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A Comparison of Traditional, Trial-Based, and Synthesized Contingency Trial-Based Functional Analyses

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A COMPARISON OF TRADITIONAL, TRIAL-BASED, AND SYNTHESIZED CONTINGENCY TRIAL-BASED FUNCTIONAL ANALYSES

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Kaitlin Suzanne Curtis

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DISCLAIMER

The work of this research project was a result of a collaborative effort with Kara Forck. Prior to the start of this study, both researchers developed the methodology and course of action for each subject. Additionally, both researchers assisted in the implementation of all methods, however, both reported the findings of their subject(s) independently. Therefore, all processes were exactly the same for all subjects, with both researchers demonstrating experimental control through a within-subject design. The assignment of subjects were alternated between the two researchers, therefore, two subjects participated in Kara Forck's, while only one subject participated in the current author's study. Only one subject participated in the current author's study due to the duration of the assessment process exceeding four months.

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Counseling, Leadership, and Special Education

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Master of Science in Education

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ABSTRACT

Researchers have developed functional analyses (FAs) to improve efficiency and correspondence that still use core components of the traditional format. The purpose of the current study was to evaluate the correspondence between the trial-based FA and the traditional FA. I also evaluated the correspondence between the synthesized-contingency trial-based FA and the traditional FA. Within this study, I determined that by combining methods, I was able to reduce false negatives for escape found within the trial-based FAs and false-positives found within the synthesized contingency FAs.

KEYWORDS: functional analysis, problem behavior, synthesized contingency, trial-based, autism

This abstract is approved as to form and content

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By

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CHAPTER I: INTRODUCTION

Roughly 64% of children diagnosed with Autism Spectrum Disorder (ASD) engage in problem behavior that may have a negative impact on their everyday lives (Murphy, Healy, & Leader, 2009). Furthermore, the prevalence of children with ASD who engage in problem behavior has been found to be relatively 10-15% higher when compared to other children diagnosed with other intellectual or developmental disabilities who engage in problem behavior (Emerson et al., 2001; Holden & Gitlesen, 2006; Santiago, Hanley, Moore, & Jin, 2016). Because these children are at an increased risk of lower performance in school and within the community, it is crucial to identify function-based treatments to reduce problem behavior (Beavers, Iwata, & Lerman, 2013).

Horner, Carr, Strain, Todd, and Reed (2002) stated that behavior is maintained by its *functional effect* and in order to reduce problem behavior, functions should be identified through the use of functional behavioral assessments (FBAs). In the field of behavior analysis, functional analyses (FAs) are considered the most rigorous functional assessments that identify behavioral function (Beavers et al., 2013; Hanley, 2012; Iwata & Dozier, 2008; Fisher, Greer, Romani, Zangrillo, & Owen, 2016).

The "traditional" FA was first reported by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994), who used a multi-element design to compare problem behavior in a control condition to several test conditions. Recent reviews (Beavers et al., 2013; Hanley, Iwata, & McCord, 2003) have found that most studies published in the field of behavior analysis using FAs, have used methods at least similar to those described by Iwata et al. The traditional arrangement has been named the "gold standard" of FAs, as it

is the only format that entails repeated exposure to conditions and requires multiple exposures to contingencies in each session (Hanley et al., 2003; Iwata & Dozier, 2008).

Researchers have since identified limitations within the traditional FA, such as time spent in assessment and resources required for the assessment (Iwata & Dozier, 2008). Accordingly, numerous variations of FAs have been developed that include shorter sessions, modifications that allow FAs to be conducted in nonclinical settings (e.g., Cooper, Wacker, Sasso, Reimers, & Donn, 1990), and the use of behavioral dimensions other than response rate (e.g., Thomason-Sassi, Iwata, Neidert, & Roscoe, 2011). Several studies such as Bloom, Iwata, Fritz, Roscoe, and Carreau, (2011) and Hanley, Jin, Vanselow, and Hanratty, (2014) have developed variations of FAs that help reduce some of the limitations discussed from the traditional FA. These specific variations include shorter durations of each segment and the environment in which the assessment is conducted within (trial-based FAs), or combining reinforcers within a single test condition (synthesized contingency FAs).

However, it is important to note that while these variations may reduce some of the limitations described by the traditional FA, researchers have still found limitations that should still be addressed. These limitations include false negatives or false positives for different functions of behavior. Through newly developed methods and replications of current FAs, researchers are finding ways to address limitations, to identify function(s) and effective treatments to reduce problem behavior in young individuals.

Purpose of the Study

The purpose of the current study was to evaluate the correspondence between the traditional FA (procedures similar to those used by Iwata et al., 1982/1994) and a synthesized-contingency trial-based FA (STBFA; Forck, 2017), consisting of synthesized contingencies evaluated within a trial-based format. The current study also compared both FAs to the original trial-based format (TBFA; Bloom et al., 2011; Bloom, Lambert, Dayton, & Samaha, 2013; Lambert, Bloom, & Irvin, 2012; Lambert, Bloom, Kunnavatana, Collins, & Clay, 2013; LaRue et al., 2010), in order to evaluate whether the STBFA reduced false negatives relative to the original format.

Significance of the Study

To address the shortcomings of the various FA formats, methods to assist in the FBA process are continuing to evolve. Specifically, researchers are evaluating the extent to which current FA methods are more susceptible to false positives or false negatives when determining the function of the behavior. Therefore, the current study added to the literature in three ways:

1) This study was the second (Forck, 2017) to evaluate the reliability of an STBFA by comparing results to those produce by the traditional FA format.

2) It was the second study (Forck, 2017) to evaluate whether the STBFA decrease the likelihood of false negatives relative to TBFAs.

3) It was one of the few studies (the fourth) to evaluate correspondence between traditional and TBFAs.

Research Questions

In order to compare results from the TBFA, STBFA, and the traditional FAs, three research questions were assessed:

1. What is the extent to which results from the STBFA correspond to results from the traditional FA?

2. What is the extent to which results from the TBFA correspond to results from the traditional FA?

3. What is the extent to which the STBFA reduces the likelihood of false negatives relative to the TBFA?

Research Hypothesis and Design

I hypothesized that combining the synthesized-contingency (Hanley et al., 2014) and TBFA methods (Bloom et al., 2011) would decrease the likelihood of false negatives relative to the TBFA and when compared to the traditional FA.

A multi-element design (Kazdin, 1982, 2011) was used to compare the test and control conditions of the traditional FA. Each test condition (i.e., attention, tangible, and escape) was compared to the control (i.e., play). Elevated rates in a test condition relative to the control indicated a function. Because responding in each test condition was compared to play, it was possible that multiple functions were identified.

Assumptions and Limitations

Based on previous research within the literature, the following assumptions were made for the current study:

1. The traditional FA will identify the "true" function(s) of problem behavior.

2. The participant's problem behavior will be maintained by multiple functions.

Additionally, the study had the following limitations:

1. The study was conducted with only one participant.

2. This study was conducted in a clinical setting with contrived environmental events rather than naturally occurring events for all FAs.

3. As part of the study, treatment data were not reported.

Terminology

1) Abolishing Operation (AO): "A motivating operation that decreases the reinforcing effectiveness of a stimulus, object, or event," (Cooper, Heron, & Heward, 2007, p. 689).

2) Applied behavior analysis (ABA): "The science in which tactics derived from the principles of behavior are applied to improve socially significant behavior and experimentation us used to identify the variables responsible for the improvement in behavior," (Cooper, Heron, & Heward, 2007, p. 690).

3) Antecedent: "An environmental condition or stimulus change existing or occurring prior to a behavior of interest," (Cooper et al., 2007, p. 689).

4) Consequence: "A stimulus change that follows a behavior of interest," (Cooper et al., 2007, p. 692).

5) Establishing operations (EO): "An antecedent that increases the value of a reinforcer and evokes behavior that has produced that reinforcer in the past," (Cooper et al., 2007, p. 695).

6) Functional analysis (FA; as part of functional behavior assessment):
   "An analysis of the purpose (functions) of problem behavior, wherein antecedents and consequences representing those in the person's natural routines are arranged within an experimental design so that their separate effects on problem behavior can be observed and measured; typically consists of four conditions: three test conditions—contingent attention, contingent escape, and alone—and a control condition in which problem behavior is expected to be low because reinforcement is freely available and no demands are placed on the person," (Cooper et al., 2007, p. 696).

7) Functional behavior assessment (FBA): "A systematic method for obtaining information about the functions of problem behavior; results are used to guide the

design of an intervention for decreasing problem behavior and increasing appropriate behavior "(Cooper et al., 2007, p. 696).

8) Interobserver agreement (IOA): The degree to which two or more independent observers report the same observed values after measuring the same events (Cooper et al., 2007, p. 698).

9) Mand: "An elementary verbal operant that is evoked by an MO and followed by specific reinforcement," (Cooper et al., 2007, p. 699).

10) Reinforcer: "A stimulus change the increases the future frequency of behavior that immediately precedes it," (Cooper et al., 2007, p. 702).

11) Tact: "An elementary verbal operant evoked by a nonverbal discriminative stimulus and followed by generalized conditioned reinforcement," (Cooper et al., 2007, p. 705).

12) Treatment integrity: "The extent to which the independent variable is applied exactly as planned," (Cooper et al., 2007, p. 707).

CHAPTER II: REVIEW OF RELATED LITERATURE

Kanner (1943) was the first to discover evidence of a distinct disorder that differed from prevailing communicative and behavioral disorders (e.g., “turning inward"; Bleuler, 1911), which is known as Autism Spectrum Disorder (ASD). According to the Diagnostic and Statistical Manual of Mental Disorders 5th edition (DSM-5), ASD is an early onset, pervasive and neurodevelopmental disorder that is characterized by repetitive behaviors and interest and difficulty with communication and social interactions (American Psychiatric Association, 2013). Based upon data from the Center for Disease Control and Prevention (2014), ASD affects as many as 1 in 68 children.

