A COMPARISON OF OUTCOMES OF INDIRECT, DIRECT AND FUNCTIONAL ANALYSIS ASSESSMENT METHODS AND IMPLICATIONS FOR CLASSROOM BASED TREATMENT FOR CHALLENGING BEHAVIOR

by

SARA K. SNYDER

(Under the Direction of Kevin Ayres)

ABSTRACT

Functional behavior assessment (FBA) is an integral component of treatment development for students with intellectual and developmental disabilities. The continuum of FBA methods includes indirect, direct, and functional analysis assessment methods. However, there is not a standard for the best approach to the FBA process. This evaluation compared the results of an indirect, direct, and functional analysis assessment method including an analogue and embedded functional analysis approach. The participants included three elementary aged participants with autism in a special education self-contained classroom. The results of this study indicated partial agreement across assessment methods for all participants which varied across participants. The inclusion of an embedded functional analysis into the student's typical classroom schedule provides important information about the ecological validity of functional analysis assessment methods. All assessments were conducted across the day to account for the possibility of the change in function and multiply maintained behavior, as functions may shift as the establishing operation changes across the day. Implications for the results of each FBA method are discussed along with implications for future research.

INDEX WORDS: functional analysis, challenging behavior, functional behavior assessment

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DEDICATION

To Daniel, my rock, and my safe space. Thank you for the endless support and sacrifices you have made. I love you the most. You never doubted that I would get here and for that I am forever thankful. To AB, your dedication to this field and this program have shaped who I am as a practitioner. May your legacy continue on.

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CHAPTER 1

INTRODUCTION

Functional assessment is integral to the development of effective interventions for the reduction of challenging behavior for students with autism and intellectual disability (Beavers et al., 2013; Campbell, 2003; Horner, 1994). Behavior analysts are ethically obligated to conduct assessment before the implementation of an intervention (Behavior Analyst Certification Board, 2020). Likewise, special educators are legally bound to assess challenging behavior in the functional behavior assessment (FBA) process if the behavior interferes with learning (20 U.S.C. § 1415(k)(1)(D)(ii)). Approaches to an FBA include indirect assessment, descriptive assessment, and functional analysis (FA; Cooper et al., 2020).

Indirect assessments include questionnaires, checklists, and rating scales that do not require observation of the individual. Common indirect assessments include Questions About Behavioral Function (QABF; Matson & Vollmer, 1995) and the Functional Analysis Screening Tool (FAST; Iwata et al., 2013). While indirect assessment provides valuable information, it may not provide sufficient detail to inform treatment (Lloyd & Kennedy, 2014). Descriptive functional assessment does not involve manipulating the environment but instead relies on data collected through observation of the individual. Before the application of FA methodology in the assessment of challenging behavior (Carr, 1977; Iwata et al, 1982/1994), Bijou and colleagues (1968) pioneered the concept of antecedent, behavior, consequence (ABC) data collection as a method for observing the relationship between individuals and the environment. Behavior analysts and classroom teachers frequently include ABC data in descriptive assessment to

hypothesize the function of a specific target behavior. The use of descriptive observation-based data provides information related to why individuals engage in particular behaviors. However, ABC data collection alone may not yield comprehensive enough information to guide treatment decisions necessitating the use of other tools like conditional probability analysis (Borrero & Borrero, 2008) to further augment ABC data.

Descriptive assessment often occurs in the students' natural setting, during a typical activity and with an implementer familiar to the student (Chezan et al., 2022). The results of indirect and descriptive assessment can inform treatment development and often lead to effective function-based treatment. In the field of applied behavior analysis (ABA), an FA is considered the gold standard for identifying the operant function of challenging behavior (Oliver et al., 2015). Years of research support the positive effects of treatment built on the results of an FA (Beavers et al., 2013). Often, the FBA process stops at the indirect and descriptive assessment steps and omits the experimental manipulation of the environment that is the defining feature of an FA (Nesselrode et al., 2022). Time constraints, lack of funding, lack of training available within the school system or severity of behavior may lead practitioners to conduct indirect and descriptive assessments in lieu of an FA.

Identification of behavioral function through an FA approach requires successfully contriving establishing operations (EO) related to reinforcers programmed in the various assessment conditions. The transient nature of these EOs contributes to potential variance in maintaining functions of challenging behavior across time (Iwata et al., 2000). An FA embedded across the entire day in the course of the individual’s normally occurring schedule can attempt to capture naturally occurring EOs and can contribute to higher quality assessment results impacting the success of subsequent treatment. Embedding functional assessment throughout the

school day represents one attempt to account for these changing EOs dependent upon the activity or time of day. Regardless of the type of assessment used, conducting the assessment at various times of the day and in naturally occurring activities and tasks should more accurately reflect the individual's everyday environment and typical events that are most likely maintaining challenging behavior.

Indirect Assessment

Indirect assessment includes questionnaires, checklists and rating scales that generate hypotheses about the function of behavior. These types of assessments do not require direct observation but can be completed by a parent or teacher that is familiar with the individual. Matson and Vollmer (1995) developed the QABF rating scale which provides scores for the following behavioral function categories: attention, escape, physical, tangible, and non-social. Based on the results, scores are calculated to hypothesize a function of behavior. Paclawskyj and colleagues (2000) further evaluated the efficacy of the QABF to determine its viability and determined high test-retest reliability of the rating scale. The QABF has been determined to have high inter-rater reliability, test-retest reliability, and internal consistency (Matson et al., 2012). In some cases, results of the QABF align or partially align with FA results; however, this is not always the case (Healy et al., 2013, Tarbox et al. 2009; Romani et al., 2023).

The FAST is a rating scale that provides scores for four behavioral function categories: social positive (attention and tangible), social negative (escape), automatic positive reinforcement and automatic negative reinforcement (Iwata et al., 2013). The development of the FAST and evaluation of validity of the rating scale compares with the reliability of the QABF rating scale. However, the results of the FAST alone should not solely drive treatment decisions (Iwata et al. 2013). When necessary, indirect assessments such as these rating scales are

preferable to a lack of functional assessment; however, further experimental evaluation of behavioral function should be conducted to confirm the function of behavior and ensure the basis for an effective treatment package for the individual. Iwata et al. (2013) concluded that within the evaluated sample, the FAST determined the function with the highest overall rate in the FA in 63.8% of cases. Further assessment, including an FA could further inform function-based treatment.

Descriptive Assessment

Descriptive assessment includes direct observation of the individual and recording of the antecedents and consequences that the target behavior is contacting in the natural environment (i.e., ABC data). The use of ABC data can further inform a hypothesis for the function of challenging behavior. Descriptive assessment is helpful to develop a precise definition for the target behavior and to determine which specific topography of behavior should be the focus of further assessment. For example, a classroom teacher may report the student is engaging in high rates of aggression, using ABC data collection, the specific topography of aggression can be pinpointed for further assessment. Additionally, ABC data collection can aid in the determination of challenging behaviors that co-occur or help to identify precursor behaviors to the target behavior. This information can assist in the planning process for an FA.

ABC data collection can include narrative and continuous recording (Cooper et al., 2020). Continuous ABC data collection uses a coding system to denote antecedents and consequences for the target behavior. By contrast, narrative ABC data provides a continuous descriptive record of the events occurring in the environment when the target behavior is both present and absent. ABC data collection assists with the development of a hypothesis of the function of behavior but without experimental manipulation of the environment a confirmation

of that hypothesis is not possible and often misrepresentative of the function of behavior (Tarbox et al., 2009; Romani et al., 2023).

Contingency Space Analysis

Contingency space analysis (CSA) is a type of descriptive functional assessment that analyzes the probability that a particular behavior contacts a specific reinforcer in the natural environment and the probability of the reinforcer given the absence of a response (Martens et al., 2008). The results of a CSA reflect naturally occurring events in an individual's environment without experimental manipulation of antecedent variables. Data collected during a CSA allow for the evaluation of the probability that a particular consequence occurs in the environment in the presence or absence of the behavior (Cooper et al., 2020). CSAs do not require manipulation of the environment and may provide unsatisfactory results that overlook certain functions. Similarly, Borrero & Borrero (2008) used probability analyses to identify likely precursor behaviors given the probability that a particular behavior was more or less likely to occur prior to the target behavior. Previous research suggests that results of probability analyses, like the CSA, may not always yield results that align with the results of an FA (Martens et al., 2010). The use of a CSA can further inform the probability that a particular behavior contacts a specific consequence in the natural environment.

The information obtained from the CSA may have greater ecological validity compared to the results of an FA because of the way the observer captures the data. The use of descriptive data can enhance the ecological validity of assessment and intervention procedures potentially impacting treatment effects (Fahmie et al., 2023). Therefore, the results of an FA should reflect the consequences the individual's behavior contacts in the natural environment. According to Ledford and colleagues (2016), ecological validity can be evaluated in terms of the familiarity of

the implementer and the context of the evaluation. Ecological validity can assist in closing the research to practice gap; however, ecological validity does not always translate to high internal validity as control of the environment and variables may be sacrificed as a tradeoff for ecological validity (Fahmie et al., 2023). Therefore, increasing ecological validity for treatment outcomes for the individual while also continuing to account for internal validity is crucial to contribute high quality meaningful research to the field. The results of a CSA can inform a function-based treatment that reflects the maintaining variables in the individuals' natural environment.

Functional Analysis

In the most basic terms, Skinner (1953) referred to functional analysis as the relationship between the environment and behavior. Iwata and colleagues (1982/1994) more specifically applied the experimental methodology of an FA in terms of the relationship between self-injury and environmental events. The development of FA methodology evolved to include other topographies of behavior and developed into an assessment tool to experimentally determine the function of behavior. In terms of components of FBA, FAs require the most training and expertise and are the most complex assessment on the FBA continuum. However, FAs yield the most controlled, high-quality results through experimental manipulation of maintaining variables for challenging behavior.

Various FA formats have been used to evaluate the function of challenging behavior in the school setting including trial-based FA (Sigafoos & Saggers, 1995; Bloom et al., 2011), multielement FA (Iwata et al., 1982/1994), brief FA, and others (Northup et al., 1991; Lloyd et al., 2015). In a review of the research, Chezan and colleagues (2022) evaluated the ecological validity of the assessments used in relation to function based intervention processes in school settings, and while FAs were conducted in 53% of the studies included in the review, 48% of

those FAs were conducted in a non-typical setting for the student and 82% occurred during a contrived activity. This approach to FA might result in conclusions hampered by assessment artifacts. Within the studies included in this review, FAs required multiple human resources while descriptive assessment, if not collecting reliability data, required only a single staff member to conduct (Chezan et al., 2022).

Jessel et al. (2019) reviewed the published FA literature and evaluated the standardization of FA methodology. While different methods exist to determine the function of challenging behavior including the interview informed synthesized contingency analysis (IISCA; Hanley et al., 2014), Jessel's review suggested that IISCA methodology incorporates completely different components than FA methodology developed by Iwata and colleagues (1982/1994). Jessel et al., (2019) concluded that FA methodology does not necessarily need to be standardized to be effective and that choosing the most effective approach for the individual should guide practitioners' decision making. Synthesized contingencies fail to determine the sole function maintaining challenging behavior. Embedding FA assessment throughout the school day and in naturally occurring EOs attempts to capture the most accurate function of challenging behavior. Multiple functions of challenging behavior may be present for an individual's behavior; however, those multiple functions are potentially dependent upon the time of day or activity.

Barriers to Functional Analysis

School personnel may view FAs as an unnecessarily complex component of the FBA process as a result of perceived barriers to implementation (Nesselrode et al., 2022). Potential impediments to FAs in the school setting include the number of staff required, disruption of the normal school day, reinforcement of challenging behavior and the time devoted to the assessment process (Lloyd et al., 2015; Oliver et al., 2015). However, overcoming these

obstacles to implementation is critical to conduct the highest quality assessment of challenging behavior. A comprehensive FBA is necessary for effective treatment development for students in special education settings. According to the ethics code for behavior analysts, assessments founded on scientific principles are required during the assessment process (Behavior Analyst Certification Board, 2020). FAs are not the only acceptable assessment tool but through systematic experimental evaluation, an FA can confirm the hypothesized function of challenging behavior.

In the majority of special education classrooms, changing the daily schedule and shifting staff assignments to conduct an FA is not feasible. According to Chezan's (2022) review of the ecological validity of behavior assessment, when FAs are conducted in the school setting 75% of published research reports FAs are conducted by implementers unfamiliar to the students. This statistic suggests that additional staff are required to conduct an FA in the classroom. Additionally, the use of an implementer unfamiliar to the student negates any history of reinforcement between the student and the staff that might influence the occurrence of challenging behavior.

Given Chezan's (2022) sample of FAs conducted in schools, several issues may arise that threaten their internal and ecological validity. Staff that are unfamiliar to the student may not evoke challenging behavior due to the lack of learning history with that individual. Additionally, the FA results may not be representative of all maintaining variables for the student's challenging behavior. Conducting an FA in an environment that is not the student's typical environment poses a threat to the ecological validity of the assessment. Exploration of alternatives to an analogue FA, refraining from disrupting the school day and reducing the need for additional staff, is necessary to overcome these barriers to conducting FAs in the classroom setting.

