An Evaluation of a Response Allocation Assessment as an Alternative to Current Functional Analysis Methodologies

Jennifer Quigley

A Dissertation Submitted to the Faculty of
The Chicago School of Professional Psychology
In Partial Fulfillment of the Requirements
For the Degree of Doctor of Philosophy in Applied Behavior Analysis

December 19, 2018

ProQuest LLC.
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106 – 1346

An Evaluation of a Response Allocation Assessment as an Alternative to Current Functional Analysis Methodologies

---

A Dissertation Submitted to the Faculty of
The Chicago School of Professional Psychology
In Partial Fulfillment of the Requirements
For the Degree of Doctor of Philosophy in Psychology

Jennifer Quigley

2018

Approved By:

Julie A. Ackerlund Brandt, Ph.D., BCBA-D, Chairperson
Assistant Professor, Applied Behavior Analysis Online Program

---

Joslyn Cynkus Mintz, Ph.D., BCBA-D, Committee Member
Adjunct Professor, Applied Behavior Analysis Online Program

Jessica Juanico, Ph.D., BCBA-D, Committee Member
Director of Clinical Services-CO, Trumpet Behavioral Health

Acknowledgements

I would like to thank my advisor Dr. Julie Ackerlund Brandt for supporting me through the dissertation process. I would also like to thank my committee members for their valuable feedback and knowledge which helped shape this project. I am grateful to my fellow students who were there for support throughout the past three years. Though we only crossed paths a few times, I have gained professional friends and colleagues for life. Most of all I would like to acknowledge my family. It is because of my parents, Tony and Martha, and my sister Kathy, that I have been able to continue this educational journey. They have supported me in any way they could through the highs and lows of the past three years. This would not have been possible without them. Thank you to my friends who have understood that balancing responsibilities, priorities, and friendship is an active work in progress and are always there for me regardless. Finally, thank you to Luci who has added to my life in ways that are beyond measure. You, your smile, your laugh, your little personality that grows each day is my inspiration and motivation.

Abstract

The “standard” functional analysis (SFA) is an empirical demonstration of a cause-effect relationship between a target behavior and environmental variables; it includes a set of test conditions compared to a control condition (Iwata & Dozier, 2008). During the past 15 years, criticisms have arisen of the SFA including (a) the experience required to successfully design and implement the analysis, (b) resources required, (c) extended duration of analysis, (d) evoking potentially dangerous behavior, (e) required control over environmental conditions, and (f) potential findings of ambiguous results (Ellis & Magee, 2004; Hanley, 2012; Iwata & Dozier, 2008). Though multiple research studies and reviews have aimed to address these concerns through a variety of modifications, the current research study aimed to replicate and extend previous research by proposing a new alternative to functional analysis methodologies, the response allocation assessment (RAA). The RAA measures the participant’s allocation of the targeted challenging behavior or functional replacement behavior in a concurrent schedule format with a latency measure. This methodology enables the clinician to identify the function of challenging behavior while also assessing the participant’s ability to engage in the targeted replacement behavior. The current study evaluated the RAA’s efficiency and effectiveness in assessing the functions of targeted challenging behavior in comparison to the SFA and discuss the possible social acceptance and validity of the RAA.

Table of Contents

List of Tables

List of Figures

Chapter 1: Nature of the Study

Functional analysis methodology uses motivating operations and reinforcement contingencies to assess the function maintaining a targeted behavior, and the identification of these maintaining variables facilitate development of a function-based treatment targeting the reduction of problem behavior and the acceleration of replacement behaviors to improve the client's overall quality of life (Iwata & Worsdell, 2010). The "standard" functional analysis (SFA) is an empirical demonstration of a cause-effect relationship between a target behavior and environmental variables. This includes a set of test conditions compared to a control condition (Iwata & Dozier, 2008). An SFA refers to a functional analysis using a multielement design and contained the standard conditions. Literature evaluating the use of the SFA is rich in examples of the successful identification of functions. (Beavers, Iwata, & Lerman, 2013; Hagopian, Rooker, Jessel, & DeLeon, 2013; Hanley, Iwata, & McCord, 2003). Since the seminal publication in 1982 (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994), researchers and clinicians have used the SFA methods to identify functions and develop function-based treatments as part of the evaluation, assessment, and treatment of severe challenging behavior (Carr & Durand, 1985; Hanley, et al., 2003; Iwata & Worsdell, 2010).

Problem Statement

During the past 15 years, criticisms have arisen regarding the SFA including (a) the experience required to successfully design and implement the analysis, (b) resources required, (c) extended duration of analysis, (d) evoking potentially dangerous behavior, (e) required control over environmental conditions, and (f) potential findings of ambiguous results (Ellis & Magee, 2004; Hanley, 2012; Iwata & Dozier, 2008). Multiple research studies and reviews have aimed to address these concerns through a variety of modifications. Caregivers and teachers have been

incorporated as therapists to implement the analyses (Ellis & Magee, 2004; English & Anderson, 2004; Lambert, et al., 2017; McAdam, et al., 2004) and successful functional analyses have been completed in classroom and home settings (Bloom, et al., 2011; Vollmer & Northrup, 1996). Also, modified versions of the SFA have been completed using trials and reduced replications to decrease overall duration of the assessment (Lambert, et al., 2017; Northrup, et al., 1991; Thomason-Sassi, Iwata, Neidert, and Roscoe, 2011). Methods to address ambiguous results have included a hierarchy of analysis application (Hagopian, et al., 2013; Rooker, DeLeon, Borrero, Frank-Crawford, & Roscoe, 2014), synthesized conditions to increase differentiation (Hanley, Jin, Vanselow, & Hanratty, 2014; Jessel, Hanley, & Ghaemmaghami, 2016; Slaton, Hanley, & Raftery, 2017), and inclusion of idiosyncratic variables (Schlichenmeyer, Roscoe, Rooker, Wheeler, & Dube, 2013). Though these modifications have demonstrated some success in identifying functions of problem behavior, there are only a few published studies addressing each modification, and agreement with the SFA has varied.

Purpose of the Study

The purpose of the current research study was to replicate and extend previous research by proposing a new alternative to functional analysis methodologies, the response allocation assessment (RAA). The RAA measures the participant's allocation of the targeted challenging behavior or functional communicative behavior in a concurrent schedule format with a latency measure. Trials are repeated, and the percentage of allocation and latency to occurrence is assessed. This methodology enables the clinician to identify the function of challenging behavior while also assessing the participant's ability to engage in the targeted replacement behavior. The inclusion of the replacement behavior sets the RAA apart from the other functional analysis methodologies presented.

Research Questions and Hypotheses

Research Question 1: Will the RAA's findings agree with those of the SFA by identifying the same function across participants?

Research Question 2: Will including functional communicative responses within the contingency to access reinforcement accurately identify the same functions as the inclusion of only challenging behavior as in the SFA?

Research Question 3: Will the RAA be more efficient in identifying the function of the challenging behavior than the SFA?

Scope of the Study

The scope of this study included children ages 8-12 attending a private day school program in eastern Pennsylvania. The participants engaged in disruptive behavior that had not been assessed by a functional analysis and was not currently being treated via function-based treatment.

Significance of the Study

This study is significant in that it is the first application of response allocation within functional analysis methodology. Board Certified Behavior Analysts (BCBA) are not required to have direct functional analysis experience and are often unqualified to implement functional analyses in clinical settings due to this lack of experience. This deficit within the field directly impacts the clients' access to function-based treatment as identified by experimental analysis rather than less effective indirect and direct measures. More applicable and user-friendly experimental analyses are needed in our field to ensure those receiving services are receiving the best care. Thus far, modifications of the SFA have produced varied results in the effectiveness of identifying functions with more efficiency (Bloom et al., 2010; Derby et al., 1991; LaRue,

Lenard, Weiss, Bamond, Palmieri, & Kelley, 2011; Thomason-Sassi et al., 2011). Only a few studies per analysis have been completed in direct comparison to the SFA. This research is also important to the current discussion within the field of isolated versus synthesized contingencies within experimental analysis. The interview-informed synthesized contingency assessment has gained popularity due to its ease of implementation and high likelihood of producing differentiated results which leads more quickly to treatment (Jessel et al., 2016; Slaton et al., 2017), but issues regarding the reliability and validity of this assessment continue to arise (Fisher, Greer, Romani, Zangrillo, & Owen, 2016). If another analysis was available which was easy to use, evoked less problem behavior, and included isolated contingencies, this may be a more acceptable alternative to the SFA than the IISCA.

Summary

This research aimed to compare a new application of response allocation and assess the utility of the RAA as an alternative to the SFA. Chapter 2 will present literature reviewing the history of the SFA, modifications of the SFA, and the current trend in the application of response allocation. Chapter 3 will present the methods that were used for this dissertation study. Chapter 4 will present the results of the study and chapter 5 will include a discussion of the research findings with suggestions for future research.

Chapter 2: Literature Review

This literature review will provide a) a summary of the seminal article (Iwata et al., 1982/1994) which introduced the SFA methodology, b) summaries of the variations within functional analysis literature as they compare to the SFA, and c) an introduction of response allocation as the term has been used within behavior analytic literature. The SFA methodology has been replicated and validated across a multitude of studies and has been repeatedly demonstrated as a viable tool for experimentally identifying the function of problem behavior (Hagopian et al., 2013). However, concerns and criticisms of the methodology and possible side effects have arisen over time and a variety of modifications of the SFA have been proposed and evaluated. A few of these modifications have been directly compared to the SFA to assess the validity of these analyses to evaluate the accuracy of those methods as compared to the "gold standard." This chapter will also review how response allocation has been studied within experimental analysis of behavior and how it may be used within concurrent schedules of reinforcement to identify the function of problem behavior as the SFA does.

Research Strategy

To complete this review, ProQuest and SAGE databases were searched through access from The Chicago School of Professional Psychology's library. Keywords used included: functional analysis, traditional functional analysis, standard functional analysis, response allocation, concurrent schedules of reinforcement, latency-based measures, trial-based functional analyses, brief functional analyses, social avoidance, and IISCA. Articles were included if they contained a direct comparison of a modification to the SFA and the SFA, a description of the SFA and comparable analyses, and/or a description of the application of response allocation or concurrent schedules of reinforcement as it relates to problem behavior.

Background

Iwata et al. (1982/1994) is the seminal article of functional analysis methodology as it introduced an operant methodology to experimentally identify functional relations between the environment and targeted challenging behavior. Through manipulation of environmental variables (i.e., antecedent and consequent variables), specific conditions evoked differentiated levels of challenging behavior in comparison to a play, or control, condition. A traditional or SFA methodology consists of four conditions: social disapproval (i.e., attention), academic demand (i.e., escape), unstructured play (i.e., control), and alone (e.g., Iwata et al, 1982/1994); however, in more recent literature, additional conditions have been tested including tangible (e.g., Mace & West, 1986), escape from social attention (i.e., social avoidance; e.g., Harper, Iwata, & Camp, 2013), and divided attention (e.g., Mace, Page, Ivancic, & O'Brien, 1986) to address various concerns or idiosyncratic variables that have been discovered.

Iwata and Worsdell (2010) completed a review of functional analysis methodology and its applications in the development of function-based treatment programs. The goal of an SFA is to identify which contingencies are maintaining the targeted challenging behavior (TCB) through comparison of test and control conditions. The establishing operation (EO) presented in the test condition should be absent in the control condition as the independent variable is removed (Hanley, et al., 2003). Functional analyses enable the clinicians to identify which interventions should work (and why) prior to developing and attempting treatment (Hanley et al., 2003). The reinforcement contingencies evaluated in an SFA include social positive reinforcement, social negative reinforcement, and automatic reinforcement, and may be tested for using a variety of specific conditions.

Social-Positive Reinforcement

Social-positive reinforcement refers to social reinforcers (i.e., attention or tangible items) that are provided following the occurrence of problem behavior. In an attention condition, a therapist is present, yet withholds attention except when the participant engages in the targeted behavior (Iwata, et al., 1994). For example, the therapist would appear busy reading a book. Contingent on the TCB, the therapist would deliver attention in the form of a brief reprimand (e.g. "No", "Don't do that") and brief physical contact. This condition tests for the maintaining variable of access to attention. In a tangible condition, the participant has access to the preferred items for one minute prior to the session beginning. At the start of the session, the items are removed from the participant by the therapist. Contingent on the TCB, the items are given to the participant (Mace & West, 1986). This condition tests for the maintaining variable of access to tangible items.

Social Negative Reinforcement

Social-negative reinforcement refers to a social reinforcer (i.e., escape) that is removed following the occurrence of problem behavior. The removal of the aversive stimulus results in an increase in the future probability of the TCB occurring. In a typical demand condition, also called an escape from demand condition, a therapist presents demands (i.e., work tasks) to the participant. Contingent on the TCB, escape from demands is given (Iwata, 1994). For example, the therapist places work demands on the participant. Contingent on the TCB, the therapist removes all work materials and stops prompting. This condition tests for the maintaining variable of escape from demands. In an escape from attention condition (i.e. social avoidance), a therapist is present and provides continuous attention to the participant (Hagopian, Wilson, & Wilder,

2001). Contingent on the TCB, attention is removed. This condition tests for the maintaining variable of escape from attention.