Roughly 64% of individuals diagnosed with ASD display problematic behavior, including aggression, self-injurious behavior (SIB), elopement, and property destruction (Murphy et al., 2009), which are often detrimental to the individual’s education and integration in society. For example, individuals who engage in severe behavior may experience medication, institutionalization, or the removal from least restrictive environments within the school setting (Horner et al., 2002; Simpson, de Boer-Ott, & Smith-Myles, 2003). Additionally, Mandell et al. (2008) found that 56% of children with ASD who engage in problem behavior have been prescribed at least one medication; some of which are associated with undesirable side effects (e.g., weight gain, tics). Accordingly, both educators and researchers are constantly developing and evaluating methods of behavioral assessment and treatment with the goals of eliminating such behavior.

Function-Based Interventions

Function-based interventions are those that are specifically based on the function of problem behavior (Cooper, Heron, & Heward, 2007; Cowdery, Iwata, & Pace, 1990). The term *function* has been used to determine the effect that behavior has on the environment, specifically the variables that maintain it (Cooper et al., 2007). Function-based interventions may be juxtaposed with those that use arbitrary stimuli or attempt to override reinforcement contingencies with aversive control. For example, if problem behavior (e.g., aggression) is maintained by social-positive reinforcement (e.g., attention), a function-based intervention utilizes attention as a consequence for an alternative or incompatible response, or utilizes noncontingent attention as an antecedent to decrease its value to abate problematic behavior. In contrast, with the same scenario, an arbitrarily selected procedure might utilize highly preferred tangibles to increase an alternative response or arrange an aversive consequence, such as physical restraint, for problem behavior. Function-based interventions (e.g., differential reinforcement, noncontingent reinforcement, extinction) are preferable to arbitrary and punishment-based procedures, as the former are more effective and are considered more ethical (Hanley, Piazza, Fisher, & Maglieri, 2005; Horner et al., 2002). Extinction (withholding reinforcement for a previously reinforced response) is rarely used alone, but the effectiveness of the other reinforcement-based procedures is enhanced by including extinction as a treatment component (Hagopian, Fisher, Sullivan, Acquisto, & LeBlanc, 1998).

The differential reinforcement procedures consist of a variety of treatments that use the contingent delivery of a reinforcer to increase an alternative response (differential

reinforcement of an alternative response; DRA) or to decrease problem behavior (differential reinforcement of other behavior; DRO; Miltenberger, 2012). For example, DRA entails the therapist reinforcing the occurrence of an appropriate alternative response (e.g., compliance) that produces the same consequence as the reinforcer (e.g., escape) that maintains problem behavior (e.g., inappropriate vocalizations; Cooper et al., 2007). A variation of DRA includes functional communication training (FCT), in which the alternative response is specifically a communicative response (i.e., a request) (Carr & Durand, 1985).

A second differential reinforcement procedure includes DRO, which entails the delivery of a reinforcer following a period of time without problem behavior (e.g., Vollmer, Iwata, Zarcone, Smith, & Mazaleski, 1993). For example, if a child does not engage in problem behavior (e.g., throwing items) for a specified period of time (e.g., 30s), the reinforcer maintaining problem behavior (e.g., attention) is delivered.

Critical to the success of function-based interventions is that they are in fact incorporating the reinforcer that maintains problem behavior. Indeed, an intervention is not function-based, by definition, if it does not directly address the function of problem behavior. The function of problem behavior is determined through the process of FBAs, including FAs.

Functional Behavior Assessment and Functional Analysis

An FA entails the systematic manipulation of antecedents and consequences to identify functional relations between environmental conditions and problem behavior (Iwata et al., 1982/1994). Prior to an FA, both indirect and descriptive assessments are

recommended to gain information that may contribute to conditions evaluated in the FA (Cipani & Schock, 2011). Indirect assessments are those in which a clinician interviews an adult (e.g., caregiver, teacher) that has observed the individual's target behavior. Indirect assessments include open- or closed-ended questions, and may also assist in building rapport between the clinician and informant (Hanley, 2012). Indirect assessments (DeLeon & Iwata, 2005; Hanley, 2012) require less time than an FA and assist clinicians in developing operational definitions of problem behavior and FA conditions. However, indirect assessments tend to have poor reliability and low correspondence between traditional FA outcomes (Iwata, DeLeon, & Roscoe, 2013). Accordingly, direct assessments (descriptive and experimental) are recommended, which include direct observations of behavior. An example of a direct descriptive assessment includes the "ABC assessment," which entails recording problem behavior along with antecedents and consequences. Despite the increased validity of the descriptive assessments, they are associated with weaknesses, such as false positives for attention and false negatives for escape (Thompson & Iwata, 2007).

After both indirect and descriptive assessments are conducted, the clinician uses results to identify potential variables that may influence problem behavior, and then evaluates those variables in an experimental arrangement (i.e., FA). Typically, three to five generic conditions are evaluated in a traditional FA: social-positive reinforcement in the form of attention, social-negative reinforcement in the form of escape from demands, a control condition, and, less frequently, social-positive reinforcement in the form of tangibles or edibles, and a test for automatic reinforcement. Within each of these conditions, establishing operations (EOs) are arranged (i.e., deprivation for a putative

reinforcer), and corresponding consequences are delivered contingent on problem behavior (Michael, 1982). Social-positive reinforcement may include the contingent delivery of attention (e.g., reprimands, physical restraint, compliance with the individual's requests, attention delivered by peers or by more than one person), tangibles (e.g., preferred items or activities), or, albeit less frequently, edibles. Social-negative reinforcement involves contingent removal of aversive stimulation (e.g., demands, certain types of social interactions). To evaluate whether behavior is at least partially maintained by automatic reinforcement an "ignore" or "alone" condition is conducted in which no programmed consequences are delivered for the occurrence of problem behavior.

The original published report of the *traditional FA* was conducted by Iwata et al. (1982/1994) and was revolutionary in that it demonstrated across individuals that topographically similar SIB was maintained by different environmental variables. This study provided a general model for assessing the influence of reinforcement contingencies (positive, negative, and automatic reinforcement) on SIB with individuals with intellectual and developmental disabilities. In each condition, a single EO was arranged and the corresponding consequence was delivered contingent on the occurrence of problem behavior. For example, in the demand condition, the therapist presented the participant with an academic task using a three-step prompting procedure. Contingent on SIB, the therapist immediately ceased delivering demands and allowed a 30-s break. In the attention condition, a variety of toys were available for the participant to interact with, while the therapist stated she, "had work to do" and diverted her attention from the participant. Contingent on SIB, the therapist delivered attention in the form of statements of concern such as, "I don't like that" or "Don't do that." An alone condition was also

conducted in which the participant was placed in a room by himself/herself without access to toys or other materials; if SIB occurred consistently during this condition, SIB occurred at least in part due to automatic reinforcement.

During the unstructured play condition, all participants showed low levels of SIB. During the demand condition, two participants' problem behavior was elevated relative to play, therefore indicated an escape function. During the attention condition, one participant's problem behavior was elevated relative to the play condition, indicating an attention function. One participant showed high rates of problem behavior during the alone condition, indicating an automatic function. For two participants, responding varied across two or more conditions, in which Iwata et al. determined their behavior as undifferentiated.

Criticisms and Variations of Traditional FA

The traditional FA has since become the gold standard in the FBA process. Its utility has been demonstrated with individuals from multiple diagnostic categories, as well as with typically developing children. However, several criticisms of the traditional FA have been identified (Hanley, 2012). For example, the duration of the entire FA may be problematic in situations in which a limited amount of time is available for assessment (e.g., an outpatient clinic, classroom). In addition, FAs may be difficult to conduct in non-clinical settings, in which barren spaces are difficult to find. Finally, because severe problem behavior must be observed in order to assist in determining the function of those specific behaviors, it can be difficult to assure caregivers that the reinforcement of problem behavior is a necessary component of assessment. Some clinicians also express

concern regarding the complexity of the traditional FA. Although researchers have developed specific rules and procedures to train non-experts (e.g., college students, caregivers) to conduct FAs, explaining the rationale for FA to caregivers or educators may be challenging.

To address these concerns, clinicians have been evaluating variations of the traditional FA that retain their accuracy but require less time, can be conducted in non-clinical spaces, and result in the less frequent reinforcement of problem behavior. Examples include the *brief FA* (Cooper et al., 1990; Northrup et al., 1991), *latency FA* (Thomason-Sassi, Iwata, Neidert, & Roscoe, 2011), the *structured descriptive assessment* (Anderson & Long, 2002; Freeman, Anderson, & Scotti, 2000), *trial-based FA* (Sigafoos & Saggers, 1995; Bloom et al., 2011), and the *synthesized-contingency FA* (Hanley et al., 2014; Fisher et al., 2016; Jessel, Hanley, & Ghaemmaghami, 2016; Santiago et al., 2016; Slaton, Hanley, & Raftery, 2017; Strohmeier, Murphy, & O'Connor, 2017). To assess the reliability of these variations, results are typically compared to those found in the traditional FA (Iwata et al., 1982/1994).

Brief FAs (Cooper et al., 1990; Northup et al., 1991) were developed as a means to assess problem behavior in outpatient and classroom settings. The individual is exposed to test and control conditions with session durations ranging from 5-10 min, and as few as one test and one control session may be conducted. Some variations (e.g., Cooper et al.) involve the manipulation of antecedents only (e.g., difficult tasks and minimal attention throughout a session), while others (e.g., Northup et al.) involve both antecedent and consequent manipulations. Tincani, Castrigiavanni, and Axelrod, (1999) found exact correspondence (the same contingencies were identified) with three participants between

traditional and brief FAs. However, in other studies such as Derby et al. (1992), researchers found around 50% correspondence between the brief and traditional FAs conducted. Therefore, a limitation within brief FAs include difficulty identifying function of low rate problem behavior, as the brief format relies on one session per test condition (Iwata & Dozier, 2008; Tincani et al.).

