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Interview-Informed Synthesized Contingency Analyses on Challenging Problem Behavior: A Single-Case Meta-Analysis

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INTERVIEW-INFORMED SYNTHESIZED CONTINGENCY ANALYSES ON CHALLENGING PROBLEM BEHAVIOR: A SINGLE-CASE META-ANALYSIS

by

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ABSTRACT

The purpose of the current study was to conduct a thorough review of the literature on the Interview Informed Synthesized Contingency Analysis (IISCA) developed by Hanley et al. (2014) and its subsequent treatments. A total of 39 articles were identified as including an IISCA to assess the function of participants' destructive problem behavior. Twenty-nine articles also conducted function-based interventions designed from the results of the IISCAs. Within those 39 studies, 235 participants participated in 293 synthesized contingency analyses (SCA) and 111 treatment evaluations. Results indicated that 95.56% of SCAs in the included studies were reported to be differentiated. Likewise, Tau-U coefficients for 96.14% of graphs were in the moderate to very large effect size range. An omnibus Hedge's g indicated that the IISCA had a large effect size overall (Hedge's g= 2.428).

Similarly, reductions in problem behavior were seen in all 111 treatment analyses, with the average percentage of reduction being 97.04% (range 60.28-100%). 98.48% of Tau-U effect sizes for treatment analyses were in the moderate to very large range. In contrast, the omnibus effect size for function-based interventions developed from the results of IISCAs was 2.007, which indicates a large effect size. Results of the current review indicate that the IISCA and function-based interventions developed from the results of IISCA produce statistically significant results. Limitations and future directions are also discussed.

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LIST OF ABBREVIATIONS

ADHD	Attention-Deficit/Hyperactivity Disorder
BCBA	Board-Certified Behavior Analyst
BCBA-D	Board-Certified Behavior Analyst-Doctoral Level
BFA	Brief Functional Analysis
EO	Establishing Operation
FA	Functional Analysis
FAI	Functional Assessment Interview
FBA	Functional Behavior Assessment
FCR	Functional Communication Response
FCT	Functional Communication Training
FCT+DDT	Functional Communication Training + Delay and Denial Tolerance
IISCA	Interview-Informed Synthesized Contingency Analysis
IOA	Interobserver Agreement
PDD-NOS	Pervasive Developmental Disorder-Not Otherwise Specified
PFA	Practical Functional Analysis
RAI	Reinforcer-Absent Intervals
RPI	Reinforcer-Present Intervals
SCA	Synthesized Contingency Analysis

TBFA	Trial Based Functional Analysis
USM	The University of Southern Mississippi
WWC	What Works Clearinghouse

CHAPTER I - INTRODUCTION

Functional Analysis

Many individuals with and without disabilities engage in problem behaviors (e.g., aggression, disruptions, self-injurious behaviors) that can impede their ability to participate in everyday life at home, school, work, and in the community. One way to decrease problem behaviors is to figure out why these are occurring using a functional analysis. A functional analysis is an experimental manipulation of the antecedents and consequences surrounding a certain behavior and is the only method that allows researchers and practitioners to confirm hypotheses about the function of their client's problem behavior. Once the maintaining function (i.e., reason for the behavior) can be determined, the behavior analysts can develop interventions to decrease the problem behavior and increase more socially appropriate behaviors that serve the same purpose as the problem behaviors (Cooper et al., 2007).

Standard (Iwata et al., 1982) Functional Analysis

Iwata et al. (1982) developed the standard or traditional functional analysis (FA), which included three experimental test conditions: social disapproval, academic demands, and alone. A control condition, called unstructured play, was also used as a comparison and served as a control condition because all reinforcers were available regardless of behavior, reducing motivation to engage in problem behavior. During each condition, the researchers manipulated a different establishing operation (i.e., environmental manipulations that momentarily increase the potency of a reinforcer) to evoke behavior. For example, during the social disapproval condition, researchers did not provide attention to the participant unless the participant engaged in problem behavior,

and attention occurred in the form of social disapproval (e.g., reprimands or concern). Therefore, the participant is deprived of attention to make obtaining attention more reinforcing. Likewise, to escape from demands during the academic demands condition, the participant had to engage in the problem behavior. The researcher placed the participant in an empty room without toys or attention during the alone condition. This condition was used to test for sensory stimulation as the reinforcer for problem behavior. During the unstructured play condition, the researcher provided the participant with continuous access to toys and attention and did not place any demands, reducing motivation to engage in problem behavior that might be reinforced by toys, attention, or escape from demands.

The number of intervals with problem behavior during the three test conditions (i.e., social disapproval, academic demands, and alone) was compared to the number of intervals during the play condition (i.e., in which problem behavior is not expected). If the number of intervals in a test condition was substantially higher than those during the unstructured play (control) condition, the problem behavior was said to be controlled or maintained by that function (Iwata et al., 1982). This process was completed with nine participants with developmental delays. Since Iwata et al. (1982), researchers have renamed conditions to reflect what the participant was trying to access. Therefore, social disapproval, academic demands, alone, and unstructured play conditions became attention, escape, alone, and toy play conditions, respectively (Cooper et al., 2007). Additionally, researchers have modified Iwata's traditional functional analysis procedures in various other ways.

Modifications to the Standard Functional Analysis

Brief Functional Analysis. One limitation of the standardized functional analysis is the length of time for completion (i.e., 6-13.25 hours for the analyses in Iwata et al., 1982). Northup et al. (1991) modified the standard functional analysis and created what is known as the brief functional analysis or BFA with three participants diagnosed with an intellectual disability. These modifications included using 5-minute and 10-minute sessions and only conducting one session per condition. BFA was created with outpatient clinic settings and schools in mind because traditional functional analysis procedures were believed to be too time consuming and intrusive for those settings.

Further studies like Wallace and Iwata (1999) and Kahng and Iwata (1999) conducted reviews to compare the results from brief functional analyses with those from standard functional analyses. Wallace and Iwata (1999) examined whether functional analyses with shorter session lengths (i.e., 5-minute and 10-minutes sessions) would be as accurate as those with the full 15 minutes. They found that 43 of the 46 5-minute analyses were identical to their corresponding 15-minute analyses, while all 46 of the 10-minute analyses were identical to their corresponding 15-minute analyses.