Multiply Maintained Challenging Behavior

According to Beavers and Iwata (2011), the prevalence of challenging behavior maintained by multiple functions has increased representation in literature included in the 2011 review. Multiply maintained behavior requires comprehensive treatment addressing all maintaining functions to effectively decrease the occurrence of challenging behavior. When conducting an FA in a contrived setting, multiple functions have the potential to be masked by times of day, implementers, and the presence or absence of an EO for a particular reinforcer. In a previous study (Snyder et al., 2018), the researcher conducted an FA in the morning and the afternoon and determined different reinforcers maintained the behavior depending on the time of the day. Researchers should consider the possibility of changing EOs over time, particularly the length of a school day. Challenging behavior may be maintained by a single function for the majority of the school day; however, different times of day, activities, or other classroom variables could alter the EO for particular reinforcers (Iwata et al., 2000). To develop a comprehensive treatment package, the assessment process should account for the changing EOs and variables that could impact the function of behavior throughout the school day.

The Present Evaluation

In consideration of barriers to conducting FAs in classroom settings, the potential for multiple maintaining functions of challenging behavior, and the variability of EOs over time, extending and embedding FAs into the school day could provide a feasible solution to the implementation of FAs and have implications for treatment outcomes. The present evaluation seeks to compare the assessment results of an embedded FA across the length of the school day in comparison to an analogue FA conducted in five min sessions alternated across time.

Additionally, comparing the results of a descriptive functional assessment of a CSA to these results as a measure of the ecological validity of the FA results. The research questions include:

1. Are the results of an FA conducted across the entire school day, embedded in the student's typical schedule and routines, consistent with the results of an analogue FA conducted in the classroom?
2. If multiple functions are identified in an analogue or embedded FA do the functions vary based on the time of day or activity?
3. Are the results of an all-day embedded or analogue FA comparable to the results of a CSA completed by a naive observer?
4. Are the results of an all-day embedded or analogue FA comparable to the results of indirect assessment (e.g., QABF)?

CHAPTER 2

REVIEW OF THE LITERATURE

The ethics code for behavior analysts (BA) requires that BA conduct assessment prior to treatment implementation (Behavior Analyst Certification Board, 2020). Likewise, teachers working with students served under IDEA, displaying challenging behavior must employ function-based interventions based on federal special education law (20 U.S.C. § 1415(k)(1)(D)(ii)). A common approach to function-based assessment (FBA) includes functional analysis (FA), as the gold standard, for systematically manipulating the environment to determine this maintaining variable for challenging behavior (Iwata et al., 1982/1994; Oliver et al., 2015). While some FAs yield results suggesting a single function and therefore a reasonably clear path to intervention, behavior maintained by multiple functions has increased prevalence within the recent literature in the fields of both applied behavior analysis and special education (Beavers et al., 2013).

According to Beavers and Iwata (2011) the increased prevalence of multiply maintained challenging behavior (MMCB) within the literature could be attributed to grouping response topographies when conducting an FA as well as the inclusion of a tangible test condition. Additionally, FA methodology has increased from the focus of self-injurious behavior (Iwata et al., 1982/1994) to assess multiple other topographies of challenging behavior including aggression and destruction. Researchers and practitioners should recognize these potential reasons for an increased prevalence of MMCB and use this information to develop and implement interventions that are socially valid and meaningful to the individual. When

assessment results indicate multiple functions and a treatment approach addressing those maintaining functions effectively decreases challenging behavior it is assumed all identified functions were indeed maintaining challenging behavior (Beavers & Iwata, 2011). In the assessment portion of this process to determine a treatment for MMCB it may be important to understand each function individually rather than multiple functions as a result of synthesized contingencies, such as in the interview informed synthesized contingency analysis (IISCA). If the researcher/therapist has a precise knowledge of the maintaining variables for behavior, the treatment approach can be fine-tuned to the individual leaving out unnecessary components of intervention. These additional components may have no effect on behavior but cause treatment to be unnecessarily complex (Fisher et al., 2016). The current literature indicates several approaches to developing treatment for MMCB including treatment packages that address some of the maintaining functions (e.g., Lalli & Kates, 1998; Mueller and Nkosi, 2007), all of the functions individually (e.g., Bloom et al., 2013; Miteer et al., 2019) or a single intervention package addressing all functions (e.g., Falcomata et al., 2012, 2013; LeJeune et al., 2019).

When developing a treatment plan, a common approach to decreasing a challenging behavior, regardless of a single or multiple functions, involves teaching a functionally equivalent replacement (Cooper et al., 2020). This approach necessitates consideration of all maintaining functions which can pose challenges with MMCB. For example, Day et al. (1994) evaluated treatment for MMCB by implementing functional communication training (FCT) for each maintaining variable but in separate conditions, not as one single treatment approach. While the separate treatment evaluations helped demonstrate experimental control, practitioners and caregivers may prefer a single treatment approach in the maintenance and generalization stages. A parsimonious approach to treatment can contribute to higher procedural fidelity, more positive

program outcomes and long-term behavior change for the individual (Durlak & Dupre, 2008; Fiske, 2008). Treatment approaches including FCT, differential reinforcement of alternative (DRA) or other (DRO) behaviors, non-contingent reinforcement (NCR) are just a few of the treatment approaches evaluated within the literature addressing MMCB.

As the field of special education and applied behavior analysis advance, a systematic approach to the treatment of MMCB presents an important next step to effectively decrease different topographies of challenging behavior. Therefore, this review examined the literature that identified multiple social functions of challenging behavior via functional analysis and the subsequent treatment to determine common approaches to interventions for MMCB.

Method

Search Procedures and Inclusion Criteria

Researchers conducted a search in January 2022 of several electronic databases including PsychInfo, APA Psych Articles, ERIC, Education Research Complete and PubMed using the search terms “multiply maintained” “multiply controlled” and “multiply determined” AND functional analysis. Figure 1 illustrates the search and inclusion process (Page et al., 2021) The initial search of these terms resulted in 100 articles which were then reviewed by the researcher by title and abstract to determine initial inclusion that included a) human participants b) written in English and c) assessment and treatment of challenging behavior. After additional duplicates were removed, 39 articles remained and the researcher assessed the full text further for the following inclusion criteria d) at least one participant in the article was stated to engage in challenging behavior maintained by two or more social functions (e.g., attention, tangible, escape). This search yielded 26 studies, that met all inclusion criteria. The researcher excluded studies if a) the study concluded automatic reinforcement as the only function of challenging

behavior and/or b) the study did not provide results from assessment and treatment of challenging behavior (e.g., only assessment or only treatment). Studies were also excluded if they initially used synthesized contingencies, due to the inability to parse out a single function. Additionally, the researcher conducted an ancestral search of the 26 articles that met all inclusion criteria, this search yielded four additional articles. The researcher conducted a backward search of the articles included in Beavers and Iwata (2013) review of functional analyses, which yielded an additional three articles meeting all inclusion criteria.

Coding Procedures

The researchers coded descriptive participant and setting characteristics including gender, age, diagnosis, setting of study and characteristics of the interventionist. Experimental characteristics included experimental design, dependent variable, type of functional analysis conducted, functions of challenging behavior, and the type of treatment used in the study. When coding the type of treatment evaluated, researchers also coded whether or not the intervention was function based which for the purposes of this review meant that the intervention addressed all maintaining functions determined via functional analysis. If the study included all functions in the treatment package, the researchers also coded whether or not the study addressed all functions simultaneously within a single treatment package or addressed each function separately with either an individual treatment or variation of the same treatment. Additionally, the researchers coded the verbiage used to describe the multiple functions of participant's challenging behavior including multiply maintained, multiply controlled, multiple functions or other.

Interobserver Agreement

Interobserver agreement (IOA) was conducted by the second author for 100% of the search, inclusion/exclusion and coding procedures. A secondary coder coded 30% of the studies in SCARF. The secondary coder, a graduate student, received training on all search procedures, coding procedures, coding definitions and SCARF procedures. The first author calculated IOA on a point-by-point basis (agreements divided by agreements plus disagreements multiplied by 100) (Ledford et al., 2018). IOA for the initial search and inclusion/exclusion was 100% agreement. For the coding of the articles IOA was scored at 97% and for the SCARF coding agreement was scored at 98.5%.

Participant and Setting Characteristics

Participant characteristics included the total number of participants in the study and the gender reported by the author, if gender was not reported researchers scored appropriately. Each participant's age was coded as well as the diagnosis reported which included intellectual disability (ID), autism, developmental delay (DD), Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS), none, other diagnoses, or multiple diagnoses (e.g., autism and ID; coded as multiple rather than each diagnosis). Researchers coded the setting of the experiment which included hospital room, therapy room, home/living space, classroom, or not reported. The interventionist that conducted sessions in the study included coding options for therapist/experimenter, teacher, parent, or not reported.

Experimental Characteristics

Researchers coded experimental characteristics that included the experimental design used to evaluate treatment effects, the dependent variable, the type of FA conducted, the reported functions of challenging behavior, and the type of treatment. Experimental designs included multiple probe/baseline, alternating treatment/multi element, withdrawal/reversal, group design

or other design. Dependent variables included aggression, disruption, self-injurious behavior (SIB), multiple/combined (e.g., aggression and SIB), or other. The type of FA included options for analogue FA, trial based, pairwise, or other. The researchers coded the following social function combinations: attention and escape (attn/esc), attention and tangible (attn/tang), escape and tangible (esc/tang), attention/escape/tangible (attn/esc/tang), or other. The researchers recorded each treatment type narratively.

Researchers also coded each article using the Single Case Analysis and Review Framework (SCARF; Ledford et al., 2020). The SCARF tool evaluates the quality and rigor of single case design studies over three domains, Rigor, Quality and Breadth of Measurement (QBM) and Primary Outcomes (Ledford et al., 2020). The Rigor domain includes evaluation of the sufficiency and reliability of the data and procedures including interobserver agreement and procedural fidelity. The QBM domain includes evaluation of social validity and participant descriptions and the dependent variables. The Primary Outcomes domain evaluates the functional relation across the demonstrations of effect within the study, evaluating positive or non-effects on a scale of 0-4. Additionally, SCARF accounts for generalization and maintenance measurement and outcomes. Generalization measurement and outcomes accounts for when generalization data is taken, how it is recorded and the positive or weak effects of those data. Maintenance measurement and outcomes indicates when maintenance data is collected with respect to withdrawal of intervention and if those data show positive or weak effects. Each single case design experiment is evaluated separately over the 3 domains. Within the 33 articles included in this review the researcher coded 87 individual single case design experiments using the SCARF tool.

Results

This study evaluated 33 total articles including 57 participants and 87 individual single case design experiments. The researcher divided the articles into three groups based on how the study intervened on MMCB. The three groups included studies that included simultaneous intervention on all maintaining functions of challenging behavior (Table 1), studies that intervened on each function of challenging behavior with a separate treatment (Table 2) and those studies that used a treatment package that did not address all maintaining functions of challenging behavior based on the results of the individuals FA (Table 3). Across all studies, the researchers coded the verbiage that the authors used to discuss multiple functions of challenging behavior. Of the 33 studies, 33% used the term multiply maintained (n=11), 52% used the term multiply controlled (n=17) while 15% used other terms which included multiply determined (n=2) or the study listed out each maintaining variable (n=3).

Simultaneous Function Based Intervention

Articles that included simultaneous intervention packages for all maintaining variables of challenging behavior comprised 33% (n=11) of the studies included in this review (Table 1). Participant characteristics included a larger proportion of males (n=14) to females (n=8) with 22 total participants within this group of studies. Participants ranged in age from 2-13 years old with the average age being 6.2 years of age. More specifically ages ranged between 0-5 (n=11), 6-12 (n=10) and 13-18 (n=1). Diagnosis of the participants included autism (n=8), developmental delay (n=5), intellectual disability (n=1), multiple diagnoses (n=2; autism and developmental delay; intellectual disability and autism), other diagnoses (n=3; down syndrome and mood disorder), and typically developing (n=3). Two studies included multiple settings and interventionists for different participants within the study, therefore the total number of settings

and interventionists recorded included a number greater than the number of studies. Study settings included most commonly a therapy room (n=6), classroom (n=4), the individual's home (n=2) and a hospital room (n=1). The interventionists included the therapist or experimenter (n=9), the parent of the individual (n=2) or their classroom teacher (n=1). Evaluation of treatment effects included withdrawal/reversal design (n=20), alternating treatment/multi element (n=5), multiple probe/baseline (n=3) or other designs (n=2). Dependent variables included aggression (n=3), disruption (n=1), multiple variables (n=5; aggression/disruption/SIB; aggression and disruption, etc.), or other variables (n=2; inappropriate mealtime behavior). Types of FAs conducted in this group of studies included analogue (n=7), pairwise analyses (n=2), trial based (n=1, LeJeune et al., 2019), and latency based (n=1; Torelli, 2021). The maintaining functions of the participants challenging behavior included the combinations of attn/esc/tang (n=9), attn/esc (n=6), esc/tang (n=4) and attn/tang (n=1). The individual study treatment packages listed in Table 1 include but are not limited to combinations of NCR, FCT (Austin & Tiger, 2015; Falcomata et al., 2012, 2013) and an individualized levels systems (Randall et al., 2018; LeJeune et al., 2019).