Another example of an FA variation includes latency FAs, which entail the termination of sessions after the first instance of problem behavior and consequence delivery (Thomason-Sassi, Iwata, Neidart, & Roscoe, 2011). As with the traditional FA, multiple sessions of each condition are conducted. Latency FAs reduce the number of responses required within a session, which in turn may reduce the duration of the session because sessions are terminated contingent on problem behavior. However, this may also serve as a limitation because within latency FAs, only one instance of problem behavior can be emitted during each session, whereas in the traditional FA, multiple instances of problem behavior can occur.

Nevertheless, researchers have found correspondence between latency and traditional FAs, which is an improvement from the accuracy seen with brief FAs described above (Thomason-Sassi et al., 2011). For example, when Thomason-Sassi et al., (2011) conducted both latency and traditional FAs on 10 participants, nine showed exact correspondence between the two FAs.

A third FA variation includes structured descriptive assessments (SDAs), which involves systematically manipulating antecedent conditions only (Anderson & Long, 2002; Freeman et al., 2000). Caregivers generally conduct sessions and are given instructions to arrange conditions in which problem behavior is likely to occur. Further,

caregivers are instructed to react to the individual's behavior as they normally would in order to observe the naturally occurring consequences for problem behavior. For example, Anderson and Long (2002) arranged an attention condition by placing the caregiver in the room with the child and instructing the caregiver to not engage in any interaction with the child unless problem behavior occurred. They further instructed the caregiver to react as he or she typically would if problem behavior occurred. The purpose of this condition was to determine if problem behavior was sensitive to attention as a consequence. The authors then assessed problem behavior with a traditional FA, in which results from 3 out of the 4 participants (75%) corresponded exactly with those found with the SDA.

Researchers have recently begun evaluating trial-based FA formats (Bloom et al., 2011; Bloom et al., 2013; Lambert et al., 2012; Lambert et al., 2013; LaRue et al., 2010). The main difference between trial-based and traditional FAs is that the former utilizes a trial- rather than time-based format. In addition, trials are shorter (2-4 min) than the sessions (10-20 min) in the traditional format. A strength of the TBFA is that the trials are designed to be embedded into activities in the individual's environment (school setting).

Each condition in the TBFA is evaluated within a series of 10-20 trials. Each trial consists of control and test segments, with test segments following control segments. The control segment for a given condition consists of an abolishing operation (AO) for the reinforcer being evaluated in the test segment. Problem behavior in a control segment does not result in a programmed consequence; the segment is terminated and the test segment is begun. Problem behavior in a test segment results in the delivery of the

consequence associated with that condition (e.g., attention from therapist, escape from demands, access to preferred items). For example, throughout the control segment for attention, the therapist provides continuous attention to the participant. When the control segment elapses (or problem behavior occurs), the test segment is initiated during which the EO for the reinforcer being evaluated is arranged. For example, in the test segment for attention, the therapist turns away from the participant (i.e., removes attention) and only provides it contingent on problem behavior. Data are collected based upon the occurrence or nonoccurrence of problem behavior in each segment and are reported as the percentage of trials with problem behavior.

Some limitations of the TBFA include the importance of antecedent control (Bloom et al., 2011). TBFAs only allow problem behavior to occur once before the segment is terminated, whereas during a traditional FA there is an opportunity for repeated instances of problem behavior before the session elapses. There has been evidence that suggests promising correspondence between trial-based and traditional FAs; however, the shorter durations of trials may result in either, "limited exposure to EO during each of the trials, or limited exposure to relevant consequences" (Bloom et al., p. 29).

Researchers have classified the types of errors that result from FA variations as either "false negatives" (incorrectly failing to identify a function) and "false positives" (incorrectly identifying a function). Errors in a TBFA have resulted from false negatives with escape, attention, and tangible functions. Table 1 shows the comparisons of the TBFA and traditional FA in the correspondence studies conducted by Bloom et al. (2011) and LaRue et al. (2010).

Table 1. Correspondence between Trial-Based and Traditional FAs.

Article	Subjects	Correspondence	Functions		Trial-Based Error[1]
			Traditional	Trial-Based	
Bloom et al. (2011)	2	Exact	Escape		NA[2]
	2	Exact	Automatic		NA
	2	Exact	Tangible		NA
	1	Exact	Escape and Tangible		NA
	1	Exact	Attention		NA
	1	Partial	Escape, Attention, Tangible	Attention, Tangible	**False-Negative Escape**
	1	None	Escape	Attention	**False-Negative Escape** *False-Positive Attention*
LaRue et al. (2010)	3	Exact	Tangible		NA
	1	Exact	Attention		NA
	1	Partial	Escape	Escape and Tangible	*False-Positive Tangible*

[1] When exact correspondence was found there was no trial-based error. False-negative errors are bolded and false positive errors are italicized.
[2] NA = not applicable.

Synthesized-contingency FAs have recently been developed and some researchers (Hanley et al., 2014; Jessel et al., 2016; Santiago et al., 2016; Slaton et al., 2017; Strohemier et al., 2017) have pointed out that in the natural environment multiple EOs and consequences are often presented simultaneously. Further, in some assessment situations in which time is limited, the use of multiple EOs in a single test condition may evoke problem behavior in fewer sessions than when they are presented in isolation.

Accordingly, synthesized-contingency FAs involve arranging multiple EOs and consequences for problem behavior in a single test condition.

The first study on the synthesized-contingency FA was conducted by Hanley et al. (2014) and was used to, "increase the efficiency of the assessment process by using an open-ended interview to inform the design of individualized analyses" (p. 17). Hanley et al. situated the synthesized-contingency FA into an FBA process that included an open-ended interview to inform the combined contingencies to be evaluated within the FA; the authors termed this process an "interview-informed synthesized contingency analysis" (IISCA). For example, if a child exhibits problem behavior that may be sensitive to escape, tangible, and attention functions, all three are tested within the same test condition.

In the study by Hanley et al. (2014), three children with developmental disabilities (two of whom had diagnoses of ASD) participated in the IISCA process. Sessions ranged from 4-10 min and were conducted in a clinical setting. During a control condition, the putative reinforcers being evaluated in the test condition were available noncontingently. During a test condition, EOs were arranged for putative reinforcers being evaluated (e.g., attention deprivation and denied access of preferred items), and problem behavior resulted in the delivery of those reinforcers. For example, results from the open-ended interview for one participant suggested that problem behavior was maintained by either/both attention and/or access to preferred items. In the control condition, both tangible items and adult attention were available noncontingently. During the test condition, the therapist diverted her/his attention from the participant and removed preferred items. Contingent on problem behavior, the therapist delivered attention in the

form of a reprimand and returned preferred items to the participant for a 30-s access period.

In one of the first published studies comparing the IISCA process to traditional FA, Fisher et al. (2016) compared results from the IISCA to those from a traditional FA for five participants and found only partial correspondence for all participants (the fifth participant did not emit problem behavior in either the IISCA or traditional FA). Table 2 shows the errors found by Fisher et al. (2016).

Results from other investigations on the IISCA have been more promising (Slaton et al., 2017; Strohmeier et al., 2017). For example, Slaton et al. (2017) compared results from the IISCA to those from traditional FAs in terms of differentiation for nine participants and found that the IISCA resulted in differentiated responding for all nine. In contrast, the traditional FA resulted in differentiation for four participants (44%). With the four participants with differentiated traditional FA results, the authors then evaluated the effects of IISCA-based FCT (incorporating all reinforcers from the IISCA simultaneously) and traditional-FA-based FCT (only incorporating the reinforcer identified in the traditional FA). They found that the IISCA-based FCT was effective with all four participants but that the traditional-FA-based FCT was effective with only two of the four. Taken together, these results suggest that the IISCA can be more efficient (more quickly identifies function) and produces more valid results (informs more effective interventions) than the traditional format. Additionally, Strohmeier et al. (2017) also conducted a study comparing the IISCA and traditional FA, however, no correspondence was found between the two FAs. Correspondence results for Slaton et al. and Strohmeier et al. are also found in table 2.

Table 2. Results from Fisher et al. (2016), Slaton et al. (2017), and Strohmeier et al. (2017).

Article	Number of Participants	Degree of Correspondence	Functions		Synthesized Error
			Traditional	Synthesized	
Fisher et al. (2016)	1	Partial	Tangible	Attention Tangible Escape	False-Positive Attention and Escape
	1	Partial	Tangible	Tangible Escape	False-Positive Escape
	1	Partial	Tangible Escape	Attention Tangible Escape	False-Positive Attention
	1	Partial	Tangible	Attention Tangible Escape	False-Positive Attention and Escape
Slaton et al. (2017)	2	Exact	Tangible Escape		NA
	2	Partial	Escape	Attention Tangible Escape	False-Positive Attention and Tangible
	1	Partial	Escape	Escape Rituals[a]	False-Positive Rituals
	1	None	Attention	Tangible Escape	False-Positive Tangible and Escape False-Negative Attention
	1	None	Undiff	Attention Tangible Escape	NA
	1	None	Undiff	Attention Tangible Escape Stereotypy[b]	NA
	1	None	Undiff	Escape Schedules[c]	NA
Strohmeier et al. (2017)	1	None	Undiff	Tangible Escape	NA

Note: Undiff= undifferentiated (no function was determined). NA=not applicable. When exact correspondence was found, there was no error. [a] Escape to rituals. [b] Escape to toys, attention, stereotypy. [c] Escape to predictable schedules.