Kahng and Iwata (1999), on the other hand, compared the results of brief functional analyses with only one session per condition and full functional analyses with more than one session per condition. They found that the interpretations of the BFAs corresponded with those of the full functional analyses in 66% of the cases. Additionally, of those full functional analyses that initially showed differentiated results, 77% of their BFAs corresponded.

Trial-Based Functional Analysis. Another modification designed to cut down on the length of functional analyses is a trial-based functional analysis. Sigafoos and Saggers (1995) first used a trial-based functional analysis (TBFA) to determine the function of aggression exhibited by two boys diagnosed with autism. Typical FAs compare the rate of problem behavior in sessions. In contrast, TBFAs look at the latency to problem behavior. Therefore, shorter latencies may indicate a maintaining function of the participant's problem behavior. TBFAs were developed to reduce the participant's exposure to reinforcement for problem behaviors and are generally the method for conducting functional analyses of severe self-injurious behaviors like eye-gouging (Cooper et al., 2007).

Another advantage of TBFAs is that practitioners can easily embed them in the natural environment during regularly scheduled activities. For example, Bloom et al. (2011) conducted TBFAs for ten students with developmental disabilities (e.g., autism, Down Syndrome) in their classrooms during regular classroom activities. These analyses were then compared to a standard functional analysis that the researchers also completed. Six out of the 10 participants showed correspondence between the results of both assessments. An additional partial correspondence was also seen for a seventh participant. The brief functional analysis of this participant showed differentiated results for only two of the three functions identified by the participant's full functional analysis (Bloom et al., 2011).

Precursor Functional Analysis. One attempt to decrease side effects (e.g., increased level of problem behaviors) of severe problem behavior functional analyses has been to use a Precursors FAs. A precursor behavior is often considered an early response-

class hierarchy member (Heath & Smith, 2019). Response-class hierarchy is a group of behaviors that all have the same function and occur in a hierarchy or temporal pattern (Cooper et al., 2007). For example, a client may often cry, then self-pinch, then self-harm. Precursors are behaviors that occur early on in the response-class hierarchy (e.g., the crying in the example provided). Precursor behaviors are identified by many different means, including caregiver reports and direct observations (Smith & Churchill, 2002), conditional probabilities (Langdon et al., 2008), and latency from the EO onset (Harding et al., 2001).

Precursor FAs are based on the premise that reinforcing early members of response-class hierarchies would prevent the later members (i.e., typically more severe in intensity and potential harm) from occurring. A review by Heath and Smith (2019) indicated that when precursor FAs and standard FAs were compared in five studies, they procedure similar outcomes (i.e., indicated the same functions of behavior) for 94% of participants. Additionally, severe problem behavior was decreased or non-existent in 85% of cases (Heath & Smith, 2019).

Idiosyncratic Functions. Researchers and practitioners have also made other modifications to conditions, like adding conditions for idiosyncratic functions. An idiosyncratic function is any function that was not in the standard FA protocol (i.e., attention, escape, alone, and toy play; Hagopian et al., 2013). For example, one early modification was to use an ignore condition where a therapist is in the room with the participant instead of the traditional alone condition when no one is with the participant (Hanley et al., 2003). Mace and West (1986) also introduced an access to tangible reinforcement condition in which preferred items or activities were only available

contingent on problem behavior. Both the ignore and tangible conditions have become integrated into the standard FA and are regularly used by researchers and practitioners when conducting FAs (Hagopian et al., 2013). Behavior analysts have included other idiosyncratic functions in FAs such as divided attention (Mace et al., 1986), social avoidance (Slocum et al., 2021), preferred conversation topics (Roscoe et al., 2010), and specific types of demands like demands to transition to other activities (McCord et al., 2001).

Synthesized Functions. Another modification used by researchers includes test conditions for synthesized functions. Synthesized "refer[s] to arrangements that involve multiple EOs [i.e., establishing operations], multiple potential reinforcers, multiple response topographies, or some combination" (Slaton & Hanley, 2018, p. 945). When all three are combined, it is a synthesized contingency (Slaton & Hanley, 2018). O'Reilly (1997) used the first synthesized EO in a functional analysis in which the participant, diagnosed with a developmental disability, had a greater motivation to escape from a loud noise because they had an ear infection. Since then, there have been more than 50 additional articles with synthesized EOs and reinforcers used in FAs and treatments. For example, Sarno et al. (2011) assessed a synthesized escape-to-attention as a potential maintaining function of problem behavior in a school setting for three participants (i.e., 2 typically developing and 1 diagnosed with ADHD).

Researchers have also compared synthesized and isolated conditions (i.e., those with only one EO/reinforcer) in roughly 30 applications. Slaton and Hanley (2018) determined that synthesis was necessary to show differentiated results in an FA or effective treatment in 80% of those applications. Hanley et al. (2014) unknowingly

developed one application of synthesized contingencies when they used an interview to create a single test condition with synthesized EOs. A matching control condition was used to test synthesized contingencies for three participants. Henceforth, this procedure has been known as an Interview-Informed Synthesized Contingency Analysis (IISCA).

Interview-Informed Synthesized Contingency Analysis

Hanley et al. (2014) involved three participants aged 3, 8, and 11 years old, diagnosed with autism or PDD-NOS, referred to a university-based clinic for services. All three participants exhibited loud vocalizations, disruptions, and aggression. The researchers interviewed each participant's parent using the Open-Ended Functional Assessment Interview (FAI; see Appendix A), which provided demographic information and information to inform the researchers about possible antecedents and consequences of the participant's problem behavior (Hanley et al., 2012). The researchers then conducted an unstructured observation in which they presented and removed various stimuli (e.g., toys, attention, demands) and noted the results (Hanley et al., 2014).

Test conditions for the IISCA were developed from the interviews and direct observations and included a single, synthesized function of all potential functions for each participant. At the beginning of the test condition sessions, the researchers provided access to all reinforcers for 30 seconds and then removed them. The reinforcers were returned for 30 seconds only when the participant engaged in problem behavior. During control conditions, the reinforcers were freely provided for the entire session, regardless of if problem behavior occurred. The researchers alternated all participants' test (T) and control (C) sessions. Results indicated that all participants responded idiosyncratically to their synthesized conditions. That is, relative to control conditions, each participant

engaged in more problem behaviors during their synthesized test conditions, resulting in differentiated FAs.

