not possible (Campbell &amp; Stanley, 1963).</td>
</tr>
<tr>
<td><strong>Other Group Design</strong></td>
<td>A group design that does not fit into the above categories.</td>
</tr>
<tr>
<td><strong>Time Series Experiment</strong></td>
<td>Periodic measurement of groups or individuals, and introduction of the experimental conditions is introduced into this series of measurements, (Campbell &amp; Stanley, 1963).</td>
</tr>
<tr>
<td><strong>Equivalent Time-Samples Design</strong></td>
<td>“Experimental design employs an equivalent sample of persons to provide a baseline against which to compare the effects of the experimental variable. In contrast, a recurrent form of one-group experimentation employs two equivalent samples of occasions, in one of which the experimental variable is present and in another of which it is absent” (Campbell &amp; Stanley, 1963, p. 43).</td>
</tr>
</tbody>
</table>
Nonequivalent Control Group Design | Treatment and control groups are both given a pre-test and post-test, however equivalence between the groups was not achieved (Campbell & Stanley, 1963).

Other Quasi-experimental | A quasi-experimental design that does not fit into the above categories.

| Participants |
|---|---|
| **H** | N |
| Record number of participants | Record the number of individuals with 1) DD/ID that were included in the study, exclude any participants that did NOT have a disability (i.e. the study includes 5 children, 1 of which was classified “typically developing” = record 4 in this column) AND 2) age is less than or equal to 21 years, exclude any participants that are 22 or older (i.e. the study includes 3 participants, 2 of which are 34 and 42 and 1 is 16 = record 1 in this column). |

**The following columns (I-BB) are coded for EACH participant and on a separate line of the Excel workbook.**  
**All columns are designed to require a response unless it states “Other”**  
*Note: It is likely the response will be the same for all participants. Please still fill in all information for each participant*  
*(May be helpful to use the drag function to fill the cells if the responses are the same)*

| **I** | Gender | Male, Female |
| **J** | Age | Record the numerical age |
| **K** | Multiple Disabilities? | Yes, No |
| **L** | Autism | Yes, No |
| **M** | DD | Yes, No |
| **N** | ID | Yes, No |

Choose YES if participant is said to have a disability classified as a developmental disability or developmental delay. Examples of this would include any general term stating a developmental delay/disability, Down syndrome, Fragile X, Fetal alcohol syndrome. Choose NO if none of these are listed or stated in participant description.
severity (see Column N). Choose NO if none of these are listed or stated in participant description.

| Level of ID | Mild | This are strictly used if the authors state the level of intellectual disability within the participant description and are not to be inferred using other information.
| Moderate | Severe |
| Not specified | Choose Not Specified if the authors indicate an ID for a participant, but do not specify the level of ID.
| NA | Choose NA if the participant is not described as having an ID/MR.

O | Other | Record information as needed | Record any other disability the participant is described as having in addition to ASD, DD, or ID. Leave blank if no other disability is reported.

Q | Multiple PB? | Yes, No | Choose YES if the participant is reported to engage in more than one problem behavior. Choose NO if the only one problem behavior is described. 
**Note:** If YES is chosen, more than one type of behavior MUST be reported by marking YES in columns Q-V or recording a behavior in W (Other). If only one of these columns is marked YES or completed, then column P should be marked NO.

R | Aggression | Yes, No | Choose YES if participant behavior is described to be aggression or fits the following definition: any behavior that results in or has the potential to cause injury in another person (Pelios et al., 1999) Examples of aggression include: kicking, punching, pinching, grabbing, hitting, fighting, pulling hair. **Note:** Aggression towards self would be included under SIB. Aggression that results in property damage would be included under destruction. Choose NO if the participant behavior does not meet this definition or is not stated to be aggression.

S | Destruction | Yes, No | Choose YES if participant behavior is described to be disruptive or fits the following definition: any behavior that results in or has the potential to cause damage to items or property (Kuhn et al., 2009). Example of destruction include: breaking, ripping, or tearing objects; throwing objects; banging on walls or objects; and swiping objects off surfaces. Choose NO if the participant behavior does not meet this definition or is not stated to be disruptive.

T | Disruption | Yes, No | Choose YES if participant behavior is described to be destruction or fits the following definition: Any behavior that causes a disturbance of social norms and/or impacts the daily functioning of the individual.
Examples of disruption include noncompliance (i.e. refusal to follow
directions), tantrums, inappropriate vocalizations, crying, screaming,
and yelling (Horner et al., 2002). Choose NO if the participant behavior
does not meet this definition or is not stated to be aggression.

<table>
<thead>
<tr>
<th>U</th>
<th>SIB</th>
<th>Yes, No</th>
</tr>
</thead>
</table>
| Choose YES if participant behavior is described to be self-injurious
behavior (SIB) or fits the following definition: Movements made by the
individual that results in injury to their own self using a part of their
body, an object, or other surfaces to cause the injury (Boyd et al.,
2012). Choose NO if the participant behavior does not meet this
definition or is not stated to be SIB. Note: This includes Pica (defined as
the ingestion of any item that is nonfood (i.e. dirt, grass, feces, paper)
(Matson & Bamburg, 1999).

<table>
<thead>
<tr>
<th>V</th>
<th>RRB/Stereotypy</th>
<th>Yes, No</th>
</tr>
</thead>
</table>
| Choose YES if participant behavior is described to be
repetitive/restricted behavior, stereotypy (vocal or motor) or fits the
following definition: Repetitious movements and/or behaviors that do
not appear to serve an extrinsic purpose or function and can be either
vocal (utterances or speech) or motor (i.e. flapping, rocking). This
definition includes both lower order (i.e. stereotypies) and higher order
(i.e. instance on sameness). (Boyd et al., 2012). Choose NO if the
participant behavior does not meet this definition or is not stated to be
RRB/Stereotypy.

<table>
<thead>
<tr>
<th>W</th>
<th>Other</th>
<th>Record information as needed</th>
</tr>
</thead>
</table>
| Record any other behavior that does not fit into one of these categories
in this column. Leave blank if there is no other behavior reported.

<table>
<thead>
<tr>
<th>X</th>
<th>Agent</th>
<th>Parent or caregiver</th>
</tr>
</thead>
</table>
| Adult who is related to the individual either by birth or adoption.

| Therapist | Adult who works with the student on a regular basis either in the
home/school/clinic/residential setting.

| Teacher | Adult who teaches the individual within a school setting (i.e. classroom).

| Clinician | Adult who does not regularly work with the individual and works within a
clinic setting (i.e. not in the home or school) Clarification: Choose
therapist if the person works with the individual on a regular basis,
choose clinician if this person only came in to do this
assessment/intervention.

| Researcher/Graduate Student | Authors of the paper, graduate student is specified as the
interventionist.