Jessel et al. (2016) replicated the IISCA with 30 participants to determine the extent to which the IISCA produced differentiated responding (the ability to identify a function based on different levels of responding in test and control conditions).

Additionally, Jessel et al. wanted to determine if the time required for the IISCA could be reduced while still holding true to the integrity of the experiment. For 26 of the 30 participants, (87%) the IISCA was replicated (i.e., produced differentiation between control and test conditions), which led the authors to identify key factors of the IISCA that facilitated differentiation. First, they were able to reduce carryover effects from one condition to the other because only two conditions were alternated within the analyses (i.e., a combined-test condition and a control condition). In addition, the authors pointed out that the IISCA addresses an issue related to AOs for problem behavior in control conditions of FAs in general. Control conditions in the IISCA are "matched" to test conditions, in that only reinforcers that evaluated in the test condition are presented noncontingently in the control. Thus, the relevant comparison to determine function is between conditions that provide the same set of reinforcers either noncontingently (the control) or contingently (the test). In contrast, test conditions in other FA formats compare control conditions in which all putative reinforcers are presented to individual test conditions in which multiple EOs are in fact present (e.g., in the attention condition highly preferred items are not available, technically EOs for both attention and highly preferred items) but only *one* reinforcer is delivered contingent on problem behavior. Thus, the relevant comparison entails control and test conditions that differ with respect to the availability reinforcers, which may result in differentiation between the conditions. Additionally, Jessel et al. also determined that the IISCA could be conducted in roughly 28 minutes, while the traditional FA conducted lasted roughly 90 minutes.

Forck (2017) developed the newest format, the synthesized trial-based FA (STBFA), which combined the trial-based methods by Bloom et al. (2013) and the

synthesized-contingency methods by Hanley et al. (2014). This variation of an FA tests at least two EOs (i.e., tangible and attention) within test and control segments in a trial-based format. During the control segments, multiple EOs were evaluated simultaneously. In other words, the participant has free access to tangibles and therapist attention, with no demands given. During the test segments, the reinforcers were withheld and only delivered contingent on problem behavior.

Forck (2017) compared this FA to the original trial-based and the traditional methods (Iwata et al., 1982/1994) to determine the degree of correspondence across FAs. Forck (2017) evaluated two participants in which found exact correspondence for participant one and partial correspondence for participant two. For participant two, the results determined a false positive for escape within the TBFA and found false positive for attention within the STBFA.

Summary and Purpose of Current Study

Researchers are developing new methods to assist in the FBA process, specifically to address criticisms associated with traditional FA. Some FAs are more susceptible to false positives (e.g., Fisher et al., 2016) or false negatives (e.g., Bloom et al., 2011) when determining the function of problem behavior. The purpose of the current study was to evaluate the correspondence between the traditional FA (procedures similar to those used by Iwata et al., 1982/1994) and a new format, an STBFA (procedures similar to Forck, 2017), which consists of synthesized contingencies evaluated within a trial-based format. The current study also compared both FAs to the original trial-based

format in order to evaluate whether the STBFA reduces false negatives relative to the original format.

CHAPTER III: METHODOLOGY

Subject, Setting, and Experimental Sequence

A Human Subject Institutional Review Board (IRB) application was submitted prior to the initiation of this study. The Missouri State University IRB approved the study on January 24, 2017 (See Appendix A for Missouri State University State Institutional Approval letter). In addition to IRB approval, informed consent from guardians were obtained (See Appendix B for informed consent form).

Caleb (a pseudonym) was a 4-year-old male referred for the assessment and treatment of problem behavior by a local ASD diagnostic clinic. Caleb had received medical diagnoses of ASD and ADHD immediately prior to the study. Caleb engaged in multiple topographies of problem behavior (aggression, property destruction, and negative vocalizations). However, only aggression and negative vocalizations were targeted for this study, as it was unclear whether all topographies comprised the same response class. Caleb had emerging echoic and vocal mand and tact repertoires. When manding, Caleb would point to an object or person or model what he wanted the therapist to do (e.g., run around the room when he wanted the therapist to chase him). Caleb followed 1-step instructions and often engaged in high rates of mands throughout sessions.

The assessments were conducted in the following order: TBFA, STBFA, and traditional FA. Assessments were conducted in this order to obtain the most valid results in a given assessment. The TBFA was conducted prior to the STBFA, because multiple consequences were provided for problem behavior in the latter format. Had the STBFA

been conducted first, behavior in the TBFA may have occurred due to a history of producing multiple consequences in the STBFA. The traditional FA involves the highest frequency of exposures to contingencies and therefore was conducted last. A different individual served as the therapist for each condition and wore a specific colored shirt to aid in discrimination of contingencies in effect during that condition. All other observers or data collectors wore orange shirts and did not interact with Caleb during trials and sessions.

Response Definitions, Measurement, and Reliability

Caleb's problem behavior was operationally defined as *negative vocalizations* (vocalizations above conversation level with a negative affect [furrowed brow, crying]) and *aggression* (throwing items at others). Nonexamples of vocalizations above conversation levels included yelling while laughing or smiling. All other behaviors were put on extinction for all assessments.

All sessions were videotaped, and data collectors later scored data on both problem behavior and therapist behavior. The TBFA (See Appendix C) and the STBFA (See Appendix D) were divided into 2-min segments during which data collectors recorded the occurrence or nonoccurrence of problem behavior. Data for these assessments were converted into percentage of trials with problem behavior by dividing the number of segments with problem behavior by the total number of trials, and multiplying by 100. The traditional FA consisted of 10-min sessions during which the data collector recorded the frequency of problem behavior (See Appendix E). Data were converted into responses per min by dividing the frequency of responses by the session

duration (10 min).

Interobserver Agreement

A second data collector collected data during 33% of all trials and sessions. Reliability for each trial in the TBFA and STBFA was calculated by dividing the number of segments with agreement with respect to the occurrence or nonoccurrence of behavior by two (the number of segments in a trial), and multiplying the quotient by 100 to yield a percentage. Thus, scores for each trial could only be 0%, 50%, or 100%. The mean percentage score for each assessment was then determined by calculating the sum of agreement scores across trials and dividing the sum by the number of trials scored for reliability. Reliability for each session in the FA was calculated by partitioning the session into 10-s intervals and dividing the smaller recorded frequency in each interval by the larger frequency. The mean agreement per interval was then calculated and was multiplied by 100 to yield a reliability score for the session. The mean percentage score for the FA was determined by calculating the sum of agreement scores across sessions and dividing the sum by the number of sessions scored for reliability. Results of interobserver agreement are as follows: trial-based, 100%; synthesized trial-based, 97%; and traditional, 97% (89%-100%).

Treatment Integrity

Therapist behavior was scored for treatment integrity of consequence delivery for 33% of all trials and sessions within each assessment (See Appendices F, G, H). Therapist behavior was scored as "correct" or "incorrect." A correct consequence

delivery consisted of the therapist delivering the programmed consequence for problem behavior within 3 s of the behavior occurring (e.g., "Don't do that" during the attention condition of the traditional FA). Incorrect consequence deliveries were scored as either "errors of omission" or "errors of commission." Errors of omission were scored when the therapist did not deliver a programmed consequence within 3 s. Errors of commission were scored when a consequence was delivered when problem behavior did not occur. Treatment integrity for each trial and session was calculated by dividing the number of correct consequence deliveries by the sum of correct and incorrect consequence deliveries. A treatment integrity score for each assessment was determined by calculating the mean of treatment integrity scores across trials (TBFA, STFA) or sessions (FA). Results of treatment integrity are as follows: TBFA, 97% (75%-100%); STBFA, 95% (81%-100%); and traditional, 95% (70%-100%).

Procedures

Indirect Assessments. The Functional Analysis Screening Tool (FAST; Iwata & DeLeon, 1996) was administered to caregivers prior to the TBFA (See Appendix I). The FAST consists of both open- and closed-ended questions, each of which addresses one of four possible maintaining contingencies: social-positive reinforcement, social-negative reinforcement, automatic-positive reinforcement, and automatic-negative reinforcement. Results of the FAST aid in the identification of general social or automatic categories, operational definitions, and antecedent and consequent events that may influence problem behavior.

Based on results from this indirect assessment, Caleb's problem behavior was evoked by the removal of preferred items, when attention was diverted, and when he was presented with demands. Therefore, all three functions were assessed individually.

An open-ended interview adapted from Hanley (2012) was conducted following the TBFA (See Appendix J). The interview consists of 20 questions that allow caregivers to describe the participant's current language and play-skill abilities, problem behavior, context in which problem behavior occurs, and others' responses to problem behavior. Results of the interview assisted in determining operational definitions and identifying relevant EOs and consequences to include in the STBFA.

Preference Assessments. Prior to the FAs, a multiple-stimulus-without-replacement (MSWO; DeLeon & Iwata, 1996), preference assessment was conducted to determine the participant's high-, moderate-, and low-preferred items to use within the FA conditions.

Within the MSWO, the therapist individually presented each item to the participant and modeled appropriate play. The items were then arranged in front of the participant, and the therapist instructed the participant to pick one. Once the participant made physical contact with an item, the participant was allowed 30-s access with that item, while the therapist removed the items that were not selected. Following the 30-s access period, the item was removed and the remaining items were re-presented in front of the participant in a different order. The participant was again instructed to choose an item out of the array, and was allowed 30 s with the item chosen, while the unchosen items were removed. This process was repeated until all items were chosen or the participant refused to make a choice. Three MSWOs were conducted. To determine the

level of preference for the FAs from the three MSWOs, we calculated the mean by dividing the number of selections for each item by the number of presentations.