Interventions for Behavior Reduction

Function-Based Interventions

Once the reinforcer for problem behavior is known by conducting a functional analysis, a function-based intervention or treatment can be created to decrease the problem behavior and replace it with more socially acceptable behavior. Function-based interventions are explicitly designed to correspond to identified functions of behavior and manipulate the contingencies surrounding those identified functions (Fisher et al., 2011). Function-based interventions are more likely to decrease problem behaviors than those chosen arbitrarily (i.e., non-function-based intervention; Hurl et al., 2016).

Functional Communication Training

One common function-based intervention used to decrease problem behaviors and increase appropriate communicative behavior is functional communication training (FCT). FCT is a form of differential reinforcement of alternative behavior in which problem behavior no longer results in access to reinforcement. Instead, the participant is taught to engage in an alternative, appropriate way to ask for what they want (i.e., the functional communication response; FCR). For example, if a functional analysis indicates that a participant's problem behavior is maintained by access to attention, therapists no longer provide attention when the participant engages in problem behavior during FCT. The therapist will only provide attention when the participant asks appropriately (e.g., "play with me, please"). FCT can be used as a stand-alone intervention or can be embedded within other treatment packages (Cooper et al., 2007).

Functional Communication Training with Delay and Denial Tolerance. One such modification to FCT that has been gaining momentum is FCT with delay and denial tolerance (FCT+DDT). FCT+ DDT is described in Hanley et al. (2014) and was used with the three participants that participated in the IISCA. In a withdrawal design (i.e., With FCT+DTT, the participants were first taught a simple FCR to ask for their functional reinforcers (e.g., “my way, please”). Once the participants had mastered the simple FCR, they were taught a complex FCR (e.g., “may I have ___, please”; Hanley et al., 2014).

During the delay and denial tolerance training phase, the therapist responded to 40% of FCRs by immediately providing access to the requested reinforcer(s). In comparison, they responded to 60% of FCRs with a delay (e.g., “not right now”) or denial (e.g., “no”) response. The participants were taught appropriate ways to respond to delay or denial responses (e.g., saying “okay”). Initially, the tolerance response was immediately reinforced with the requested reinforcer. However, the delay to the reinforcer interval was progressively increased, and compliance with instructions was eventually required for the participant to access their requested reinforcer (Hanley et al., 2014).

Previous Reviews on the IISCA

Coffey, Shawler, Jessel, Nye, et al. (2020) completed a literature review on IISCA publications between 2014 and October 2018. Their search criteria included any articles that mentioned the use of the IISCA or the procedures implemented by Hanley et al. (2014). A total of 17 articles across five journals were identified, with 89 participants

with 102 IISCA applications. Additionally, 14 studies reported conducting treatments with 55 treatment evaluations (Coffey et al., 2020).

Participants' ages ranged from 1 to 30 years, while vocal abilities ranged from non-vocal to using complete sentences. Participants' diagnoses included autism spectrum disorder, attention-deficit hyperactivity disorder, disruptive behavior disorders, mood disorders, anxiety disorders, etc., while four individuals were typically developing. The top three problem behaviors reported were aggression, disruption, and self-injurious behaviors. Settings for the IISCA analyses included outpatient clinics, homes, schools (e.g., elementary school, university-based preschool, and specialized school for children with autism and other special needs) and day habilitation centers (Coffey et al., 2020).

The total number of sessions included in the IISCA ranged from 5 to 10 sessions, while the duration of sessions ranged from three to fifteen minutes each. They also reported that two studies (Fisher et al., 2016; Slaton et al., 2017) compared IISCAs for 14 participants to standard FAs. Overall, differentiation was seen for 13 of the 14 participants in the IISCA. In contrast, differentiation was only seen for 8 of the 14 participants in the standard FA. Across the 55 treatment evaluations, 54 evaluations used FCT, while one used a different treatment package. All evaluations showed at least a 90% reduction in problem behavior by the end of treatment. Coffey et al. (2020) did not, however, calculate effect sizes for the IISCAs or treatments identified in their review. Nor did they evaluate the methodological quality of included reviews by assessing if studies met the design standards for single-case research developed by What Works Clearinghouse (Coffey et al., 2020; What Works Clearinghouse, 2020).

Metras and Jessel (2021) conducted a review that described researchers' various adaptations to the IISCA. The adaptations identified included a latency-based IISCA format, a trial-based IISCA format, and a single-session IISCA format (Metras & Jessel, 2021). The latency-based IISCA format was first used by Jessel, Ingvarsson, Metras, et al. (2018) to assess elopement in two participants. Therefore, sessions lasted until the participant engaged in elopement or for three minutes if no elopement occurred. IISCAs for both participants showed that elopement occurred exclusively in the test conditions (i.e., within 60 seconds of the sessions starting), demonstrating differentiation for both participants. A latency-based IISCA was later also used by Boyle et al. (2020) to assess the function of one participant that also engaged in elopement (Metras & Jessel, 2021).

The trial-based IISCA format was used by Curtis et al. (2020) with three participants and were conducted in their natural environments to improve ecological validity as assessments and treatment developed in analog environments may lack ecological validity. That is, behavioral presentation in one setting and accompanying behavioral function may differ, for the same individual, in another setting. As a result, treatments based on analog analyses may not be practical or generalize to the natural environment (Solnick & Ardoin, 2010).

Twenty trials, which included a two-minute control segment and a two-minute test segment, were conducted for each participant. This trial-based format resulted in differentiation for all three participants (Curtis et al., 2020). No other studies were reported to have used the trial-based IISCA format (Metras & Jessel, 2021). A single session IISCA format was used by Jessel, Hanley, et al. (2018) with three participants. The single session was identical to a test condition session in a full IISCA. The

researchers compared the rate of problem behavior during reinforcer-absent intervals (RAI; i.e., 10-second intervals during which the reinforcer had been removed during the session) and reinforcer-present intervals (RPI; i.e., 10-second intervals during which the client had access to the reinforcer during the session). Differentiation was demonstrated for all three participants (Jessel, Hanley, et al., 2018).