Separate Function Based Interventions

Forty-five percent (n=15) of studies in this review included interventions that addressed each function of challenging behavior separately (Table 2). Participant characteristics included again a larger proportion of males (n=21) to females (n=5) with 26 total participants included in this group of studies. Participants ranged in age from 2-34 years of age with the average age being 6.7 years. Age range of the participants mainly fell within the 0-5 (n=12) and 6-12 (n=12) range with outliers in the 13-18 (n=1) and 18 years of age or older (n=1) range. The participant's diagnoses included autism (n=11), multiple diagnoses (n=7), intellectual disability (n=3),

developmental delay (n=3), and PDD-NOS (n=2). The setting of these studies included most commonly a therapy room (n=7), the individual's home (n=4), their classroom (n=3), and a hospital room (n=2). One study included multiple settings for assessment and treatment of challenging behavior (Sumter et al., 2020) and two studies included multiple interventionists (Falcomata et al., 2017; Vollmer et al., 1996). Interventionists within these studies included therapist or experimenter (n=11), the individual's parent (n=3), their teacher (n=2) and one study did not include the interventionists characteristics (Day et al., 1994). Experimental designs included withdrawal/reversal (n=20), alternating treatment (n=15), and multiple probe/baseline (n=11). Dependent variables included multiple variables (n=11), aggression (n=2), SIB (n=2) and other (n=2; screaming/crying; precursors behaviors). Type of FA conducted included analogue (n=11), trial based (n=2), pairwise analysis (n=1) and other (n=1). The maintaining functions of challenging behavior included attn/esc/tang (n=7), esc/tang (n=7), attn/tang (n=5), attn/esc (n=2) and other (n=1; esc from attn/tang). The treatment packages listed in Table 2 mostly include different combinations of FCT and differential reinforcement, for example, DRA/FCT (Vollmer et al., 1996; Bloom et al., 2013), NCR/DRA (Fritz et al., 2013; Borrero & Vollmer, 2006), etc.

Non-function-based Intervention

Articles that included intervention for some maintaining variables but not all functions determined via FA comprised 21% (n=7) of articles included in this review (Table 3). Participant characteristics included a more even distribution of males (n=5) and females (n=4) with 9 total participants within these studies. The participants age ranged from 2.5 to 13 years of age with the average age being 6.8 years of age. Most participants fell within the 0-5 (n=4) and 6-12 (n=3) range with a couple participants in the 13-18 range (n=2). The participant's diagnoses included

multiple diagnoses (n=3), developmental delay (n=3), autism (n=2), and intellectual disability (n=1). Study setting included therapy room (n=2), the individual's home (n=2), their classroom (n=2) and a hospital room (n=1). Interventionist characteristics included a therapist or experimenter (n=7). Experimental designs included withdrawal/reversal (n=6), alternating treatment (n=4) and other (n=1). Dependent variables included multiple variables (n=3), other (n=3; perseverative speech, breath holding, vomiting) and SIB (n=1). All FAs conducted in this group of studies included analogue FAs. The maintaining functions of challenging behavior included attn/esc/tang (n=3), attn/tang (n=3), attn/esc (n=2) and esc/tang (n=1). Treatments used within these studies included different combinations of differential reinforcement and NCR (Table 3).

SCARF

The researcher coded all 33 articles included 87 individual single case designs with the SCARF tool (Figure 2). Results from the SCARF analysis included evaluation of the overall quality and rigor of the study, quality and rigor of generalization measurement and the latency of maintenance measurement.

Quality, Rigor and Primary Outcomes

The domain of quality and rigor and primary outcomes received a score ranging from 0 to 4 the higher score indicated higher study quality and rigor and positive outcomes overall, with primary outcomes scored based upon visual analysis (Ledford et al., 2020). Quality and rigor of the 87 designs in this review scored within the range of .92 to 3.08 (possible range, 0 to 4) with an average score of 2.07. Primary outcomes ranged between 0 to 4 with an average of 2.88.

Generalization Measurement and Outcomes

Generalization measurement and outcomes received a scored ranging from 0 to 4. 94% of designs within this review (n=82) did not collect generalization data. The studies that collected generalization data received an average scored of 3.2 for generalization outcomes which indicated mostly positive effects. These studies scored an average of 1.6 for generalization measurement (score of 1 indicated post intervention only or score of 4 indicated that generalization was measured within the context of a single case design). Mueller and Nkosi (2007) evaluated generalization within the context of a single case design while the other studies conducted a posttest only (Lalli et al., 1998; Randall et al., 2018).

Maintenance Measurement and Outcomes

Maintenance measurement and outcomes received a score that ranged from 0 to 4, 94% of studies within this review did not collect maintenance data. The studies that collected maintenance data received an average score of 3.5 for maintenance outcomes which indicated mostly positive effects but might also include some weak effects. These studies scored an average of 3.25. LeJeune et al., 2018 collected maintenance data immediately after intervention ceased while the other studies collected maintenance data at least one month post intervention (Sigafoos et al., 1996; Vollmer et al., 1996).

Discussion

Overall, the results of this review demonstrate the efficacy of various approaches to the treatment of MMCB. However, results highlight that within the literature more studies have focused on developing a treatment for each maintaining variable thus requiring more complex procedures. While this may help evaluate experimental control, a unified treatment package could provide greater benefit to the participant's and those implementing treatment in the generalization and maintenance stages (e.g., Falcomata et al., 2012, 2013; LeJeune et al., 2019).

Beginning with this component analysis, addressing each treatment separately demonstrates that there is a need for each treatment component addressing the maintaining variable determined via FA. With this information, researchers and practitioners confirm the importance of an FA to precisely determine the maintaining variables of behavior contributing to positive treatment outcomes. Using this information to then develop a unified treatment approach, for ease of implementation by caregivers is most socially valid to the individual.

Several studies within this review implemented a treatment that did not address all maintaining functions of challenging behavior (Table 3). While these studies resulted in a decrease in challenging behavior, 57% of these studies included an extinction component within treatment. In contrast, the studies that addressed all functions simultaneously (18%) or separately (12%) included extinction as a component of intervention significantly less often. The ability to decrease challenging behavior without the use of an extinction component decreases the likelihood of extinction induced side effects including response variability and extinction bursts (Cooper et al., 2020). Additionally, non-extinction-based procedures are typically more generalizable to the home setting for caregiver implementation and could lead to more positive treatment outcomes (probably need a citation for this).

Another significant take away from the results of this review included the distinct lack of true maintenance data with only three studies within this review including maintenance data. Two of these three studies took place within the school setting (Sigafoos & Meikle, 1996; LeJeune et al., 2019). In the three studies that reported maintenance data, maintenance included evaluation of the long-lasting effects of treatment beyond the experimental design evaluation (e.g., follow up post initial treatment sessions). Maintenance did not however include treatment effects once treatment was discontinued or the schedule of reinforcement was systematically

thinned. While this is not the true definition of maintenance, where behavior change is seen post intervention (Nevin & Wacker, 2013), it is still important to note that intervention was effective. However, in terms of long-term treatment effects, the evaluation the thinning of the schedule of reinforcement and reducing the intensity of the intervention is most meaningful in terms of long-term implementation and treatment outcomes. The significant lack of generalization and maintenance data within the studies included in this review raises some concern for the rigor of the studies overall. While behavior change occurred as a result of treatment within the parameters of the study sessions, whether or not the behavior changes continued, or generalization occurred is unknown. As far as social validity, these treatment effects are of utmost importance to the individuals that received these treatments.

Future Research

Future directions based on the results of this review, include a further look into a unified treatment approach for individuals in all settings that engage in challenging behavior that is maintained by multiple social functions. Additionally, increased research in the school setting is important for the field of special education and the impact of applied behavior analysis in the school setting. A closer look at the effectiveness of each intervention in terms of the reduction of challenging behavior could provide further knowledge as to what components of treatment are necessary when an FA results in multiple maintaining functions. A unified approach to treatment for MMCB is beneficial to practitioners across the board to increase accessibility to treatment packages that allow for a decrease in challenging behavior that might be barriers to lesser restrictive settings for students in special education. Additionally, determining the appropriate assessment method to determine the function maintaining challenging behavior, whether the behavior is maintained by a single or multiple functions, is imperative to treatment success.

Table 1

Studies including simultaneous intervention packages for all maintaining variables

Citation	Participant(s)	Diagnoses	Dependent Variable	Functions	Treatment
Austin et al., 2015	13-year-old, male	ID	Aggression	Attn/Tang	FCT for both functional reinforcers, tolerance to denial with alternative reinforcers
Bachmeyer et al., 2009	3-year-old, female 4-year-old, male 4-year-old, female	Developmental delay	Inappropriate meal time behavior	Attn/Esc	Attn and Esc EXT
	5-year-old, male	Typically developing			
Falcomata et al., 2012	8-year-old, male	ASD	Disruption	Attn/Esc/Tang	FCT+chained schedule
Falcomata et al., 2013	7-year-old, male	ASD	Aggression, disruption	Attn/Esc/Tang	FCT+chained schedule of reinforcement
	12-year-old, male	ASD	Aggression, SIB	Attn/Esc/Tang	
Kirkwood et al., 2020	3-year-old, female 6-year-old, male	Typically developing	Inappropriate meal time behavior	Attn/Esc	Attn and Esc EXT w/differential reinforcement
	2-year-old, male	Developmental delay			
	5-year-old, male	Downs syndrome			

Kodak et al., 2003	7-year-old, female	Mood disorder	Inappropriate vocalizations, aggression, disruption	Attn/Esc	NCR w/ attn/esc; DRO w/ attn/esc
Lalli & Casey, 1996	6-year-old, male	Developmental delay	Aggression	Attn/Esc/Tang	Esc from demands contingent on compliance; compliance contingent esc +attn
LeJeune et al., 2019	10-year-old, female	Down syndrome	Aggression, disruption	Attn/Esc/Tang	Individualized levels system w/DRO, DRA, response cost and positive punishment (FCT)
Randall et al., 2018	11-year-old, female	ASD and ID	Aggression	Attn/Esc/Tang	Individualized levels system
Torelli, 2021	5-year-old, female	Developmental delay	Aggression, disruption, dangerous acts, SIB	Attn/Esc/Tang	Attn/Tang/Esc FCT
Tsami & Lerman, 2020	3-year-old, male	ASD	Screaming, aggression, disruption	Attn/Esc/Tang	Combined and isolated FCT w/schedule thinning
	6-year-old, male 5-year-old, male	ASD	Screaming, aggression, disruption	Esc/Tang	
	6-year-old, female	ASD	Aggression, disruption	Esc/Tang	

5-year-old, male	ASD	Screaming, aggression	Esc/Tang		

Table 2

Studies including separate interventions for all maintaining variables

Citation	Participant(s)	Diagnoses	Dependent Variable	Functions	Treatment
Adelinis et al., 2001	12-year-old, male	ASD, ADHD, mild to moderate ID	Aggression	Attn/Esc	Differential reinforcement without extinction
Barretto, 2001	3-year-old, male	ID	SIB, Aggression, Disruption	Attn/Esc/Tang	FCT
Bloom et al., 2013	5-year-old, male	Developmental delay	Aggression, disruption	Esc/Tang	DRA+EXT (FCT)
	4-year-old, male	ASD	Aggression, screaming/ crying	Esc/Tang	
Borrero & Vollmer, 2006	7-year-old, male	ID	Aggression, disruption	Attn/Esc/Tang	Noncontingent attention; DRA for esc and tang
Day et al., 1994	9-year-old, female	ASD	SIB	Esc/Tang	FCT
	34-year-old, female	Severe ID	SIB		
	18-year-old, male	Severe ID	Aggression		
Falcomata et al., 2017	2.5-year-old, male	ASD	Aggression, SIB	Attn/Esc/Tang	High and low proficiency mands embedded in FCT

	4.5-year-old, male	ASD	Aggression, disruption	Attn/Esc/Tang	
Fritz et al., 2013	6-year-old, male	ID	Precursors to Aggression	Esc/Tang	NCR+DRA
Hagopian et al., 2001	6-year-old, male	ASD, mild ID	Aggression, disruption, SIB, spitting	Esc from Attn/Tang	FCT w/ NCR (enriched environment on fixed time schedule)
Miteer et al., 2019	7-year-old, male	ASD	Aggression, disruption, SIB	Attn/Esc/Tang	FCT
	7-year-old, male		Aggression, disruption, SIB	Attn/Esc/Tang	
Neidert et al., 2005	3-year-old, female	PDD-NOS	Aggression, disruption, SIB	Attn/Esc	FCT+EXT
	4.5-year-old, male	ASD	Aggression, SIB	Attn/Esc	
Piazza et al., 1998	4-year-old, male	learning and speech delays	Aggression, disruption	Attn/Esc/Tang	Differential reinforcement for compliance
	8-year-old male	Mild ID, ADHD	Aggression, disruption, SIB		
Rispoli et al., 2013	2-year-old, female	PDD-NOS	Screaming, hiding face/laying down	Esc/Tang	Non contingent tang/esc
	4-year-old, male	ASD	Screaming/crying		

Sigafoos & Meikle, 1996	8-year-old, male	ASD	Aggression, disruption, SIB	Attn/Tang	FCT
	8-year-old, male	ASD	Aggression, disruption, SIB	Attn/Tang	
Sumter et al., 2020	8-year-old, female	ASD, ADHD, RAD	Aggression, disruption, SIB	Attn/Tang	FCT and delay to reinforcement w/ alternative reinforcers
	7-year-old, male	ASD	Aggression, disruption	Attn/Tang	
Vollmer et al., 1996	4-year-old, male	Speech and language delay	Aggression, screaming/crying, disruption	Attn/Tang	DRA/FCT
	3-year-old, male	Speech and language delay	Aggression, screaming/crying, disruption	Attn/Esc/Tang	