Automatic Positive Reinforcement

Automatic positive reinforcement refers to the addition of a non-social (i.e., automatic) reinforcer following the occurrence of problem behavior. For example, the ocular sensation one may experience when pressing against your eyes. In an alone condition, the participant is observed in a relatively barren room. Under some conditions, a researcher may be present in the room (i.e., aggression as a target behavior); however, the researcher will not engage with the participant before or after problem behavior. This condition tests for maintaining variables in the absence of social contingencies.

Automatic Negative Reinforcement

Automatic-negative reinforcement refers to the removal of a non-social (i.e., automatic) stimulus following the occurrence of problem behavior. For example, the attenuation of pain one may experience from an ear infection by pressing and wiggling a finger in the ear canal. This function is often assessed prior to an SFA by a medical examination but may also be indicated by higher levels of behavior with the alone condition.

Functional Analysis Methodology

The standard functional analysis (SFA) is the "gold-standard" assessment within clinical research on problem behavior and was recognized as a best practice procedure by the National Institute of Health in 1989 (NIH, 1989). The multielement design is the most-efficient design because it includes multiple comparisons within a short amount of time (Iwata & Dozier, 2008). Iwata and Worsdell (2010) highlighted the advantages of the SFA methodology, mainly, the identification of cause and effect relationships, and a flexibility in assessing variability and

variation. In two substantive reviews of SFA literature, the percentage of SFAs that produced differentiated results ranged from 94% to 95.9% (Beavers et al., 2013; Hanley et al., 2003). When further analyzed in a review of 176 SFAs completed in an inpatient hospital setting, Hagopian et al. (2013) found that only 46.6% of SFAs produced differentiated results without any modifications. Following up to two modifications, this percentage was increased to 93.3% of cases further supporting the need for the inclusion of modifications as part of the functional analysis methodology.

The SFA is also the most-complex method of assessing functional relationships and requires a high degree of consistency and training for proper implementation. Within an SFA, the test condition includes three functional components: a discriminative stimulus (SD), an EO, and a consequence (Fisher, et al., 2016). Session lengths typically vary from 10 to 15 minutes (Iwata et al., 1994; Fisher, Piazza, & Chiang, 1996) but modifications of the SFA have included sessions ranging from 5 minutes (Querim**,** Iwata, Roscoe, Schlichenmeyer, Ortega, & Hurl, 2013) to 30 minutes (Reese, 1997).

Hanley et al. (2003) completed a review of published research assessing FAs to determine best-practices within FA methodology. The authors identified best practice as attending to experimental integrity and ecological validity. Experimental integrity includes limiting response classes, including programmed consequences, incorporating EO influence and clear SDs, using brief sessions, assessing for automatic reinforcement, considering reinforcement durations, testing for functional relations only when assessment information supports a potential function, starting with brief and simple manipulations, and using other sources of information to supplement the design of the assessment. Rooker, et al. (2014) added to this by recommending formal preference and demand assessments to be completed prior to analysis to ensure items

used within the analysis are relevant to what is occurring in the natural environment. An example of conducting FAs with experimental integrity includes using an antecedent-behavior-consequence analysis in comparison to an antecedent-behavior analysis. The inclusion of the consequence increases the precision of the analysis and is therefore viewed as best practice (Hanley, et al., 2003).

Ecological validity refers to the extent in which the test conditions represent what is occurring in the natural environment. Hanley et al. (2003) highlighted the importance of conducting FA sessions in a manner which closely resembles the naturalistic conditions in which the response-reinforcer relationship occurs. This may include implementing a functional analysis within the classroom setting, such as the trial-based FA designed by Sigafoos and Saggers (1995). Other modifications to increase ecological validity of the FA include the addition of caregiver interview and direct observation of the participant to inform the development of each condition (Hanley, 2012; Hanley, et al., 2014). Rooker, et al. (2014) also suggested to include demands typically presented and attention typically provided in the natural environment to increase the likelihood of responding during the FA.

Concerns/Criticisms of SFA

Iwata and Dozier (2008) and Hanley (2012) listed and addressed many of the commonly mentioned concerns or restrictions in the implementation of an SFA in their respective reviews. Critics of SFAs emphasize the resources required for the completion of an FA including the knowledge required of the clinician (Hanley, 2012) and the environment required of the analysis (Iwata & Dozier, 2008). It is important to have a BCBA trained in the design and completion of functional analyses present to conduct or supervise an SFA, and oftentimes, an analogue setting is used to conduct the assessment. An SFA may also be time intensive (Iwata & Dozier, 2008). Each condition must be run until stable

responding occurs and trends in data can be analyzed. With five-minute sessions and four test conditions and a control condition, this would require a minimum of 25 minutes per series and at least three rounds to assess stable responding. There are also many examples in the literature of SFAs not producing sufficiently differentiated results (e.g., Carter, 2009; Finkel, Derbey, Wether, & McLaughlin, 2003; Hagopian, Bruzek, Bowman, & Jennett, 2007; Kahng & Iwata, 1999; Schlichenmeyer, et al., 2013; Tiger, Fisher, Toussaint, & Kodak, 2009); however, reviews of SFA research have found the percentage of analyses which produced undifferentiated results range from 4.2% to 12.5% of published cases (Hanley et al., 2003; Iwata et al., 1994; Kurtz, Chin, Huete, Tarbox, O'Connor, Paclawskyj, & Rush, 2003). Undifferentiated results may occur due to the behavior being maintained by an automatic function which would require additional alone sessions to confirm. Many of these concerns or limitations have been addressed through extensions and modifications of the SFA methodology.

Extensions of the SFA

As SFA research has evolved, many modifications to the SFA have emerged. Iwata and Dozier (2008), Hagopian et al. (2014), Hanley (2012), and Rooker et al. (2014) outlined procedural variations which addressed noted limitations. These include FAs that can be completed a) in the natural environment, b) in shorter periods of time, and c) with behaviors that occur at high intensities or low frequencies. Other functional analysis designs, such as the reversal design and pairwise design, offer additional benefits and risks. Only modifications directly addressing limitations of the SFA are included within this review.

Trial-Based FAs

Ellis and Magee (2004) completed a review of the application of FAs in school settings and the frequent modifications necessary to produce meaningful results. Types of modifications

included changes to antecedents, experimental design, task inclusion, task variation, idiosyncratic variables, and physiological conditions. Consequent-based modifications included inclusion of an escape from social demands, access to peer attention, access to tangible, access to varied attention, and altered escape. Ellis and Magee highlighted the need for modifications within FAs to improve accuracy and efficiency, especially in non-traditional settings. Non-traditional settings may include the client's home, the community, classrooms, and hospital settings. One way to address this need is to use trial-based FAs. A trial-based FA is implemented in the natural environment and trials occur throughout the individual's typical programming (Bloom et al., 2011). Each trial consists of a brief test period and control period (Sigafoos & Saggers, 1995). LaRue et al. (2010) first compared the trial-based FA to the SFA across five participants. Direct correspondence was found in 4 of the 5 participants with partial correspondence displayed with the fifth participant. The average duration of the trial-based FA was 31.6 min across participants while the SFA required an average of 3 hr 28 min. Bloom et al. (2011) extended the application of trial-based FAs by implementing trials in the classroom setting across 10 participants. Similar to LaRue et al, Bloom et al. also compared the results of the trial-based FA to those of the SFA. Direct correspondence was found in six of the ten participants with partial correspondence in the seventh participant further supporting that the trial-based FA may be a viable alternative to the SFA. Bloom et al. reported significantly longer average durations for the trial-based FA, 4 hr 31 min, as compared with the SFA requiring 3 hr 53 min. When resources required to complete an SFA are unavailable, such as available clinicians, and sterile settings, the trial-based FA may be an applicable modification though the trial-based FA may not be more time efficient (Bloom et al., 2011).

Latency-based FAs

Latency-based FAs addressed the concern of repeatedly evoking high-intensity problem behavior by using a latency measure rather than ending at a predetermined time (Beavers et al., 2013). Thomason-Sassi et al. (2011) assessed response latency in comparison to rate to determine if latency was an accurate predictor of function. In a record review of 38 graphs, correspondence of function was observed for 87% was observed supporting the use of latency for high-risk, challenging behavior. Lambert et al. (2017) also assessed the effectiveness of latency-based FAs in identifying function with individuals who engage in severe problem behavior. This research discussed latency-based FAs as an alternative to the SFA. All relevant conditions to individuals were implemented in a latency-based design and the latency to challenging behavior was measured. Lambert et al. identified maintaining variables (i.e., differentiated results) in 44% of participants. This finding was much lower than Thomason-Sassi et al. (2011) with 87% agreement to SFAs with differentiated results. This variation may be due to procedural differences across studies. These differences included the amount of sessions implemented prior to making any procedural changes as well as the inclusion of a fixed-time alone condition to assess for an automatic function (Lambert et al., 2017). Additional research comparing the results of latency-based FAs to those of the SFA may help to support the use of this modification.

Brief FAs

A brief FA is a modification specifically focusing on function identification in less time. A brief FA consists of one presentation of each social condition and an alone condition. Following one round of analysis, a contingency reversal is completed for each condition in

which the targeted behavior occurred (Northrup et al., 1991). A contingency reversal consists of differential reinforcement as a consequence for the functional communicative behavior and extinction as a consequence for the targeted behavior (Vollmer & Northrup, 1996). Responding during the contingency reversal then supports or refutes the initial findings of the analysis. Northrup et al. (1991) demonstrated the utility of the brief FA by completing the FA and a treatment assessment within a 90-min observation at an outpatient clinic across three participants. Brief analog conditions, including a contingency reversal, were sufficient in identifying the maintaining variables of problem behavior across all participants. Derby et al. (1992) further assessed the use of the brief FA by analyzing 79 cases in which the brief FA was used. Of these 79 cases, 63% of cases displayed occurrences of the targeted behavior. Of those 49 cases in which the targeted behavior occurred, a function was identified in 74% of, or 36, participants. Badgett and Falcomata (2015) extended the literature on brief FAs by assessing the variations within the brief FA model to determine correspondence. Modifications included a latency measure, an antecedent-behavior model, and an antecedent-behavior-consequence model. The three modifications of the brief FA were effective in identifying functions via differentiation for 81% of the participants. Confirmation of the results was determined by contingency reversal rather than in comparison to the SFA methodology (Badgett & Falcomata, 2015).

Interview-Informed Synthesized Contingency Assessment (IISCA)

The IISCA was developed to improve the efficiency of the functional analysis while maintaining an experimental standard (Hanley, 2010, 2011, 2012; Hanley et al., 2014). The IISCA has been shown to be completed in less time with high rates of differentiation between test and control conditions. The IISCA begins with an open-ended interview followed by direct observation. Then the variables identified in the open-ended interview are manipulated in a test-

control format. The test and control conditions are matched; they vary only in that the reinforcer is delivered contingent on problem behavior in the test condition and is present throughout in the control condition. This differs from the SFA without modifications in which EOs are presented in isolation rather than in one combined, or synthesized, condition. The SFA also includes only one control condition that differs from the test conditions in multiple ways (Hanley et al., 2014). To evaluate the utility of the IISCA, Hanley et al. (2014) assessed the effect of the IISCA on identifying maintaining functions of challenging behavior and determining appropriate replacement behaviors. Differentiated results were produced across all participants and challenging behavior was eliminated across all three participants with an increase in appropriate behavior following completion of the IISCA and treatment analyses. Fisher et al. (2016) also assessed the utility of the IISCA in comparison to the SFA. Fisher et al found the IISCA to produce differentiated results but the identified functions did not match the functions identified by the SFA. In four of the five participants, individual contingencies were identified by the SFA and corresponding treatment analyses were successful in reducing the targeted behavior. This research demonstrated the utility of the IISCA in producing differentiated results though agreement between the IISCA and SFA requires additional research.

Assessing Response Allocation

Measuring response allocation has been used in a variety of ways in the literature, most frequently in relation to the matching law (e.g., Christianson, 2009; Jarmolowicz, Sofis, & Darden, 2016; Kangas, Berry, Cassidy, Dallery, Vaidya, & Hackenberg, 2009; Rapp, Rojas, Colby-Dirksen, Swanson, & Marvin, 2010; Rapp, Vollmer, St Peter, Dozier, & Cotnoir, 2004). The matching law states that relative rates of responding should match relative rates of reinforcement under concurrent schedules of reinforcement and accurately predicts responding

within a concurrent schedule under a range of conditions (Poling, Edwards, Weeden, & Foster, 2011).

Jarmolowicz, et al. (2016) used progressive-ratio schedules to assess response allocation in rats when the likelihood of reinforcement was modified within a concurrent chain arrangement. One schedule of reinforcement was held constant while the second schedule of reinforcement was manipulated, and allocation of responding was measured. The authors hypothesized that allocation of responding would change dependent on the probability of reinforcement available associated with a specific schedule. They found that patterns of allocation change was dependent on the probability of reinforcement available while responding on the control schedule remained unchanged. Allocation decreased when the schedule of reinforcement was thinned and increased when the schedule of reinforcement was made denser.

Kangas et al. (2009) also applied the matching law to six adult human participants across three schedules of reinforcement. The researchers assessed response allocation via a rock, paper, scissors game in which the reinforcement schedules were manipulated to determine which schedules were necessary for allocation to change. The programmed probabilities were manipulated while allocation of responding was measured. Kangas et al. hypothesized that allocation of responding would match the probability of reinforcement based on the matching law. This expanded previous research on the generality of the matching law and response allocation by including three choice alternatives rather than just two. Generalized matching law was a good fit for the human responses observed during the game across all schedules of reinforcement. This research demonstrates a further application of response allocation in the literature which demonstrates utility of assessing allocation across multiple schedules and a sensitivity of the matching law to changing contingencies.