Purpose of the Current Study

Relative to the broader functional analysis literature, the IISCA literature has appeared more recently, includes a limited number of studies, and there has not been a systematic review of the IISCA literature that includes effect size calculations to summarize the effect of IISCA derived treatments. Therefore, the purpose of the current study is to add to the IISCA literature by conducting an updated review of the literature so that more studies may be included. Additionally, this study will include a meta-analysis of the studies that include IISCA derived treatments so that an overall effect of IISCA derived treatments can be estimated. Finally, this study includes a review of the methodological rigor of research designs used to test IISCA derived treatments, which has not been included in previous reviews. This study will make an important contribution to the IISCA literature and identify gaps in the literature and future research directions.

Research Questions

1. What are the demographics of participants included in IISCA research?
2. What elements of the original IISCA study (Hanley et al., 2014) are still being used in IISCA literature, and what elements have been modified?
3. Does the IISCA produce differentiated results?

4. What types of interventions and intervention components are being used in function-based interventions developed from the results of the IISCA?
5. Do function-based interventions developed from the results of IISCAs produce meaningful reductions in destructive problem behaviors?
6. To what extent do function-based interventions developed from the results of IISCAs meet research design standards as defined by What Works Clearinghouse?

CHAPTER II - METHOD

Search Method

Search Process

During the current review, the primary researcher followed 70% .27 of the Preferred Reporting Items for Systematic reviews and Meta-Analyses guidelines. To identify articles, the primary researcher conducted a search using the PSYCHinfo and ERIC databases (last searched 5/15/2022). The primary researcher used the following search terms in the first line: “interview-informed synthesized contingency analysis” OR “IISCA” OR “Practical Functional Analysis” OR “PFA”; “functional analysis” OR “FA” OR “functional behavior assessment” OR “FBA” OR “functional assessment” on the second line; and “synthesized” OR “multiple control” OR “multiple reinforcers” OR “combined reinforcers” OR “combined + problem behavior” OR “multiple + problem behavior” OR “synthesized contingency” on the third line. The first and second lines were connected by the “OR” Boolean operant, while the second and third lines were connected by the “AND” Boolean operant.

Article Identification

Initial Literature Search. Appendix B illustrates the search process. The initial search generated 346 articles. As Hanley et al. (2014) published the original IISCA research study in 2014, the primary researcher applied a year limitation to only include studies published in 2014 or later. Following the year limitation, 140 articles were removed, leaving 206 studies.

Abstract and Title Review. The primary researcher screened the 206 remaining articles via a title and abstract review. During the title and abstract review, the primary

researcher excluded articles if it was evident that they met at least one of the following exclusion criteria: a) the article was written in any other language than English, b) behavior was not the dependent variable, c) participants were not human, d) data in the article were not original research (i.e., data had been included in a previous article or article was a meta-analysis, literature review, or systematic review), e) article was written before 2014 (i.e., before the Hanley et al., 2014 article was published), or f) no functional analysis was conducted. Following the title and abstract review, 159 articles were removed, leaving 43 articles that were retained.

Full-Text Review. After the title and abstract review, the primary researcher conducted a full-text review of the remaining 43 articles. The primary researcher used the following inclusion criteria during the review (i.e., articles had to meet all inclusion criteria): a) article was written in English, b) behavior was the dependent variable, c) research was original (i.e., not previously published or articles is a systematic review/meta-analysis/literature review), d) article was published in 2014 or after, f) a synthesized functional analysis was conducted, g) the Hanley (2012) interview was conducted to inform the functional analysis, h) a single-case design was utilized in the functional analysis or treatment analysis. Following the full-text review, 17 articles were removed, leaving 26 articles.

Excluded Studies. The primary researcher excluded 12 studies during the full-text review as they contained neither the Hanley (2012) interview nor a synthesized contingency analysis. Specifically, three articles did not include the Hanley (2012) interview, while two studies did not conduct a synthesized contingency analysis. Additionally, the primary researcher excluded eight studies as they were not original

research using a single-case design, and one article was excluded because the participants were not human.

Duplicates removal and dissertation/article retention. The primary researcher removed duplicate articles during the full-text review stage. Additionally, if a dissertation/thesis was published on the same data set as a peer-reviewed journal article, the journal article was retained, and the dissertation or thesis was removed. The primary researcher excluded a total of four duplicates (including dissertations/theses).

Ancestral and Descendant Citation Search. For each article that passed the full-text review, the primary researcher conducted ancestral and descendant citation searches to identify any potentially missed articles not identified by the initial literature search. For the ancestral citation search, the primary researcher reviewed the titles of all articles listed in the references section. Additionally, for the descendant citation search, the primary researcher used Google Scholar to review articles that cited each article that passed the full-text review. The primary researcher followed the same criteria listed for the title and abstract review and full-text reviews for any potential articles. Following the ancestral and descendant searches, an additional ten articles were identified, resulting in a total of 36 articles.

Additional Sources. The primary researcher also created alerts on Google Scholar for "interview-informed synthesized contingency analysis" and "practical functional assessment" to identify additional articles. The primary researcher identified an additional three articles using these Google Scholar alerts. This resulted in a total of 39 articles that were included in the current review.

Variable Coding

The primary researcher utilized an Excel document to code variables from each article that passed the full-text review. A unique coding key (see Appendix C) was created for each item. For example, for participant ethnicity/race, the primary researcher coded "1" for Black/African-American, "2" for Asian, "3" for Hispanic/Latino, "4" for Native American, "5" White/Caucasian, "9" or other, or "888" for not specified. For each participant, the primary researcher coded 28 items (i.e., participant demographics, FA context, and IISCA items). For participants who participated in treatment, the primary researcher coded an additional 16 items (e.g., type of treatment, treatment implementer, treatment integrity) for a total of 44 items.