Table 3

Studies including treatments for only some of the maintaining variables

Citation	Participant(s)	Diagnoses	Dependent Variable	Functions	Treatment
Falcomata & Gainey, 2014	4-year-old, female	ASD	SIB	Attn/Esc/Tang	NCR/AT; NCR/AT+TA; NCR/AT+work; NCR/AT+TA+ work
Falligant et al., 2020	8-year-old, male	ASD	Vomiting	Attn/Esc	repeated prompting procedure in response to vomiting
Ingvarsson et al., 2008	8-year-old, female	ASD, moderate ID	Aggression, Disruption, SIB	Esc/Tang	High/low density NCR w/ edibles; DRA
Kern et al., 1995	7-year-old, female	Severe ID	Breath holding	Attn/Esc/Tang	EXT, scheduled attn, mand training
Kuntz et al., 2020	13-year-old, male	ASD, mild ID	Perseverative speech	Attn/Tang	DRA+EXT+prompt
Lalli & Kates, 1998	2.5-year-old, male	Developmental delay	Aggression, SIB	Attn/Esc/Tang	EXT+NCR; EXT+NCR+ choice of alternative toy
	3-year-old, male		Aggression, SIB	Attn/Tang	
	3.5-year-old, male		Aggression, disruption	Attn/Tang	
Mueller & Nkosi, 2007	13-year-old, female	Severe ID, ASD	Aggression, SIB	Attn/Esc	DRA+Esc EXT

Figure 1

Adapted PRISMA Flow Diagram for Article Inclusion

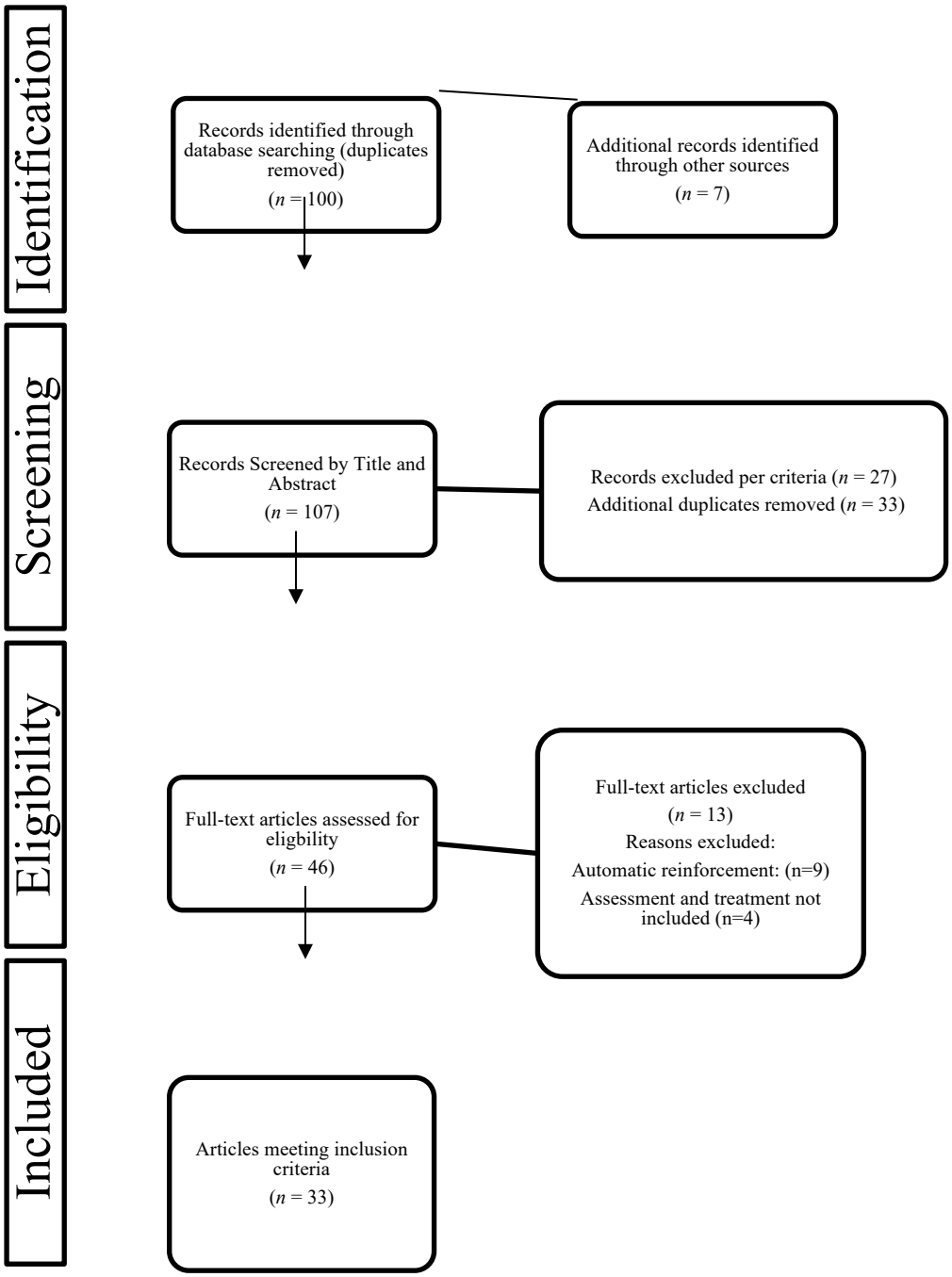
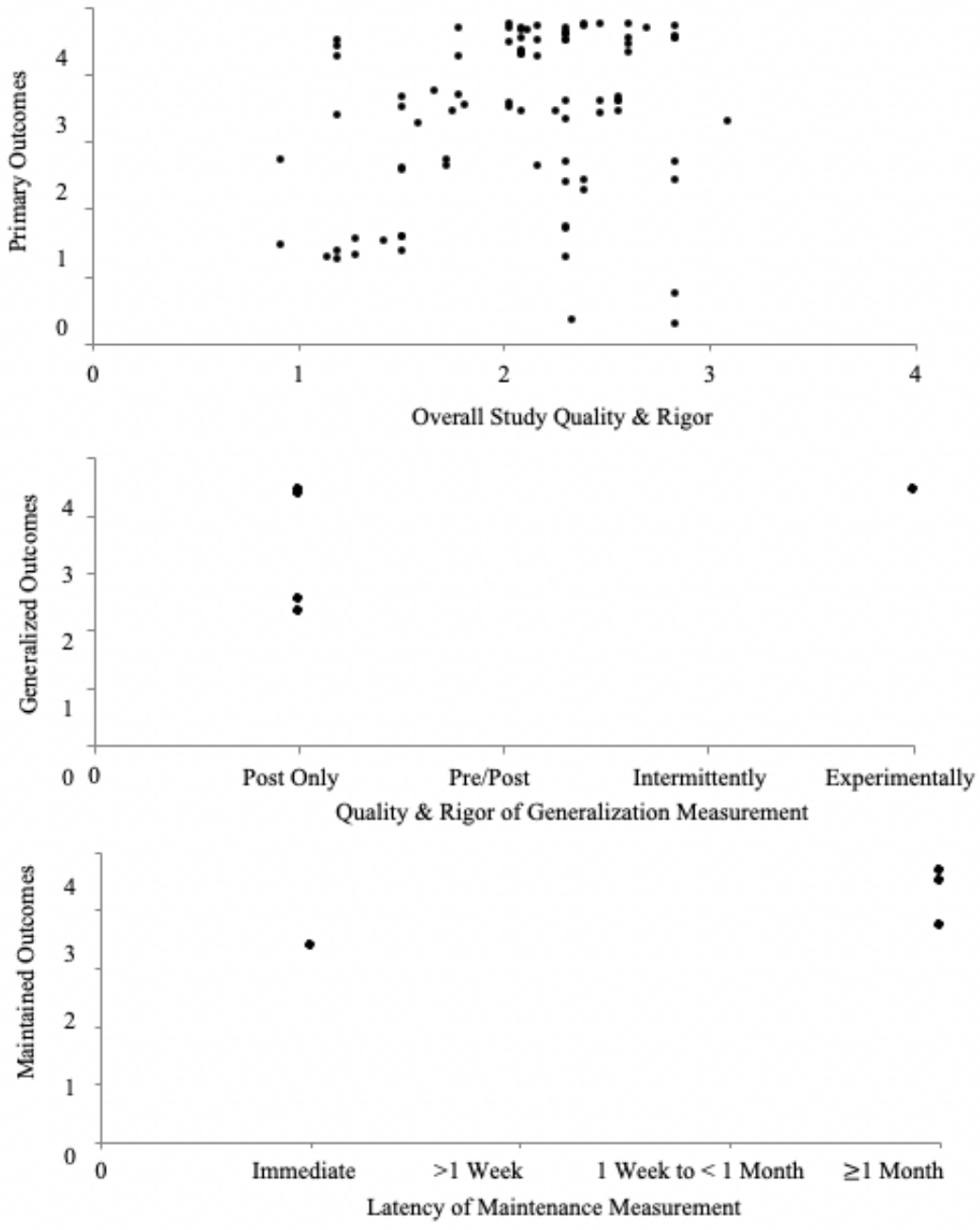


Figure 2

SCARF Outcomes



Intermittently = during the course of a single case design (e.g., in baseline and intervention conditions) but with fewer than three data points in each condition. Experimentally = in the context of a single case design with at least three data points per condition.

CHAPTER 3

METHOD

Participants

This study included three participants between the ages of nine and 11 years old. All three participants were recruited from a third through fifth grade special education classroom. Legal guardians provided informed consent for all participants and each individual provided assent for each session by remaining in their area and working with their assigned staff member. The consent process was approved by the university institutional review board. The participants' classroom was a university-based model classroom for students with needs for intensive behavior support and communication training. In order to participate, students in the classroom had a a) previously conducted FA and b) results of the FA that indicated socially maintained challenging behavior.

Jamal was a 9-year-old black male with autism spectrum disorder (ASD), moderate intellectual disability (MOID) and speech or language impairment (SLI) special education eligibility. Jamal received a score full scale IQ score of 42 on the Stanford and Binet Scales of Intelligence, Fifth Edition scoring in the <.1 percentile rank. Individualized education program (IEP) goals for Jamal included expressive identification of sight words, money value, counting using 1:1 correspondence, answering listening comprehension questions and typing familiar words. Challenging behavior for Jamal included crying/screaming in short bursts for extended periods of time. Partial interval recording data indicated that Jamal's crying occurred at various and inconsistent times throughout the school day and was often loud enough to be heard down

the hallway with the door closed. Jamal communicated his wants and needs by reaching for an adult's hand towards an item or when prompted using three to four word “I want” statements (e.g., teacher asks what Jamal wants for snack, he responds “I want chips”; teacher asks what Jamal worked for he responds, “I want iPad”, etc.).

Kenneth was a 10-year-old black male with ASD, MOID and SLI special education eligibility. Kenneth received a full-scale IQ standard score of 40 on the Stanford and Binet Intelligence Scales, Fifth Edition scoring in the <.1 percentile rank. IEP goals for Kenneth included expressive identification of letters, numbers, colors, function of common objects, rote counting, answering listening comprehension questions and spelling his name. Challenging behavior for Kenneth included aggression, disruption, and disrobing. Partial interval recording data indicated that Kenneth’s challenging behavior occurred at various times throughout the day but more consistently in the afternoon time. Kenneth communicated through 4–5-word vocalizations and could answer general personal questions including name, age, mom’s name, school, and birthday.

James was a 11-year-old black male with ASD, MOID and SLI special education eligibility. James received a non-verbal IQ standard score of 42 on the Stanford and Binet Intelligence Scales, Fifth Edition scoring in the <.1 percentile rank. IEP goals for James included identification of letters, numbers, shapes, colors, and common objects using his augmentative and alternative communication (AAC) device. James engaged in aggression throughout the school day. He communicated using his AAC device with the Language Acquisition for Motor Planning (LAMP) application. James used his AAC device to request items using one-word phrases, he could make requests using a variety of buttons on different pages of the device including food/drink items, the iPad and preferred television shows.

Setting

This study was conducted in a third through fifth grade special education classroom for students with autism and intellectual disabilities. Classroom staff included university master's students pursuing board certification in applied behavior analysis or special education certification with oversight from university faculty and BCBA supervisors. Each student paired with one master's student throughout the entirety of the school day in a similar manner to a 1:1 paraprofessional, this staff member rotated throughout the day. Students had their own individual desk area within the classroom for 1:1 work time. During whole group times students all sat at the front of the classroom at a long rectangular table facing a smartboard. All sessions took place within the classroom (9 m x 4.5 m) at the student's individual desk (1.2 m x .6 m) or at the whole group table (2.4 m x 1.2 m). Staff members varied throughout the day depending on the staff member that was paired with the student during the time that a session occurred.

Materials

During embedded FA sessions, materials included academic manipulatives that were familiar to the student. The typical materials that would be used for the appropriate activity of the day included laminated index cards with corresponding instructional targets (e.g., letters, numbers, colors, etc.). James had access to his AAC device (Accent 800 with the LAMP software). An iPad was used during tangible conditions for James. Jamal had access to multiple tangible toy items including pop its, paperback books, stretchy fidgets and various figurine character toys. Kenneth had access to a lanyard strap during tangible sessions. Tangible items used were consistent with tangible items available in the classroom daily.

Dependent Variable, Response Definitions and Measurement

The researcher measured challenging behavior as the primary dependent variable. The topography of challenging behavior varied across participants. Kenneth's challenging behavior included aggression, disruption, and disrobing. Aggression was defined as hitting/kicking (student's hand or foot contacts another person), throwing (student releases an object making contact with another person outside of appropriate toy play), pushing (student displaces another person), scratching (student's nail comes into contact with another person), biting (students mouth opens and closes around another person's body), grabbing/pinching (students hands/fingers open and close around another person's skin/body part), head butting (students head comes into contact with any part of another person's body), hair pulling (grasping the hair and/or pulling the hair resulting in the person's head moving from the original position), and spitting (saliva leaves the students mouth and makes contact with another person).