Structured Observation. A structured observation was conducted prior to the functional analyses using procedures similar to those used by Fisher et al. (2016). The purpose of this observation was to identify potential variables that may influence problem behavior. This observation consisted of one 24-min session divided into six 4-min control and test segments. The top two highly preferred items identified in the MSWO were used in tangible segments. In the test segments, the therapist arranged putative EOs and consequences for problem behavior. In the control segments, the participant received noncontingent access to one or more putative reinforcers.

In the first 4-min segment, the participant received noncontingent access to tangibles, attention, and escape (control for all three putative reinforcers). Contingent on problem behavior, no consequences were delivered. The second 4-min segment began with the therapist either restricting access to the tangibles or diverting her attention, depending on whether the participant was interacting with the item or with the therapist at the end of the first 4-min segment (test for positive reinforcement in the form of tangibles or attention). If the participant engaged in problem behavior, the putative reinforcer was delivered for 20 s. If the participant did not engage in problem behavior for 30 s after the initiation of the segment, the putative reinforcer was returned to the participant. This process (removing access to a putative positive reinforcer, returning it contingent on problem behavior or after a period of time without problem behavior) continued for the entirety of the segment. The third 4-min segment (beginning at 8 min into the observation) consisted of the therapist again providing noncontingent access to tangibles,

attention, and escape (control, identical to the first segment). The fourth 4-min segment (beginning at 12 min into the observation) began with the therapist either restricting access to the tangibles or diverting her attention (i.e., same as the second segment described above). However, in this segment, the therapist delivered demands (e.g., receptive motor movements) to the participant. Demands were selected based on results from the Hanley et al. (2014) indirect assessment that evoked problem behavior. Contingent on problem behavior, demands were removed for 20 s, or after 30 s elapsed with no problem behavior, whichever occurred first (test for negative reinforcement). The fifth segment (beginning at 16 min) again consisted of noncontingent access to tangibles, attention, and escape (control). The final segment (beginning at 20 min) again consisted of the delivery of demands (test, identical to negative reinforcement segment).

Trial-Based Functional Analysis. Procedures for the TBFA were based on those by Bloom et al. (2011). In the TBFA, each trial consisted of two segments. Each segment lasted 2 min or until problem behavior occurred, and 20 trials were conducted in each condition. Each trial consisted of one control segment followed by one test segment. Control segments were always conducted prior to test segments to avoid the carryover of problem behavior from the test condition (when the EO is present) to the control condition (EO is absent) (Bloom et al., 2011).

If problem behavior occurred in the control segment, the segment was terminated and the test segment was begun. We implemented a 5-s changeover delay in which the test segment did not begin until 5 s occurred without problem behavior, to avoid adventitious consequences for problem behavior. In other words, if problem behavior occurred in the control, the therapist waited until problem behavior had not occurred for

at least 5 s before initiating the test segment. If problem behavior occurred in the test segment, the putative reinforcer was delivered and the segment was terminated; no consequences were provided for any other behavior. In addition, we implemented a 1-min inter-trial interval (ITI) following reinforcer delivery or the lapse of the 2 min test segment, whichever occurred first, prior to the initiation of the next trial. The inter-trial interval lasted at least 1 min. If problem behavior occurred during the second half of the ITI, the therapist waited until no problem behavior had occurred for 30 s prior to starting the next trial.

During both segments of the attention trials, the participant had noncontingent access to moderately preferred items identified from the MSWO. During the control segment, the therapist also provided noncontingent attention to the participant and responded to all bids for attention. During the test segment, the therapist stated she "had to do some work" and turned away from the participant. If problem behavior occurred during the test segment, the therapist delivered brief attention to the participant in the form of a statement of concern or reprimand ("Please don't do that" or "That's not nice") and the segment was terminated.

During the control segment of the tangible trials, the therapist provided noncontingent access to highly preferred items identified from the MSWO and neutrally responded to all bids for attention from the participant. During the test segment, the preferred items were removed and kept out of reach, but still in sight of the participant. If the participant engaged in problem behavior, the therapist provided access to the item for 30-s and the segment was terminated.

During the control segment of demand trials, no materials were present. The therapist was within reach of the participant but was turned away from him and did not provide attention. During the test segment, the therapist turned to the participant and delivered receptive motor tasks (e.g., stomp your feet, turn around, clap your hands) using three-step prompting (vocal, model, and full-physical). If problem behavior occurred, the therapist stated, "Okay, you don't have to" and delivered a 30-s break, after which the segment was terminated.

Synthesized-Contingency Trial-Based Functional Analysis. The STBFA was conducted by merging the methods of the synthesized contingency FA developed by Hanley et al. (2014) and the TBFA developed by Bloom et al. (2011). The STBFA consisted of 20 trials, and two 2-min segments (control and test) comprised each trial. Contingencies were based upon results from the Hanley (2012) interview. Trials were identical to those in the TBFA described above, except that each test condition consisted of at least two EOs and consequences for problem behavior.

Results from the Hanley (2012) interview and structured observation (Hanley et al., 2014; Fisher et al., 2016) suggested that problem behavior was evoked when preferred items were removed, attention was diverted, or demands were delivered (or some combination of the three). Therefore, all three conditions were assessed simultaneously (attention + tangible + escape). During the control segments, the participant was given noncontingent attention, preferred items, and escape from demands. During the test segments, the therapist removed the tangibles and delivered demands using three-step prompting sequence. Contingent on problem behavior, all putative

reinforcers (i.e., tangibles, therapist's attention, and termination of demands) were returned and the test segment was terminated.

Traditional Functional Analysis. A traditional FA was conducted based upon the procedures developed by Iwata et al. (1982/1994). Each session lasted 10 min and included four conditions (i.e., attention, escape, tangible, and play). Sessions were conducted within a multi-element design (Kazdin, 1982, 2011). At least three cycles (each cycle consisted of one session of each condition) were conducted. After the initial multi-element arrangement, we conducted additional analyses with the participant in a "pairwise" arrangement to isolate each test condition (Iwata, Duncan, Zarcone, Lerman, & Shore, 1994). Sessions were conducted until rates of problem behavior were differentiated across conditions. In all conditions, putative reinforcers were only delivered contingent on problem behavior. No programmed consequences were delivered for other behavior.

During the attention condition, the participant had noncontingent access to moderately preferred items identified from the MSWO. The therapist instructed the participant to, "Play with the toys" and then stated that, "She had some work to do." Contingent on problem behavior, the therapist provided brief attention in the form of a statement of concern (e.g., "Don't do that" or "I don't like that").

During the tangible condition, the therapist removed highly preferred items identified by the MSWO from the participant and stated, "my turn." If the participant engaged in problem behavior, the therapist delivered 30 s access to the highly preferred items. Following the 30 s, the therapist removed the items and then redelivered the items contingent on problem behavior.

During the escape condition, demands in the form of receptive motor movements (e.g., sit down, stand up, turn around) were delivered by the therapist using three-step prompting. If the participant complied, the therapist neutrally provided praise and issued another instruction. If the participant engaged in problem behavior, the therapist said, "Okay, you don't have to," and terminated the instructions for 30 s. Following the 30 s, the therapist resumed issuing instructions.

During the play condition, the participant received noncontingent access to highly preferred items, attention, and no demands were given. The therapist engaged in play and social interactions at the same "energy level" as the participant to maintain the value of her attention. No consequences were delivered contingent on problem behavior.

Results from each assessment were reviewed by three Master's- or doctoral-level Board Certified Behavior Analysts (BCBAs) for determination of behavioral function. Coders were blind regarding which results were associated with the same participant to avoid biased interpretations of data (e.g., it is possible that coders would be more likely to score a graph for a given function if they have previously scored a different graph from the same participant).

CHAPTER IV: RESULTS

Indirect Assessments

Based upon the results of the FAST, possible functions for problem behavior included social-positive reinforcement and social-negative reinforcement. In the area of social-positive reinforcement, Caleb scored 4 out of 4, indicating a possible attention function. In the area of social-negative reinforcement, Caleb score 3 out 4, indicating a possible escape function. It was noted that Caleb also engaged in problem behavior when items were removed or were not freely available, indicating a possible tangible function.

Caleb's mother stated that her primary concerns were Caleb's aggression, property destruction, and negative vocalizations. Aggression was defined as making physical contact to another person. Examples that were given were hitting, pulling hair, throwing objects at people, and chasing people with objects. However, throwing objects at people was the only topography targeted for aggression. Property destruction was defined as destruction to an item (e.g., throwing items, hitting objects together. Negative vocalizations (raising the volume in one's voice louder than a typical tone or volume), included yelling and screaming at a high rate and volume with a negative affect.

For the purpose of these assessments, the therapist focused on Caleb's mother's primary concerns, of which included aggression and negative vocalizations, because these behaviors occurred most frequently.

Based on results of the open-ended interview (Hanley, 2012), Caleb's mother indicated that he engaged in aggression (e.g., hitting, kicking, biting, throwing things at people), and negative vocalizations (e.g., screaming, yelling). Caleb's mother suggested

that the forms of problem behavior occur in a "hierarchy" (i.e., in a specific order), beginning with aggression and followed by negative vocalizations, which suggested that they comprised the same response class (i.e., are sensitive to the same variables). Caleb's mother also described that common antecedents (i.e., events that occur prior to behavior) included when he was denied access to an item, when he was asked to do something (e.g., clean up a toy), or when he has been told "No." Caleb's mother also reported that when routines were changed (e.g., Caleb's dad being home), Caleb engaged in problem behavior. Common consequences (i.e., events that follow behavior) included timeout and attempts to distract him with a toy, book, or activity. Results from the open-ended interview suggested multiple functions including attention, access to tangibles/preferred activities, and/or escape. For the purpose of this assessment, we focused on Caleb's mother's primary concerns, which included aggression and negative vocalizations, because these behaviors occurred most frequently.

Preference Assessment and Structured Observation

Results from the MSWO are shown in Figure 1. The highly preferred item identified were the toy cars. The moderately preferred items identified were the ball, blocks, and toy caterpillar. The low preferred item identified was the tablet.