Participant Characteristics and Functional Analysis Context

For each participant, the primary researcher coded the participant's reported ethnicity/race, gender, age, diagnosis(es), verbal abilities (e.g., nonverbal, full fluency, picture exchange; scale adopted from Jessel, Ingvarsson, Kirk, and Whipple, 2018), and topographies of problem behavior(s) targeted (e.g., aggression, disruption, self-injurious behaviors). Additionally, the primary researcher coded the setting for the functional analysis, who the interviewer and interviewee were, and whether a direct observation was conducted prior to the functional analysis.

Synthesized Contingency Analysis (SCA)

For each analysis conducted (i.e., some participants had more than one SCA completed), the primary researcher coded the measurement methods for the primary dependent variable (e.g., frequency, duration), the hypothesized synthesized functions included in the analysis (e.g., escape, attention), whether precursors were consequated in

the analysis, who implemented the analysis, the training that the implementer received prior to implementing the analysis, how long the sessions were in minutes, the number of sessions conducted, whether modifications were used during the SCA, whether the first five sessions followed the Control-Test-Control-Test-Test sequence, and whether the SCA was reported to be differentiated or not (i.e., by the experimenters of each study).

Interobserver Agreement (IOA) and Procedural Integrity. For each analysis, the primary researcher recorded whether IOA was reported and, if applicable, the percentage of sessions that had IOA and the average IOA value reported. Similarly, the primary researcher recorded if procedural integrity for the SCA was reported and, if so, the method of data collection (e.g., direct observation, permanent product), the percentage of sessions it was collected for, and the average value reported.

Treatment

For studies that completed a treatment evaluation for one or more of their participants, we coded the type of treatment (e.g., functional communication training, token economy system), the single-case design used to evaluate the treatment, who implemented the treatments, and the training that the implementer received.

Interobserver Agreement (IOA) and Treatment Integrity. Similar to the SCA, the primary researcher recorded whether IOA was reported for the treatment evaluation and, if so, the percentage of sessions that had IOA and the average IOA value reported. Additionally, the primary researcher coded whether treatment integrity was reported for each treatment evaluation and, if applicable, the treatment integrity data collection method, percentage of sessions with treatment integrity, and the average integrity value reported.

Methodological Quality Analysis

In addition to the variable coded for studies that completed a treatment evaluation, the primary researcher also assessed the quality of that treatment using *WWC* (What Works Clearinghouse, 2020) standards. Studies could either meet design standards, not meet design standards, or meet design standards with reservations. The primary researcher assessed each study on four measures: systematic manipulation, interobserver agreement, attempts of intervention effect, and phase length. Studies were *rated* as meeting the criteria for systematic manipulation if the experimenter systematically changed the independent variable. For IOA, studies had to have IOA collected in at least 20% of each condition across participants to meet the criteria. For the attempts of intervention effect, there needed to be at least three attempts. For studies implementing a phase change design (i.e., withdrawal, reversal, pairwise, or changing criterion's design), there needed to be at least four phases; a multiple baseline or multiple probe design needed at least three baseline conditions (i.e., AB designs across at least three people, three behaviors, or three settings). For phase length, each phase in the study needed at least five data points to meet design standards or at least 3 data points to meet with reservations.

Outcomes Analysis

Data Extraction

The primary researcher completed outcomes analyses for all published graphs for levels of problem behavior during participants' SCA and treatment analyses. Due to the nature of the data extraction and outcome analysis method, only data displayed using line graphs were included in the outcome analyses. Therefore, the primary researcher

extracted X and Y coordinates from every line graph published in the articles using the DigitizeIt Version 2.5 (Bormann, 2012) software (see Figure 1). DigitizeIt was deemed a reliable and valid method for extracting raw data from single-subject experimental research (Rakap et al., 2016).

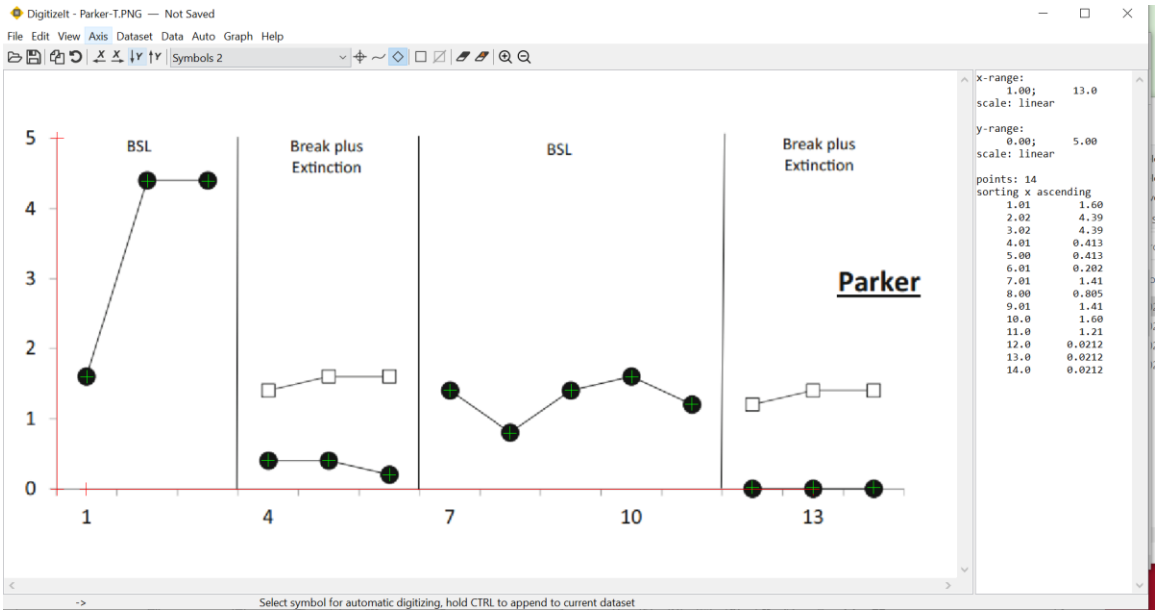


Figure 1. Example of DigitizeIt Raw Data Extraction

Kendall's Tau

Following extraction, the primary researcher input the Y-coordinates for different conditions (e.g., test vs. control; baseline vs. treatment) into a Tau-U calculator (Vannest et al., 2016) to calculate a Kendall's Tau coefficient for SCA and treatment graphs. Tau-U is an index that combines nonoverlap of adjacent phases and trends between and within phases (Parker et al., 2011). Tau-U coefficients can be between -1.0 and +1.0. Coefficients of 0.2 or lower are considered a small effect size, while coefficients between 0.2 and 0.6 are considered a moderate effect size, 0.6 to 0.8 a large effect size, and 0.8 and above a large to very large effect size (Vannest & Ninci, 2015).