<p>| Other | Anyone who does not fit into one of these categories. |</p>
<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Setting</strong></td>
<td>Location where the individual lives with family or caregivers.</td>
<td>Home</td>
</tr>
<tr>
<td></td>
<td>Location of the individual’s primary educational services and is under the direction of a teacher.</td>
<td>Public School</td>
</tr>
<tr>
<td></td>
<td>Location where individuals receive primary care on a daily basis but does not particularly state that educational services are being administered.</td>
<td>Child care setting</td>
</tr>
<tr>
<td></td>
<td>Any setting that does not fit into one of these categories.</td>
<td>Other</td>
</tr>
<tr>
<td></td>
<td>The authors do not specify the setting where the assessment was conducted. Do not assume the setting; Report what is said in the article.</td>
<td>Unknown</td>
</tr>
<tr>
<td><strong>Indirect Assessments</strong></td>
<td>Choose YES if the assessment includes any form of indirect assessment that uses someone (different person or individual) provides information about the function and/or occurrence of behaviors such as surveys, interviews, and/or questionnaires. Choose NO if indirect measures were not used in the assessment of function (i.e., observation of the behavior and/or experimental manipulation is used).</td>
<td>Yes, No</td>
</tr>
<tr>
<td><strong>Type of Indirect Assessment</strong></td>
<td>Adult (i.e., caregiver, teacher, etc.) or individual responds to questions verbally about the individual’s behaviors, environmental factors, reinforcers, etc. Choose this response if this type of indirect is specifically named.</td>
<td>Open-ended Interview</td>
</tr>
<tr>
<td></td>
<td>Adult (i.e., caregiver, teacher, etc.) or individual completes a questionnaire or survey about the individual’s behaviors, environmental factors, reinforcers, etc.</td>
<td>Closed-ended questionnaire/Survey</td>
</tr>
<tr>
<td></td>
<td>Any other rating scale that is completed to identify behaviors and/or function of the behavior.</td>
<td>Rating Scale</td>
</tr>
<tr>
<td></td>
<td>Choose OTHER if any other form of indirect assessment (assessments that do not involve directly observing behavior and/or manipulating the environment) was used to determine function of behavior.</td>
<td>Other</td>
</tr>
<tr>
<td><strong>Descriptive Assessments</strong></td>
<td>Choose YES if the assessment includes any form of descriptive assessment (i.e., direct observation, ABC chart) that includes determining function and/or environmental factors without directly interacting with the individual or manipulating the environment. Choose NO if descriptive measures were not used in the assessment of function.</td>
<td>Yes, No</td>
</tr>
<tr>
<td>AD</td>
<td>Type of Descriptive Assessments</td>
<td>Direct Observation</td>
</tr>
<tr>
<td>----</td>
<td>--------------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td></td>
<td>ABC chart</td>
<td>A chart is completed that outlines the antecedents (A), behaviors (B), and consequences (C) while observing the behaviors in real time or via video.</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>Choose OTHER is any other form of descriptive method of assessing function is described.</td>
</tr>
<tr>
<td>AE</td>
<td>Preference Assessment</td>
<td>Yes, No</td>
</tr>
<tr>
<td></td>
<td>Use of Indirect assessment</td>
<td>Define behavior</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Develop hypothesis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Both</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Not reported</td>
</tr>
<tr>
<td></td>
<td>FA Approach</td>
<td>AB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ABC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Both</td>
</tr>
<tr>
<td></td>
<td>Variation of FA</td>
<td>TFA (Traditional)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BFA (Brief)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TBFA (Trial Based)</td>
</tr>
<tr>
<td>Type</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>---------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>PFA (Precursor)</td>
<td>FA of precursor behaviors, behaviors that occur prior to severe behaviors and serve the same function, are assessed experimentally (Smith &amp; Churchill, 2002).</td>
<td></td>
</tr>
<tr>
<td>LFA (Latency)</td>
<td>Uses a measure of latency, or time until onset of problem behavior, rather than frequency to measure the strength of the behavior in each session (Thomason-Sassi et al., 2011).</td>
<td></td>
</tr>
<tr>
<td>SA (Structural analysis)</td>
<td>An assessment that focuses on establishing a functional relationship between antecedent variables (i.e., independent variables) and subsequent behaviors (i.e., dependent variables; Stichter &amp; Conroy, 2005).</td>
<td></td>
</tr>
<tr>
<td>SDA (Structured descriptive assessment)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>Choose Other if the type of modification does not fit the above descriptions and explain in call AN.</td>
<td></td>
</tr>
<tr>
<td>Additional Analysis?</td>
<td>Yes, No</td>
<td></td>
</tr>
<tr>
<td>Explain</td>
<td>Record a short explanation of either the modified condition or additional analysis</td>
<td>Record the type of modification (what condition was modified or added) or the type of additional analyses.</td>
</tr>
<tr>
<td>Number Conditions</td>
<td>Record a numerical response</td>
<td>Record the number of conditions the authors tested in their assessment of the function of behavior. Leave this cell blank if it is unclear how many conditions were tested.</td>
</tr>
<tr>
<td>Total number of FA sessions</td>
<td>Record a numerical response</td>
<td>Count the total number of sessions per FA using the graph or summary in the text.</td>
</tr>
<tr>
<td>Session duration</td>
<td>Record a numerical response, NR</td>
<td>Record the length of the session in minutes, NR = Not reported.</td>
</tr>
<tr>
<td>Estimated FA duration</td>
<td>Record a numerical response, NR</td>
<td>Multiply the total number of sessions by session duration. Note: Will be set up in excel to do this automatically, NR = One was not reported.</td>
</tr>
<tr>
<td>Data Collection</td>
<td>Partial Interval, Frequency, Duration, Momentary time sampling, NR</td>
<td>Choose the method of data collection used to measure problem behavior DURING each FA based on author report.</td>
</tr>
<tr>
<td>Attention</td>
<td>Yes, No</td>
<td>Choose YES if the attention condition was included in the FA, Choose NO if the authors do not report an attention condition.</td>
</tr>
<tr>
<td>-----------</td>
<td>---------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Categorized</td>
<td>Standard, Adapted, NA</td>
<td>Choose standard if description of condition matched those in a traditional FA. Choose Adapted if the description of the condition was modified in any way from traditional (e.g., specific aspect of the reinforcement was modified). Choose NA if this condition was not included in the FA.</td>
</tr>
<tr>
<td>Demand</td>
<td>Yes, No</td>
<td>Choose YES if the demand condition was included in the FA, Choose NO if the authors do not report a demand condition</td>
</tr>
<tr>
<td>Categorized</td>
<td>Standard, Adapted, NA</td>
<td>Choose standard if description of condition matched those in a traditional FA. Choose Adapted if the description of the condition was modified in any way from traditional (e.g., specific aspect of the reinforcement was modified). Choose NA if this condition was not included in the FA.</td>
</tr>
<tr>
<td>Tangible</td>
<td>Yes, No</td>
<td>Choose YES if the tangible condition was included in the FA, Choose NO if the authors do not report a tangible condition.</td>
</tr>
<tr>
<td>Categorized</td>
<td>Standard, Adapted, NA</td>
<td>Choose standard if description of condition matched those in a traditional FA. Choose Adapted if the description of the condition was modified in any way from traditional (e.g., specific aspect of the reinforcement was modified). Choose NA if this condition was not included in the FA.</td>
</tr>
<tr>
<td>Alone/Ignore</td>
<td>Yes, No</td>
<td>Choose YES if the authors report an alone OR ignore condition was included in the FA, Choose NO if the authors do not report an alone/ignore condition.</td>
</tr>
<tr>
<td>Play/Control</td>
<td>Yes, No</td>
<td>Choose YES if the play condition was included in the FA, Choose NO if the authors do not report a play condition.</td>
</tr>
<tr>
<td>Other Adapted</td>
<td>Record type of adaption</td>
<td>Record the type of adaptation included in the FA. This could include which condition was modified or what the additional condition included.</td>
</tr>
<tr>
<td>Conclusive Results?</td>
<td>Yes, No</td>
<td>Choose YES if the authors were able to report a conclusive function to the behavior based on their FA procedures. Choose NO if they report that the function is undifferentiated or inconclusive (i.e. behavior may serve multiple functions).</td>
</tr>
<tr>
<td>Undiff?</td>
<td>Yes, No</td>
<td>Choose YES if the final results of the FA were undifferentiated (a function could not be determined). Choose NO if the final results of the FA were differentiated and the authors report a function of the behavior</td>
</tr>
<tr>
<td>AV</td>
<td>Multiple Functions?</td>
<td>Yes, No</td>
</tr>
<tr>
<td>-----</td>
<td>---------------------</td>
<td>---------</td>
</tr>
<tr>
<td>AT</td>
<td>Results (Function of the Behavior)</td>
<td>Record the function of the behavior using the terms Automatic Reinforcement, Attention, Escape, or Tangible</td>
</tr>
</tbody>
</table>

**Intervention Characteristics**

Directions: The following are coded for EACH participant and on a separate line of the Excel workbook. Only extract data for individuals in the study that meet the age requirement (Age ≤ 8).

All columns are designed to require a response unless it states “Other”

Note: It is likely the response will be the same for all participants. Please still fill in all information for each participant (May be helpful to use the drag function to fill the cells if the responses are the same)

<table>
<thead>
<tr>
<th>AX</th>
<th>Intervention Included?</th>
<th>Yes, No</th>
<th>Choose YES if there is an intervention included in the study that occurred after the FA was conducted, Choose NO if there was no intervention included. If NO, the next cells (AY-BC) will be NA.</th>
</tr>
</thead>
<tbody>
<tr>
<td>AY</td>
<td>Connection described?</td>
<td>Yes, No, NA</td>
<td>Choose YES if the authors clearly state that the intervention was chosen as a connection to the FA results, Choose NO if there is not an explicit statement that the intervention was informed by the FA.</td>
</tr>
<tr>
<td>AZ</td>
<td>Function based intervention</td>
<td>Record the type of intervention that was used</td>
<td>Record the name of the all interventions that were described in the study separated by a comma.</td>
</tr>
<tr>
<td>BA</td>
<td>Agent</td>
<td>Parent/caregiver</td>
<td>Adult who is related to the individual either by birth or adoption.</td>
</tr>
<tr>
<td></td>
<td>Therapist</td>
<td>Adult who works with the student on a regular basis either in the home/school/clinic/residential setting.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Teacher</td>
<td>Adult who teaches the individual within a school setting (i.e. classroom).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Clinician</td>
<td>Adult who does not regularly work with the individual and works within a clinic setting (i.e. not in the home or school).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Researcher/Graduate Student</td>
<td>Authors of the paper, graduate student is specified as the interventionist.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>Anyone who does not fit into one of these categories.</td>
<td></td>
</tr>
<tr>
<td>BB</td>
<td>Setting</td>
<td>Unknown</td>
<td></td>
</tr>
<tr>
<td>----</td>
<td>---------</td>
<td>---------</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Home</td>
<td>Location in which the individual lives with family or caregivers.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>School</td>
<td>Location of the individual’s primary educational services and is under the direction of a teacher. This setting is only available for participants to age 21.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>Any setting that does not fit into one of these categories.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unknown</td>
<td>The authors do not specify the setting where the assessment was conducted. Do not assume the setting; Report what is said in the article.</td>
<td></td>
</tr>
</tbody>
</table>