Another application of response allocation assessed response allocation during a free-operant preference assessment to identify if response allocation helped determined preference (Rapp et al., 2010). The researchers hypothesized that more time would be allocated to the higher preferred items. Items were presented within a free-operant preference assessment and time allocated towards each item was measured. After the preference assessment was completed, researchers identified the highest preferred items by longest duration spent interacting with the item. Rapp et al. found that the highest allocated item and the first item allocated to corresponded during 55% of the sessions. Based on these results, the authors suggested that the first item to be engaged with during free-operant preference assessments may not be the most preferred item overall. Allocation of responding across the first 15-min of the session was a better predictor of the highest preferred item, corresponding with the highest preferred items in 70% of sessions.

Athens and Vollmer (2010) assessed response allocation between an alternative response and a problem behavior when manipulating components of the reinforcement for the alternative response. Components assessed included duration, quality, delay, and a combination package. Reinforcement for the problem behavior was held constant; extinction was not implemented. Athens and Vollmer found that behavior was sensitive to reinforcement changes and a combination of modifications to the reinforcer had the most impact. This research supported that allocation between responses can be manipulated via the reinforcement contingencies associated with each behavior.

Response allocation is an applicable measurement in the analysis of behavior in that it can be used to determine which consequence is reinforcing the targeted behavior more efficiently by measuring allocation across the available choices. This measurement may be applied to functional analyses in that it allows multiple consequences to occur within the same condition. It

also enables the participant to choose between multiple responses to access the targeted consequence. Patterns of responding enable the researcher to not only draw conclusions about the function of the behavior, but also assess the effectiveness of any other functional communicative responses that may be within the participant's repertoire.

Summary

Function-based treatment has been shown to be the most effective in decreasing problem behavior. Determining the function of challenging behavior is imperative in designing function-based interventions leading to the decrease in the targeted challenging behavior and an increase in the replacement communicative behavior. The SFA has been repeatedly demonstrated to accurately identify the function of challenging behavior and lead to effective function-based treatment improving the quality of life of the individual receiving services. The RAA is being proposed as an additional alternative to the SFA which includes both functionally equivalent alternative behaviors and challenging behaviors to determine in which behavior the participant allocates responding it will be evaluated for effectiveness in determining functions of challenging behavior. This modification may increase the applicability of function-based experimental analysis and therefore increase the number of children accessing function-based interventions.

Chapter 3: Research Design and Method

The main purpose of this study was to determine if the RAA could accurately identify the function of challenging behavior while responding to both communicative behavior and challenging behavior as compared to the SFA. A secondary purpose was to determine if the RAA is more efficient in identifying the function of challenging behavior than the SFA. This chapter will review the participants and setting for this study, materials, response measurement, interobserver agreement, experimental design, and procedures. The primary researcher, BCBA, conducted the analyses. A research assistant collected interobserver agreement (IOA) data and completed procedural fidelity checks to ensure reliability of data and procedures. A pairwise design was used for each participant and analysis to determine the effectiveness of the RAA as compared to the SFA.

Research Questions and/or Hypotheses and their Rationales

First, would the RAA's findings agree with the findings of the SFA in identifying the function of problem behavior? This question will directly answer whether the RAA could be an acceptable alternative to the SFA. If agreement between analyses is high, the RAA may be an appropriate alternative for clinicians aiming to determine the function of a client's problem behavior. Second, did the inclusion of FCRs, previously trained or untrained, within the contingency to access reinforcement accurately identify the same functions as the inclusion of only challenging behavior as in the SFA? If FCRs can be used to identify function of behavior, then evoking problem behavior may not have to be the only method of identifying an appropriate function-based treatment. The third research question addressed the efficiency of the RAA in identifying the function of the challenging behavior compared to the SFA. Efficiency is an

important aspect of an analysis in that more efficient analyses produce reliable, valid results while requiring less resources.

Methods

Participants and Setting

One BCBA served as the lead researcher for this study and implemented all components of the research: parent interview, multiple stimulus preference assessment, SFA, and RAA. One additional BCBA served as a research assistant and collected reliability data which was compared to the lead researcher's data. The research assistant also completed procedural fidelity checks which verified that the analyses were being implemented as written. All members of the research team completed the Human Subjects Protection Training.

Participants. Participants in this study included five, school-aged students, ranging in age from 8-12-years-old. See Table 1 for demographics of all participants. All participants attended a private day school program located in a small suburban town. All students attending this school were placed there due to significant educational and behavioral needs and were receiving direct instruction from trained staff members. All children recruited for this study engaged in disruptive behavior that was impacting their participation in daily activities. Participants were identified via clinical director and clinician interview. Types of disruptive behaviors included throwing items, screaming, noncompliance, and hitting walls. All participants were available for assessment during school hours.

Dylan, a nine-year-old male, engaged in disruption, which was operationally defined as throwing objects and climbing on furniture. He communicated using picture exchange. Cody was an eleven-year-old male who was vocal. Cody engaged in disruption including any instance of pushing furniture, which makes an audible sound, throwing, kicking, or breaking items, pushing

desks, running into walls, kicking walls, or ripping materials. Matt was a twelve-year-old male who engaged in disruption including any instance of throwing, swiping, or breaking items. Matt communicated through picture exchange. Josh, a ten-year-old male, engaged in disruption in the form of throwing, breaking, ripping, hitting, or kicking objects. Josh communicated using picture exchange. Callie was an eight-year-old female who engaged in screaming, which was operationally defined as any instance of producing loud noises that last longer than 3 seconds and can be heard from twenty feet away. She communicated using an augmentative communication device.

Inclusion criteria consisted of discrete, observable, disruptive behavior exhibited daily in the school or home environment that occurred at least 10 times per day and was hypothesized by the clinical team to be maintained by social contingencies (i.e., attention, escape, or tangible items). We excluded any participants with (a) any dangerous behavior that required physical redirection or restraint for safety, (b) any behavior hypothesized as maintained by automatic reinforcement, (c) any behavior occurring fewer than 10 times per day, or (d) any behavior without a discrete beginning and end.

Setting and Materials. All sessions took place in a treatment room located within the school building. The treatment room was non-padded. Each treatment room was 6 feet by 10 feet. Each room contained a desk and a chair. A two-way mirror was installed in the door of the treatment room which enabled viewing from an observation room. Condition-specific materials, described within conditions, were placed on or next to the desk. Each condition included the applicable materials (e.g. tangible items, work materials). Materials to disrupt were chosen based on clinician interview and were present in the room across conditions. If applicable, these materials were also included in the MSWO to ensure they were not highly preferred; this

decreased the chances of the disruptive materials competing with the motivation to access the programmed consequences.

Dependent Variables & Response Measurement

The dependent variables measured for this assessment included the targeted challenging behavior (TCB) and the functional communicative response (FCR) identified for each participant. The frequency of targeted behaviors (challenging and communicative) were measured via the Countee® application installed on the researcher's cell phone. All TCBs and FCRs were measured using frequency within sessions which was converted to rate at the end of each session. This was done by taking the total count per session and dividing it by the number of minutes within the session. All responses were scored per the definitions specified for each participant. Additional challenging behaviors that occurred or communicative responses that did not meet the definition were ignored. Each TBC and FCR was operationally defined following the formal interview with the clinician and prior to beginning the analyses. An example of an operational definition is as follows: disruption will be defined as any instance of swiping items off the desk (each swipe is scored as one occurrence), hitting furniture with a closed fist, or kicking walls from 12 inches or greater. An example of the corresponding FCR included requesting a break defined as any instance of the participant vocally stating "break" or "no work,", requesting attention defined as any instance of the participant saying "hi" or "excuse me.", or requesting tangible items defined as any instance of the participant saying the item's name or exchanging a picture card representing the item.

The duration of each session and assessment were also measured. The SFA sessions were all 5 min. This was a change from Iwata et al. (1982/1994) to minimize the difference in total duration between two-minute trials in the RAA and the duration of the SFA. A five-minute

session duration was supported by Wallace and Iwata (1999). This study assessed the agreement between five, ten, and fifteen-minute SFAs and found that the results of the five-minute sessions agreed with results of the ten-minute sessions across 96% of participants.

Total duration of the SFA was calculated by multiplying the number of sessions by the set duration (5 min) for each session. Due to the latency measure within the RAA, each session varied in length; therefore, a timer on the application was used to measure the length of each of these sessions. The total duration of this assessment was found by summing the durations of all the sessions conducted.

Interobserver Agreement

A second trained observer collected data for at least 30% of sessions across analyses; 24% of RAA trials and 36% of SFA sessions. Interobserver agreement (IOA) was calculated using total-count agreement within each session for the SFA. At the end of each session in which IOA was collected, the total frequencies of both observers were compared, and percent agreement was calculated by dividing the smaller frequency by the larger frequency. Due to the latency measure of the RAA, the calculation was changed slightly. IOA for the RAA was calculated by dividing the shorter latency by the larger latency and multiplying by 100% as used in Thomason-Sassi et al. (2011). The mean reliability of the RAA was 95% with a range of 60%-100%. Per participant within the RAA, IOA ranged from 91.3% to 100% with one participant within which IOA was not able to be calculated. This was due to an inability to record his sessions and will be discussed in more detail in the discussion section. IOA for the SFA was calculated using total count IOA; the smaller frequency was divided by the larger frequency and multiplied by 100. IOA for the SFA ranged from 50%-100% with an average of 90% agreement. Per participant within the SFA, IOA ranged from 87.8%-95.3%.

Procedural Fidelity

Procedural fidelity was measured using a task analysis created specifically for this study. An individual task analysis was created for each assessment to ensure each step of each assessment was accounted for. Procedural fidelity was assessed across a minimum of 30% of the sessions by the second trained observer. This included scoring each step of the task analysis as accurate or inaccurate by scoring plus or minus based on the description of each step. For example, the therapist was required to divert attention during the attention test condition. If the therapist were to provide attention noncontingently or in response to a non-targeted behavior, the step would have been scored as a minus. Alternatively, if the therapist correctly delivered attention contingent on TCB, a plus was scored. The total number of accurate steps was divided by the total number of opportunities and multiplied by 100%.

Procedural fidelity was calculated for the same sessions as IOA for a total of 30% of sessions. When assessing the RAA, procedural fidelity scores showed that the analysis was implemented with 95% accuracy with a range of 75-100%. The SFA was implemented with 98% accuracy with a range of 83-100% as scored by a task analysis individualized per assessment and including each step of the analyses.

Experimental Design

A multielement design was used for the SFA, and a Concurrent Operant Arrangement (Test/Control) design was used for the RAA to compare the level of TCB across conditions. Additionally, the implementation order of assessments was counter-balanced across participants to control for potential carryover effects across analyses (See Table 2 for order of analyses per participant). The order of sessions within the SFA was attention, play, escape, and tangible. The order of sessions within the RAA was attention control/test, escape/test, and tangible control/test.

Procedure

Both assessments were implemented with each participant in a randomized and counter-balanced order. All preassessment information was collected using an informal interview with caregivers and/or clinicians (Hanley, 2009) and a formal preference assessment prior to the start of the analyses.

Preference Assessment. A 9-item, multiple-stimulus without replacement (MSWO) preference assessment was completed for each participant prior to beginning any of the assessments (DeLeon & Iwata, 1996). This assessment included the presentation of nine items equal distance apart in a straight line on a table in front of the participant. Following the selection of an item, the item was removed from the array and all items were rotated as described in DeLeon and Iwata. The second trial followed immediately. This process was repeated until all items were chosen or no choice was made within 30 s of the presentation. All items included in the array were either edibles or tangible items depending on the participant's preferences. Three rounds of the MSWO were completed for each participant and an average of preference was calculated. Ranked order was based off the average preference across the three rounds of the MSWO. The top two items were used within the functional assessments. If there was not clear differentiation of the two most chosen items, additional rounds were completed, and/or additional items were included within the assessment.

Standard Functional Analysis (SFA). An SFA was conducted based on Iwata et al. (1982/1994), Fisher, Piazza, and Chiang (1996), and Fisher et al. (2016). The analysis included attention, tangible, demand, and play conditions. Ignore or alone sessions were not included due to the absence of a test for an automatic function as part of the other assessment. Though previous research has typically used 10-minute sessions within the SFA, the decision to include

5-minute sessions was made to decrease the difference in duration between the 2-minute trials of the RAA.

Undifferentiated results across assessments would suggest an automatic function and additional analyses would be conducted outside of this research due to this research's focus on socially-mediated behavior. Toy play, attention, escape, and tangible sessions were completed for each participant. FCRs across all social conditions were ignored. Social avoidance was included for each participant except Josh. This condition was included if supported by clinician interview or by consistent responding in the attention control condition if the RAA was completed first. The order of implemented sessions was attention, toy play, escape, and tangible. If social avoidance was included, the condition was implemented following each tangible session. Each condition was implemented a minimum of three times to establish a pattern of responding in a multielement design. Necessary conditions were repeated following the third round if a pattern of differentiated responding was not observed. Visual analysis following each round was used to determine the necessity of further sessions. The only difference between the sessions described in Fisher et al. (2016) was a reinforcement period of 30 s rather than 20 s. This change was made to implement consistent reinforcement periods across both analyses. All sessions were 5 min in length.