The primary researcher calculated a Tau-U coefficient for each set of adjacent control/baseline (A) and test/treatment (B) conditions (Parker et al., 2011) within all applicable SCA and treatment graphs. A Tau coefficient was not calculated between adjacent treatment conditions as Tau is designed to compare non-similar conditions (Parker et al., 2011). Additionally, a Tau coefficient was not calculated for nonadjacent conditions as only adjacent conditions can be directly compared in single-case research (Gast &Ledford, 2014). The primary researcher calculated a Tau coefficient between the control (A phase) and test (B phase) conditions for each synthesized contingency analysis. If a participant had participated in multiple SCAs, a Tau-U coefficient was conducted separately for each SCA.

The primary researcher also calculated a Tau-U coefficient for each treatment graph for every adjacent baseline (A) and treatment (B) condition. Therefore, for multiple baseline or multiple probe designs, a Tau-U coefficient was calculated for each AB combination for each tier. For withdrawal, reversal, or pairwise single-case designs, a Tau coefficient was calculated for each set of adjacent non-similar conditions (i.e., baseline and treatment or treatment and baseline). For example, if a design followed an ABCABC design (i.e., where A=baseline, B=treatment 1, and C=treatment 2), a Tau coefficient was calculated between the first A and B conditions (i.e., A1 vs. B1), the first C condition and second A condition (i.e., C1 vs. A2), and the second A and B conditions (i.e., A2 vs. B2). For graphs that used a Changing-Criterion Design (e.g., ABCDE), only the first treatment condition (B) was compared to the baseline condition (A) as the following treatment conditions (C, D, and E) were not adjacent to the baseline condition.

However, the Tau-U calculator is designed to test the effect size of treatments in which skill acquisition is the dependent variable. For these types of treatments, low levels of behavior at baseline and high levels of behavior in treatment sessions are ideal. However, the dependent variable for treatments in the current study was problem behavior. Therefore, high levels of problem behavior are expected in baseline, while lower levels of problem behavior are expected in treatment. Because of this, the primary researcher inversed data for treatment graphs so that values were presented as negative numbers rather than positive numbers. For example, if a y-coordinate was 4.56, the inverse was -4.56. The inversed data were then put into the Tau-U calculators to determine the effect size of the treatment. The inversed data allowed the Tau-U calculator to provide an accurate effect size for these treatments.

Hedge's g

The primary researcher also used extracted data to calculate omnibus Hedge's g coefficients for the IISCA and the treatments designed from the results of IISCAs. Hedge's g is an effect size index that looks at the standardized mean difference between an experimental group or treatment/test conditions, and a control group, or baseline condition. Hedge's g is usually chosen over Cohen's d for comparisons with small sample sizes. Several assumptions must be met in order to include studies and condition comparisons in the Hedge's g calculation. For example, one Hedge's g assumption is that the article provided data for at least three participants. Therefore, any studies that only included one or two participants were excluded from the calculations. Additionally, the standard deviations for conditions had to be larger than zero. Therefore, any condition comparisons in which at least one of the standard deviations was zero were excluded

from the calculations as well. The primary researcher calculated separate Hedge's g coefficients for SCAs and treatment graphs. Hedge's g coefficients of 0.2 to 0.5 are considered small, 0.5 to 0.8 moderate, and 0.8 and over are considered large.

Interobserver Agreement (IOA)

Two researchers conducted IOA during the article search process, variable coding, and data extraction phases for at least 20% of articles. The primary researcher calculated IOA via a trial-by-trial method during the initial literature database, title and abstract review, and full-text review (Cooper et al., 2007).

An agreement was counted if the results of the initial literature search of both researchers provided the same article(s) or both researchers retained the article in the title and abstract review or full-text review. Then the number of agreements was divided by the total number of agreements plus disagreements. The outcome was then multiplied by 100% (Cooper et al., 2007). A disagreement was counted if one researcher's initial literature database results provided an article that was not included in the other researcher's results or one researcher retained an article while the other researcher did not (Cooper et al., 2007). If there was a disagreement on an article, both of the researchers met to decide on a consensus on whether the article met inclusion criteria

The primary researcher calculated IOA for variable coding and data extraction using a mean count per interval IOA method. IOA was calculated for each variable by comparing the codes of each researcher. If the researchers both had the exact same codes, that variable had an IOA of 100%. If both researchers did not put the same code (e.g., one researcher put “2” while the other put “3”), IOA for that variable was 0%. If the researchers had some, but not all, of the same codes IOA for that variable was calculated.

For example, if one researcher put “2” while the other put “2;3”, they agreed on one of two codes. Therefore, IOA for that variable would be 50%. The values for each code were averaged for each participant. Similarly, IOA was calculated for each data point in data extraction by dividing the smaller value (i.e., extracted by one researcher) by the larger value (i.e., extracted by the other researcher). These values were then averaged and multiplied by 100% to provide an overall IOA value for data extraction (Cooper et al., 2007).

CHAPTER III RESULTS

The primary researcher identified 39 studies that included IISCA analyses. Twenty-nine studies published both SCA and treatment analyses, while nine studies published SCA analyses alone. Additionally, one article, Ward et al. (2021), published only treatment analyses; however, the SCA analyses for the participants in Ward et al. (2021) were published in a previous article, Warner et al. (2020). See Table A1 for study-level information, including the number of participants, average Tau and Tau-U scores for SCA and treatment analyses, and whether treatment analyses met WWC design standards (What Works Clearinghouse, 2020). The 39 studies were published between 2014 and 2022 published across 10 different peer-reviewed journals including Journal of Applied Behavior Analysis (n=17), Behavioral Intervention (n=6), Behavior Analysis in Practice (n=4), Education & Treatment of Children (n=2), Advances in Neurodevelopmental Disorder (n=1), Behavior Modification (n=1), Canadian Journal of School Psychology (n=1), Developmental Neurorehabilitation (n=1), European Journal of Behavior Analysis (n=1), and Journal of Autism and Developmental Disorder (n=1). Figure 2 demonstrates the cumulative frequency of articles published per year and indicates a steady increase in the number of articles published on the IISCA since 2017. Within those 39 studies, 235 participants completed 293 SCA and 111 treatment evaluations.