**Alignment with Recommendations to Address Practical Barriers (Hanley, 2014; Lloyd et al., 2015)**

<table>
<thead>
<tr>
<th>Brief 5 min sessions</th>
<th>Yes, No, NR</th>
<th>Choose YES if the FA sessions were 5 minutes or less, Choose NO if the FA sessions were longer than 5 minutes, Choose NR if session length was not reported.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Included no more than 2 conditions in the FA</td>
<td>Yes, No, NR</td>
<td>Choose YES if there are 2 or less conditions tested during the FA, Choose NO if 3 or more conditions were tested, Choose NR if you cannot tell from the article how many conditions were tested.</td>
</tr>
<tr>
<td>Conducted open-ended interviews</td>
<td>Yes, No, NR</td>
<td>Choose YES if an open ended interview was conducted, Choose NO if only closed ended questionnaires or rating scales were used, Choose NR if there was no interview conducted or none was reported by the authors.</td>
</tr>
<tr>
<td>Adapted or individualized at least one test condition</td>
<td>Yes, No, NR</td>
<td>Choose YES if adapted conditions were reported for the FA in at least one conditions, Choose NO if only standard conditions were used in the FA, Choose NR if you cannot tell from the article if adaptions were made to the conditions.</td>
</tr>
<tr>
<td>Use a variation in FA method</td>
<td>Yes, No, NR</td>
<td>Choose YES if any variation (e.g., brief, trial based, latency based, precursor, SA) was used, Choose NO if FA procedures followed traditional FA procedures as outlines by Iwata et al., Choose NR if you cannot tell what type of FA was conducted.</td>
</tr>
<tr>
<td>Conducted FA in an environment that allows behaviors to occur safely</td>
<td>Yes, No, NR</td>
<td>Choose YES if precautions were taken to allow for the safe display of problem behaviors (e.g., protective equipment, conducted in an area without other children). Choose NO if precautions were not taken or described.</td>
</tr>
<tr>
<td>Included clearly signaled</td>
<td>Yes, No, NR</td>
<td>Choose YES if the contingencies in the test condition were clearly signaled salient clues for the conditions by vocal phrase, gestural or...</td>
</tr>
<tr>
<td>Contingences in the test condition</td>
<td>pictures, different therapist. Choose NO if it was not report the signaling of contingencies. Choose NR if it is not clear.</td>
<td></td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Programming continuous schedules of consequences in test conditions</td>
<td>Yes, No, NR Choose YES if there is a clear programmed consequence for each test conditions, Choose NO if no schedule of consequence has been programmed (e.g., AB model) or if an intermittent schedule of reinforcement was used. Choose NR if you cannot tell from the author report if continuous schedules of reinforcement were used.</td>
<td></td>
</tr>
</tbody>
</table>
Search Strategy

1) Autis*
2) Autism spectrum disorder*
3) Developmental disorder*
4) Developmental disabil*
5) Developmental Delay*
6) PDD*
7) Pervasive developmental disorder*
8) Intellectual disabil*
9) Mental retard*
10) Down* Syndrome
11) Fragile X
12) 1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9 OR 10 OR 11
13) Functional assessment*
14) Functional Behavioral assessment*
15) FBA
16) Functional analys*
17) Function-based assessment*
18) Function-based intervention*
19) Function based
20) 13 OR 14 OR 15 OR 16 OR 17 OR 18 OR 19
21) 12 AND 20
22) Challenging behavior*
23) Problem behavior*
24) Aberrant behavior*
25) Aggressi*
26) Disrupti*
27) Destructi*
28) Externalizing behavior*
29) Self-injurious
30) SIB
31) Stereotypy
32) 22 OR 23 OR 24 OR 25 OR 26 OR 27 OR 28 OR 29 OR 30 OR 31
Phase 1: Initial Search and (Titles & Abstracts)

Research Questions

1) What are the characteristics of the participants with whom TBFA has been conducted?

2) What are the characteristics of the TBFAAs (e.g., implementer, setting, conditions, trial duration) in the literature?

3) What are the assessment outcomes for the TBFA literature?

4) What are the gaps in the TBFA literature that should be examined in future research?

Database search

The following databases are searched using the included search strategy that includes the combination of the terms "trial-based," "trial based," or "discrete trial" with the term "functional analysis:" PsycINFO, ERIC, and Academic Search Premier. A search of the included studies in the Rispoli et al. (2014) review of the TBFA literature was consulted. Finally, an examination of literature citing the initial TBFA study conducted by Sigafoos and Saggers (1995) was included to identify other possible studies. The initial search is exported from the databases to EndNote. Titles and abstracts are screened through this program and sorted into a "possible inclusion" folder if they meet the initial criteria below.

The search is limited to peer-reviewed empirical articles from 1994 to present. The limit on the date was determined from the date the methodology was first described by Sigafoos and Saggers (1994).

Screening Inclusion/Exclusion Criteria

Studies will be included if:

1) A TBFA was conducted to examine the function of problem behavior.

   - Does the study include a TBFA defined as an experimental procedure to assess problem behavior by systematically manipulating environmental variables using test and control trials? The TBFA includes trials distributed across time and data are collected on the occurrence and non-occurrence of problem behavior (Rispoli et al., 2014).
     - YES = Include
     - UNCLEAR = Include
     - NO = Exclude
2) The outcomes of the TBFA are reported.

- Does the study include outcomes of the TBFA in the publication (e.g., was a function identified, was it comparable to a traditional FA)?
  - YES = Include
  - UNCLEAR = Include
  - NO = Exclude

**Phase 2: Full Text Coding**

Studies that are included during Phase 1 will move to Phase 2: Full text coding. Use the provided Excel workbook to respond “Yes” or “No” to all of these questions. These criteria are to be used as a hierarchy and the questions should be responded to until the first one that a “NO” is recorded. That reason will be recorded as the “Reason for Exclusion” on the PRISMA diagram.

Studies during this phase will be included if the answer is yes to all of the following:

1) Is the study empirical, experimental, and quantitative?

- **Definition:** Empirical studies use observation and/or experimental procedures to verify the research question. Experimental (not correlational or descriptive) methodology that allows the researcher to test a hypothesis between the independent and dependent variable.
- Uses a single-case research design to examine the research questions:
  - Single case design – allows for a within- and between-subjects comparison to control for threats to internal validity to demonstrate functional (i.e. causal) relationships between the independent and dependent variables (Horner et al., 2005).

2) Does the study use a trial-based procedure for assessing problem behavior?

- TBFA defined as an experimental procedure to assess problem behavior by systematically manipulating environmental variables using test and control trials? The TBFA includes trials distributed across time and data are collected on the occurrence and non-occurrence of problem behavior (Rispoli et al., 2014).

3) Does the analysis address some form of problem behavior (e.g., aggression, disruption, destruction, and defiance)?
**Phase 3: Data Extraction**

Data will be extracted from individual articles and recorded using an Excel workbook. Each article will be coded for participant and study characteristics, assessment components, intervention components, outcome, and study methodological quality. Each Excel column is defined below including response options and further definitions/clarifications.

<table>
<thead>
<tr>
<th>Basic Information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Column</strong></td>
</tr>
<tr>
<td>B</td>
</tr>
<tr>
<td>C</td>
</tr>
<tr>
<td>D</td>
</tr>
<tr>
<td>E</td>
</tr>
<tr>
<td>F</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>G</td>
</tr>
</tbody>
</table>
and effects are demonstrated by evaluating changes in behavior when the intervention was applied (Kazdin, 2011).

<table>
<thead>
<tr>
<th>Withdrawal/Reversal</th>
<th>A design in which the experimental effect of the intervention is evaluated by alternating the baseline condition with the intervention condition and these phases are repeated (i.e. ABAB design) (Kazdin, 2011).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi-element</td>
<td>Implementation of two or more interventions within the same phase with each intervention associated with distinct stimulus conditions to show that the behavior varies systematic as a function of that particular stimulus (Kazdin, 2011).</td>
</tr>
<tr>
<td>Alternating Treatment</td>
<td>Different treatment conditions are alternated across different stimulus conditions. This differs from a multi-element design as the interventions are purposely balanced and not connected from a specific stimulus (Kazdin, 2011).</td>
</tr>
<tr>
<td>Changing Criterion</td>
<td>Experimental effects are shown by demonstrating that the behavior changes gradually over time and improves in increments to match a specified criterion (Kazdin, 2011).</td>
</tr>
<tr>
<td>2+ SCD used</td>
<td>Two or more of the above designs were used in the intervention.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>H</th>
<th>N</th>
<th>Record number of participants</th>
<th>The total number of participants in the study.</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Gender</td>
<td>M. F</td>
<td>Number of males (M) and females (F) included in the study.</td>
</tr>
<tr>
<td>J</td>
<td>Age of participants</td>
<td>Numerical</td>
<td>All the ages of the participants.</td>
</tr>
<tr>
<td>K</td>
<td>Include ≥8</td>
<td>Yes, No</td>
<td>Indicate if the study included participants age 8 or younger (yes) or if all participants were age 9 and older (no).</td>
</tr>
<tr>
<td>L</td>
<td>Disability</td>
<td>Record the reported disabilities of the participant</td>
<td>ASD = autism spectrum disorder, DD = developmental delay, ID = intellectual disability; write out any others.</td>
</tr>
<tr>
<td>M</td>
<td>Target behaviors</td>
<td>Aggression, Destruction, Disruption, SIB</td>
<td>Aggression: any behavior that results in or has the potential to cause injury in another person (Pelios et al., 1999) Examples of aggression include: kicking, punching, pinching, grabbing, hitting, fighting, pulling hair. Destruction: any behavior that results in or has the potential to cause damage to items or property (Kuhn et al., 2009). Example of destruction include: breaking, ripping, or tearing objects; throwing objects; banging</td>
</tr>
</tbody>
</table>

| 259 |
on walls or objects; and swiping objects off surfaces. Disruption: Any behavior that causes a disturbance of social norms and/or impacts the daily functioning of the individual. Examples of disruption include noncompliance (i.e. refusal to follow directions), tantrums, inappropriate vocalizations, crying, screaming, and yelling (Horner et al., 2002). SIB: Movements made by the individual that results in injury to their own self using a part of their body, an object, or other surfaces to cause the injury (Boyd et al., 2012).