Attention. In the attention condition, the therapist provided 1-2 min of pre-session attention. At the session start, attention was removed, and the therapist directed their attention to a competing activity such as reading a magazine or writing on a piece of paper. The only items present in the room were the chair, desk, and any identified disruptive materials. Contingent on the TCB, the therapist provided 30 s of attention in the form of verbal reprimands, commentary, and physical contact.

Play (control). The toy play condition consisted of the participant having access to two highly preferred items as identified in the MSWO preference assessment. The therapist provided continuous access to attention in the form of verbal and physical interactions. If social avoidance was hypothesized as a function, the schedule of attention delivery decreased to one time per 30 seconds and upon request by the participant. Preferred items were freely available throughout the session and demands were not placed.

Escape. The therapist would begin placing non-preferred demands using three-step prompting (i.e. verbal-model-physical guidance). The therapist delivered praise contingent on compliance with the verbal or model prompt. Contingent on problem behavior, a 30 second break was given in which the therapist removed work materials, did not place demands, and turned away from the participant.

Tangible. The therapist provided 1-2 min of pre-session access to the high preferred items as identified in the MSWO preference assessment. If the preferred items were edible, the edible items were delivered every 15 seconds and upon request. At session start, the items were removed from the participant by the therapist. Contingent on problem behavior, the therapist provided access to the items for 30 seconds.

Social Avoidance. The therapist provided attention in the form of verbal comments about the participant and physical attention every 5 seconds. Contingent on problem behavior, the therapist removed attention for 30 seconds.

Response Allocation Assessment (RAA). The RAA included control and test trials targeting each condition implemented within the SFA (i.e. attention, tangible, demand, social avoidance). The order of conditions implemented replicated the order of sessions implemented within the SFA. Within each social condition, the EO was manipulated as it was in the SFA, but

the contingency was placed on either the TCB or the identified FCR, whichever occurred first. For example, in the attention condition, the putative reinforcer, access to attention, would be given contingent on either disruption or stating, “Excuse me.” The trial would end after the 30 second reinforcement period or after 2 min. Trials targeting the same social contingency were run consecutively until a pattern of responding was observed with a minimum of three trials per social condition. A pattern of responding was demonstrated by at least three consecutive trials of the same response or same pattern of responding. A function was identified if the FCR or TCB occurred during the majority of the trials. Following three trials, the researcher assessed the need for further trials after each additional trial. This was to ensure only the necessary amount of trials were implemented and the participant was not in the assessment process longer than necessary. The next social contingency was implemented following the observation of a pattern of responding in the previous social contingency condition.

Attention Control. Attention was continuously available throughout the trial. No contingent consequences were delivered for TCB or FCR. Session ended at 2 minutes or 30 seconds following the occurrence of TCB or FCR.

Attention Test. Attention was removed at the start of the trial. Only items available for disruption were present in the room as available items have been demonstrated to potentially mask the reinforcer effect of access to the social reinforcer of attention (McCord & Neef, 2005). The therapist engaged in a competing behavior including reading a book or writing on a piece of paper. Contingent on the TCB or an FCR for attention, 30 seconds of attention was delivered, and the trial ended or at the two-minute mark if a response did not occur.

Escape Control. The therapist was in the room approximately 5 feet from the participant. No demands were placed. No programmed consequences for TCB or FCR were implemented. Session ended at 2 minutes or 30 seconds following the occurrence of TCB or FCR.

Escape Test. The therapist placed demands to complete non-preferred work tasks using a three-step prompting hierarchy (i.e. verbal-model-physical guidance). Contingent on the targeted TCB or an FCR for escape, 30 seconds of escape was delivered, and the trial ended or at two minutes if no responding occurred.

Tangible Control. The therapist was in the room approximately 5 feet from the participant. The participant had free access to the high preferred tangible items as identified by the MSWO preference assessment. No consequences for TCB were delivered. Session ended at 2 minutes or 30 seconds following the occurrence of TCB or FCR.

Tangible Test. The therapist removed access to the preferred items at the start of the trial. Contingent on the TCB or the FCR for access to tangibles, the items were given to the participant for 30 seconds and the trial ended.

Social Avoidance Control. The therapist was in the room approximately 5 feet from the participant. The therapist did not interact with the participant and diverted eye contact from the participant. No programmed consequences for TCB or FCR will be delivered. Sessions ended at 2 minutes or 30 seconds following the occurrence of TCB or FCR.

Social Avoidance Test. The therapist was within 2 feet of the participant. At the start of the trial, the therapist delivered continuous attention in the form of verbal and physical interactions. Contingent on the targeted TCB or the FCR for social avoidance, the therapist removed attention by stopping any verbal and physical interaction and stepping 5 feet away from the participant. The trial ended after 30 seconds of no attention.

Ethical Assurances

Participants were chosen from a private day school in Pennsylvania that agreed to serve as the research site. Students at the school who currently engaged in disruption which impacted their ability to participate in daily programming were identified as potential participants by the senior clinician and clinical team. Once a student was identified as a potential participant, the written consent form was sent home to the parent. If returned, the consent form was given to the researcher and the student became a participant. Participation remained confidential; participants were each given a number as an identifier. All data is kept on a password protected computer and will be saved for the required five years per APA guidelines.

Chapter 4: Results

Results of the current study show differentiation in functions maintaining the TCB for all participants across both analyses. Socially-maintained functions were identified for each of the participants' targeted behaviors. When the FCR was accepted as an alternative to access the determined consequence within the RAA, each participant allocated to the FCR at least one time.

Table 3 summarizes the durations across analyses. The RAA was completed in significantly less time than the SFA across all participants with a range in difference of duration from 26.8 to 70.6 minutes and an average difference of 52.3 minutes.

Dylan

Figures 1 and 2 display Dylan's results across the RAA and SFA. Figure 1 displays the results of the RAA. During the RAA, there was consistent, fast responding allocated to the FCR during the tangible test condition. This suggested a tangible function. Within the tangible test condition, Dylan engaged in the FCR during each of the three trials with a latency ranging from 19 seconds to 73 seconds.

Figure 2 displays the results of the SFA for Dylan. Dylan engaged in variable rates of disruption across both the attention and tangible sessions as compared to the control sessions. This indicated a tangible and attention function for disruption. For Dylan, the RAA was completed in 49.4 minutes while the SFA required 120 minutes to complete.

Cody

Figures 3 and 4 display Cody's results across the RAA and SFA. Figure 3 displays the results of the RAA. In the RAA, Cody manded for attention during the third, fourth, and sixth trials; manding extinguished and no responding (FCR or TCB) occurred in the remaining three trials. Within the tangible test condition, Cody manded for his preferred items across all three

trials with low latencies ranging from 4 seconds to 8 seconds. No responding occurred within the escape test or social avoidance test conditions.

Figure 4 displays the results of the SFA for Cody. He engaged in disruption across attention sessions, except for the first session of no responding. Disruption occurred across all three tangible sessions. No responding occurred within the play condition. Differentiated responding between the tangible and attention data paths and the toy play data path was observed. The RAA was completed in 53.2 minutes while the SFA required 80 minutes to complete.

Matt

Figures 5 and 6 display the results for Matt. Figure 5 displays the results of the RAA. The RAA identified a tangible, escape, and social avoidance function. In the RAA, Matt engaged in one instance of disruption during one tangible control trial with no responding during the remainder of the trials. During the tangible test condition, Matt engaged in the FCR across all three test trials. During the attention control condition, he engaged in disruption within 12 seconds for all three trials. Due to this responding, attention control was discontinued, and the attention test condition was omitted. The social avoidance condition was included. No responding occurred during the escape control condition and during the escape test condition, Matt engaged in an untrained FCR (e.g. exchanging a break card) across all three trials with a latency ranging from 46 seconds to 58 seconds. Within the social avoidance control condition, no responding occurred. Matt then did not respond during the first test trial of the social avoidance test condition. Disruption occurred during the subsequent three trials within social avoidance test. Figure 6 displays the SFA results of Matt. The SFA identified an escape and social avoidance function for his disruptive behavior. Differentiated responding occurred between the

escape data path and the social avoidance data path in comparison to the toy play data path. No responding occurred within the attention, escape, and toy play conditions. The RAA was completed in 27.4 minutes and the SFA was completed in 85 minutes; a difference in duration of 57.6 minutes.

Josh

Figures 7 and 8 display the results of Josh's RAA and SFA. Figure 7 displays the results of the RAA. The RAA identified a tangible, attention, and escape function. In the RAA, Josh did not engage in any responding in any of the control trials. Within the attention test condition, he allocated to the FCR across all three trials with latencies ranging from 6 seconds to 10 seconds. In the escape test condition, Josh allocated to the FCR in trial 1 and 3 and TCB in trial 2 with latencies ranging from 8 seconds to 119 seconds. During the tangible test condition, Josh engaged in the FCR across all three trials with latencies ranging from 6 seconds to 9 seconds. Figure 8 displays the results of the SFA. The SFA identified escape and attention functions. In the SFA, occurrences of disruption occurred across each attention condition. During the escape condition, the rate of disruption increased across sessions. No responding occurred within the toy play condition and one instance of disruption occurred within the first tangible condition but then decreased to zero for the remaining three sessions. Participant four's RAA required 21.3 minutes to complete while the SFA required 65 minutes to complete.

Callie

Figures 9 and 10 display the results of Callie's RAA and SFA. Figure 9 displays the results of the RAA. Results of the RAA suggest Callie's TCB/FCR are maintained by escape from demands and access to tangibles. Within the RAA, no responding occurred in the control sessions for all conditions. In the escape test condition, Callie allocated to the TCB across all

three trials with a latency ranging from 7 seconds to 9 seconds. In the tangible test condition, she allocated to FCRs using her communication device across all three trials with decreasing latencies from 23 seconds to 8 seconds. Results of the SFA are displayed in figure 10. In the SFA, although Callie engaged in disruption during the first series, including the play condition, the TCB decreased to zero in the play, attention, and social avoidance conditions across the remainder of the series. Moving into the second round of the SFA, responding presented at differentiated levels with no further responding occurring in the play conditions. Elevated levels of disruption occurred across all three tangible sessions with a range of 1.8 to 2 occurrences per minute. Levels of disruption also occurred consistently during the escape conditions with a range of 1.6 to 2.2 occurrences per minute. For Callie, the RAA required 37.1 minutes while the SFA required 100 minutes.

Overall Results

To assess the utility of a new analysis, its validity must be measured in comparison to accepted analyses within the field. Table 4 provides a summary of the results across participants and analyses. This study found a 67% correspondence in identifying the function between the RAA and the SFA with a range of 66%-100% agreement between analyses for participants. Correspondence was calculated by diving the total functions agreed upon by the total functions identified. Previous research comparing FA modifications to the SFA had compared agreement using full correspondence, partial correspondence, and absence of correspondence terminology (Bloom et al., 2011; LaRue et al., 2010). In this study, full correspondence was demonstrated in 20% of participants, partial correspondence was demonstrated in 100% of participants, and zero participants demonstrated an absence of correspondence. Of studies assessing correspondence between the SFA and modified analyses, correspondence has ranged from 87% (Thomason-Sassi

et al., 2011) to 56% correspondence (Bloom et al., 2011). The correspondence between the RAA and the SFA is comparable to percent correspondence of other FA modifications.

Another method of determining the validity of an assessment is to measure the percentage of conditions in which differentiated results were identified. Of other studies that have assessed differentiation as a measure of effectiveness, differentiation has ranged from 44% (Lambert et al., 2017) to 100% (Slaton et al., 2017) with an average differentiation of 74% (Derby et al., 1992; Fisher et al., 2016; Northrup et al., 1991). The RAA produced differentiated results across conditions for all five participants. The SFA also produced differentiated results across all conditions for all five participants, but 9 out of the 24 conditions required additional sessions to produce differentiation in comparison to only 4 of the 37 conditions within the RAA. Within the 37 trials in which responding occurred during the RAA, 25 of those responses were FCRs and 12 of the responses were TCB.

The RAA accurately identified 80% of the functions of the TCB and FCR assuming that the SFA accurately predicted the functions of the TCB with 67% correspondence across all identified functions. Differentiation between test conditions and the play/control condition was observed in all five participants within the RAA and SFA though the RAA required less overall additional sessions to produce differentiated results. The RAA was also able to be completed in 52.3 minutes faster, on average, then the SFA.

Chapter 5: Discussion and Conclusions

The purpose of this study was to evaluate if the RAA is a comparable and effective modification to the SFA. A secondary purpose was to assess whether placing the contingency within the RAA on either the TCB or the FCR would produce results that agreed with the SFA. Finally, the efficiency of the RAA was evaluated as compared to the SFA in producing differentiated results. The RAA produced results with 80% agreement of identified functions to the SFA. When comparing the RAA and SFA equally, this study found 67% agreement between the analyses. Both the RAA and SFA produced differentiated results across all participants, but 37% of the SFA conditions required additional sessions to demonstrate differentiated results compared to only 11% of the RAA conditions. In comparison to other modifications of the SFA, the RAA was similar in effectiveness. Research assessing the trial-based FA has produced differentiated results in 80-100% of analyses (Bloom et al., 2011; LaRue et al., 2010). Differentiation when using the brief FA has ranged from 47-100% (Derby et al., 1992; Northrup et al., 1991) while the latency-based FA has produced differentiated results during 44% of analyses (Lambert et al., 2017). When implementing the IISCA to determine the function of targeted behaviors, differentiated results have ranged from 80-100% (Fisher et al., 2016; Slaton, Hanley, & Raftery, 2017).