Disruption was defined as throwing/swiping items (student releases the item in an over or underhand motion through the air or moves work materials form a reachable position of the teacher), banging surfaces (student's hand comes into contact with surface), flopping onto the table (student's feet leave the ground and his belly comes in contact with a table), spitting (saliva leaves the students mouth and does not make contact with a person) and knocking objects over (student alters the natural orientation of a chair/bookshelf/divider/etc.). Disrobing was defined as any instance in which the student moved the waistband of pants/pullup down from his waist resulting in pants needing to be pulled back up to the waist.

Jamal's challenging behavior included screaming and crying defined as any vocalization above normal conversational tone with or without visible tears. James' challenging behavior included aggression which was defined as hitting/kicking (student's hand or foot contacts

another person), pushing (student displaces another person) and spitting (saliva leaves the students mouth and makes contact with another person). Challenging behavior data were collected using the Countee application for data collection. The application calculated the rate of challenging behavior using the count of each behavior divided by the total time of the session. For Jamal, duration data were collected in seconds for crying/screaming during each session. Each session was video recorded for IOA collection purposes. The primary staff member collected data during each session. For each session, the activity, time of session, and the staff member present was noted.

Interobserver agreement and Procedural Fidelity

The researcher collected data for the purpose of calculating interobserver agreement (IOA) for QABF observations and FA sessions. IOA was collected for 31.5% of Jamal's QABF observations, 46% of Kenneth's and 30% of James' observations. For FA sessions, IOA was collected across analogue and embedded series for 41.3% of Jamal's sessions, 30% of Kenneth's, and 60% of James' sessions. An independent secondary researcher collected IOA using the identical Countee app template used for primary data collection. Secondary data collectors were trained on each student's challenging behavior topographies by watching videos of each student and scoring according to the definitions, using a behavioral skills training model (BST; Parsons et al., 2013). The researcher calculated point by point IOA by dividing the number of agreements by the number of agreements plus disagreements multiplied by 100 (Ledford et al., 2018, Chapter 5). For FA sessions, IOA was 99.8% (range: 92-100%) for Jamal, 92.4% (range: 80-100%) for Kenneth, and 99% (range: 88-100%) for James.

Additionally, procedural fidelity data were collected during 100% of CSA observations and analogue and embedded FA sessions to ensure staff members were following procedures

throughout all sessions. The primary researcher collected procedural fidelity using a checklist with steps of the procedures listed out. Procedural fidelity was calculated by taking the total number of steps completed divided by the total number of steps multiplied by 100. Procedural fidelity across QABF observations was 100% for all participants. For Jamal, procedural fidelity was 100% across both analogue and embedded FA sessions. Procedural fidelity was 100% during analogue FA sessions and 99.4% (range: 87.5-100%) for embedded FA sessions for James. For Kenneth, procedural fidelity for analogue FA sessions was 99.4% (range: 87.5-100%) and 98% (range: 85.7-100%) for the embedded FA sessions.

Pre-Experimental Procedures

Preference Assessment

Researchers conducted multiple stimulus without replacement (MSWO; DeLeon & Iwata, 1996) preference assessments for all participants for edible items and tangible items. The items used in preference assessments were not novel items but rather items that the individuals had access to on a typical day in the classroom. The results provided information on high and moderately preferred items used during FA conditions.

Questions About Behavioral Function

Indirect assessment in the form of a QABF was completed for each participant prior to the CSA and embedded FA. The QABF was completed by the classroom teacher and staff members in the classroom that had known the students for a minimum of six months and were familiar with the rating scale. The classroom teacher was aware of the results of the previously conducted FAs.

Contingency Space Analysis

A university master's student conducted CSA observations prior to the FAs. The primary researcher trained this master's student on the procedures of a CSA and behavior definitions for each participant. Researchers trained the data collector on partial interval recording and behavior definitions using a video of the study participants. The data collector was given directions on what behavior to score and how to score the occurrence or non-occurrence of the behavior. Additionally, the data collector was instructed how to score the consequences present during each interval (e.g., attention, access to tangible items, and escape from task demand/activity). The same operational definitions that the researcher used during the FA were used for the purpose of the CSA. Prior to observations, the data collector scored the training videos. 100% agreement between the data collector and the researchers' data for the training videos was required for the data collector to conduct live CSA observations.

The CSA observations were conducted by a master's student who was naive to the results of the FA that had previously been conducted in the classroom but had experience working with the students. Observation periods for the CSA occurred across the entire school day to be most comparable to the embedded FA. The observation period was 5 min in duration across different activities throughout the school day. The researcher divided the five min periods into 15s intervals. During each interval, the observer recorded the occurrence (+) or non-occurrence (-) of the target behavior. Additionally, the observer recorded if the student was receiving attention, a tangible item, and/or escaping a task demand or activity during 15s intervals. If the target behavior did not occur during the interval the observer recorded a (-) for the target behavior but recorded a (+) for the most relevant consequence present during the interval. Observations occurred over the span of, at minimum, three data collection days with at least two observations occurring during each hour of the school day.

General Functional Analysis Procedures

The staff member conducted an analogue and an embedded FA both in the morning and the afternoon. FA sessions occurred across the entire school day. Both an analogue and embedded FA series occurred each day. For example, a series of analogue in the morning (between 8 and 11 AM) and a series of embedded in the afternoon (between 11 AM and 2 PM). The next day the order of types of FAs would occur in reverse order (e.g., embedded in the morning and analogue in the afternoon). Sessions lasted 5 min and researchers conducted at least two full series (attention, tangible, escape, control) each school day (one of each type). Researchers randomized each series (attention, escape, tangible, free play) to control for sequencing effects. All sessions occurred in the classroom, researchers did not conduct sessions outside of the classroom (e.g., recess, mealtimes).

Prior to the start of the school day the primary researcher briefed classroom staff on the sessions that they would be responsible for conducting during the school day. For analogue sessions, these sessions occurred sequentially with minimal time in between sessions and sessions occurred outside of any typically occurring activity. However, for embedded FA sessions, the daily schedule was not altered to accommodate sessions but instead sessions occurred during typically occurring activities. In an effort to minimally disrupt classroom functioning during embedded sessions, staff could run the session at any point during the certain schedule block for that session. Each staff member had a notecard with the sessions that needed to be run and during which activity for the embedded FA sessions. All other classroom staff did not interact with the students during sessions analogue or embedded sessions, only the staff member that was paired with the student at the time. Procedures below describe each condition for the embedded FA. Analogue FA sessions procedurally looked nearly identical to embedded

sessions; however, analogue sessions were not embedded into naturally occurring activities and the task materials/items used during analogue sessions were familiar to the students but not the materials they would normally have/use during that time of day.

Attention

For attention sessions, the staff member interacted with the student for 1 min prior to the start of the session. When the session began, the staff member said, “I have to do some work right now, you can play with ___ (moderately preferred item) __”. Following this statement, the staff member immediately diverted their attention to a notebook, folder, or other paperwork they had on the desk. Contingent on the occurrence of the target behavior, the staff member delivered attention to the student in the form of verbal reprimands for 5s immediately after the occurrence of the target behavior. For example, “stop hitting me, I don’t like that” or “don’t cry, it’s okay”. Immediately after delivering this attention, the teacher diverted attention from the student. Procedures were repeated for each occurrence of the target behavior until the session was over. The staff member ignored any non-targeted challenging behavior and any appropriate requests for attention during the session. These procedures for attention sessions remained the same across activities.

Escape

For escape sessions, the demands placed matched the activity that the session occurred during. For example, if an escape session occurred during a work time, materials from the students work time binder were used to place academic demands. If the escape session occurred during whole group times the staff member placed demands to participate in whole group activities such as answering questions, touching answers on the smart board, etc. All demands were consistent with typical demands that would be placed during the corresponding activity

during a normal school day. Prior to the start of the escape session the staff member ensured that the student had a 1 min break with no demands being placed. The session began with the staff member saying, “it’s time to do some work”. Upon the occurrence of the target behavior, the staff member provided the student with a 30s break from the demand task, removed all materials from in front of the student and provided zero attention during the break. Once the 30s elapsed the staff member resumed placing demands and following the same procedures until the end of the session. The staff member provided general praise statements for compliance with demands such as “good job working”.

Tangible

Prior to the start of tangible sessions, the staff member ensured the student had access to the highest preferred tangible item for 1 min and provided attention every 30s. After 1 min elapsed, the staff member began the session by taking the tangible item and saying, “my turn”. The staff member held the tangible item and provided attention to the student approximately every 30s. If the student engaged in the target behavior the staff member delivered the tangible item and said “okay you can have it”. After the 30s, the staff member removed the tangible item and stated “my turn”. The staff member ignored any no-targeted challenging behavior and any appropriate requests for the tangible item during the session. Procedures continued until the end of the five min session.

Free play

Free play sessions served as the control condition and occurred during times of the day that did not typically involve demands to embed the sessions most easily into the normal school day schedule. During free play sessions, the staff member provided attention every 30s and placed zero demands. The student had access to the highly preferred tangible item during the free

play session. There were no programmed consequences for challenging behavior during free play sessions.

Research Design and Data Analysis

A multielement design was used to evaluate the function of challenging behavior determined through the analogue and embedded FA. All sessions were randomized per series. The researcher continued data collection until a minimum of 5 sessions occurred per condition. Results of the analogue and embedded FA were evaluated using the rules established by Roane et al., (2013). Using the rules, the researcher placed an upper and lower criterion line on each FA graph indicated one standard deviation above and below the mean of the rate of challenging behavior in the free play condition. The researcher then counted the number of data points above and below the upper and lower criterion lines to determine a functional relation. If more than 50% of the data points were above the upper criterion line the condition was determined to be differentiated. Special rules for determining an automatic function and rules for lower rate behavior were followed using the guidelines of Roane et al., (2013). A secondary data collector coded IOA for each FA graphed evaluated by the primary researcher.

CHAPTER 4

RESULTS

This study compared the results of different functional behavior assessment methodology including indirect (QABF), direct (CSA), and two different approaches to functional analysis assessment and the correspondence between these different methods. Additionally, with the FA, this study sought to compare the results of an analogue FA and an FA embedded into the student's typical school schedule and activities. Researchers hypothesized that the function of challenging behavior could vary based on the time of day (e.g., morning or afternoon) and thus ran series of both types of FAs at these varying times. The results of the FAs completed in the current study can also be compared to the previously conducted analogue FAs for each participant.

The primary researcher applied the rules from Roane et al., 2013 to interpret the results of all FAs. IOA was collected for interpretation of results and agreement was 100% across all participants data. Results for each participant and assessment method are discussed below with a summary of results in Table 4. For each participant the assessment results are presented in the order in which they were conducted, original FA, QABF, CSA, analogue and embedded FA.

Jamal

Jamal's original analogue FA conducted prior to the start of the study indicated that crying was maintained by positive reinforcement in the form of access to tangible items (Figure 8). This FA data demonstrated a clear differentiation between the control condition and the elevated tangible test condition.

QABF

The results of the QABF completed by Jamal's classroom teacher and long-term classroom staff indicated that crying was maintained by non-social and physical reinforcement. These survey results suggested a potential automatic function for crying.

CSA

CSA results for Jamal (Figure 3, top panel) indicated that crying was maintained by access to tangible items, similar to the original analogue FA. The tangible data point fell above the line on the CSA graph and indicated that there was a high probability that tangible items were provided as a consequence for challenging behavior. Time spent in CSA observations totaled 95 min over the span of five data collection days (Table 6).

Analogue FA

The combined analogue FA data (Figure 4, bottom panel) displayed elevated data across free play, attention, tangible and escape conditions. This data suggests an automatic function for crying. The morning only analogue FA (Figure 4, top panel) also indicated an automatic function with elevated data in the control, tangible, escape and attention conditions. The afternoon only analogue FA (Figure 4, middle panel) displayed elevated data in the attention condition only with zero level of challenging behavior occurring in the control condition. These results suggested an attention function for challenging behavior in the afternoon. Time spent in the analogue FA totaled 100 min for morning and afternoon assessments respectively, across five data collection days.

Embedded FA

The combined embedded FA (Figure 4, bottom panel), displayed data for both morning and afternoon sessions, showed higher levels of crying in the escape condition suggesting an

escape function. In the morning embedded FA (Figure 4, top panel) the escape condition was at an elevated level in comparison to the control condition indicating an escape function. The afternoon only embedded FA (Figure 4, middle panel) had higher levels of challenging behavior in the escape condition indicating an escape function. Time spent in the embedded FA totaled 100 min for each morning and afternoon assessments across five data collection days.

Kenneth

Kenneth's original analogue FA was conducted in the morning and the afternoon similar to the current study. The results of this FA (Figure 9) indicated an attention function for challenging behavior in the morning and in the afternoon an attention, tangible and escape function. In this FA there was clear differentiation between the elevated attention condition and the control in the morning and afternoon, with clear elevated levels in the escape condition in the afternoon in comparison to the control condition.

QABF

Kenneth's QABF, filled out by his classroom teacher and two long term staff, indicated an attention and escape function for all topographies of challenging behavior evaluated in the FAs.

CSA

Kenneth's CSA (Figure 3, middle panel) indicated only an attention function. The attention data point fell above the line on the CSA graph and this indicated that there was a high probability that attention was provided as a consequence for challenging behavior in the classroom. Time spent in observation for the CSA totaled 65 min across three data collection days.