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>Setting</td>
<td>Describe setting as reported by authors Describe the location of the TBFA (e.g., home, special education classroom) as the authors describe the setting in the study.</td>
</tr>
<tr>
<td>O</td>
<td>Implementer</td>
<td>Person implementing the TBFA Describe the person who was implementing the TBFA (e.g., parent, teacher, researcher, graduate student) as described by the author.</td>
</tr>
<tr>
<td>P</td>
<td>Number of conditions</td>
<td>Numerical Number of conditions that were presented during the TBFA. Indicate if these varied per participant.</td>
</tr>
<tr>
<td>Q</td>
<td>Conditions</td>
<td>Attention, Escape, Tangible, Ignore Describe the different conditions from the study. If an additional (modified) condition was used, describe it as the authors do in the study.</td>
</tr>
<tr>
<td>R</td>
<td>Segment Duration</td>
<td>Numerical Write the duration of the test and control segments in each trial.</td>
</tr>
<tr>
<td>S</td>
<td>Number of trials per condition</td>
<td>Numerical Write the total number of trials that were presented in each TBFA. Use NR if the number is not reported, use NA if the focus of the study was on fidelity and thus these data are not available.</td>
</tr>
<tr>
<td>T</td>
<td>Data Collection</td>
<td>Dependent variable Describe the variables (e.g., occurrence, latency, fidelity) collected during the TBFA</td>
</tr>
<tr>
<td>U</td>
<td>Description of Trials</td>
<td>Describe trials Provide a description of the trials including the order and how many times a week the trials were presented. Also include length of session is applicable.</td>
</tr>
<tr>
<td>V</td>
<td>Outcomes</td>
<td>Function determined? Describe the outcomes of the TBFA by indicating if function was determined. Write NA if these data are not reported.</td>
</tr>
<tr>
<td>W</td>
<td>Function based intervention</td>
<td>Yes = Describe, No If intervention was included, provide the type of intervention used. If no intervention is described use No.</td>
</tr>
</tbody>
</table>
Search Strategy

1) trial-base*
2) trial base*
3) discrete trial*
4) 1 OR 2 OR 3
5) functional analys*
6) 4 AND 5
APPENDIX C
SCREENING/CONSENT PROTOCOL AND IRB FORMS

Phase 1: Child eligibility

Upon contact with a family, the following questions should be used as an initial screening for child eligibility:

1. Is the child between the ages of 3 and 5 and primarily speak English in the home?
2. Is the child eligible for special education services under the category of ASD or developmental delay?
3. Does the caregiver report at least one socially mediated problem behavior in the home?
4. *Follow up question: Does the behavior happen at least 5 times within a 30-minute period?*
5. Can the family identify at least one caregiver who will be available for every home session and will act as the primary collaborator throughout the study?
6. Does the family have a predictable schedule so that sessions can be scheduled?
7. *While family schedules can often fluctuate, the family should be able to initially identify a consistent time that would have minimal chances of being affected.*

If the answer is yes to all questions, then the child is eligible for the second phase of screening. If the answer is no to any of these questions, the child is not eligible for the study. The follow-up question can be confirmed with the informal observation after consent is signed.

Phase 2: Eligibility confirmation

- If all above responses are “Yes,” consent to participate in the study can be signed by the caregiver. Assent from the child will be conducted.
- Following signed consent, the CARS-2 will be administered to all participants by the researcher. Child participants must have a score of 30 or above to indicate symptoms at-risk for ASD.
• An informal observation of a home routine chosen by the caregiver will be conducted to determine if the behavior(s) occurs at a high frequency.
  o Observer should watch routine for approximately 15-30 minutes and tally occurrences of any problem behavior. Criterion is at least 5 occurrences in a 30-minute session.
• One 5-10 minute observation of the child alone (i.e., no additional people or materials available) to screen for automatically reinforced behaviors.

Following instructions on the screening form, the PI will determine if the child meets the criteria for participation in the study. Eligibility will be indicated at the bottom of the form.

Screening forms for ineligible children will be shredded and discarded.
**Participant Screening Form**

Participant ID: ___________________________ Date _______________ Researcher: _________________________

### Child eligibility

<table>
<thead>
<tr>
<th>Criteria</th>
<th>YES</th>
<th>NO</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is the child between the ages of 3 and 5 and primarily speak English?</td>
<td></td>
<td></td>
<td>DOB:</td>
</tr>
<tr>
<td>Is the child eligible for special education services under the category of ASD or developmental delay?</td>
<td></td>
<td></td>
<td>ASD</td>
</tr>
<tr>
<td>Does the caregiver report at least one socially mediated problem behavior in the home?</td>
<td></td>
<td></td>
<td>Aggression</td>
</tr>
<tr>
<td>Follow up: According to caregiver, does the behavior happen at least 5 times within a 30-minute period?</td>
<td></td>
<td></td>
<td>Disruptive</td>
</tr>
<tr>
<td>Identified at least one caregiver who will be available for every home session and will act as the primary collaborator throughout the study</td>
<td></td>
<td></td>
<td>SIB</td>
</tr>
<tr>
<td>Family has a predictable schedule so that sessions can be scheduled</td>
<td></td>
<td></td>
<td>Who will participate?</td>
</tr>
</tbody>
</table>

If the answer is yes to all questions, then the child is eligible for the second phase of screening. If the answer is no to any of these questions, the child is not eligible for the study.

### Consent (Check all apply)

- ☐ Child not eligible, consent not signed
- ☐ Child Participant consent signed
- ☐ Child assent administered

### Informal Observation (after consent)

Date: _________________________
Routine: _______________________
Family present: __________________
Time: ______________ to ___________

Number of occurrences ________
Describe behavior(s) here:

### Eligibility Confirmation

| Frequency of behavior confirmed | Yes ☐ No ☐ | Child is eligible ☐ |
| Behaviors appear to be socially mediated | Yes ☐ No ☐ | Child IS NOT eligible ☐ |
| CARS-Score is 30 or above | Yes ☐ No ☐ |

If yes is checked for all above criteria, the child is eligible to participate in the study. If no is checked for any of the above criteria, the child is not eligible to participate in the study.
IRB Forms

University of Florida
School of Special Education, School Psychology and Early Childhood Studies
Anita Zucker Center for Excellence in Early Childhood Studies
PO Box 117050, 1345 Norman Hall
Gainesville, FL 32611-7050

PARENTAL INFORMED CONSENT

Please read the following consent form carefully before deciding whether or not to give permission for your child to take part in this research study.

I am conducting a research study on an assessment method (called trial-based functional analysis) as my doctoral dissertation under the supervision of my advisors, Drs. Maureen Conroy and Brian Reichow. This method will help practitioners and family members determine factors in the home that might be contributing to children’s problem behaviors. I will then design an intervention program that can help you change these factors.

The purpose of this letter is to explain my study and ask if you will grant permission for your child to participate in the study. If you agree to have your child participate, the phases of the study described below will take place in your home.

This study will have four phases. The first phase will be a confirmation of eligibility for the study. The second phase will include pre-assessments and planning. The third phase will be the identification of factors related to your child’s problem behavior. Finally, the fourth phase will be the implementation of the intervention. Each phase will be described in detail here.

Phase 1: Confirmation of eligibility - The purpose of this first phase is to confirm that your child is eligible to participate in this study. To do this, an observation will take place in your home to determine if there is problem behavior occurring. After the observation, I will administer the Childhood Autism Rating Scale -2nd Edition (CARS-2; Schopler, 2010) which will confirm the presence of autism symptoms. If eligible to participate, the next three phases will continue. If ineligible for the study, I will refer you to proper services that can better fit you and your child’s needs.

Phase 2: Pre-assessment and planning – The purpose of the second phase is to identify your child’s problem behavior. I will then ask questions to see if there are any routines, materials, and people who may influence that behavior. Two interviews will be conducted with you that will ask you questions about your child. The first interview will ask you to explain when and where the behaviors occur, as well as what the behaviors look like. The second interview will be used to identify items/activities that your child prefers. The questions will also help to identify how your child currently communicates his/her needs or wants. Following the interview, I will observe your child to identify other factors that might contribute to the behavior. After the interview and observation, I will meet with you to discuss how the behaviors will be assessed in the next phase. Phase 1 should take 1-2 weeks to complete.

IRB-201700212
Phase 3: Identify factors related to your child’s problem behavior(s) – The purpose of the third phase is to develop an assessment procedure that is individualized to your child. Using the information from Phase 1, I will test some of the factors I believe are influencing the behavior. During these short tests, I anticipate that your child will demonstrate some problem behaviors. As soon as those behaviors are observed, I will remove any factor that may be causing that behavior. I expect the assessment phase to last 2-3 weeks depending on the number of sessions conducted per day/week.