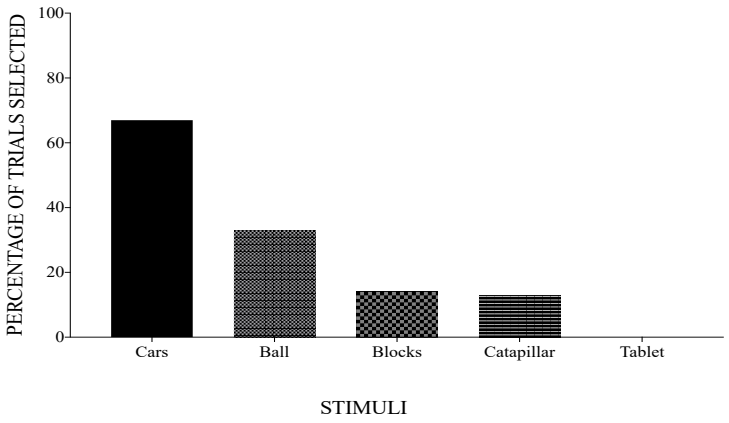

Figure 1. Results of the MSWO.

Figure 2 shows the results of the structured observation. These results indicated that when Caleb had free access to both attention and tangibles, he engaged with both reinforcers simultaneously. In addition, when the therapist restricted access to either attention or tangibles, Caleb engaged in problem behavior 56% of occasions. When the therapist delivered demands, Caleb engaged in problem behavior 10% of occasions. In addition, when the therapist combined all three EOs simultaneously, Caleb engaged in problem behavior on 100% of occasions.

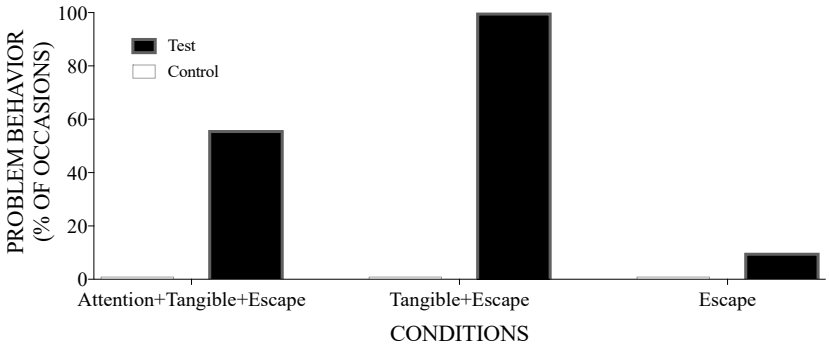

Figure 2. Results of the Structured Observation.

Trial-Based Functional Analysis Results

Figure 3 shows results of the TBFA. In the attention condition, Caleb engaged in more problem behavior during test segments (45%) relative to control (20%), indicating an attention function. In the escape condition, Caleb engaged in more problem behavior during the control condition (70%) relative to the test condition (55%), therefore, no escape function was indicated. In the tangible condition, Caleb engaged in more problem behavior during the test segments (100%), relative to the control condition (40%), indicating a tangible function.

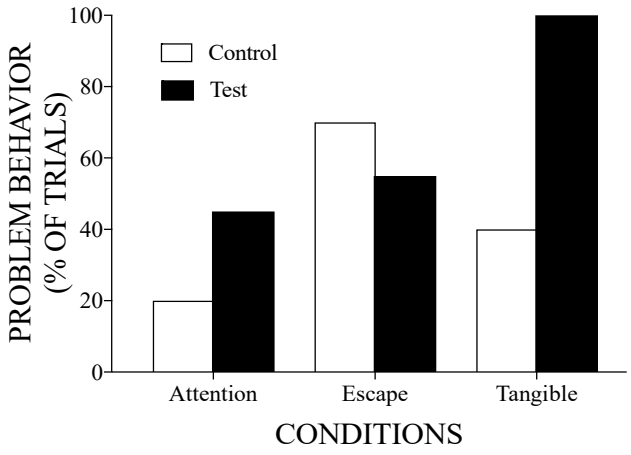

Figure 3. Results of the TBFA.

Synthesized-Contingency Trial-Based Functional Analysis Results

Figure 4 shows the results from the STBFA. In the synthesized condition, Caleb engaged in more problem behavior during the test segments (80%), relative to the control condition (0%), indicating multiple functions including tangible, attention, and escape.

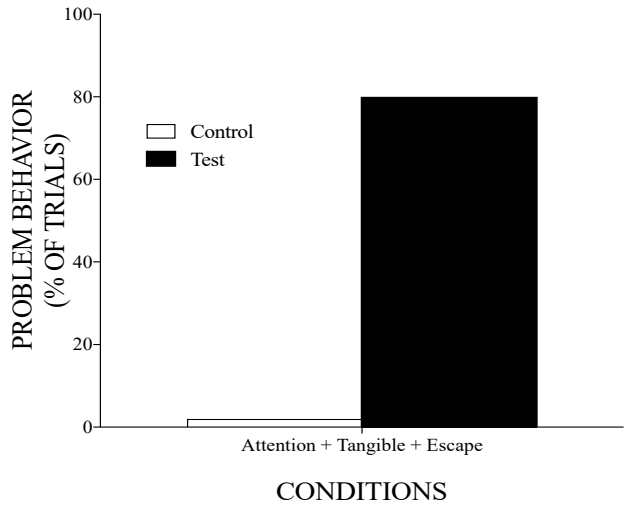

Figure 4. Results of STBFA.

Traditional Functional Analysis Results

Results from the traditional FA are shown in Figure 5. Five rounds of each condition were conducted, however, problem behavior continued to be variable in all test conditions. Therefore, we conducted a pairwise arrangement to isolate each function. First, tangible and control conditions were conducted in a semi-random order (i.e., play, tangible, tangible, play, tangible and so forth). When isolating the tangible condition with a control (play) condition, problem behavior was elevated relative to play, indicating a tangible function.

Following the tangible pairwise, attention was isolated with play. Problem behavior was also elevated relative to play, indicating an attention function. Finally, the escape condition was isolated with play in the escape pairwise for Caleb. Relative to play, escape remained at high levels, indicating an escape function.

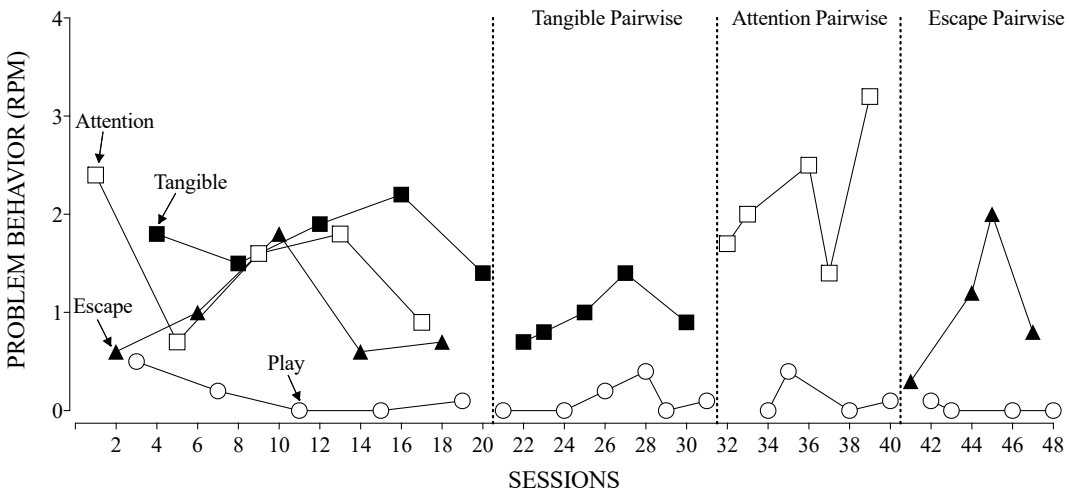

Figure 5. Results of the Traditional FA.

The results of the traditional and STBFA showed exact correspondence in functions (attention, tangible, and escape), while there was a false positive for escape identified in the TBFA. Results from each assessment were sent to three Master's-or doctoral level Board Certified Behavior Analysts (BCBAs) to determine behavior function. Two of the three BCBAs reported their scores. Both observers had exact agreement for all behavior functions from the FAs (i.e., indicating attention, tangible, and escape functions).

CHAPTER V: DISCUSSION

The current study evaluated the correspondence between three FAs with one participant with autism who engaged in problem behavior. The study compared the function identification results of the TBFA and traditional FA, where contingencies were assessed individually, and the novel, STBFA, with contingencies assessed simultaneously.

The traditional FA developed by Iwata et al. (1982/1994) has been found to successfully identify the function of problem behavior. However, limitations have been identified regarding duration of assessment and need for environmental control, which have led researchers to develop variations to address these concerns. Within the current study, the traditional FA identified attention, escape, and tangible functions (i.e., problem behavior in all test conditions was elevated relative to play). The results of the current study found partial correspondence with the TBFA (false negative for escape), and exact correspondence with the STBFA. Additionally, the results of Forck (2017) found exact correspondence between the traditional, STBFA, and TBFA for one participant and partial correspondence for participant two. For participant two, the STBFA resulted in a false positive for attention, while the TBFA resulted in a false positive for escape.

One of the rationales for conducting the STBFA was to address a limitation of the TBFA regarding false negatives for escape, also identified as a limitation in the studies by Bloom et al. (2011, 2013). Two behavioral patterns in the escape condition of the TBFA provide evidence for the lack of an escape function: low levels of problem behavior in both control and test segments, or higher levels of problem behavior in

control segments than in test segments. Caleb engaged in more problem behavior in control segments than in test segments (the second pattern; see Figure 3), which led to the conclusion that his problem behavior was not sensitive to escape. In control segments of escape trials, the therapist diverted her attention from Caleb, which may have functioned as an EO for attention. Because results from the traditional FA showed an attention function, it is possible that the reason the TBFA did *not* show an escape function was due to elevated levels of problem behavior evoked by an EO for attention in the control segments.