Interpretation of Findings

Although many studies have evaluated alternatives to the SFA, only a few have directly compared these alternative analyses to the SFA (e.g., Bloom et al., 2011; Fisher et al., 2016; LaRue et al., 2010; Muething, Call, Mevers, Zangrillo, Clark, & Reavis, 2017; Slaton, Hanley, & Raftery, 2017; Thomason-Sassi et al., 2011). Research comparing the trial-based FA to the SFA found full correspondence ranging from 60%-80% with 56-83% agreement across all functions

identified; the RAA demonstrated 20% full correspondence with 67% agreement across all functions identified. Though the RAA demonstrated a lower percentage of full correspondence, the RAA agreed with the SFA at comparable percentages to the trial-based FA (2010). When assessing the agreement between the brief FA and the SFA, Muething et al. (2017) found the brief FA's results agreed with the SFA 22% of the time with 32% correspondence between the two analyses; these levels of agreement and correspondence are much lower than those of the RAA as compared to the SFA.

Without direct comparison, the accuracy of these analyses can only be informed by the number of participants in which the analysis produced differentiated results more frequently (Derby et al., 1992; Hanley, Jin, Vanselow, & Hanratty, 2014; Lambert et al., 2017; Northrup et al., 1991). The latency-based FA produced differentiated results in 44% of cases in Lambert et al. (2017). The brief FA produced differentiated results in 47% of cases (Derby et al., 1992). Slaton et al. (2017) demonstrated differentiated results across 100% of the participants. A comparable study completed by Fisher et al. (2016) found 80% differentiation when implementing the IISCA. In this study, the RAA produced differentiated results in 100% of participants; 89% of conditions produced differentiated responding without requiring additional trials (more than the minimum 3 trials per condition). The SFA produced differentiated results in 100% of conditions as well, but 37% of SFA conditions required additional sessions to demonstrate a clear pattern of responding. The need for additional sessions to demonstrate differentiation between data paths added to the overall resources, specifically time in the treatment room, required by the SFA.

One potential advantage of the RAA is that it took substantially less time to implement. Each participant was able to complete the RAA in significantly less time than the SFA, ranging

in a difference of duration from 26.8 minutes to 70.6 minutes. The average time required for the RAA to be completed was 37.7 minutes; the average time required for the SFA to be completed was 90 minutes. This difference in duration supports the RAA being a much more efficient method to identify function than the SFA.

Perhaps the strongest advantage of the RAA is that it directly informs the clinician about what FCRs the participant is using; these FCRs could include both trained and untrained responses. Two of the participants used untrained FCRs during the RAA effectively to access the contingent reinforcer. Cody asked for attention using the researcher's name, which was an untrained response, and Matt asked for break during the escape test condition using a picture card he had no previous history with. One benefit of the RAA is that when a function is identified using the RAA, the clinician has observed whether the student is using an appropriate communicative behavior (FCR) to access the consequence or whether the student is allocating to TCB. This can directly inform where the clinician should begin with function-based treatment.

One interesting pattern of responding observed across the RAA was the identification of a tangible function via consistent FCRs occurring across tangible test trials. The RAA identified a tangible function across all five participants and the SFA only identified a tangible function in three of five participants. Tangible and edible items have been shown to be highly effective reinforcers. Because of this, access to these items during functional analyses may evoke new behaviors that weren't historically displayed under the present conditions or higher rates of behavior already in the participant's repertoire (Rooker, Iwata, Harper, Fahmie, & Camp, 2011). One explanation for the high occurrence of both FCRs and TCBs across analyses within this study is that the items included were reinforcing and therefore increased the occurrence of both

the TCB within the SFA and FCRs within the RAA. All participants engaged in some type of behavior to access tangible reinforcers in 80% of the analyses.

Another possibility is that the RAA overidentifies the tangible function due to FCRs being equated to TCB. The prevalent occurrence of requests for tangible items in the tangible test condition may have been due to the participants' learning histories rather than functions of challenging behavior. Mands for tangible items such as preferred toys and foods are often the most trained mand; the motivation can be increased by the presence of the item in the environment, tangible items are easily included within preference assessments, and the item can be quickly delivered following the mand (Albert, Carbone, Murray, Hagerty, & Sweeney-Kerwin, 2012; Loughrey et al., 2014). Mands for break, attention, and social avoidance are less concrete; these do not consist of concrete items that can be placed in the child's view to increase motivation to request. Most often, mands for break, attention, and social avoidance are not taught unless the corresponding function has been identified via a functional analysis (Egan & Barnes-Holmes, 2009; Harper, Iwata, & Camp, 2013; Plavnik & Ferreri, 2012). This unequal balance of functional communication training may lead to participants asking for tangible items because of the learning history of requesting items when they are present in the environment regardless of the function of the TCB. One way to address this limitation would be to include untrained items in the preference assessment. Using preferred items that do not have a previous learning history may decrease the likelihood of the FCR being emitted due to previous training.

In contrast, the RAA may have underestimated the attention function. This may be due to the short duration of each trial or a decreased motivation to access attention due to the control trials immediately preceding the test trials. Attention was identified as a function by the SFA for participants Dylan and Cody, but not identified in the RAA. Although both participants

displayed intermittent responding in the attention test condition, neither did so with consistency to meet the criteria for pattern of responding. Within-session analyses showed that 50% of Dylan's responding occurred within the first 120 seconds during the SFA and 50% of responding occurred in the last three minutes of the session. For Cody, the first instance of disruption in each of the attention sessions in which responding occurred happened within the first 120 seconds of the session. This would refute the explanation that the short duration led to less responding. It is likely that control trials immediately preceding the test trials may have acted as an abolishing operation on the motivation to access attention as a reinforcer. Adding in a pause time between attention control and attention test conditions or running the controls trials after the test trials may decrease the likelihood of the control trials decreasing the motivation to access attention.

An additional aspect of this research that differs with prior analyses, including a social avoidance function, was the preemptive modification to the play/control conditions across both analyses. A social avoidance function was hypothesized for four of five participants, but only identified with Matt. Matt displayed consistent responding within the attention control condition which supported a potential social avoidance function. This function of behavior can have a negative impact on the ability for the analysis to produce differentiated results due to the typical inclusion of attention within the play condition. Prior research has reactively modified the play condition; doing so only after multiple sessions of elevated responding within the play condition (Harper et al., 2011; Hagopian, Wilson, & Wilder, 2011). By modifying the play condition prior to implementation, the efficiency of the analysis is improved.

Previously, response allocation has been used primarily within the experimental analysis of behavior literature in reference to the matching law (Jarmolowicz et al., 2016; Kangas et al., 2009). Because the RAA is a new application of the principles of response allocation and the

matching law, it may be tailored to include components of many of the previously supported modifications to the SFA: conditions implemented in trials like the trial-based FA, latency-measure as in the latency FA, and short durations comparable to the brief FA. These components, implemented together, potentially addressed limitations of these individual analyses.

First, limitations noted in Bloom et al. (2011) related to implementing trials as the opportunity arises as done within a trial-based FA. This leads to limited exposure to the establishing operations and consequences of the condition. This could impact the ability for the participant to contact the contingency repeatedly and therefore require additional trials to produce differentiated responding. Due to the design of the RAA, participants are exposed to the current contingency repeatedly through the consecutive presentation of trials within one condition until a pattern of responding is observed.

Second, a limitation noted of the latency-based FA is that there are fewer opportunities for the behavior to come under discriminative control because there is only one occurrence per trial (Lambert et al., 2017; Thomason-Sassi et al., 2011). The repeated trials within the RAA also addresses this concern; trials implemented consecutively will replicate multiple exposures to the establishing operation, discriminative stimulus, and consequence as if in one longer session similar to in the SFA.

Third, a concern of the brief FA is the high percentage of participants who did not display the TCB within the assessment. In an analysis of 79 cases, Derby et al. (1992) found that 37% of participants did not display any challenging behavior during the analysis. This was hypothesized to be due to the brief FA functioning more as a reinforcer probe than a functional analysis. To address this concern, Derby et al. recommended the modified analysis to replicate the extended

analysis, the SFA, as closely as possible to increase the likelihood of agreement across analyses. In this study, the methods of the RAA replicated those of the SFA in the preferred items used, the materials included, the reinforcement period, and the order of implementation of sessions. This close approximation may have increased the likelihood of agreement based on previous research (Derby et al., 1992).

The RAA also demonstrates that an analysis can identify functions of singular, targeted behaviors in isolated conditions and still be efficient. Slaton, Hanley, and Raftery (2016) proposed that one reason synthesized contingencies were more effective in producing differentiated results is that precursors were included within the TCB definition. They also hypothesized that interactions between the contingencies may have been responsible for the increased differentiation. In this study, the RAA produced differentiated results in significantly less time than the SFA while informing function-based treatment and identifying isolated contingencies.

Limitations

Interpretation of these results must be considered considering some limitations. First, the tangible control condition for participant three should have been continued until stable responding was observed. This oversight may have impacted the comparison between tangible control and test trials when identifying a function. Graphing each datapoint in the moment would limit oversights in decision making.

Second, the rate of FCRs was not tracked within the SFA to provide a comparison between the two analyses. Potentially tracking FCRs within the SFA could inform function-based treatment as in the RAA or patterns of responding (e.g., participant engaging in the FCR multiple times before allocating to the TCB and accessing the consequence) could be observed

which would provide the clinician with similar information as in the RAA. The FCR would not be reinforced within the SFA though and rate of responding would most likely decrease due to the behavior being placed on extinction in that context. A present second data collector or recordings of all sessions would have an enabled more detailed data collection.

A third limitation of this research was the previously mentioned overprediction of the tangible function within the RAA. The RAA identified a tangible function for all participants within the study, potentially due to a history of mand training across participants. By including untrained items, the learning history would be removed as a confound. Additionally, materials to disrupt were chosen based on clinician and parent report. Materials most likely to be disrupted were not assessed in a systematic manner. By including these items within a preference assessment to ensure they were not highly preferred or assessing the rate of disruption towards specific items in the natural environment prior to the research, the items chosen could have been more systematically identified as neutral items likely to be disrupted.

A final limitation of this study is the absence of a treatment analysis. The inclusion of a treatment analysis could have verified the findings of the RAA and SFA and confirmed which functions were accurately identified by which assessment. This information would further support or refute the potential equivalence of the FCR and TCB. This also would have provided further validity to the results of the analyses and supported which analysis identified the correct functions based on the behavioral change observed during treatment analyses.

Conclusion

The current study has extended the literature on function-based assessment and potentially treatment development within that assessment. It would be beneficial for additional

research to be conducted into whether the RAA can consistently produce high rates of agreement with the SFA across a multitude of participants. This could include implementing the RAA with additional participants across a variety of settings (e.g. inpatient facilities, outpatient centers, and residential school programs). Collecting information on training of FCRs during clinician/parent interview to further inform potential patterns of function identification in the RAA would also add to the research. This information could identify patterns of learning prior to the RAA being implemented and further inform the high rate of identification of the tangible function by the RAA.

The findings from the current study support the RAA as a viable alternative to the SFA. The RAA was demonstrated to have high agreement with the SFA, be completed in less time, and to inform function-based treatment by the tracking of FCRs. This research adds to the literature of more user-friendly variations to the SFA while still identifying isolated contingences using experimental methods. Further research can support or refute the utility of the RAA as an additional analysis to determine the function of problem behavior, potentially with decreased occurrences of the TCB with the acceptable alternative of communicative responses.

References

Albert, K. M., Carbone, V. J., Murray, D. D., Hagerty, M., & Sweeney-Kerwin, E. J. (2012). Increasing the mand repertoire of children with autism through the use of an interrupted chain procedure. *Behavior Analysis in Practice, 5*(2), 65-76.

Athens, E. S., & Vollmer, T. R. (2010). An investigation of differential reinforcement of alternative behavior without extinction. *Journal of Applied Behavior Analysis*, *43(4)*, 569-589. doi: 10.1901/jaba.2010.43-569

Badgett, N. & Falcomata, T. S. (2015). A comparison of methodologies of brief functional analysis. *Developmental Neurorehabilitation, 18(4)*, 224-233. doi: 10.1901/jaba.2010.43-56910.3109/17518423.2013.792298

Baer, D. M., Wolf, M. M., & Risley, T. R. (1968). Some current dimensions of applied behavior analysis. *Journal of Applied Behavior Analysis, 1(1),* 91-97. doi: 10.1901/jaba.1968.1-91

Beavers, G. A., Iwata, B. A., & Lerman, D. C. (2013). Thirty years of research on the functional analysis of problem behavior. *Journal of Applied Behavior Analysis, 46(1),* 1-21. doi: 10.1002/jaba.30

Bloom, S. E., Iwata, B. A., Fritz, J. N., Roscoe, E. M., & Carreau, A. B. (2011). Classroom application of a Trial-Based Functional Analysis. *Journal of Applied Behavior Analysis, 44(1),* 19-31. doi: 10.1901/jaba.2011.44-19

Carr, E. G., & Durand, V. M. (1985). Reducing behavior problems through functional communication training. *Journal of Applied Behavior Analysis, 18(2),* 111-126. doi: 10.1901/jaba.1985.18-111

Carter, S. L. (2009). Use of treatment analysis following ambiguous functional analysis results. *Behavioral Interventions, 48(2),* 205-213. doi: 10.1901/jaba.1985.18-111

Christensen, D. R. (2009). Response allocation in a rapid acquisition concurrent-chains procedure: Effects of overall terminal-link duration. *Behavioural Processes*, *81*(2), 233-237. doi: 10.1016/j.beproc.2009.01.006.