Phase 4: Training and implementation of the intervention – After I identify the factors related to the problem behavior, I will meet with you to discuss the results. At this time I will identify a form of communication that can replace the problem behavior. I will teach your child to use this new form of communication. After this is done, I will work with you so you can learn how to use the same strategies in your home. Each intervention session will last approximately 60 minutes and will occur 1-2 times a week depending on your availability and schedule.

Time required:

If you agree to participate, I will come to your home 1-2 times per week to work with your child. Each visit will last approximately 1-2 hours and will be scheduled at a time convenient to you and your family. I expect the entire duration of the study to last approximately 3-4 months including assessment and intervention on problem behaviors. Due to illness, holidays, and absence from sessions, the study may last longer.

Confidentiality:

All of the information collected on your child during the study will be kept confidential to the extent provided by the law. These data will be kept for the foreseeable future in a locked room that only research personnel has access to. The results of this study may be presented at conferences or published in professional journals. Your child will be given a code number, and his or her name will not be used on any documentation, publication, or presentation. The results of this study will be shared with you at the end of the study.

Video recording:

I will video record all sessions. This will be done to record the behaviors that occur during the session and to evaluate differences that may occur during the study. All videos will be stored for the foreseeable future on the University of Florida’s College of Education secure server. These video recordings will only be accessible to the research staff (e.g., persons collecting and scoring the data) at the University of Florida. Videos may also be used at professional presentations outside of the university for research and training purposes. You should be aware, however, that the showing of these videotapes might result in others being able to recognize your child. I, along with Drs. Conroy and Reichow, will strictly monitor the confidentiality and security of the videos.

Risks and benefits:
There are no known risks for participation in this study. You and your child will not receive any compensation for participation in this project. Possible benefits of participation include identification of reasons why your child may be displaying problem behaviors in the home, the development of an appropriate intervention to match those reasons, and assistance for you in the home in naturally occurring routines on how to implement that intervention.

Voluntary participation:

Participation in this study is completely voluntary. Participation or non-participation in this study will not affect your child’s placement in any programs. You have the right to withdraw consent for your child at any time without any consequence.

Consent

I have read the procedures described above for this project. I have received a copy of this statement and I agree to allow my child, ___________, to participate. I am free to ask questions to express any concerns that I have about the project. I am free to withdraw consent at any time and this will have no effect on other services provided to my child.

__________________________________________
Signature

__________________________________________
Date

__________________________________________
Relationship to participant

I give consent to use the video recordings for purposes beyond data collection including professional presentations and trainings.

__________________________________________
Signature

__________________________________________
Date

For information regarding your rights as a research participant, please contact the IRB at 352-392-0433. Questions about this research project may be directed to: Debra Prykanowski (Principal Investigator), 609-915-2715/dprykanowski@ufl.edu, Dr. Maureen Conroy, 352-273-4382/mconroy@coe.ufl.edu, or Dr. Brian Reichow, 352-273-4287/breichow@coe.ufl.edu

IRB-201700212
Child Assent Script (Participant)

Hi, my name is [researcher’s name]. I’m a student at the University of Florida. Right now I am trying to learn about how you play and talk with your parents. I would like to ask you to help me by being in a study. A research study is a way to learn information about something.

I will ask you to play and talk with your parent in your home. By being in the study, you will help me understand how you and your parents play together and communication.

When I tell other people about my study, I will not use your name and no one will be able to tell whom I’m talking about.

Your parent said it is okay for you to be in my study, but if you don’t want to be in it, you don’t have to be. I won’t be upset, and no one else will be upset if you don’t want to be in the study. If you want to be in the study now, but change your mind later, that’s okay. You can stop at any time. If there is anything you don’t understand you should tell me so I can explain it to you.

You can ask me questions about the study. If you have questions later that you can’t think of now, you can call me or ask your parents to ask me.

Do you have any questions for me now?

Would you like to be in my study and play with your parents?

Child’s name _______________________
Witness ___________________________
Date _______________________________

IRB-201700212
Seeking Young Children for a Research Study

Do you have a young child (age 3-5) with or at risk for autism spectrum disorder who exhibits problem behavior? Consider participating in this research study

An Examination of Individualized Trial-Based Functional Analysis with Intervention in the Home for Young Children with Autism Spectrum Disorder

I am conducting a research study to test an assessment method called trial-based functional analysis. This will help practitioners and family members determine factors in the home that might be contributing to children’s problem behaviors. I will also design an intervention program that can help you change these factors.

Eligibility for the research study:

- Child between ages of 3-5
- Eligible for Exceptional Student Education (ESE) services under categories of Autism Spectrum Disorder or Developmentally Delayed
- Exhibits problem behavior in home routines
- Willingness to schedule weekly home visits for approximately 3-4 months

Anita Zucker Center for Excellence in Early Childhood Studies
UNIVERSITY OF FLORIDA
www.cee.cs.education.ufl.edu

For more information, please contact:
Debra Prykanowski, doctoral candidate at the University of Florida
Email: dprykanowski@ufl.edu *Phone: 609-915-2715 *IRB Protocol: 201700212
APPENDIX D
PRE-ASSESSMENT FORMS/INTERVIEWS

Caregiver and Child Demographic Interview

1. What is today’s date (mm/dd/yyyy)? _____/_____/_________

2. What is your child’s date of birth (DOB, mm/dd/yyyy)? _____/_____/_________

3. What is your child’s racial background?
   □ African American/Black  □ Native American/American Indian
   □ Asian/Pacific Islander  □ Hispanic/Latino
   □ Caucasian/White        □ Other (Please specify): ________________________

4. What is your child’s sex? □ M □ F

5. Are you the child’s primary caregiver? □ Y □ N

6. What is your relationship to the child?
   □ Birth mother  □ Birth father
   □ Adopted mother □ Adopted father
   □ Foster Parent  □ Relative (Please specify) ______________________________
   □ Other (Please specify) __________________________

7. What your ethnic background?
   □ African American/Black  □ Native American/American Indian
   □ Asian/Pacific Islander  □ Hispanic/Latino
   □ Caucasian/White        □ Other (Please specify): ________________________

8. What is your sex? □ M □ F

9. What is your age (check one)?
   □ Under 18  □ 18-25  □ 26-35  □ 36-45
   □ 46-55      □ Over 55      □ I would prefer not to say

Please complete both sides of this form
10. What is the highest level of education that you have completed (check one)?

☐ Bachelor’s degree  ☐ Master’s degree  
☐ Doctoral degree  ☐ Other (Please specify): ________________________

11. How many adults live in your home? ________________
(Note: include yourself, but do not include your adult children who are over the age of 18).

Relation to the child____________________________________________________

12. How many children live in your home? ________________

Relation to the child ________________________________________________

Please complete both sides of this form
Open-Ended Functional Assessment Interview

Date of Interview: ________

Developed by Gregory P. Hanley, Ph.D., BCBA-D
(Developed August, 2002; Revised: August 2009)

Child ID: _____________________________ Respondent: ________________________

Respondent’s relation to child/client: ___________________ Interviewer: ________________

RELEVANT BACKGROUND INFORMATION

1. His/her date of birth and current age: ____ - ____ - _________ ______ yrs
   ____ mos Male/Female
2. Describe his/her language abilities.

3. Describe his/her play skills and preferred toys or leisure activities.

QUESTIONS TO INFORM THE DESIGN OF A FUNCTIONAL ANALYSIS

To develop objective definitions of observable problem behaviors:
4. What are the problem behaviors? What do they look like?

To determine which problem behavior(s) will be targeted in the functional analysis:
5. What is the single-most concerning problem behavior?

6. What is the top 3 most concerning problem behaviors? Are there other behaviors of concern?

To determine the precautions required when conducting the functional analysis:
7. Describe the range of intensities of the problem behaviors and the extent to which he/she or others may be hurt or injured from the problem behavior.

To assist in identifying precursors to dangerous problem behaviors that may be targeted in the functional analysis instead of more dangerous problem behaviors:
8. Do the different types of problem behavior tend to occur in bursts or clusters and/or does any type of problem behavior typically precede another type of problem behavior (e.g., yells preceding hits)?

To determine the antecedent conditions that may be incorporated into the functional analysis test conditions:

9. Under what conditions or situations are the problem behaviors most likely to occur?

10. Do the problem behaviors reliably occur during any particular activities?

11. What seems to trigger the problem behavior?

12. Does problem behavior occur when you break routines or interrupt activities? If so, describe.

13. Does the problem behavior occur when it appears that he/she won’t get his/her way? If so, describe the things that the child often attempts to control.

To determine the test condition(s) that should be conducted and the specific type(s) of consequences that may be incorporated into the test condition(s):

14. How do you and others react or respond to the problem behavior?

15. What do you and others do to calm him/her down once he/she engaged in the problem behavior?
16. What do you and others do to distract him/her from engaging in the problem behavior?

In addition to the above information, to assist in developing a hunch as to why problem behavior is occurring and to assist in determining the test condition(s) to be conducted:

17. What do you think he/she is trying to communicate with his/her problem behavior, if anything?

18. Do you think this problem behavior is a form of self-stimulation? If so, what gives you that impression?

19. Why do you think he/she is engaging in the problem behavior?
Caregiver Preference Assessment Interview

(Conroy, 2008)

Child’s ID: ____________________________ Caregiver/Interviewee: __________________________

Primary Interviewer: ____________________ Date of Interview: ______/_____/_______

The purpose of this interview is to identify what toys/routines/activities your child likes when you are playing with him or her and what toys/routines/activities your child is more neutral about engaging in with you. We want to focus on toys/routines/activities that require both of you to play together (e.g., Lego’s, cars, tickling, peek-a-boo) rather than toys/routines/activities that your child might play with alone (e.g., watching a video).