A concern with FAs that include multiple contingencies is that the relative influence of each contingency is unclear. For example, it could be that only one of the contingencies (e.g., tangible) in a combined condition is the one maintaining problem behavior, while others (e.g., escape and attention) are incidental or irrelevant. Ghaemmaghami, Hanley, Jin, & Vanselow (2015) pointed out that traditional FAs aim to "identify the role of each reinforcer, however, may not be well suited to identify 'interactional effects' of reinforcers" (p. 83). In other words, interactional effects may be a possibility when conditions are combined, reinforcers are tested simultaneously, and multiple functions are indicated. However, Ghaemmaghami et al. and others (Fisher et al., 2016) have stated concerns regarding the possibility that all reinforcement contingencies identified in the synthesized FAs may not be functionally related to problem behavior, and additionally, may not identify the role of each reinforcer directly related to problem behavior. However, the current study attempted to address these concerns by conducting a traditional FA (in addition to the trial-based versions), in which contingencies were isolated for each condition. By isolating each condition, it was

possible to identify the influence of each contingency that was included in the STBFA. After conducting the traditional FA, results corresponded with the STBFA, and all three functions (attention, tangible, and escape) were indicated for the participant. These results strengthened the results of the STBFA, showing that regardless of if the contingencies were synthesized or isolated, all functions were indicated.

Limitations

Although a functional relation was found between two of the three FAs for the study, it is important to note some limitations. First, the current study was conducted with only one participant, which limits the extent to which results may be generalized to other individuals. Relatedly, the participant's problem behavior was sensitive to all three sources of reinforcement that were tested (attention, tangible, and escape), via results of the traditional FA. It is possible that the STBFA and/or TBFA shows correspondence with individuals whose problem behavior is sensitive to specific forms of reinforcement but not others.

Another potential limitation was that trials and conditions were assessed under contrived environmental conditions. Test conditions were arranged rather than allowing them to naturally occur, which could in turn lack important discriminative stimuli that may normally evoke behavior. This is only a limitation regarding the TBFA, however, as problem behavior occurred in all test conditions from the STBFA and traditional FA. It should be noted, however, that contrived environmental settings limit the occurrence of compromised assessments due to outside factors (e.g., other children, caregivers interrupting assessments).

A third limitation is that treatment data are not being reported as part of the study. This may be a limitation because we did not validate the results of the FAs by demonstrating an effective treatment. However, treatment has been initiated with the participant.

Future Research

The results of this study are encouraging due to the correspondence between the traditional FA and the STBFA. The STBFA offered methods used by Bloom et al. (2011, 2013) that may be incorporated into natural settings while also incorporating methods reported by Hanley et al. (2014) that combine several contingencies into a single test condition. However, further research is needed to determine the reliability of the assessment by evaluating treatments indicated by the results. Future researchers may wish to conduct the STBFA with a larger number of participants with problem behavior that may be sensitive to different functions (only social positive or negative), in additional settings, and/or with treatment plans to provide a more definitive evaluation of the STBFA.

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APPENDICES

Appendix A: Human Subjects IRB Approval Form

To:
Megan Boyle
Counseling Ldrshp & Special Ed

RE: Notice of IRB Approval
Submission Type: Initial
Study #: IRB-FY2017-459
Study Title: Comparison of Trial-Based, Synthesized-Trial-Based, and Traditional Functional Analyses
Decision: Approved

Approval Date: Jan 24, 2017
Expiration Date: Jan 24, 2018

This submission has been approved by the Missouri State University Institutional Review Board (IRB) for the period indicated.

Federal regulations require that all research be reviewed at least annually. It is the Principal Investigator's responsibility to submit for renewal and obtain approval before the expiration date. You may not continue any research activity beyond the expiration date without IRB approval. Failure to receive approval for continuation before the expiration date will result in automatic termination of the approval for this study on the expiration date.

You are required to obtain IRB approval for any changes to any aspect of this study before they can be implemented. Should any adverse event or unanticipated problem involving risks to subjects or others occur it must be reported immediately to the IRB.

This study was reviewed in accordance with federal regulations governing human subjects research, including those found at 45 CFR 46 (Common Rule), 45 CFR 164 (HIPAA), 21 CFR 50 & 56 (FDA), and 40 CFR 26 (EPA), where applicable.

Researchers Associated with this Project:
PI: Megan Boyle
Primary Contact: Megan Boyle
Other Investigators: Linda Garrison-Kane, Reesha Adamson, Kaitlin Curtis, Kara Forck

Appendix B: Informed Consent Form

CONSENT FOR PARTICIPATION

A Comparison of Traditional, Trial-Based, and Synthesized Trial-Based Functional Analyses

Dr. Megan Boyle, Kaitlin Curtis, & Kara Forck

Introduction

Before you agree to participate in this study, it is important that you read and understand the following explanation of the procedures involved. The principal investigator, Dr. Megan Boyle, will also explain the project to you in detail. If you have any questions about the study now or in the future, please do not hesitate to contact Dr. Boyle by phone (417-836-4140) or via email MeganBoyle@MissouriState.edu.

To provide consent for your child to participate, you will need to sign this. Taking part in this study is entirely your choice, and you may withdraw your consent at any time. If you decide to stop, you do not have to provide a reason, and there will be no negative consequences for ending your participation.

Purpose of this Study

The purpose of this study is to compare three methods of assessing problem behavior (traditional, trial-based, and synthesized trial-based functional analyses) with children diagnosed with autism spectrum disorders. Specifically, we are interested in the extent to which the three methods of assessment produce the same results.

Description of Procedures

Prior to the start of the assessments, you will be asked to answer questions about your child's behavior to be assessed in the functional analyses. Your child will then attend weekly sessions (one visit per week) which will last up to 2.5 hours. Total time spent in the study (prior to treatment sessions) will range from 5-20 hours, with exact time based on how consistent your child's problem behavior is. Sessions will be conducted in a clinic room equipped with a one-way observation window at a Missouri State University office building. You will have the opportunity observe all sessions and Dr. Boyle will be available to answer any questions while sessions are conducted. Your child will participate in preference assessments to identify preferred items, functional analyses to determine the functions or reasons why problem behavior is occurring, and treatment sessions in order to identify methods to improve your child's behavior.

What are the risks?

Your child may experience emotional discomfort during functional analysis and treatment sessions, as the functional analysis is designed to encourage problematic behavior, and treatment will entail the withholding of reinforcement for problem behavior. Due to the nature of your child's behavior (aggression, property destruction,

self-injury, etc.), there is a possibility of physical injury. We will take precautions during assessment and treatment by conducting sessions in a clinic room with padded floors. Therapists will block any of your child's attempts to bite him or herself, or to make forceful contact between his or her head and the wall. Sessions will be terminated if problem behavior occurs so frequently that therapists are unable to prevent injury.

What are the benefits?

Following this study, we will conduct a reinforcement-based treatment evaluation with your child using results from the traditional functional analysis. The treatment evaluation will continue until problem behavior has been reduced by at least 80%. Caregivers will then be trained on how to implement the intervention in the participants' homes.

Results of this study will also benefit the field of Applied Behavior Analysis by contributing to its technology of assessing problem behavior.

How will my privacy be protected?

The results of this study are confidential and only the investigators will have access to the information which will be kept in a locked facility at the University. A pseudonym will be used in place of your child's name. Personal identifying information will not be used in any published reports of this research. Data collected in the study (with no identifying information) will be kept indefinitely for dissemination purposes (in publications or at conferences). Data with identifying information will be destroyed within six months following completion of the study (for each participant).

Consent to Participate

If you would like your child to participate in this study you are asked to sign below, confirming that you agree with the following:

"I have read and understand the information in this form. I have been encouraged to ask questions and all of my questions have been answered to my satisfaction. By signing this form, I agree voluntarily to allow my child to participate in this study. I further understand that audiotaping and/or videotaping of activities that include my child may be conducted, and that these materials will only be used to supplement data collection for the current study (e.g., if in-person data collectors are unavailable for sessions). I may also consent for video to be utilized following the study for training purposes or at conference presentations, but this is *not* a requirement of the study. I know that I can withdraw from the study at any time. I have received a copy of this form for my own records."

Check the corresponding statement to indicate your consent for video for training and conference purposes.

_____ Yes, I also consent for videos of my child to be used for training and conference purposes.

_____ No, I do *not* consent for videos of my child to be used for training and conference purposes.

_____ _____
Parent/Guardian Signature Date

_____
Printed Name of Participant

_____ _____
Signature of Person Obtaining Consent Date

Appendix C: Trial-Based Data Sheet

Trial-Based FA Data Sheet

Client: Failed Trials: Primary/Reli Target BX:

Condition:

Date	Obs.	Control	Test	TH	TX I?

Date	Obs.	Control	Test	TH	TX I?

Condition:

Date	Obs.	Control	Test	TH	TX I?

Date	Obs.	Control	Test	TH	TX I?

Condition:

Date	Obs.	Control	Test	TH	TX I?

Date	Obs.	Control	Test	TH	TX I?

Appendix D: Synthesized Trial-Based Data Sheet

Synthesized Trial-Based Data Sheet

Client: Failed Trials: Primary/Reli Target BX:

Condition:

Date	Obs.	Control	Test	TH	TX I?

Date	Obs.	Control	Test	TH	TX I?

Condition:

Date	Obs.	Control	Test	TH	TX I?

Date	Obs.	Control	Test	TH	TX I?