DeLeon I. G, & Iwata B. A. (1996). Evaluation of a multiple-stimulus presentation format for assessing reinforcer preferences. *Journal of Applied Behavior Analysis, 29(4)*, 519-532. doi: 10.1901/jaba.1996.29-519

Derby, K. M., Wacker, D. P., Sasso, G., Steege, M., Northrup, J., Cigrand, K., & Asmus, J. (1992). Brief functional assessment techniques to evaluate aberrant behavior in an outpatient setting: a summary of 79 cases. *Journal of Applied Behavior Analysis, 25(3*), 713-721. doi: 10.1901/jaba.1992.25-713

Egan, C. E., & Barnes-Holmes, D. (2009). Emergence of tacts following mand training in young children with autism. *Journal of Applied Behavior Analysis, 42(3)*, 691-696. doi: [10.1901/jaba.2009.42-691]

Ellis, J., & Magee, S. (2004). Modifications to basic functional analysis procedures in school settings: a selective review. *Behavioral Interventions, 19(3),* 205-228. doi: 10.1002/bin.161

English, C. L., & Anderson, C. M. (2004). Effects of familiar versus unfamiliar therapists on responding in the analog functional analysis. *Research in Developmental Disabilities, 25(1)*, 39 –55, doi: 10.1016/j. ridd.2003.04.002

Finkel, A. S., Derby, K. M., Weber, K. P., & McLaughlin, T. F. (2003). Use of choice to identify behavioral function following an inconclusive brief functional analysis. *Journal of Positive Behavioral Interventions, 5(2)*, 112-121. doi.org/10.1177/10983007030050020601

Fisher, W. W., Greer, B. D., Romani, P. W., Zangrillo, A., N., & Owen, T. M. (2016). Comparisons of synthesized and individual reinforcement contingencies during functional analysis. *Journal of Applied Behavior Analysis, 49*(3), 596-616. doi: 10.1002/jaba.314

Fisher, W. W., Piazza, C. C., & Chiang, C. L. (1996). Effects of equal and unequal reinforcer duration during functional analysis. *Journal of Applied Behavior Analysis, 29(1),* 117–120. doi: 10.1901/jaba.1996.29-117

Hagopian, L. P., Rooker, G. W., Jessel, J., & DeLeon, I. G. (2013). Initial functional analysis outcomes and modifications in pursuit of differentiation: A summary of 176 inpatient cases. *Journal of Applied Behavior Analysis, 46(1),* 88-101. doi: 10.1002/jaba.25

Hagopian, L. P., Bruzek, J. L., Bowman, L. G., Jennett, H. K. (2007). Assessment and treatment of problem behavior occasioned by interruption of free-operant behavior. *Journal of Applied Behavior Analysis, 40(1),* 89–103. doi: 10.1901/jaba.2007.63-05

Hagopian, L. P., Wilson, D. M., & Wilder, D. A. (2001). Assessment and treatment of problem behavior maintained by escape from attention and access to tangible items. *Journal of Applied Behavior Analysis, 34(2),* 553-562. doi: 10.1901/jaba.2001.34-229

Hanley, G. P. (2010). Prevention and treatment of severe problem behavior. In E. Mayville & J. Mulick (Eds.), *Behavioral foundations of effective autism treatment* (pp. 233–256). New York, NY: Sloan.

Hanley, G. P. (2011). Functional analysis. In J. Luiselli (Ed.), *Teaching and behavior support for children and adults with autism spectrum disorder: A "how to" practitioner's guide* (pp.22–29). New York, NY: Oxford University Press.

Hanley, G. P. (2012). Functional assessment of problem behavior: Dispelling myths, overcoming

implementation obstacles and developing new lore. *Behavior Analysis in Practice, 5*(1), 54–72. doi:10.1007/BF03391818

Hanley, G. P., Jin, S., Vanselow, N. R., & Hanratty, L. A. (2014). Producing meaningful improvements in problem behavior of children with autism via synthesized analyses and treatments. *Journal of Applied Behavior Analysis, 47(1),* 16-36. doi: 10.1002/jaba.106

Hanley, G. P., Iwata, B. A., & McCord, B. E. (2003). Functional analysis of problem behavior: A review. *Journal of Applied Behavior Analysis, 36(2),* 147-185. doi: 10.1901/jaba.2003.36-147

Hanley, G. P. (2009). Open-ended functional assessment interview form. Retrieved from https://www.abainternational.org/media/46721/HanleyFAInterview.pdf

Harper, J. M., Iwata, B.A., & Camp, E. M. (2013). The assessment and treatment of social avoidance. *Journal of Applied Behavior Analysis, 46(1),* 147-160. doi:10.1002/jaba.18

Iwata, B. A., Dorsey, M. F., Slifer, K. J., Bauman, K. E., & Richman, G. S. (1994). Toward a functional analysis of self-injury. *Journal of Applied Behavior Analysis*, *27(2)*, 197–209. doi: 10.1901/jaba.1994.27-197

Iwata, B. A., & Worsdell, A. S. (2010). Implications of functional analysis methodology for the design of intervention programs. *Exceptionality, 13(1)*, 25-34. doi: 10.1207/s15327035ex1301_4

Iwata, B. A., & Dozier, C. L. (2008). Clinical application of functional analysis methodology, *Behavior Analysis in Practice, 1*(1), 3-9. doi: 10.1007/BF03391714

Jarmolowicz, D. P., Sofis, M. J., & Darden, A. C. (2016). Concurrent progressive ratio schedules: effects of reinforcer probability on breakpoint and response allocation. *Behavioural Processes, 128(1),* 103-107. doi: 10.1016/j.jneumeth.2014.06.024

Jessel, J., Hanley, G. P., & Ghaemmaghami, M. (2016). Interview-informed synthesized contingency analyses: thirty replications and reanalysis. *Journal of Applied Behavior Analysis, 49(3),* 576-595. doi: 10.1002/jaba.316

Johnston, J. M., & Pennypacker, H. S. (2009). *Strategies and tactics of behavioral research* (3rd ed.). New York, NY: Routledge.

Kahng, S., & Iwata, B. A. (1999). Correspondence between outcomes of brief and extended functional analyses. *Journal of Applied Behavior Analysis, 32(2),* 149–159. doi: 10.1901/jaba.1999.32-149

Kangas, B. D., Berry, M. S., Cassidy, R. N., Dallery, J. Vaidya, M., & Hackenberg, T. D. (2009). Concurrent performance in a three-alternative choice situation: response allocation in a rock/paper/scissors game. *Behavioural Processes, 82(1),* 164-172. doi: 10.1016/j.beproc.2009.06.004

Kurtz, P. F., Chin, M. D., Huete, J. M., Tarbox, R. S. F., O'Connor, J. T., Paclawskyj, T. R., & Rush, K. S. (2003). Functional analysis and treatment of self-injurious behavior in young children a summary of 30 cases. *Journal of Applied Behavior Analysis*, *36(2)*, 205–219. http://doi.org/10.1901/jaba.2003.36-205. doi: 10.1901/jaba.2003.36-205

Lalli, J. S., Vollmer, T. R., Progar, P. R., Wright, C., Borrero, J., Daniel, D., ... May, W. (1999). Competition between positive and negative reinforcement in the treatment of escape behavior. *Journal of Applied Behavior Analysis, 32(3)*, 285-296. doi: 10.1901/jaba.1999.32-285

Lambert, J. M., Staubitz, J. E., Roane, J. T., Hourchins-Juarez, N. J., Juarez, A. P., Sanders, K.

B., & Warren, Z. E. (2017). Outcome summaries of latency-based functional analyses conducted in hospital inpatient units. *Journal of Applied Behavior Analysis, 50(3),* 487-494. doi: 10.1002/jaba.399

LaRue, R. H., Lenard, K., Weiss, M. J., Bamond, M., Palmieri, M., & Kelley, M. E. (2010). Comparison of traditional and trial-based methodologies for conducting functional analyses. *Research in Developmental Disabilities, 31(1),* 480-487. doi: 10.1016/j.ridd.2009.10.020

Loughrey, T. O., Contreras, B. P., Majdalany, L. M., Rudy, N., Sinn, S., Teague, P., Marshall, G., McGreevy, P., & Harvey, A. C. (2014). Caregivers as interventionists and trainers: teaching mands to children with developmental disabilities. *Analysis of Verbal Behavior, 30(2)*, 128-140. doi: 10.1007/s40616-014-0005-z

Mace, F. C., & West, B. J. (1986). Analysis of demand conditions associated with reluctant speech. *Journal of Behavior Therapy and Experimental Psychiatry, 17(4)*, 285-294. doi: 10.1016/0005-7916(86)90065-0

Mace, F. C., Page, T. J., Ivancic, M. T., & O'Brien, S. (1986). Analysis of environmental determinants of aggression and disruption in mentally retarded children. *Applied Research in Mental Retardation, 7(2),* 203-221. doi:10.1016/0270-3092(86)90006-8

McAdam, D. B., DiCesare, A., Murphy, S., & Marshall, B. (2004). The influence of different therapists on functional analysis outcomes. *Behavioral Interventions, 19(1),* 39-44. doi: 10.1002/bin.148

McCord, B. E., & Neef, N. A. (2005). Leisure items as controls in the attention condition of functional analyses. *Journal of Applied Behavior Analysis, 38(3)*, 417-426. doi: 10.1901/jaba.2005.116-04]

Muething, C. S., Call, N. A., Mevers, J. L., Zangrillo, A. N., Clark, S. B., & Reavis, A. (2017). Correspondence between the results of functional analyses and brief functional analyses. *Developmental Neurorehabilitation, 20*(8), 549-559. doi: 10.1080/17518423.2017.1338776

National Institutes of Health (1989). NIH consensus development conference on the treatment of destructive behaviors in persons with developmental disabilities. Bethesda, MD.

Northup, J., Wacker, D., Sasso, G., Steege, M., Cigrand, K., Cook, J., & DeRaad, A. (1991). A brief functional analysis of aggressive and alternative behavior in an outclinic setting. *Journal of Applied Behavior Analysis, 24(3),* 509-522. doi: 10.1901/jaba.1991.24-509

Plavnik, J. B., & Ferreri, S. J. (2012). Collateral effects of mand training for children with autism. *Research in Autism Spectrum Disorders, 6(4),* 136-1376. doi: 10.1016/j.rasd.2012.05.008

Poling, A., Edwards, T. L., Weeden, M., & Foster, T. M. (2011). The Matching Law. *Psychological Record, 61(*2), 313-322.

Poling, A., Methot, L. L., & LeSage, M. G. (1995). *Fundamentals of Behavior Analytic Research*. New York, NY: Spring Science.

Querim, A. C., Iwata, B. A., Roscoe, E. M., Schlichenmeyer, K. J., Ortega, J. V., & Hurl, K. E. (2013). Functional analysis screening for problem behavior maintained by automatic reinforcement. Journal of Applied Behavior Analysis, 46(1), 47-60. doi: 10.1002/jaba.26

Rapp, J. T., Rojas, N. C., Colby-Dirksen, A. M., Swanson, G. J., & Marvin, K. L. (2010). Predicting preference for items during periods of extended access based on early response allocation. *Journal of Applied Behavior Analysis, 43(3)*, 473-486. doi: 10.1901/jaba.2010.43-473

Rapp, J. T., Vollmer, T. R., St Peter, C., Dozier, C. L., & Cotnoir, N. M. (2004). Analysis of response allocation in individuals with multiple forms of stereotyped behavior. *Journal of Applied Behavior Analysis*, *37(4)*, 481-501. doi:10.1901/jaba.2004.37-481

Reese, R. M. (1997). Biobehavior analysis of self-injurious behavior in a person with profound handicaps. *Focus on Autism and Other Developmental Disabilities, 12(2)*, 87–94. doi: 10.1177/108835769701200204

Rooker, G. W., DeLeon, I. G., Borrero, C. S. Frank-Crawford, M. A., & Roscoe, E. M. (2015). Reducing ambiguity in the functional assessment of problem behavior. *Behavioral Interventions, 30(1),* 1-35. doi: 10.1002/bin.1400

Rooker, G. W., Iwata, B. A., Harper, J. M., Fahmie, T. A., & Camp, E. M. (2011). False-positive tangible outcomes of functional analyses. *Journal of Applied Behavior Analysis, 44(4),* 737-745. doi: 10.1901/jaba.2011.44-737

Sanetti, L. M. H., & Kratochwill, T. R. (2014). *Treatment Integrity: A Foundation for Evidence-Based Practice in Applied Psychology*. Washington, D.C: American Psychological Association.