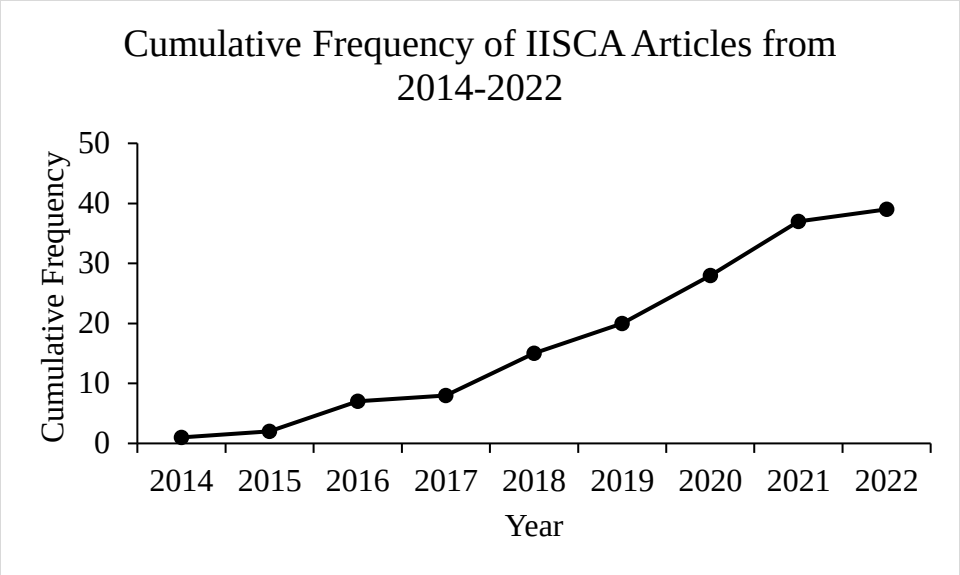


Figure 2. Cumulative Frequency of IISCA Articles from 2014 to 2022

Participant, Functional Analysis, and Treatment Characteristics

Participant Characteristics

Gender. Participant characteristic items are summarized in Table A2. Of the 235 participants, 189 (80.43%) were male, while 46 (19.57%) were female.

Ethnicity/Race. For participants' ethnicity/race, 22 (9.36%) participants were identified as White or Caucasian, eight (3.40%) were identified as Hispanic or Latino, three (1.28%) as Black or African-American, and three (1.28%) as Asian. In comparison, 201 (85.53%) of participants' ethnicities/races were not reported.

Age. The average age of participants was 7.2 years old, while the mode age was 4 (i.e., 40 participants). More specifically, 14 (5.96%) participants were 0-2 years old, 92 (39.15%) 3-5 years old, 76 (32.34%) 6-10 years old, 35 (14.89%) 11-14 years old, 10 (4.2%6) 15-19 years old, three (1.28%) 20-24 years old, and five (2.13%) 25 years old or older.

Verbal Abilities. For participant's verbal abilities, 35 (14.89%) of participants were non-verbal, 46 (19.57%) used one-word utterances, 46 (19.57%) used short-disfluent sentences, 73 (31.06%) had full-fluency, 10 (4.26%) used a Speech Generating Device, 11 (4.68%) used some form of picture exchange, three (1.28%) used Sign Language, and 17 (7.23%) of participant's verbal abilities were not specified (scale adopted from Jessel, Ingvarsson, Kirk, & Whipple, 2018).

Diagnoses. Of the 235 participants, 204 (86.81%) participants had at least one diagnosis, while 31 (13.19%) did not have a formal diagnosis or were identified as typically developing. 80 (34.04%) participants had more than one diagnosis. A total of 178 (75.74%) participants had a diagnosis of Autism Spectrum Disorder (i.e., Asperger's syndrome, Autism, ASD); 46 (19.57%) had a diagnosis of Intellectual Disability; and 38 (16.17%) with Attention-Deficit/Hyperactivity Disorder. Other diagnoses for participants included Generalized Anxiety Disorder (8, 3.40%), Pervasive Developmental Disorder-Not Otherwise Specified (4, 1.70%), Oppositional Defiant Disorder (4, 1.70%), Conduct Disorder (4, 1.70%), Destructive Behavior Disorder (3, 1.28%), Hydrocephalus (3, 1.28%), Down Syndrome (2, 0.85%), Global Developmental Delay (2, 0.85%), Fetal Alcohol Syndrome Disorder (2, 0.85%). Additionally, one individual each (0.43%) was diagnosed with Bipolar, Depression, DiGeorge Syndrome, Dyspraxia, Emotional Disturbance, Episodic Mood Disorder, Fragile X, Growth Hormone Deficiency, Intermittent Explosive Disorder, Klinefelter's Syndrome, Landau-Kleffner Syndrome, Marfan's Syndrome, Pica, Short-Bowel Syndrome, Tic Disorder, and Tourette's Syndrome.

Problem Behaviors. Problem behaviors exhibited by participants included aggression (193, 82.13%), disruption (103, 43.83%), property destruction (54, 22.98%), self-injurious behaviors (97, 41.28%), inappropriate vocalizations (78, 33.19%; including screaming, crying, yelling, cursing, etc.), tantrums (53, 22.55%), flopping/dropping (21, 8.94%), and eloping (22, 9.36%). Other problem behaviors (e.g., noncompliance, disrobing, inappropriate sexual behaviors, food refusal behaviors, transition refusal behaviors, and spitting) were exhibited by 24 participants (10.21%).

Functional Analysis Context

Functional analysis context items are summarized in Table A3. As four participants participated in two entirely independent functional analyses, including separate interviews and direct observations, there were 232 functional behavior assessments (i.e., functional analysis context combined with synthesized contingency analyses).