Condition:

Date	Obs.	Control	Test	TH	TX I?

Date	Obs.	Control	Test	TH	TX I?

Appendix E: Traditional FA Data Sheet

Generic Session Data Sheet

Client: Therapist: Date:

Data Collector(s): Session Duration: Intervals (Y/N):

Response 1:

Response 2:

Response 3:

Sessions & Descriptions	R1	R2	R3
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

Appendix F: Trial-Based FA Treatment Integrity

Control Condition: Attention

Steps	Correct/Incorrect/NA
Provides attention throughout	
Provides moderately preferred items	
Does not provide demands	
Does not provide consequences for problem behavior	
Ends segment when problem behavior occurs or 2 min	

Test Condition: Attention

Steps	Correct/Incorrect/NA
Turns away from the student	
States “I have some work to do”	
Ignore all behavior besides the targeted behaviors	
Turns toward students and makes delivers brief attention	
Ends segment when problem behavior occurs or 2 min	
1 min inter-trial prior to next trial	

Control Condition: Tangible

Steps	Correct/Incorrect/NA
Provides highly preferred items	
Does not provide demands	
Does not provide consequences for problem behavior	
Ends segment when problem behavior occurs or 2 min	

Test Condition: Tangible

Steps	Correct/Incorrect/NA
Remove the highly preferred items	
Ignore all behavior besides the targeted behaviors	
Return preferred items contingent on problem behavior	
Ends segment when problem behavior occurs or 2 min	
1 min inter-trial prior to next trial	

Control Condition: Escape

Steps	Correct/Incorrect/NA
Does not provide preferred items	
Does not provide demands	

Does not deliver attention	
Does not provide consequences for problem behavior	
Ends segment when problem behavior occurs or 2 min	

Test Condition: Escape

Steps	Correct/Incorrect/NA
States a receptive motor/clean up task	
Uses 3 step prompting sequence	
Ignore all behavior besides the targeted behaviors	
Remove the demands contingent on problem behavior	
Ends segment when problem behavior occurs or 2 min	
1 min inter-trial prior to next trial	

Appendix G: Synthesized Trial-Based Treatment Integrity

Control Condition: Attention+Tangible+Escape

Steps	Correct/Incorrect/NA
Provides attention throughout	
Provides highly preferred items	
Does not provide demands	
Does not provide consequences for problem behavior	
Ends segment when problem behavior occurs or 2 min	

Test Condition: Attention+Tangible+Escape

Steps	Correct/Incorrect/NA
States “Clean up your toys”	
Uses three-step prompting sequence	
Ignore all behavior besides the targeted behaviors	
Return preferred item, attention, and removes demands contingent on problem behavior	
Ends segment when problem behavior occurs or 2 min	
1 min inter-trial interval prior to next trial	

Control Condition: Attention+Tangible+Escape

Steps	Correct/Incorrect/NA
Provides attention throughout	
Provides highly preferred items	
Does not provide demands	
Does not provide consequences for problem behavior	
Ends segment when problem behavior occurs or 2 min	

Test Condition: Attention+Tangible+Escape

Steps	Correct/Incorrect/NA
States “Clean up your toys”	
Uses three-step prompting sequence	
Ignore all behavior besides the targeted behaviors	
Return preferred item, attention, and removes demands contingent on problem behavior	
Ends segment when problem behavior occurs or 2 min	
1 min inter-trial interval prior to next trial	

Appendix H: Traditional FA Treatment Integrity

Attention

Steps	Correct	Incorrect (C or O)
States "I have some work to do"		
Ignores all behavior besides the targeted behavior		
Provides brief reprimand/statement of concern contingent on problem behavior Or 30s access to attention *(For Emmanuel only)*		
Diverts attention after 30 s *(For Emmanuel only)*		

Escape

Steps	Correct	Incorrect (C or O)
Delivers demands		
Ignores all behavior besides the targeted behavior		
States “Okay you don’t have to” contingent on problem behavior		
Turns away from subject contingent on problem behavior		
Delivers demands after 30s		

Tangible

Steps	Correct	Incorrect (C or O)
Removes highly preferred item and states “It’s my turn”		
Ignores all behavior besides the targeted behavior		
States “Okay you can have it” contingent on problem behavior		
Gives highly preferred back contingent on problem behavior		
Removes highly preferred after 30s		

Play

Steps	Correct	Incorrect (C or O)
Provides attention		
Provides highly preferred items		
Does not deliver demands		
No consequences were delivered contingent on problem behavior		

Appendix I: Functional Analysis Screening Tool

FAST

Functional Analysis Screening Tool

Client:_____ Date:_____

Informant:_____ Interviewer:_____

To the Interviewer: The FAST identifies factors that may influence problem behaviors. Use it only for screening as part of a comprehensive functional analysis of the behavior. Administer the FAST to several individuals who interact with the client frequently. Then use the results to guide direct observation in several different situations to verify suspected behavioral functions and to identify other factors that may influence the problem behavior.

To the Informant: Complete the sections below. Then read each question carefully and answer it by circling "Yes" or "No." If you are uncertain about an answer, circle "N/A."

Informant-Client Relationship

1. Indicate your relationship to the person: ___Parent ___Instructor ___Therapist/Residential Staff _____(Other)
2. How long have you known the person? ____Years ____Months
3. Do you interact with the person daily? ____Yes ____No
4. In what situations do you usually interact with the person?
   ___ Meals ___ Academic training
   ___ Leisure ___ Work or vocational training
   ___ Self-care _____(Other)

Problem Behavior Information

1. Problem behavior (check and describe):
   __ Aggression _____
   __ Self-Injury _____
   __ Stereotypy _____
   __ Property destruction _____
   __ Other _____
2. Frequency: __Hourly __Daily __Weekly __Less often
3. Severity: __Mild: Disruptive but little risk to property or health
   __Moderate: Property damage or minor injury
   __Severe: Significant threat to health or safety
4. Situations in which the problem behavior is most likely to occur:
   Days/Times_____
   Settings/Activities _____
   Persons present _____
5. Situations in which the problem behavior is least likely to occur:
   Days/Times_____
   Settings/Activities _____
   Persons present _____
6. What is usually happening to the person right before the problem behavior occurs?_____
   _____
   _____
7. What usually happens to the person right after the problem behavior occurs?_____
   _____
   _____
8. Current treatments_____
   _____
   _____
   _____
   _____

1. Does the problem behavior occur when the person is not receiving attention or when caregivers are paying attention to someone else?	Yes	No	N/A
2. Does the problem behavior occur when the person's requests for preferred items or activities are denied or when these are taken away?	Yes	No	N/A
3. When the problem behavior occurs, do caregivers usually try to calm the person down or involve the person in preferred activities?	Yes	No	N/A
4. Is the person usually well behaved when (s)he is getting lots of attention or when preferred activities are freely available?	Yes	No	N/A
5. Does the person usually fuss or resist when (s)he is asked to perform a task or to participate in activities?	Yes	No	N/A
6. Does the problem behavior occur when the person is asked to perform a task or to participate in activities?	Yes	No	N/A
7. If the problem behavior occurs while tasks are being presented, is the person usually given a "break" from tasks?	Yes	No	N/A
8. Is the person usually well behaved when (s)he is not required to do anything?	Yes	No	N/A
9. Does the problem behavior occur even when no one is nearby or watching?	Yes	No	N/A
10. Does the person engage in the problem behavior even when leisure activities are available?	Yes	No	N/A
11. Does the problem behavior appear to be a form of "self-stimulation?"	Yes	No	N/A
12. Is the problem behavior less likely to occur when sensory stimulating activities are presented?	Yes	No	N/A
13. Is the problem behavior cyclical, occurring for several days and then stopping?	Yes	No	N/A
14. Does the person have recurring painful conditions such as ear infections or allergies? If so, list:_____	Yes	No	N/A
15. Is the problem behavior more likely to occur when the person is ill?	Yes	No	N/A
16. If the person is experiencing physical problems, and these are treated, does the problem behavior usually go away?	Yes	No	N/A

Scoring Summary

Circle the number of each question that was answered "Yes" and enter the number of items that were circled in the "Total" column.

Items Circled "Yes"	Total	Potential Source of Reinforcement
1 2 3 4	____	Social (attention/preferred items)
5 6 7 8	____	Social (escape from tasks/activities)
9 10 11 12	____	Automatic (sensory stimulation)
13 14 15 16	____	Automatic (pain attenuation)

Appendix J: Hanley (2012) Interview

Client's Name: _____ DOB: _____

Interviewee: _____ Relationship to Client: _____

Interviewer: _____ Date of Interview: _____

Problem Behavior: Definitions and Priorities

1. **What are the top 2 concerning behaviors, in order of importance and what do they look like?**

2. **Describe the intensity of the problem behavior(s)? Is s/he or anyone else likely to get hurt? Is property likely to be destroyed?**

3. **When problem behavior occurs, do multiple behaviors occur together in clusters (e.g., yelling while also hitting and swiping items off surfaces)?**

4. **Do specific low-level problem behaviors typically precede other problem behavior (e.g., yelling comes just before hitting or throwing items)?**

Antecedent Conditions

1. **In what situations is the problem behavior most likely to occur (e.g., activities, situations)?**

2. **What seems to trigger problem behavior?**

FAI

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

4. Does problem behavior occur when he/she does not get his/her way? If so, describe the things that the child attempts to control.

Reactions & Consequences

1. How do you and others react to the problem behavior?

2. What do you and others do to calm him/her down once problem behavior has started?

3. What do you and others do to distract him/her from engaging in problem behavior?

4. What do you think he/she is trying to communicate with his/her problem behavior?

5. Do you think problem behavior is form of self-stimulation?

6. Why do you think he/she engages in problem behavior?

Adapted from the "Open-Ended Functional Assessment Interview"