Santiago, J. L., Hanley, G. P., Moore, K., & Jin, C. S. (2016). The generality of interview-informed functional analyses: systematic replications in school and home. *Journal of Autism and Developmental Disorders, 46(3),* 797-811. doi: 10.1007/s10803-015-2617-0

Schlichenmeyer, K. J., Roscoe, E. M., Rooker, G. W., Wheeler, E. E., & Dube, W. V. (2013). Idiosyncratic variables affecting functional analysis outcomes: a review (2001-2010). *Journal of Applied Behavior Analysis, 46(1),* 339-348. doi: 10.1002/jaba.12

Sigafoos, J., & Saggers, E. (1995). A discrete-trial approach to the functional analysis of

aggressive behaviour in two boys with autism. *Australia & New Zealand Journal of Developmental Disabilities, 20(4)*, 287-297. doi: 10.1080/07263869500035621

Slaton, J. D., Hanley, G. P., & Raftery, K. J. (2017). Interview-informed functional analyses: a comparison of synthesized and isolated components. *Journal of Applied Behavior Analysis, 50(2)*, 252-277. doi: 10.1002/jaba.38

Thomason-Sassi, J., Iwata, B. A., Neidert, P. L., & Roscoe, E. M. (2011). Response latency as an index of response strength during functional analyses of problem behavior. *Journal of Applied Behavior Analysis, 44(1)*, 51-67. doi:10.1901/jaba.2011.44-51

Tiger, J. H., Hanley, G. P., & Bessette, K. K. (2009). Incorporating descriptive assessment results into the design of a functional analysis: a case example involving a preschooler's hand mouthing. *Education & Treatment of Children, 29(1),* 107-124. doi: http://www.jstor.org/stable/42899872

Vollmer, R. T., & Northrup, J. (1996). Some implications of functional analysis for school psychology. *School Psychology Quarterly, 11*(1), 76-92. doi: 10.1037/h0088922

Wallace, M. D., & Iwata, B. A. (1999). Effects of session duration on functional analysis outcomes. *Journal of Applied Behavior Analysis, 32(2)*, 175-183. doi: 10.1901/jaba.1999.32-175

Table 1

Participant Demographics

	Gender	Age (Years)	TCB	Disrupted Materials	Preferred Items	Topography of Communication
Dylan	Male	9	Disruption	Puzzles Books Desk Therapy ball	Pop tarts Skittles Oreos	Picture exchange
Cody	Male	11	Disruption	Paper Puzzle Chair Shoes Desk	Popcorn Cheese curls Cookie	Vocal
Matt	Male	12	Disruption	Puzzle Mr. Potato Head Play doh	Chair Ball	Picture exchange
Josh	Male	10	Disruption	Desk Chair Paper	Therapy ball Mr. Potato Head Play doh	Picture exchange
Callie	Female	8	Screaming	N/A	Ipad Book	AAC device

Table 2

Order of Analysis

Participant	First Analysis	Second Analysis
Dylan	SFA	RAA
Cody	RAA	SFA
Matt	RAA	SFA
Josh	SFA	RAA
Callie	RAA	SFA

Table 3

Summary of the Durations of Each Analysis

Participant	**RAA (total duration)**	**SFA (total duration)**	**Difference in Duration**
1	49.4 minutes	120 minutes	70.6 minutes
2	53.2 minutes	80 minutes	26.8 minutes
3	27.4 minutes	85 minutes	57.6 minutes
4	21.3 minutes	65 minutes	43.7 minutes
5	37.1 minutes	100 minutes	62.9 minutes

Table 4

Correspondence of Identified Functions Between the RAA and the SFA

Participant	RAA	SFA	Correspondence between Analyses
1	Tangible	Attention Tangible	66%
2	Tangible	Attention Tangible	66%
3	Tangible Escape Social Avoidance	Escape Social Avoidance	80%
4	Tangible Attention Escape	Attention Escape	80%
5	Escape Tangible	Escape Tangible	100%

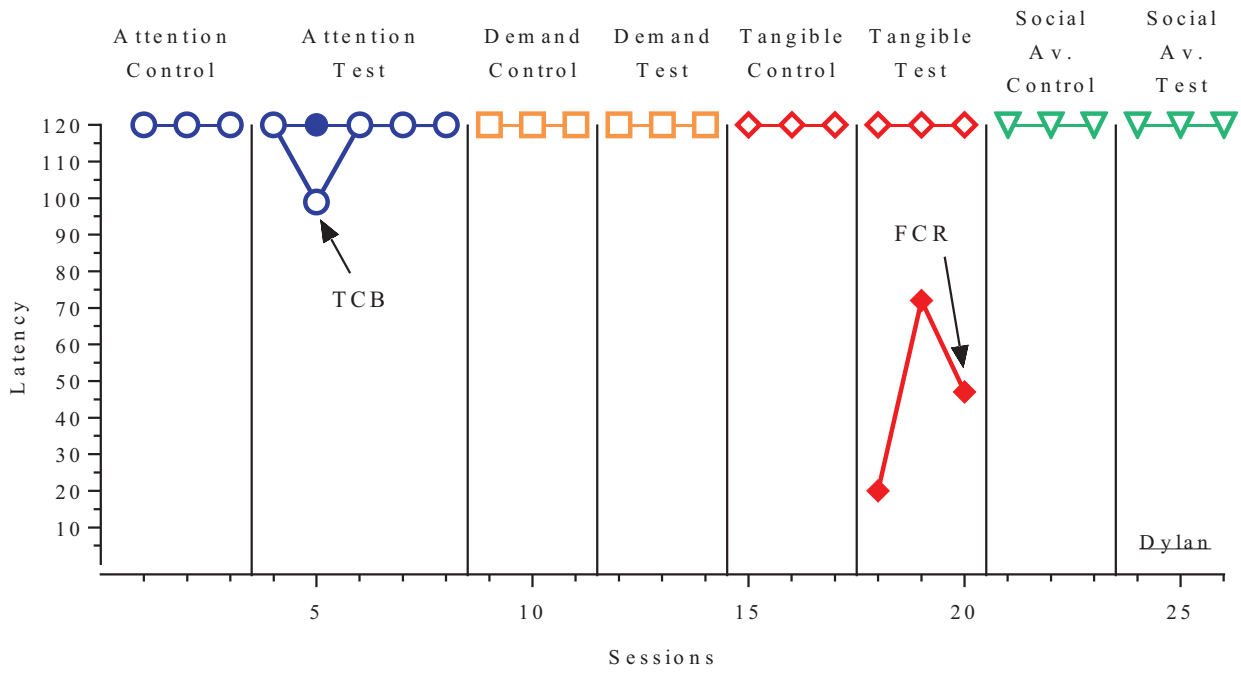

Figure 1. Response allocation assessment graph depicting the latency to problem behavior or replacement behavior across conditions for Dylan.

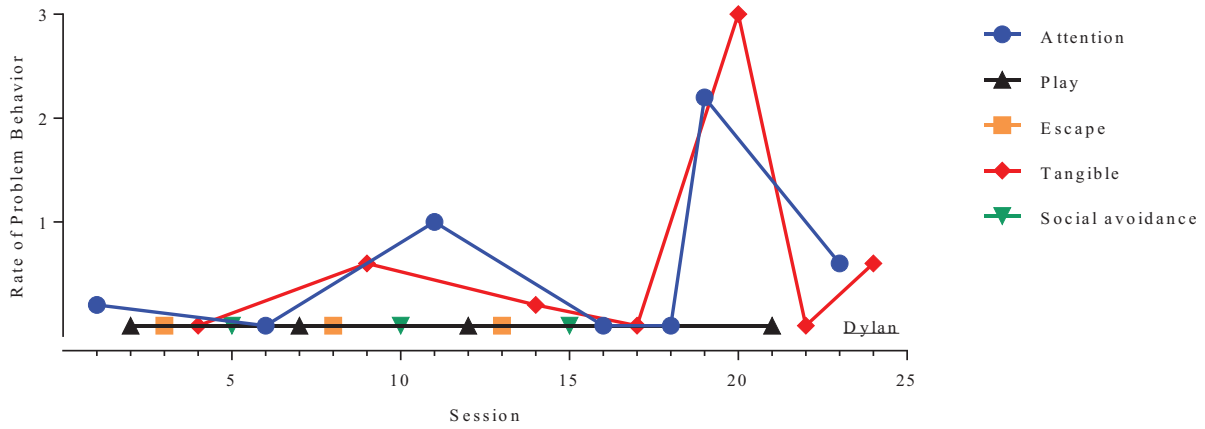

Figure 2. Standard functional analysis graph depicting the rate of problem behavior across conditions for Dylan.

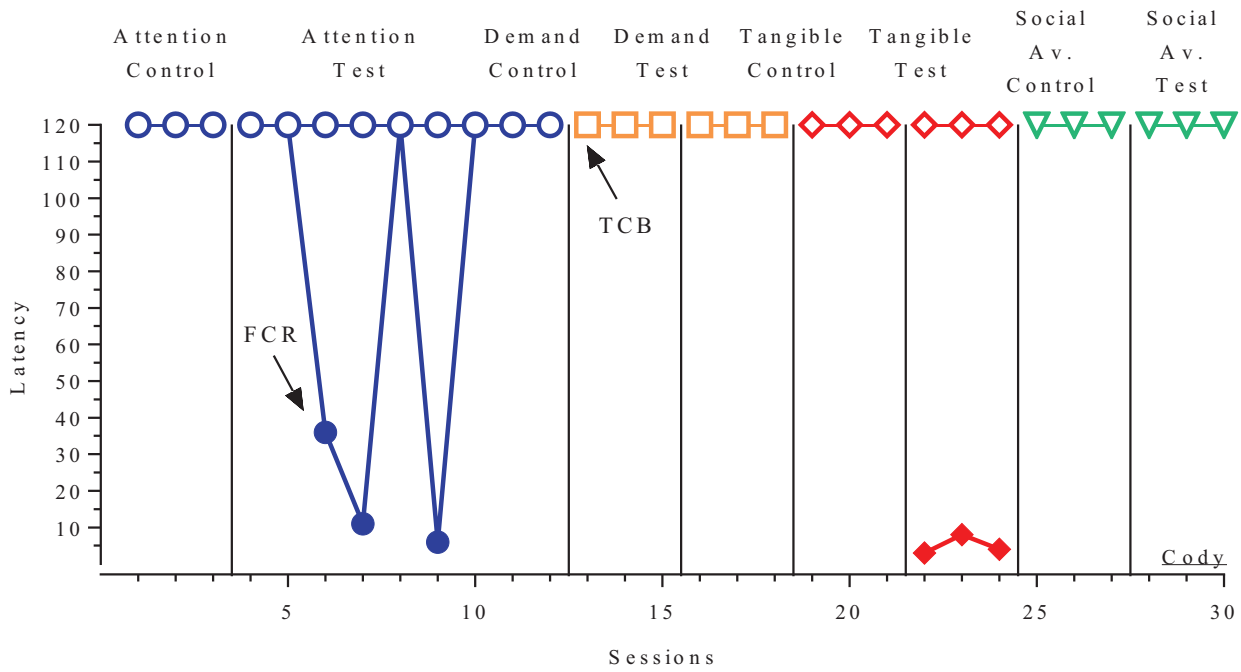

Figure 3. Response allocation assessment graph depicting the latency to problem behavior or replacement behavior across conditions for Cody.

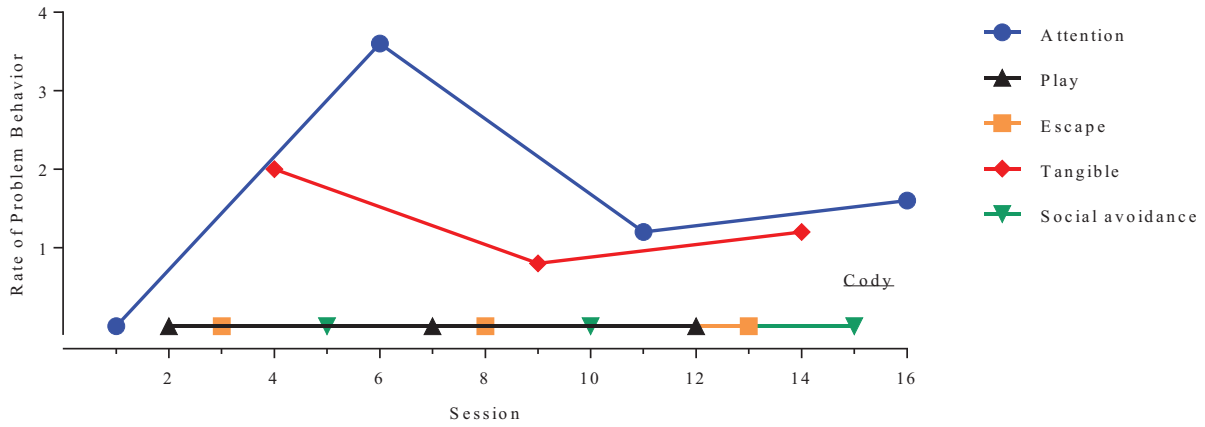

Figure 4. Standard functional analysis graph depicting the rate of problem behavior across conditions for Cody.