Please list 3 toys/routines/activities that your child enjoys playing together with you

1. 

2. 

3.

Please list 2 toys/routines/activities that your child engages in with you but are not necessarily as enjoyable as the first three you listed.

1. 

2.

In this section, we want to learn ways that you and your child typically play together with each of the toys/routines/activities you listed. For example, you may use Legos to build a tower with your child or take turns tickling your child.

1. ________________ Can you describe ways you and your child typically play with this together?

2. ________________ Can you describe ways you and your child typically play with this together?

3. ________________Can you describe ways you and your child typically play with this together?
4. _________________ Can you describe ways you and your child typically play with this together?

5. _________________ Can you describe ways you and your child typically play with this together?

In this section of the interview, we want to identify words and/or gestures or vocalizations (e.g., pointing, reaching, naming) your child uses to communicate that she or he does not like something and wants to escape the situations (e.g., to indicate s/he is finished playing with you, s/he wants to be left alone, you or other people are too close to her/him or does not like a current toy/activity/routine).

Can you list any sounds or words your child uses to try to communicate that she/he wants to escape situations?

Can you list any gestures your child uses to try to communicate that she/he wants to escape situations?

Can you list any challenging behaviors (e.g., crying, tantrum) that your child engages in if she or he wants to escape a social situation?
In this section of the interview, we want to identify words and/or gestures or vocalizations (e.g., pointing, reaching, naming) your child uses to communicate that she or he wants to gain your social attention (e.g., wanting you to talk with her/him).

Can you list any sounds or words your child uses to try to communicate that she/he wants to gain your attention?

Can you list any gestures your child uses to try to communicate that she/he wants to gain your attention?

Can you list any challenging behaviors (e.g., crying, tantrum) that your child engages in if she or he wants to gain your attention?

In this section of the interview, we want to identify words and/or gestures or vocalizations (e.g., pointing, reaching, naming) your child uses to communicate that she or he wants to gain access to preferred toys/routines/activities (e.g., wants you to tickle him or her).

Can you list any sounds or words your child uses to try to communicate that she/he wants to gain access to a toy/routine/activity?

Can you list any gestures your child uses to try to communicate that she/he wants to gain access to a toy/routine/activity?

Can you list any challenging behaviors (e.g., crying, tantrum) that your child engages in if she or he wants to obtain a favorite toy/routine/activity?
### ABC (Antecedent – Behavior – Consequence) Chart

Child’s ID: ___________________________
Caregiver/Family Present: ______________
Primary Observer: ______________
Date of Observation: _____/_____/______
Time: _____ to ______ Length of observation _______ Setting ______________

<table>
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<th>Time</th>
<th>Setting Events</th>
<th>Antecedent</th>
<th>Behavior</th>
<th>Consequence</th>
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Trial-Based Functional Analysis Planning Form

Child’s ID: ________________ Caregiver/Family Present: ______________________
Primary Researcher: _______ Date of Meeting: ______/______/__________
Time: ____________ to ________________ Length of meeting ______________ min

Definition of problem behavior(s):

Hypothesized function(s):

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<thead>
<tr>
<th>Condition</th>
<th>YES/NO</th>
<th>Modifications</th>
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<td>Escape</td>
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<td>Ignore</td>
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<tr>
<td>Escape + Tangible</td>
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<tr>
<td>Attention + Tangible</td>
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<tr>
<td>Other</td>
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Additional components to the conditions (e.g., materials, routines, people)
Child’s ID: ____________________________

<table>
<thead>
<tr>
<th>Condition</th>
<th>Context</th>
<th>Materials</th>
<th>People</th>
<th>Test</th>
<th>Control</th>
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APPENDIX E
TBFA EXPERIMENTAL PROTOCOL

Materials: All relative stimuli identified during the pre-assessments for routine, timer, TBFA Planning Form, Trial-based FA Data Collection Form, TBFA Summary Form.

Location: All trials for the TBFA will be conducted in the participant’s home. The setting within the home will be determined by the selected routine and will then remain constant across additional trials.

Duration: All conditions will last up to 2 min (i.e., 1 min control segment, 1 min test segment). Data will be collected for 1 min following the conclusion of the test segment. A 5 min break between conditions will be used. Approximately 5-7 trials per home visit.

General Session Procedures:

- Use TBFA Planning Form to identify conditions and materials.
- Conditions should be determined based on the routines selected. Once all conditions are completed one time, return to first one, and repeat until response differentiation is achieved.
- Bring child to the area where the first routine will take place.
- Be sure that any relevant stimuli are in this area prior to beginning the session.
- Clear the setting of unnecessary materials not related to the conditions as best as possible (e.g., if conducting an attention condition, ensure highly preferred items are not available).

Videographer Instructions:

- Video equipment should be tested prior to beginning of the session to ensure that it is working properly.
- Videographer should frame the video to include people and materials. The priority should be to keep the video framed on the child at all times.
- Videographer will need to speak loudly so that they can be heard on the video clearly.
- Videographer should begin by stating the child ID and session number.
- Videographer will set the digital timer to 1 min, which would indicate the beginning of the control segment.
• Recording a TBFA trial
  
a) Videographer will state the condition [Say “This is tangible condition”]
  
b) Signal the beginning of the control condition by counting down and show timer on video as you start it. [Say “Control condition. 3, 2, 1 start”]
  
c) Transitioning to test
  
d) If the segment ends with no problem behavior, the videographer will signal the switch. [Say “Switch, test”]
  
e) If the segment ends with problem behavior, the PI will signal the switch. [PI will say “Switch, test”]
  
• End of a trial
  
a) If the test segment ends with no problem behavior, the videographer will signal the end of session. [Say “Session”]
  
b) If the test segment ends with problem behavior, PI will signal the end of session. [PI will say “Session”]
  
• Continue to videotape for an additional minute following the end of the condition.

Conducting the TBFA trials

• Following the start signal from the videographer, the PI will deliver the relative reinforcer (i.e., attention, tangible, removal of demand, or combination of these) for the entire control segment.
  
a) Attention control includes continuous positive attention throughout the 1 min approximately every 15 s. The videographer should signal the PI every 15 s to ensure this occurs.
  
b) Tangible control includes continuous access to the highly preferred item identified during the pre-assessments. This item should be able to be removed from the setting easily (e.g., a TV is difficult to remove so should not be used if possible).
  
c) Escape control includes access to quality attention and moderately preferred items. No demands, even in the form of a question, should be delivered during the control condition. The highly preferred item identified for the tangible condition should not be present unless this is a combined contingency condition. Moderately preferred and items typically in the space can be available.
  
• Control segments end contingent on problem behavior or the passage of 1 min.
After the control segment is complete, the videographer will be reset for 1 min, which signals the beginning of the test segment of the condition.

Test segments end contingent on problem behavior. On the first instance of problem behavior, the PI will deliver reinforcer and data collection will begin on frequency of behavior for 1 min following the conclusion of the test segment.

If problem behavior does not occur during the test segment, the timer will indicate the end of the test segment after 1 min and the 1 min data collection session will begin.

A 5 min break will be used between the presentations of each condition.

An incorrect trial (i.e., the procedures were not implemented as intended) will not be counted for the TBFA. This condition must be redone at a later time.

Attention Test Procedures

- When prompted, PI will tell the child, “Ok, I have work to do” and turn away. PI will stay near by the child but will not interact.

- If any problem behavior occurs, PI will immediately interact with the child, as the caregiver typically would. Examples include: “Don’t do that” or “Stop, that hurts me”

Tangible Test Procedures

- PI will take away the highly preferred item and say, “All done” or “My turn” and begin to manipulate the item. PI will not make eye contact with the child or interact with him/her at all.

- If problem behavior occurs, the item will be immediately returned to your child and PI will say, “Ok you can have it”.

Escape Test Procedures

- PI will begin this condition by giving the child an instruction. Example include: “Eat your dinner” or “Time to work.”

- If the child does not comply with the instruction within 5 s, PI will use least to most prompting to help the child through the task using a verbal or gestural prompt. If the child still does not comply with the instruction after another 5s, PI will physically prompt them using hand over hand. An example of a physical prompt is holding a hand while child is holding the spoon and scooping up food.

- If child follows the direction, PI will give them praise (e.g. “thank you for eating”) and wait 5s before giving another instruction.
• If problem behavior occurs, PI will say “Ok you don’t have to ___” and stop all prompting.

**Escape + Tangible Test Procedures**

• PI will remove the highly preferred tangible from the child and immediately give an instruction to complete a task. Examples include: “Ok, play time is over, it is time to go to the table for dinner.”

• If problem behavior occurs, PI will say, “OK, you don’t have to. Here is your _____” and deliver the tangible item.

**Data Collection**

• All TBFA will be videotaped for data collection.

• Data will be recorded via pencil and paper from video within 24 hours by trained data collection project staff.