Analogue FA

The combined analogue FA (Figure 5, bottom panel), both morning and afternoon data, displayed elevated levels in attention and tangible conditions suggesting multiple maintaining functions. Results were similar across the morning only (Figure 5, top panel) and afternoon only (Figure 5, middle panel) analogue FAs which both indicated an attention and tangible function for challenging behavior.

Kenneth's challenging behavior consistently occurred when the establishing operation was absent (EOA); therefore, the establishing operation present (EOP) data for challenging behavior was recorded and graphed for Kenneth only because the other participants did not engage in the target behavior when the EO was absent. The data in Figure 6 display the EOP only data. This EOP data reflects the challenging behavior Kenneth engaged in to access the restricted reinforcer within each session. The analogue data for both morning and afternoon (Figure 5) indicated an attention and tangible function. The lower-level escape and tangible data paths in comparison to the EOA/EOP aggregated data indicate that there was a significant rate of challenging behavior occurring when the EO was absent (e.g., Kenneth had access to the tangible item or a break from work and was still engaging in challenging behavior). Summarized results of Kenneth's EOP data are summarized in Table 5.

Embedded FA

The results of Kenneth's embedded FA for morning, afternoon and the combined data indicated an attention function for challenging behavior (Figure 5). The EOP data for the morning indicated an attention and tangible function with an added escape function in the afternoon embedded sessions (Figure 6). The combined EOP data for the embedded FA indicated

just an attention and tangible function. Thus, comparing the EOP data only to the aggregated EOA/EOP data, the EOP data indicated multiple maintaining functions for challenging behavior.

James

The results of James' original analogue FA (Figure 10) indicated that aggression was maintained by multiple forms of positive reinforcement: access to attention and tangible items. There was clear differentiation in level between the attention and tangible conditions and the control condition.

QABF

James' QABF results, also filled out by his classroom teacher and two long term classroom staff, indicated that aggression was multiply maintained by attention, access to tangible items and escape from demands.

CSA

The results of James' CSA observations (Figure 3, bottom panel) indicated that aggression was maintained by access to tangible items. The tangible data point fell above the line on the CSA graph which indicated that there was a high probability that tangible items were provided as a consequence for challenging behavior in the classroom. Time spent in observation for the CSA for James totaled 85 min over five data collection days.

Analogue FA

Across all FA sessions for James, the attention condition had the highest overall level in comparison to the control condition. All analogue FA results aligned with the original analogue FA, previously conducted in James' classroom indicating an attention and tangible function. In the combined analogue FA (Figure 7, bottom panel), attention and tangible conditions were consistently elevated in comparison to the control condition suggesting a tangible and attention

function. For the morning (Figure 7, top panel) and afternoon (Figure 7, middle panel) analogue data, the results were similar, with consistently high levels in the attention and tangible conditions in comparison to the control.

Embedded FA

The results of all embedded FA sessions indicated that James' aggression was maintained by access to tangible items and attention. For the embedded combined data (Figure 7, bottom panel) attention, tangible and escape conditions were elevated in comparison with the control condition. For the morning embedded FA (Figure 7, top panel), the tangible condition was elevated at a higher rate in comparison to control than the other conditions; however, attention conditions were elevated at lower levels in comparison to the control in the morning embedded FA. The afternoon embedded results (Figure 7, middle panel) indicated an attention and tangible function.

Summarized Results

Table 4 provides summarized results for each assessment method for each participant. For Jamal there was total correspondence between the QABF and the analogue morning and combined analogue FA data. There was also total correspondence between the CSA and the previously conducted analogue FA. There was zero functional correspondence between the analogue and embedded FA conducted in this study for Jamal. For Kenneth, there was total correspondence between the QABF and the afternoon analogue FA data. For the analogue FA the function differed from morning to afternoon and for the embedded FA there was total correspondence across morning and afternoon. For James, between the analogue and embedded FA data and the prior analogue FA. For all participants, there was zero total correspondence across all FBA methodology (e.g., QABF, CSA and FA).

Figure 3

CSA results for Jamal, Kenneth and James.