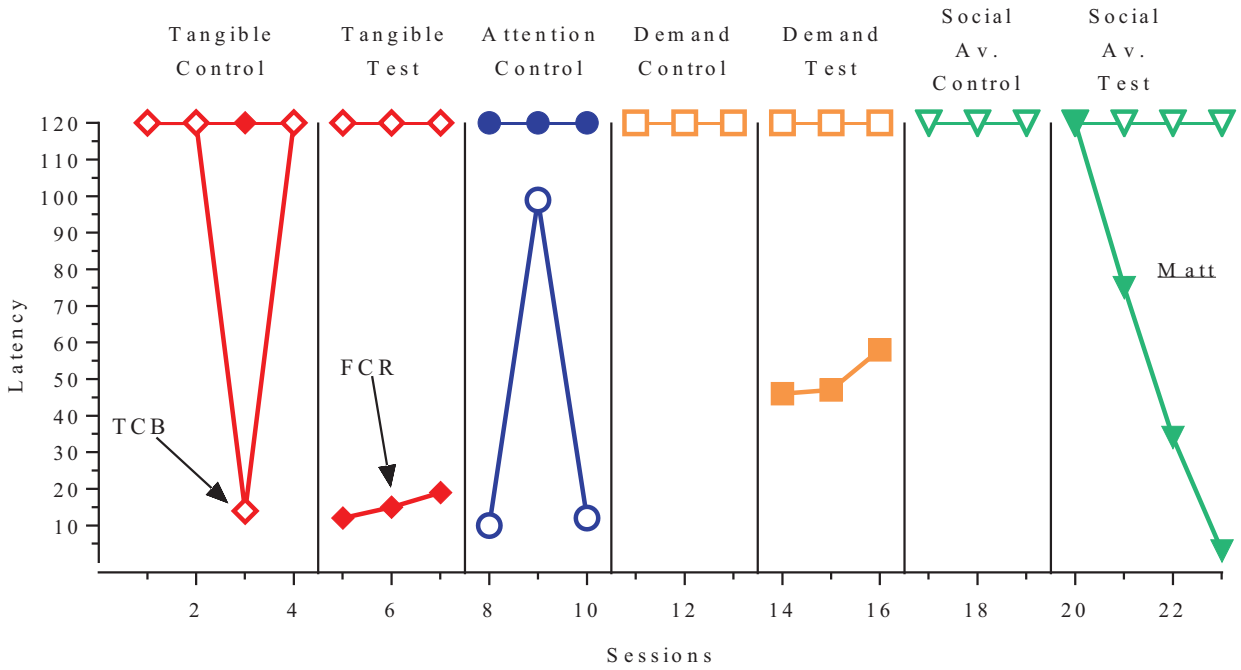

Figure 5. Response allocation assessment graph depicting the latency to problem behavior or replacement behavior across conditions for Matt.

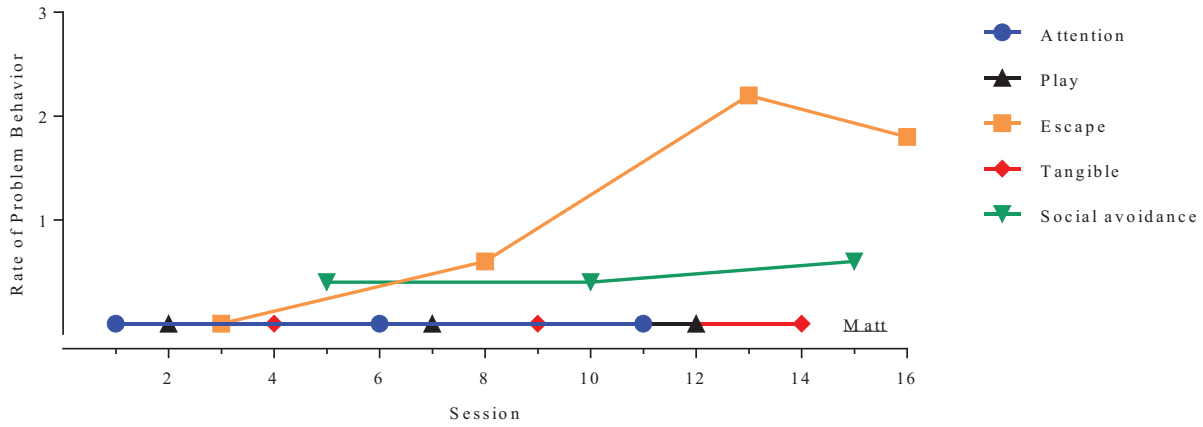

Figure 6. Standard functional analysis graph depicting the rate of problem behavior across conditions for Matt.

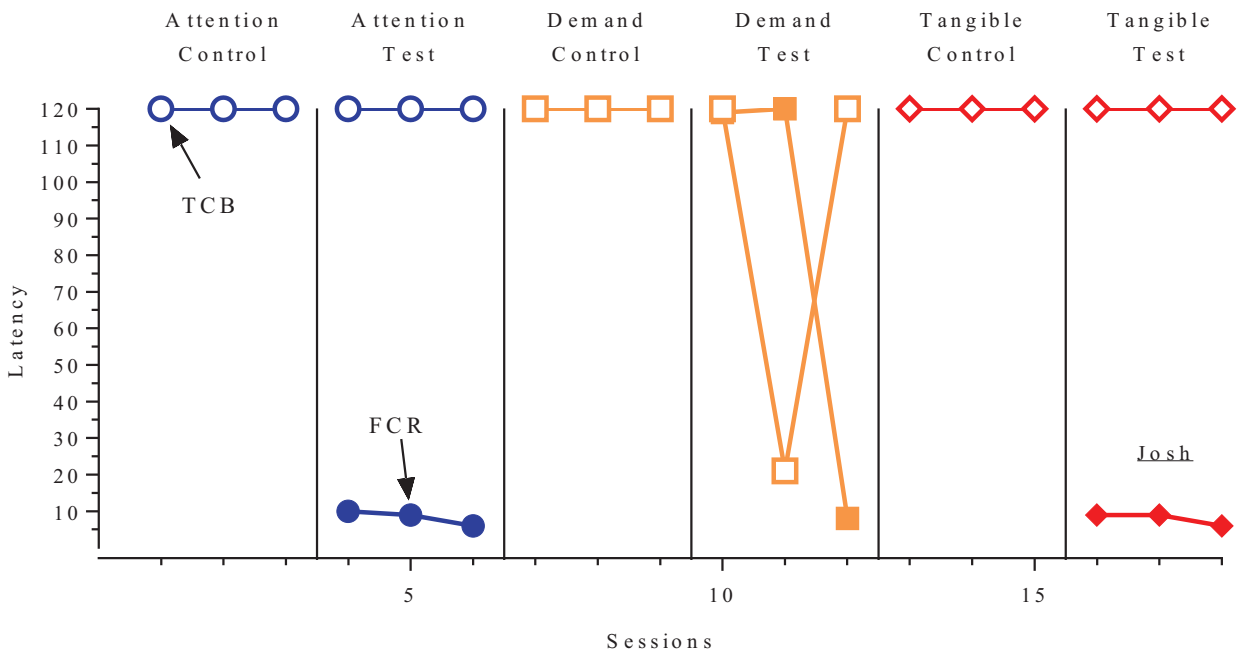

Figure 7. Response allocation assessment graph depicting the latency to problem behavior or replacement behavior across conditions for Josh.

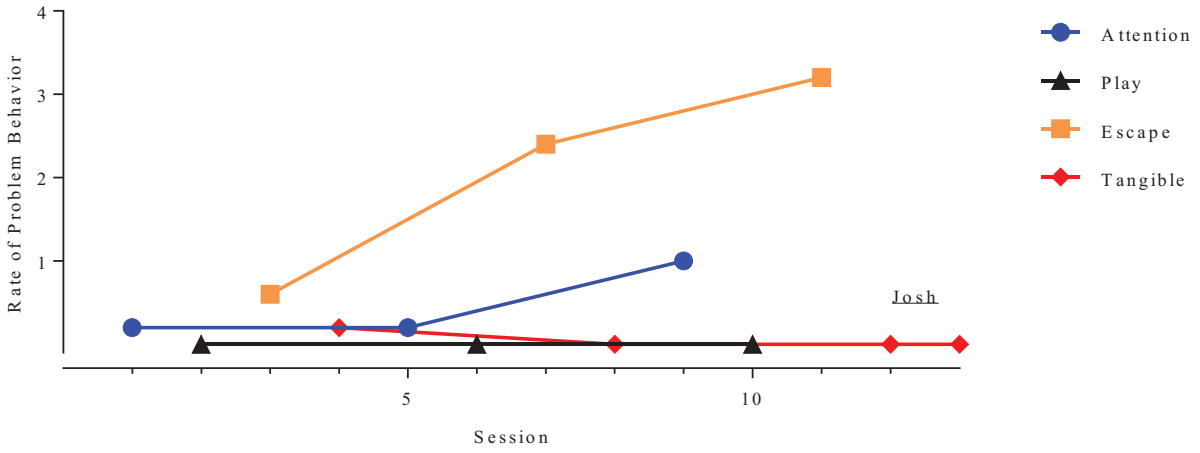

Figure 8. Standard functional analysis graph depicting the rate of problem behavior across conditions for Josh.

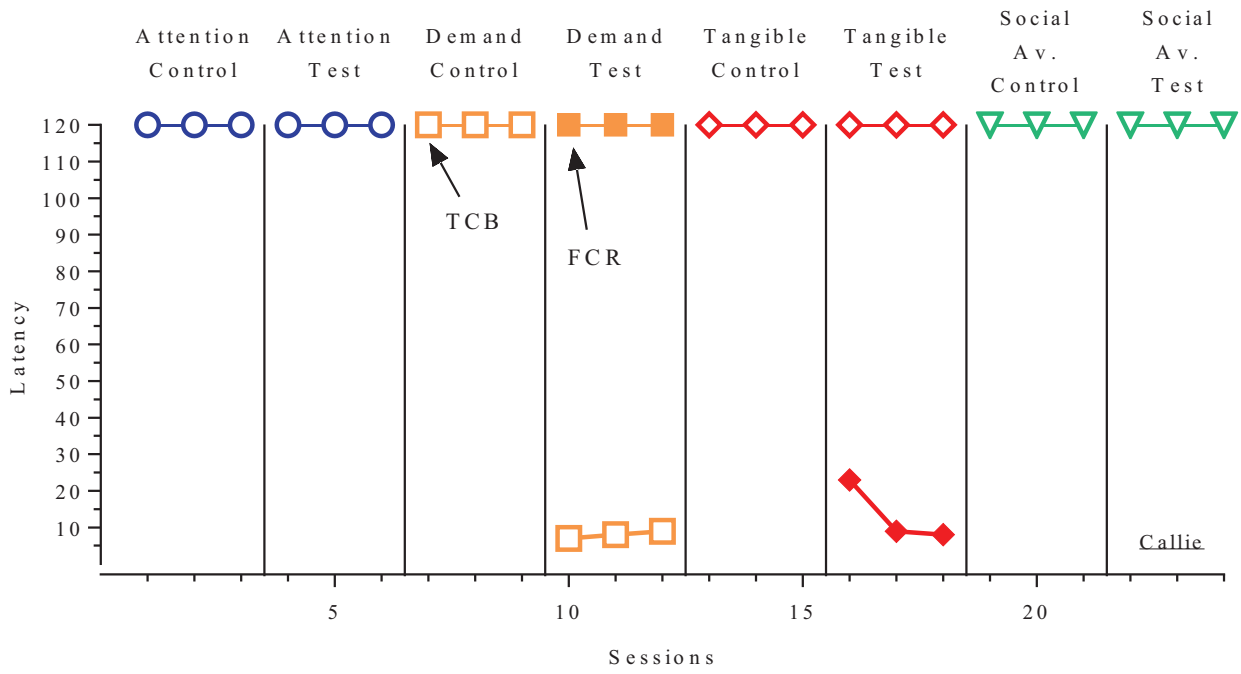

Figure 9. Response allocation assessment graph depicting the latency to problem behavior or replacement behavior across conditions for Callie.

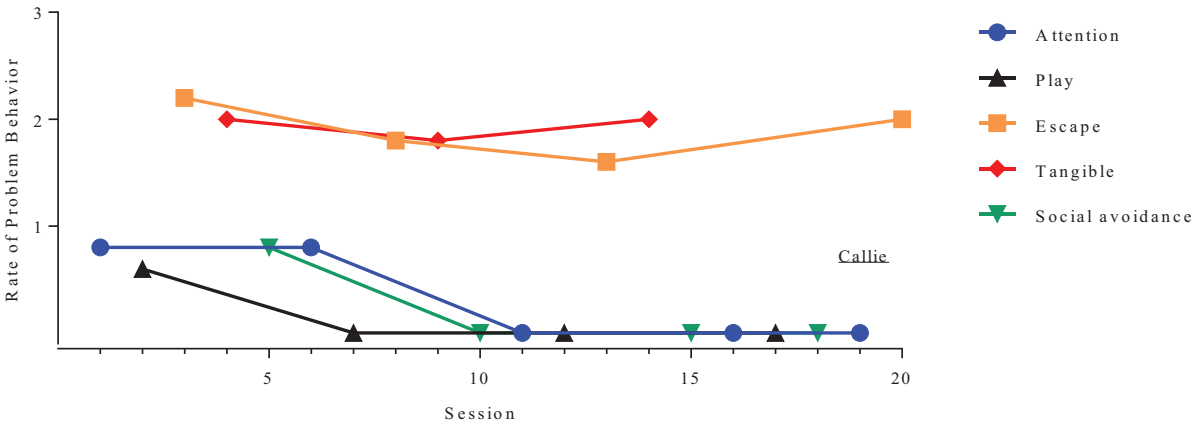

Figure 10. Standard functional analysis graph depicting the rate of problem behavior across conditions for Callie.