• Using the data collection form
  
a) Complete the top section prior to the start of the session. This requires indicating the child ID, date, researcher initials that is completing the TBFA, setting in home, activity, and target behaviors. One data collection form will be used per date.

b) Indicate the trial number, and condition.

c) Use the codes that correspond to the condition being conducted (i.e. ATT during attention, TANG during tangible, INSTRUC during escape) to indicate which stimuli are present during the trial.

d) Indicate the presence or absence of the problem behavior during the condition by circling the plus (+) or minus (-).

e) For fidelity purposes, indicate if the PI reinforced or ignored any other behaviors (e.g., those that were not targeted during the TBFA) and if the transition to the test segment was appropriate (e.g., test segment began after the passage of 1 min or contingent on problem behavior).

f) Tally all instances of communicative responses during the length of each segment.

g) Begin tallying frequency of problem behavior during 1 min following the conclusion of the test segment.

h) Repeat procedures for the test condition.
i) For fidelity purposes, indicate if delivery of the reinforcer occurred contingent upon problem behavior.

- A second data collector will also complete data collection form via video for 40% of trials conducted across participants.
- Videos will be chosen for IOA and fidelity. PI will ensure that videos that are chosen are equally spread across all programmed conditions. See procedures for IOA and fidelity for detailed protocol for these measures.

Data Analysis

- After each session is complete (approximately 5-7 trials per visit), data will be transferred to the TBFA Summary Form that will be an Excel spreadsheet located on the secure server. This divides the data by condition. Example shown here:

*Example of a completed summary form for one condition*
Determining response differentiation

- A minimum of 5 trials of each condition will be completed.
- After 5 trials of one condition are complete, determine the overall response rate of the occurrence of problem behavior in test and control segments.
- Differentiation between the test and control has to be at least 20% or more.
APPENDIX F
DATA COLLECTION FORMS
Trial-based Functional Analysis- Data Collection Form

Participant: ___________ Session Date ___________ Code Date ___________ Researcher: ___________
DC: ________ IOA: Y  N IOA Initials ___________
Setting: ___________ Activity: _________________
Target behavior(s): _______________________________

Instructions: For each of the conditions, indicate the relevant stimuli presented during the trial. Indicate whether the problem behavior did (+) or did not (-) during the condition.

Code condition (C): A = Attention, T = Tangible, E = Escape; PB = Problem behavior; Bx = reinforce the correct behavior (+), reinforce the incorrect behavior (-); Tran = transition; Comm. = communication; END = appropriate end of test segment; Fidelity = # of correct steps out of 5

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<th>#</th>
<th>C</th>
<th>ATTN</th>
<th>TANG</th>
<th>DEMAND</th>
<th>PB</th>
<th>Bx</th>
<th>Tran.</th>
<th>Comm.</th>
<th>ATTN</th>
<th>TANG</th>
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<th>Frequency</th>
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(Adapted from Lloyd et al. 2015)
# Trial-based Functional Analysis – Summary Form (Excel File Example)

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Operation Definition of Target Behaviors (s):

Results of TBFA

<Graphs here>

Function of Behavior: The behaviors are functioning to ___________________. Preffered items used in the TBFA include ________________.

Communicative behaviors: ______________________________________

Description:

Setting: In order to implement the intervention effectively, intervention will be implemented in a designated area of the home that can be cleared of distractions. Following increases in communicative responses in that setting, the intervention will be conducted in naturalistic setting in the home.

Setting for instruction:

Generalization setting:

Duration: Intervention will be implemented in the home 2-3 times a week at a time agreed on by caregiver and therapist for one hour. Each intervention session will be 5 min and approximately 3-5 sessions will occur during each intervention visit. Trials will be continuously presented during each session and may vary in number due to child behavior.

Day(s) of the week:

Time:

Materials: Preferred items will be chosen by the caregiver and therapist and might include edibles, toys, or TV. Before each session, preference assessment will be conducted using the following steps: (1) three items will be presented and your child will be asked to choose one, (2) the chosen item will be removed and your child will be asked to choose between the two remaining items. Generalized communication cards will include pictures for toys, edibles, and electronics.
Preferred items to use in the training
1.
2.
3.

**Procedures:** The intervention will take place in four phases: (1) Baseline, (2) Functional Communication training, (3) Delay to reinforcement training.

**General Procedures (for all phases)**
- Each session will include 5 trials and will be followed by a 5 min break.
- Sessions will not begin if [CHILD] is engaging in problem behavior.
- All relative materials (e.g., see materials section) will be in view including preferred items and communication cards that will be used for the intervention.
- Remind [CHILD] of a reinforcer (e.g., favorite movie/TV show, special snack) that he will receive for remaining in the area. This will be determined by the caregiver prior to the session and will only be delivered contingent on remaining in the intervention area.
- Access to the preferred item/edible paired with positive attention will be given prior to beginning each session similar to the control condition of the TBFA.
- If problem behaviors escalate to dangerous levels at any point in the intervention, the crisis management plan will be implemented. Decisions about continuing the sessions will be made based on this plan.

**Baseline**
The purpose of baseline is to identify level of problem behavior and communicative skills prior to the intervention. Typically, three baseline sessions will be needed before intervention. The following steps will be used in a baseline session:
- Therapist will begin the trial by ______________________________.
- Problem behavior will result in 30 s access to _________________.
- The communicative response (use of the picture card and/or vocal response) will result in access to _________________ as well if they occur.
- After the 30 s, the ____________________will be removed again beginning the next trial.
- These procedures will be repeated until 5 trials have been completed.

**Functional Communication Training (FCT) + Extinction**
The purpose of this phase is to teach a functionally equivalent communicative response to problem behavior. For this intervention, the functionally equivalent response will be _________________________________.
- Procedures will be the same as the test condition in the tangible trials of the trial-based functional analysis and baseline as described above. The therapist will
begin the trial by removing ______________________ and delivering a verbal instruction.

- The verbal instruction will indicate that the reinforcer is being removed (e.g., “All done”) and provide an instruction on exactly how [CHILD] should communicate to access the item. For example, the verbal instruction could be “If you want the ______, give me the card.”

- **Begin with a 0 s prompt delay.**
  - Immediately following the verbal instruction, therapist will use a physical prompt (i.e., hand over hand) to prompt the picture card paired with a vocal (e.g., “I want _____, please.”).
  - After the prompt, the reinforcer will be delivered for 30 s paired with verbal praise (e.g., “Thank you for asking, here is your ______.”).
  - All prompted or independent communicative behaviors will result in access to the reinforcer for 30 s.

- **Extinction procedures**
  - Extinction will be used in combination with the FCT by discontinuing previous reinforcement for problem behaviors. This procedure will be applied consistently to every instance of problem behavior.
  - If [CHILD] engages in problem behavior following the verbal instruction, the therapist will wait for a 3s break in the behavior and present the verbal instruction again.
  - The following procedures will be followed:
    - Problem behavior no longer results in access to preferred items/activities. If the problem behavior is observed, reinforcement in the form of delivering the tangible/attention/escape will not occur.
    - Planned ignoring will be used for disruptive behaviors such as screaming or throwing objects that are not breakable or harmful to another person (e.g., clothing). Therapist will not vocally respond or redirect these behaviors.
    - Therapist will not vocally respond to any instances of aggression including instances of items being thrown directly at a person. Therapist will either turn away from KA or move out of arm or leg reach. Items that are being thrown will be removed from the setting. If behaviors continue during extinction, the crisis management plan will be implemented.
  - Prompt delays will be systematically increased.

**FCT + EXT + Delay to Reinforcement**

Delay to reinforcement will be added to the FCT + EXT procedures described above. The purpose of these procedures is to teach [CHILD] to wait for a tangible when it is not immediately made available.
The sessions will be similar to those of baseline and initial FCT + EXT training. The therapist will begin by removing the reinforcer.

If a request for item does not occur after 5 s, the therapist will prompt the response using the verbal instruction (e.g., “If you want ______, give me the card.”).

Therapist will deliver the verbal instruction every 5 s if the response is not emitted. If problem behavior occurs, therapist will wait for a 3 s break in the behavior before delivering the verbal instruction again.

Once the communicative response is emitted; the therapist will place a yellow card in front of [CHILD] and tell him “Thank you for asking for the ______. You need to wait.”

Delays will begin with 5 s and systematically increase. During the delay, therapist will hold the desired tangible (i.e., restrict access) and remove other attention (e.g., eye contact). Subsequent requests for the item during the delay will be ignored.

After the designated delay with no problem behavior, the yellow card will be removed.

The child will receive access to the reinforcer for 30 s (similar to the FCT procedures) if the communicative response is emitted and the delay is tolerated (e.g., no problem behavior).

Programmed delays will be increased by 5 s for every three sessions with no problem behavior and 100% trials of appropriate tolerating of the delay.

Varied schedules of waiting will be used (e.g., ranging from no wait to 30 s wait time before the reinforcer is delivered).

Extinction procedures described above will continue during this experimental phase.

If [CHILD] engages in problem behavior following the verbal instruction, the therapist will wait for a 3s break in the behavior and present the verbal instruction again.

Termination of services

1. After successful transfer of skills (i.e., 100% responding without problem behavior for 3 trials) from the training session to the home routine occurs, the services will be faded out.
   o Weekly sessions will decrease to 1 session per week and then to a consultative basis.
FCT + EXT procedures will be modeled for the caregiver.

Caregiver will practice FCT intervention with the therapist present.

2. If additional services are needed, therapist will assist caregiver in identifying the appropriate outlets to seek out those services.