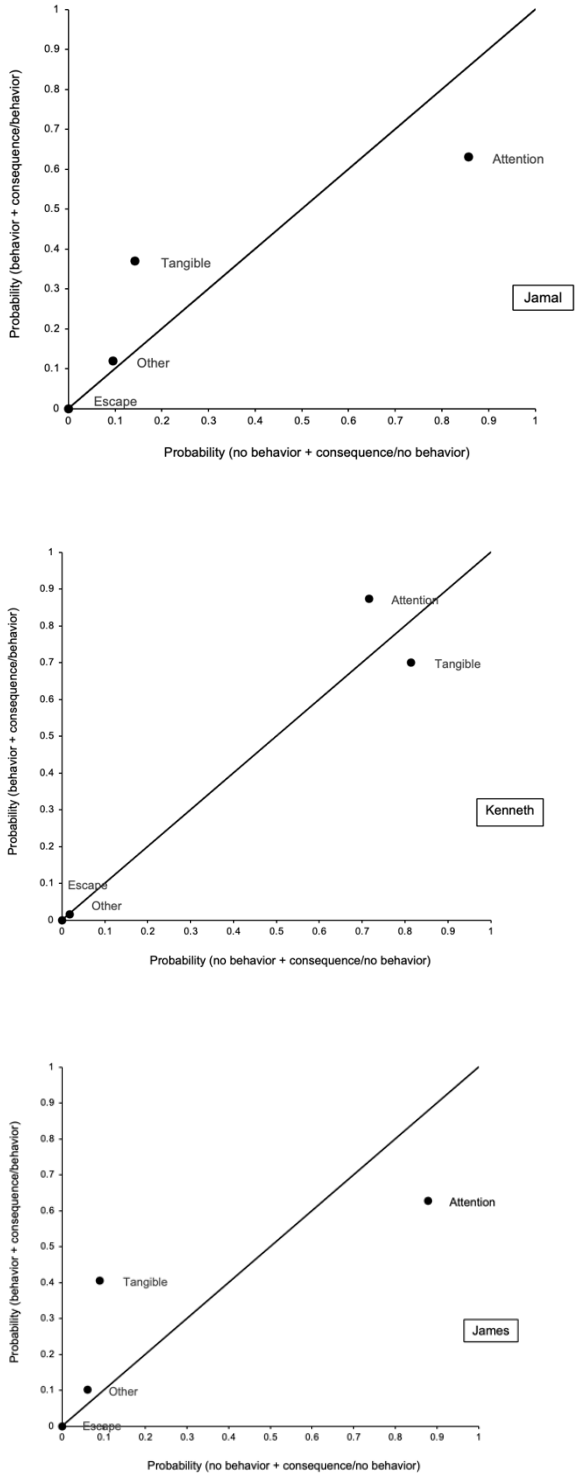


Figure 4

Jamal's FA results

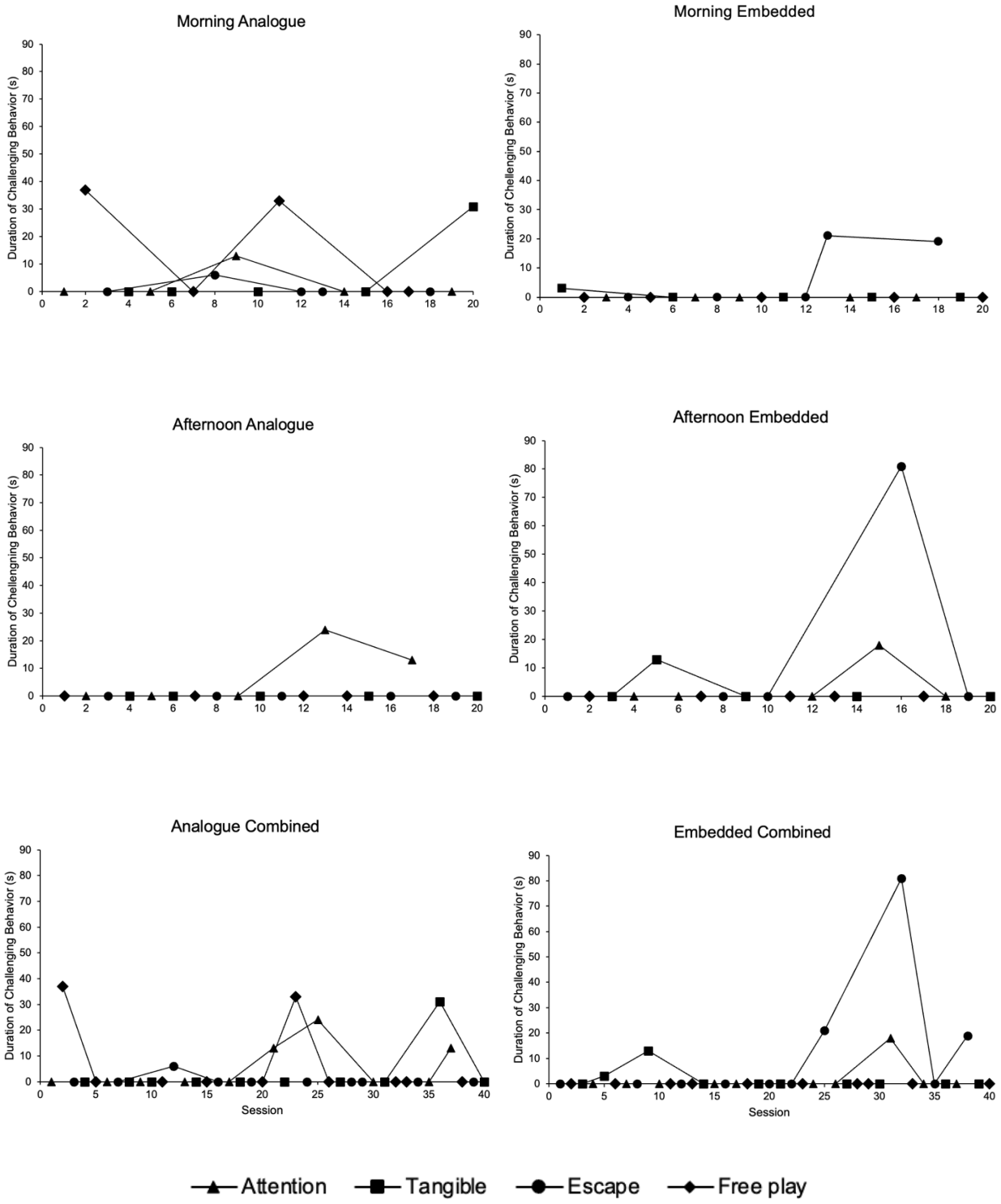


Figure 5

Kenneth's FA results

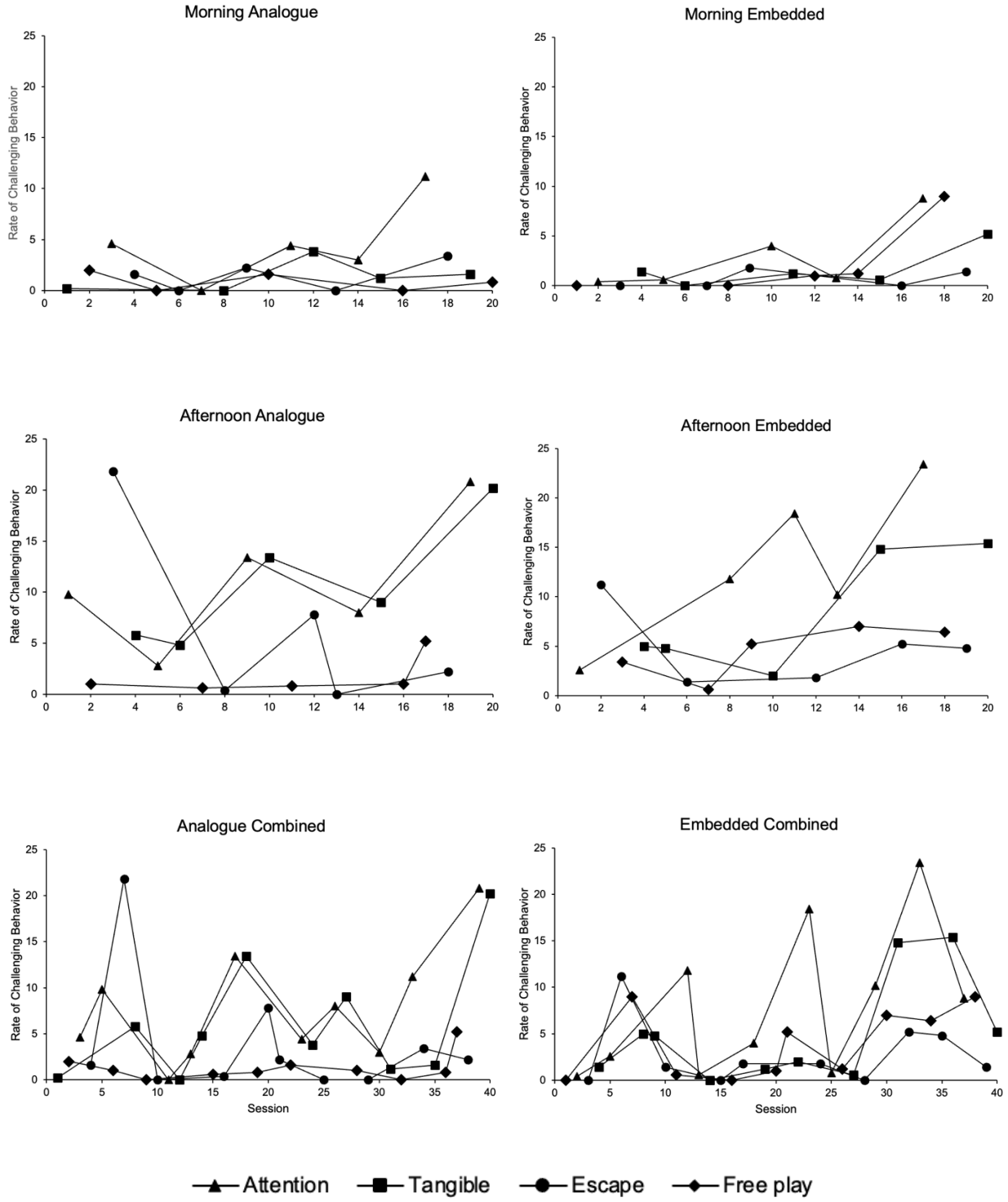


Figure 6

Kenneth's EOP FA data

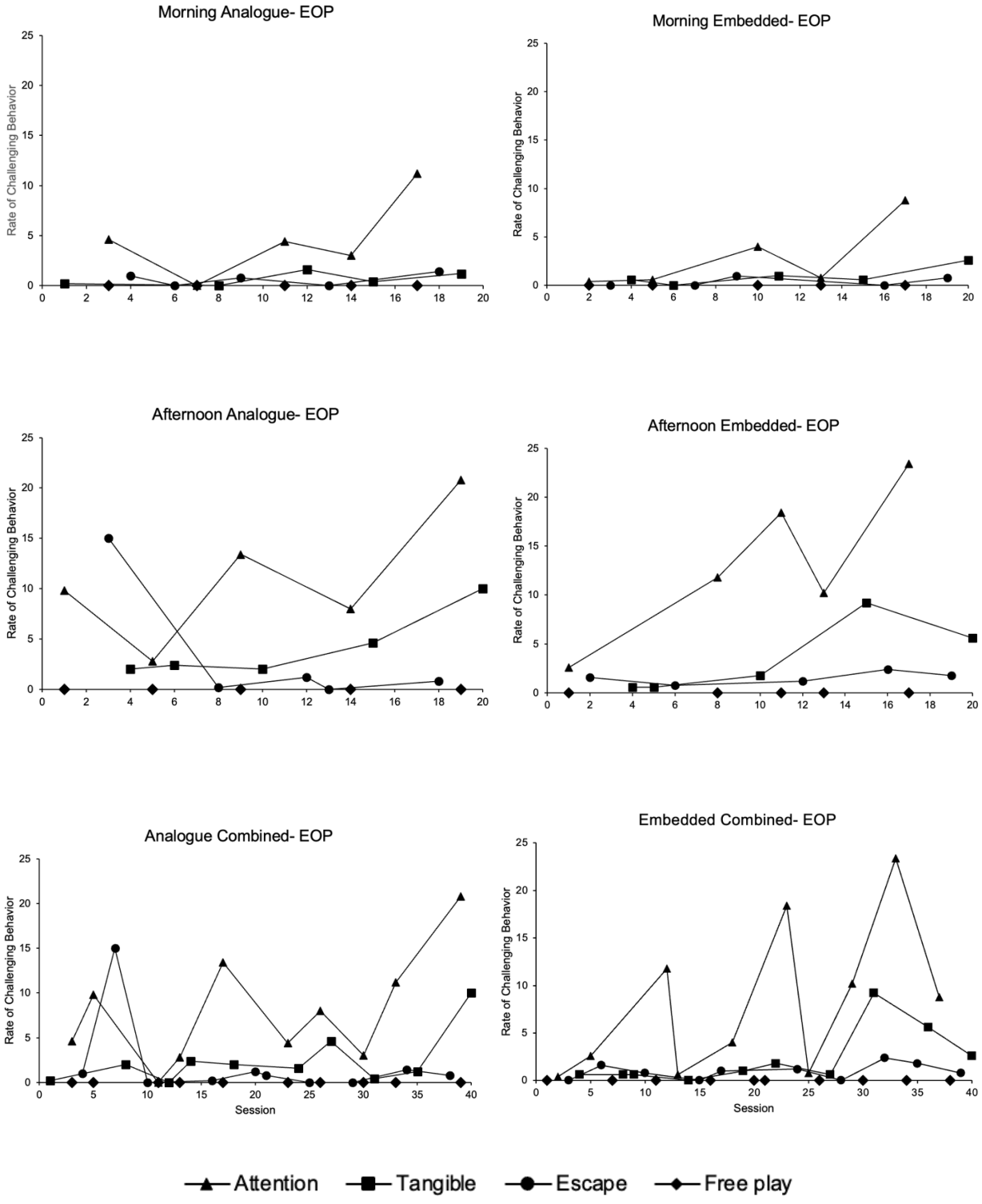


Figure 7

James' FA results

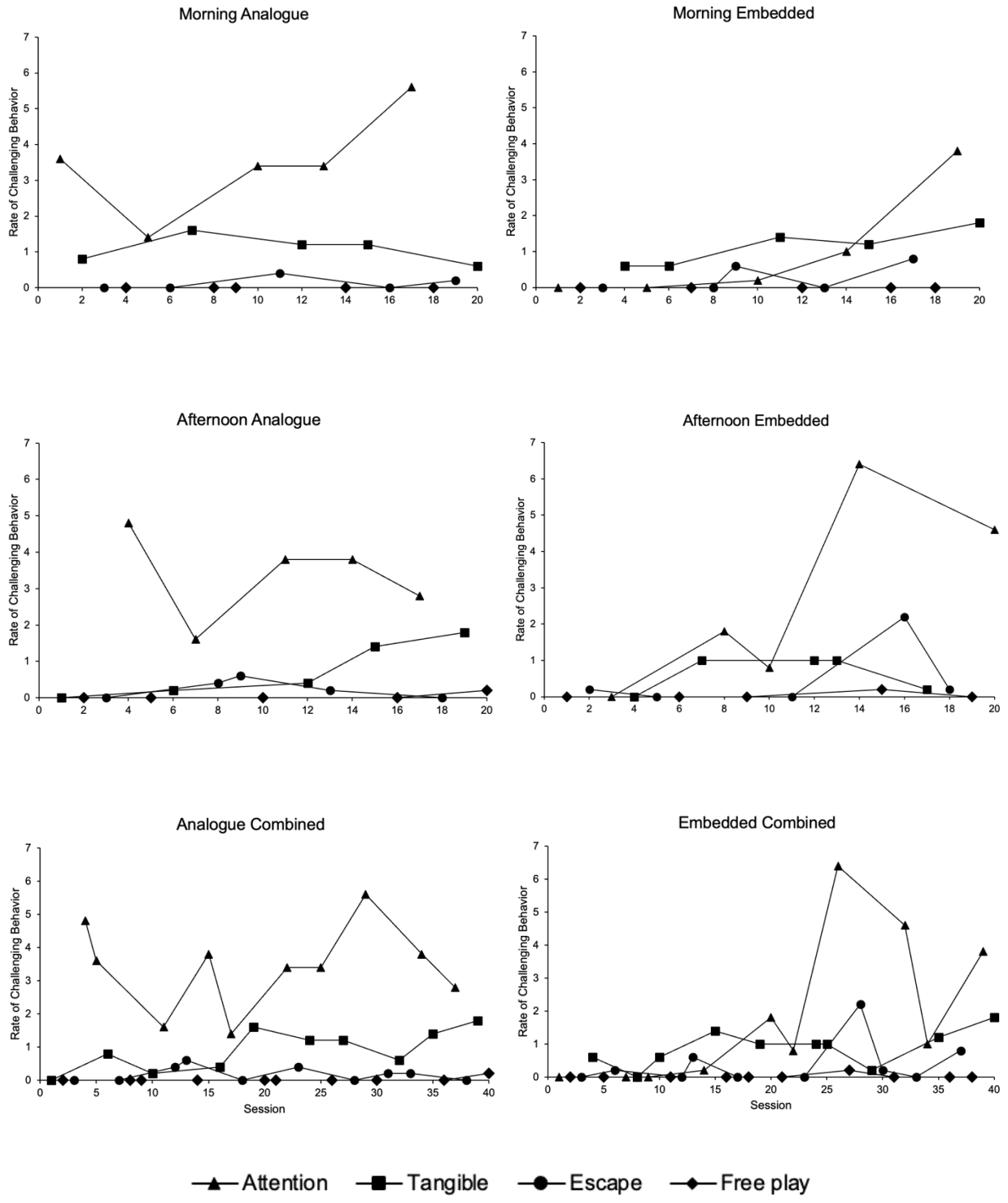


Figure 8

Jamal's original analogue FA data

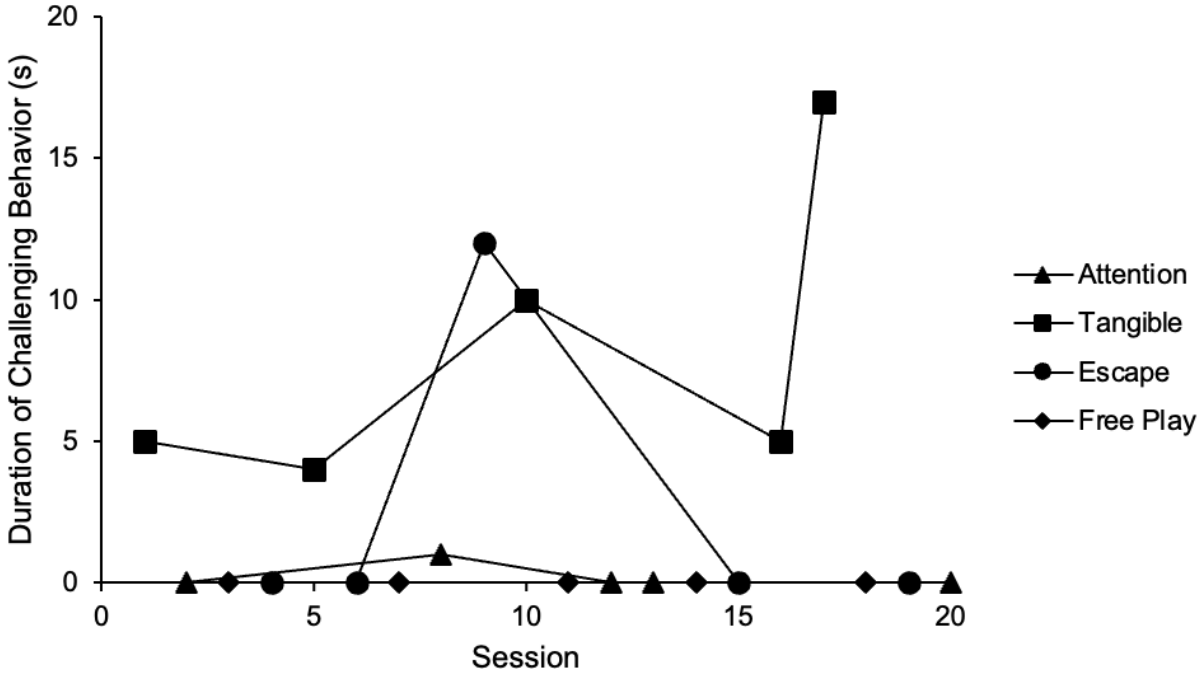


Figure 9

Kenneth's original analogue FA data

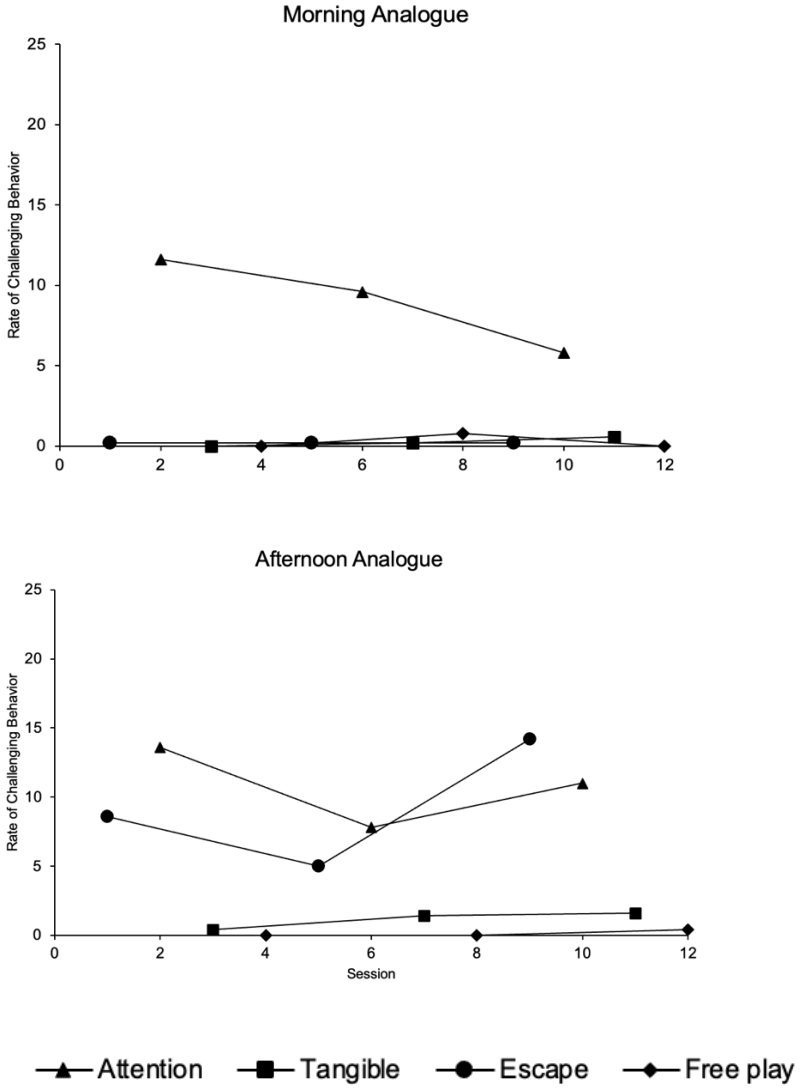


Figure 10

James' original analogue FA data

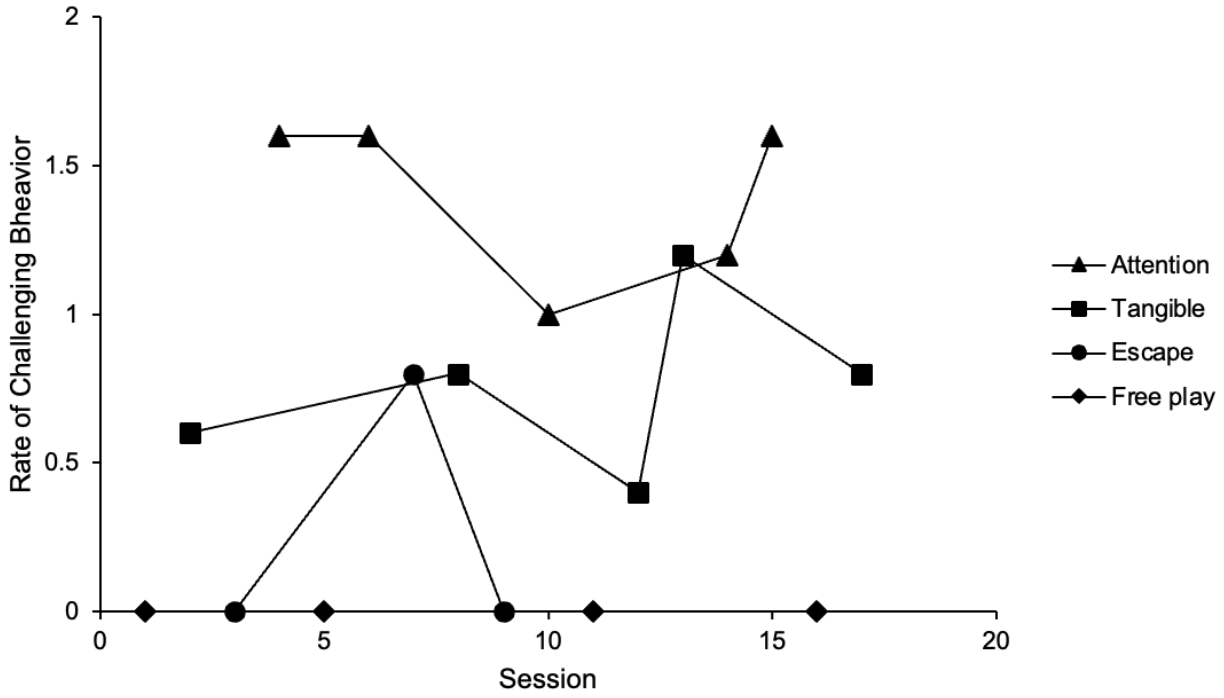


Table 4

Summarized results of indirect, direct assessment and functional analyses for each participant

Participant	QABF	CSA	Analogue FA			Embedded FA			Previous Analogue
			Morning	Afternoon	Combined	Morning	Afternoon	Combined	
Jamal	Non-social Physical	Tangible	Automatic	Attention	Automatic	Escape	Escape	Escape	Tangible
Kenneth	Attention Escape	Attention	Attention	Attention Tangible	Attention Tangible	Attention	Attention	Attention	Attention (AM/PM) Escape (PM) Tangible (PM)
James	Attention Tangible Escape	Tangible	Attention Tangible	Attention Tangible	Attention Tangible	Attention Tangible	Attention Tangible	Attention Tangible	Attention Tangible

Note. QABF = Questions About Behavioral Function; CSA = Contingency Space Analysis; FA = Functional Analysis; FA data interpreted using the rules established by Roane et al., 2013

Table 5

Kenneth FA results for EOP data

Analogue FA			Embedded FA		
Morning	**Afternoon**	**Combined**	**Morning**	**Afternoon**	**Combined**
Attention Tangible	Attention Tangible	Attention Tangible	Attention Tangible	Attention Escape Tangible	Attention Tangible

Table 6

Time devoted to individual assessments in minutes.

Participant	CSA	Analogue and Embedded	Previous Analogue
Jamal	85	100	100
Kenneth	65	100	120
James	95	100	85

CHAPTER 5

DISCUSSION

FBA is an integral component to function-based treatment and behavior reduction programs in the school setting (Beavers et al., 2013; Campbell, 2003; Horner, 1994). The continuum of FBA can lay the groundwork for effective treatment, allowing practitioners to understand what variables maintain the behavior in the natural environment (Cooper et al., 2020). The present evaluation sought to determine the concordance among commonly used FBA assessment methods including indirect, direct and FA assessment. Specifically, researchers sought to determine if the assessment form of FA could be more ecologically valid if the FA procedures were conducted in an embedded fashion in the school setting.

In short, this evaluation did not result in consistent agreement across indirect, direct and FA assessment methods for the three participants included in the study. While the results of this evaluation indicated that there was agreement across at least two assessment methods for each participant, there was never agreement across more than two methods. Additionally, the agreement across methods was inconsistent across participants. For Jamal, there was agreement between the QABF and the morning/combined analogue FA. For Kenneth, there was total agreement between the QABF, the embedded FA and the morning analogue FA. For James, there was correspondence between the analogue, embedded FA and the previously conducted analogue FA. Further, the maintaining functions for one participant (James) did not vary across the day in either FA configuration. For Jamal and Kenneth, the functions did vary across the day in the analogue FA but not in the embedded FA.

FA is considered by many the “gold standard” of functional assessment. For several previously mentioned reasons, practitioners may rely on other assessments such as CSA. For the participant sample within this evaluation, the CSA observation data resulted in a single function for all participants missing a second function for all participants in at least one FA evaluation. While the QABF identified multiple functions for all participants, the FA narrowed down the maintaining variables. Further evaluation of treatment for challenging behavior is necessary to determine which variables are maintaining challenging behavior; however, the data in this study suggest that the use of an FA pinpoints specific variables maintaining challenging behavior in the classroom setting.

Practicality

In terms of practical implementation of the FAs, all embedded and analogue FA sessions only required one staff member to implement. For the analogue and embedded FAs, the staff member that was with the student was able to complete all sessions without another staff member's assistance. The staff members with Jamal and James were able to run the session and simultaneously collect accurate data. All of Jamal’s sessions were conducted with 100% procedural fidelity and for James there were only two sessions with less than 100% procedural fidelity (87.5%). Both sessions for James with less than 100% procedural fidelity were conducted by two different staff members during an attention and escape session.

However, for Kenneth, due to the high intensity and high rate of challenging behavior, the staff member with him was unable to collect accurate data and complete the FA session with fidelity. For Kenneth’s sessions, a second staff member collected primary data. Kenneth’s sessions had the lowest procedural fidelity across all participants. This could, in part, be due to the higher intensity of the behaviors targeted for his FA. The sessions with lower procedural

fidelity were across two staff members and across all condition types. Staff members were retrained on procedures after sessions that their procedural fidelity was below 100%. The embedded FA sessions resulted in lower procedural fidelity overall for Kenneth. While procedural fidelity was not grossly low, procedural fidelity for Kenneth's sessions was the lowest in comparison to the other participants in the study. This component could have contributed to the variable data during the embedded sessions for Kenneth.

In the classroom setting, if the student engages in lower intensity challenging behavior, like Jamal and James, a single staff member could easily implement the embedded or analogue FA procedures with fidelity and collect accurate data without placing a strain on the classroom staff. If the student, like Kenneth, engages in higher intensity challenging behavior that requires management to remain safe, a video recording could be used, and data collected afterwards to limit the strain on classroom staff. However, monitoring of procedural fidelity is paramount for FA procedures to ensure that the collected data are an accurate reflection of variables maintaining challenging behavior rather than a byproduct of low fidelity.

The FA sessions conducted in this evaluation minimally disrupted the normal functioning within the classroom. There were two other students in the classroom that were not participants in this study, and they were able to continue along on their typical schedule while FA sessions occurred. During the analogue sessions, the student did not complete typical classroom activities but rather the staff member with them completed the FA sessions. During the embedded sessions, there was zero interruption to the student's typical schedule as all sessions occurred during normally occurring activities without adaptation to their normal school schedule. This component of the embedded FA could explain some of the highly variable data, particularly