Crisis Management Plan - Example

*Note: Individualized per Participant*

The purpose of this plan is to manage behaviors that present an extreme and immediate risk to the safety and well-being of KA or others in the environment. Crisis management procedures should be implemented if the intervention is not immediately feasible or safe. At this time, the goal of the procedures will be to de-escalate and manage dangerous behaviors.

**Prevention**

- Protective clothing (e.g., long sleeves, long pants, closed toe shoes) should be worn during all sessions. This will prevent access to exposed skin for scratching.
- Assess the current setting to determine the safest place to implement the procedures. Be sure that the setting is clear of dangerous objects that could be used to hurt others or self.
- Increase the use of positive behavior specific praise for appropriate behaviors (e.g., sitting, remaining in the area, using communicative responses to initiate or respond).
- Allow for at least a 5 min break in between sessions. Allow movement during the breaks and continue to reinforce all appropriate behaviors.

**Escalation**

- Extinction procedures will be used for instances of screaming. No attention will be delivered (e.g., “Don’t scream” or “quiet”) for screaming behavior and all instances will be ignored.
- Identify precursor behaviors. In KA’s case, screaming and falling to the ground often occur prior to more physically dangerous behavior (e.g., aggression, throwing items). If precursor behaviors occur, no attention will be given. If these behaviors occur during a break, the intervention session will not begin until these behaviors end.
- If aggression occurs in one instance, but then does not occur within the next 10 s, intervention procedures can continue.
Therapist will allow for a break that is longer than 5 min (e.g., 10 min) if some problem behavior has been observed during a session. Length of the break will be tracked on the data collection form.

Judgment about continuation of the sessions can be made at this time. If behaviors discontinue, intervention procedures can continue. If there are still signs of precursor behaviors, then the session will be terminated.

Use of a calm, neutral tone during the session and increased behavior specific praise for all other behaviors than problem behavior. For example, when a precursor behavior is discontinued such as screaming the therapist will say, “I like how quiet you are” or “I like the way you are talking right now.”

Crisis

If aggression continues for 5 min, then crisis management plan will be implemented.

Therapist and data collector will move out of reach of KA and place something (e.g., chair) in between them and him.

Eye contact and other attention will be minimal as this results in increased intensity of problem behavior.

If needed, therapist and data collector can leave the area but continue to monitor KA for safety. Limit the amount of physical contact while KA is engaging in aggression.

Block attempts to elope (e.g., run) from the area.

Discontinue crisis management procedures if KA demonstrates appropriate compliant behaviors.

Slowly, re-engage KA in the intervention procedures.

Increase reinforcement for appropriate behaviors

Observe for precursor behaviors and take precautions described under “Escalation”

Direct KA to complete any task that was delayed by the problem behavior and to restore the setting to the condition it was prior to the behavior (e.g., pick up any thrown items)

If aggression continues following the initial procedures and does not show signs of decreasing, data collector will notify the caregiver of the aggression while therapist monitors the behaviors.

Caregiver can attempt to calm KA while remaining within a safe distance.

Sessions will be terminated for this visit if the caregiver is unable to calm KA in the intervention setting.
# Intervention - Data Collection Form

(Adapted from Lloyd et al. 2015)

## Participant: _____ IOA: Y N

Researcher: _____ IOA Initials _______

Target behavior(s): ________________

Condition ________________________

### Instructions:

For each condition, indicate the relevant stimuli presented during the trial. Record if this is a BL (baseline) or INT (intervention). Indicate time between verbal instruction and delivery of prompt (INT only). Write NA if no prompt was needed. Tally if multiple verbal instructions are presented in the trial in the OTR column. Tally frequency of problem behavior and communication. Indicate the start and end time for reinforcement and the number of s reinforcement was delivered in the R+ column. All shaded columns represent fidelity measures. For fidelity, record the number of steps (out of 4) that were completed correctly.

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<th>TANG</th>
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APPENDIX G
DATA MANAGEMENT & STORAGE GUIDELINES

- All consent forms will be stored in a locked cabinet in the Anita Zucker Center for Excellence in Early Childhood Studies away from raw data.
- Raw data forms will be scanned and stored in a locked cabinet in an office in the College of Education.
- All data will be stored on the University of Florida’s secure server.
  - Data collectors will be given permission to access the server.
  - Data to be stored on the server include:
    - Video files of TBFA, baseline, direct instruction, intervention sessions
    - Scanned raw data collection forms
    - Excel files and graphs
- Files will be named using the following unique IDs:
  - **TBFA**
    - Child Participant ID _ Session # _ Condition Type _ Date using MM.DD.YYYY_Data collector initials
      - Example: 100_S2_Attention_01.30.2017_DP
  - **Baseline & Intervention**
    - Child Participant ID_BL or IN_Routine #_Session # _ Date MM.DD.YYYY_Data Collector initials
      - Example for baseline: 100_BL_R1_S2_01.31.2017_DP
      - Example for intervention: 100_IN_R2_S1_02.01.2017_DP
- Data collectors will access the videos via the server. Each data collector will have a folder on the server with his or her name as the label. Data collectors’ folders will contain three additional folders: “TBFA”, “Direct Instruction”, and “Intervention”.
  - Within each folder for secondary data collectors, there will be subfolders for “IOA” and “Procedural Fidelity.”
  - Once they are done coding the videos, data collectors will update Excel files and graphs in their appropriate folders.
APPENDIX H
SOCIAL VALIDITY FORMS

Acceptability of the TBFA
(Adapted from Lloyd et al. 2015)

Child Participant ID _______________________
Date _____/_____/_______
Respondent __________________ Relation to child ______________________

Instructions: Please rate the following items based on a 6 point Likert scale where 1 = strongly disagree and 6 = strongly agree.

1. This was an acceptable assessment for my child. 1 2 3 4 5 6
2. Most caregivers would find this assessment appropriate for their child’s problem behaviors. 1 2 3 4 5 6
3. I would suggest the use of this assessment to other caregivers. 1 2 3 4 5 6
4. My child’s problem behavior is severe enough to warrant the use of this assessment. 1 2 3 4 5 6
5. This assessment is NOT likely to result in negative side effects for my child. 1 2 3 4 5 6
6. This assessment is a fair way to handle my child’s problem behavior. 1 2 3 4 5 6
7. I liked the procedures used in this assessment. 1 2 3 4 5 6
8. Overall, this assessment was beneficial for my child. 1 2 3 4 5 6

Instructions: Please rate the following items based on a 6 point Likert scale where 1 = very different and 6 = very similar. Write in modified conditions as needed.

How similar was this trial to the events that your child typically encounters in your home setting?

Attention trial 1 2 3 4 5 6
Tangible trial 1 2 3 4 5 6
Escape trial 1 2 3 4 5 6

Please add any additional comments regarding acceptability of the TBFA here.
Acceptability of Intervention

(Adapted from Lloyd et al. 2015)

Child Participant ID ___________________________ Date _____/_____/_______
Respondent _____________________ Relation to child ______________________

Instructions: Please rate the following items based on a 6 point Likert scale where 1 = strongly disagree and 6 = strongly agree.

1. This was an acceptable intervention for my child. 1 2 3 4 5 6
2. Most caregivers would find this intervention appropriate for their child’s problem behaviors. 1 2 3 4 5 6
3. I would suggest the use of this intervention to other caregivers. 1 2 3 4 5 6
4. My child’s problem behavior is severe enough to warrant the use of this intervention. 1 2 3 4 5 6
5. This intervention is NOT likely to result in negative side effects for my child. 1 2 3 4 5 6
6. This intervention is a fair way to handle my child’s problem behavior. 1 2 3 4 5 6
7. I liked the procedures used in this intervention. 1 2 3 4 5 6
8. Overall, this intervention was beneficial for my child. 1 2 3 4 5 6
9. I saw improvements in my child’s behavior after the intervention was used. 1 2 3 4 5 6

Instructions: Please rate the following items based on a 6 point Likert scale where 1 = very different and 6 = very similar. Write in modified conditions as needed.

How similar was the trial component to the events that your child typically encounters in your home setting? 1 2 3 4 5 6

Please add any additional comments regarding acceptability of the intervention here.
LIST OF REFERENCES


g:1177/1088357618755695.


BIOGRAPHICAL SKETCH

Debra Ann Prykanowski earned her Doctor of Philosophy in Special Education with an emphasis in Early Childhood Studies from the University of Florida in 2018. Debra’s research interests are related to the (a) functional analysis of problem behavior in the natural environment; (b) assessment and intervention for young children with autism spectrum disorders; and (c) measurement of behavior in applied settings.

Prior to enrolling in the doctoral program at the University of Florida, Debra had 11 years of teaching experience in a public school district in northern New Jersey. In this district, she held positions as a special education teacher learning and/or language disabilities class (gr. 6-8), behavioral consultant (gr. Pre-K to 12), and special education teacher for a classroom for children with autism (gr. 1-3). She earned her Master of Arts in Special Education with an emphasis is behavioral disorders and applied behavior analysis from Teachers College, Columbia University in New York City in 2002. She earned dual Bachelor of Science degrees in Inclusive Elementary and Special Education and Sociology in 2001.

Following completion of her doctoral degree, Debra accepted a position as an assistant professor in the Reading and Special Education Department at Appalachian State University in Boone, North Carolina. She continues to serve children with ASD through teaching, research, and service.