during control for Kenneth, given that there were significantly more uncontrolled variables during the embedded sessions (e.g., whole group instruction).

Often a concern with conducting FAs in the classroom includes hesitancy to reinforce challenging behavior and the carryover that might impact the remainder of the school day (Chezan et al., 2022). During this study, students participated in all of their typical school day activities outside of sessions including eating breakfast in the cafeteria, going to recess and PE and other classroom activities. While data was not collected specifically on this variable, anecdotal data suggest that students did not miss out on any activities due to challenging behavior carryover from FA sessions.

Each morning and afternoon series of FA sessions required 100 min of time devoted to assessment. In comparison to the time spent in CSA observations for Kenneth, James and Jamal (65, 85, 95 min), both analogue and embedded FAs took more time overall but not significantly more time. The FA results also provided data that suggested multiple maintaining functions, whereas all participant's CSAs only identified a single maintaining function for challenging behavior. This information could be helpful to determine the most "prominent" function for challenging behavior given that the most probable reinforcer the student is encountering in their classroom setting is evident in the CSA results. When conducting an FA is not feasible a CSA might be a good starting place for assessment and quick path to treatment.

Each of the participants included in this study had participated in a previous analogue FA; however, the results did not show total correspondence between the previous FA and the analogue FA data from the current study. James results were congruent across the current and previous analogue FA data; however, James' previous FA was conducted 6 months prior to the

current study, the most recent in comparison to Kenneth and Jamal. Kenneth's FA was conducted 4 years prior to this study and Jamal's 2 years prior.

Kenneth's original FA conducted in the morning and the afternoon provided the original hypothesis for this study. Given that the maintaining functions shifted across the school day from a single maintaining function to multiple functions in the afternoon. Within the current evaluation, for all participants in the embedded FA there was a consistent function identified across the school day. However, for Kenneth and Jamal, in the analogue FA there were different functions from morning to afternoon. This information suggests that the analogue FA might be more sensitive to isolate variables and identify shifts in function across the school day. While there was partial concordance across analogue and embedded FA results for Kenneth, for Jamal the results of the analogue and embedded FAs were drastically different. For Jamal, the morning analogue FA detected an automatic function, the potential for an automatic function for the target behavior could be explanative of the variable results across assessment methods.

Limitations

Given the setting for both the analogue and the embedded FA was the same across conditions, this variable could have contributed to carryover between conditions from the morning to afternoon sessions. All sessions occurred at the student's desk, to be as naturalistic as possible. However, for the analogue sessions taking the student to another location within the classroom or another room in the school building might have been more representative of a typical analogue FA conducted in the school setting. Additionally, the tangible items used for the tangible sessions were the same across analogue and embedded conditions. While this kept variables the same across conditions, most tangible sessions procedurally looked the same across analogue and embedded sessions to ensure there was experimental control and no other variables

were at play during tangible sessions. However, using different tangible items or the same item for all analogue sessions and a variety of items for embedded sessions depending on what the student was currently engaged with might have been a better measure of the tangible function in embedded sessions.

In order to be the most ecologically valid, all classroom staff conducted FA sessions across both FA types. However, this could have contributed to variability across sessions given that there was a different learning history with each staff member for each participant. Keeping the staff member consistent across the day (e.g., 2-3 staff members on rotation rather than 8-10) could have provided more control and contributed to less variable data.

The data for this study were collected over the span of 10 data collection days to account for 5 data points in each condition for each type of FA and the intense number of staff required to video sessions and collect primary data and IOA for three participants. The extended length of time to conduct the FA could have contributed to variable data given that the previous analogue FAs were completed over the span of 2-3 data collection days.

Implications for Practice

Future research should take the functional assessment results similar to this evaluation and implement treatment for the different maintaining variables to determine which treatment or treatment package results in the largest reduction in challenging behavior. Implementing treatment would allow researchers to determine which method of FBA might be the most indicative of the actual maintaining variables and subsequently which assessment method or combination of assessments might be the most reliable. The results of this study need to further be further verified with the implementation of treatment for individual functions and the subsequent reduction of challenging behavior.

Additionally, future research should further evaluate the point at which functional assessment, or an FA should be updated to reflect the function of challenging behavior. In this evaluation, James' previous FA was the most recently conducted assessment across all three participants. James was also the only participant that had total correspondence between the current and previous analogue FA.

Research on assessment methods in the school setting for individuals with intellectual and developmental disabilities is critical to continue to move towards the most parsimonious and informative process to allow students access to effective treatment in the quickest way possible. Further education of school staff on FA benefits and limited barriers to implementation could also allow FA assessment to become more common in the school setting. This evaluation demonstrates that FAs can be conducted in the school setting without the need for additional staff, extended amounts of time and strain on the daily classroom functioning. The expansion and adaptation of FBA methodology seeks to provide the path to the most effective function-based treatment for students in special education settings.

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