Interviews. Eighty-two (34.31%) of the interviews were conducted by one of the researchers or experimenters (i.e., qualifications not specified), 74 (30.96%) were conducted by a Board-Certified Behavior Analyst (i.e., BCBA), 47 (19.67%) by a behavior analyst or behavior therapist, and nine (3.77%) by a graduate student; however, for 27 (11.30%) participants, the interviewer was not specified. For the interviewee, 173 (72.38%) of participants had a caregiver interviewed (i.e., the specified caregiver was not specified), 36 (15.06%) had a parent interviewed, 21 (8.79%) had a teacher or other educational staff member, nine (3.77%) had their BCBA, and 11 (4.60%) had some other individual interviewed (e.g., therapist, grandmother, lifeguard, direct care staff, graduate student).

Direct Observations. The researchers conducted a direct (i.e., descriptive) observation before the synthesized contingency functional analysis with 192 (80.33%) participants, while no direct observation was conducted for 47 (19.67%) participants. Of those participants that had a direct observation, 105 (43.93%) of those were structured direct observations, 79 (33.05%) were unstructured observations, and eight (3.35%) were not specified as to whether they were structured or unstructured.

Synthesized Contingency Analysis

As many participants were included in multiple analyses, there were 293 SCA analyses completed across the 235 participants. SCA results are summarized in Table A4.

Settings. One hundred twenty (40.96%) of participants' analyses were conducted in an outpatient clinic, 94 (32.08%) were conducted in a university-based clinic, 45 (15.36%) in a school, 22 (7.51%) in the participant's home, six (2.05%) in a day habilitation center, two (0.68%) in a residential center, and four in some other setting (1.37; e.g., university-based preschool). Of those analyses conducted in a school, 41(13.99%) were conducted in a specialized school for children with disabilities or children with ASD. In comparison, only one (0.34%) was conducted in the participant's classroom in a public school and three (1.02%) were conducted in a separate room (e.g., meeting room) within the participant's public school (i.e., elementary or middle school).

Dependent Variable Measurement. For 277 (94.54%) participants, frequency or rate was used to measure the dependent variable, problem behavior, in the functional analysis. In comparison, latency was used with six (2.05%) participants, and partial interval recording was used with 10 (3.41%) participants.

Hypothesized Functions. All hypothesized functions were combined into one test condition for each participant's SCA. Two hundred thirty-eight (81.23%) of SCAs included an escape function, 170 (58.02%) included an attention function, 277 (94.54%) included a tangible function, 37 (12.63%) included mand or request compliance as a function. In comparison, 12 (4.10%) included some other function of behavior (e.g., divided attention, social avoidance, access to rituals).

Precursors. Precursor behaviors were included in the primary functional analysis for 46 (15.70%) analyses and a separate or second functional analysis for 28 (9.56%) SCAs. Precursors were also considered for an additional 29 (9.90%) analyses, but ultimately no precursors were identified to be included. On the other hand, 190 (64.85%) of analyses did not include or consider including precursors. For those studies that did include precursors, the precursors identified included yelling, screaming, making threats, growling, cursing, and body tensing.

IISCA Implementer. Two hundred thirty-one (78.84%) of analyses were conducted by a behavior analyst or behavior therapist, 42 (14.89%; credential not specified) by a BCBA, six (2.13%) by a participant's parent, four (1.42%) by the participant's tutor, one (0.35%) by the participant's teacher, one (0.35%) by a master's student in ABA and one (0.35%) did not have an implementer specified. Training for implementers was via behavioral skills training for three (1.02%) implementers, live coaching for one (0.34%) implementer, and 44 (15.02%) had received prior training on functional analyses, while training was not specified for 246 (83.96%) of implementers.

Session Length. Functional analysis sessions were 2 minutes long for three (1.02%) analyses, 62 SCA sessions (21.16%) were 3 minutes, 14 (4.78%) were 4

minutes, 133 (45.39%) were 5 minutes, two (0.68%) were 6 minutes, 20 (6.83%) were 10 minutes, one (0.34%) was 15 minutes or longer, and 25 (8.53%) were only identified as being between 3 and 10 minutes. Session length was not specified for 36 (12.29%) analyses.

Number of sessions. Six (2.05%) analyses had less than 5 sessions, 147 (50.17%) analyses had exactly 5 sessions, 49 (16.72%) had 6 sessions, 14 (4.78%) had 7 sessions, 11 (3.75%) had 8 sessions, seven (2.39%) had 9 sessions, 19 (6.48%) had 10 to 14 sessions, four (1.37%) had 15 to 19 sessions, and four (1.37%) had 20 to 24 sessions. However, for 31 (10.58%) analyses, the number of sessions was not specified.

Modifications. One hundred forty-one (48.12%) analyses did not need to be modified, while 152 (51.88%) had some modification. For those that included modifications, 106 (36.18%) SCAs had more than five sessions, six (2.05%) had less than five sessions, six (2.05%) analyses switched implementers or used more than one implementer, five (1.71%) changed the contingencies or functions included, four (1.37%) were modified for another reason, and seven (2.39%) were modified, but the modification was not specified. Whether or not a modification was used could not be determined for 28 (9.56%) analyses (e.g., graphs for the SCAs were not provided).

Control-Test-Control-Test-Test Sequence. One hundred ninety-six (66.89%) of analyses followed the control-test-control-test-test sequence developed by Hanley et al. (2014), while 60 (20.48%) of analyses did not follow the sequence. Thirty-seven (12.63%) analyses were not able to be analyzed as to whether they followed the sequence or not.

Analysis Differentiation. Two hundred and eighty (95.56%) of analyses reported their respective researchers as differentiated, while 13 (4.44%) were said not to be differentiated.

Interobserver agreement. Interobserver agreement (IOA) was reported for 292 (99.66%) of analyses, while it was not reported for one (0.34%) analysis. IOA was collected for 10-19% of sessions in 21 (7.19%) analyses, 20-29% of sessions in 94 (32.19%) analyses, 30-39% of sessions in 32 (10.96%) analyses, 40-49% of sessions in 60 (20.55%) analyses, 50-59% of sessions in eight (2.74%) analyses, 60-69% of sessions in 47 (16.10%) analyses, 70-79% of sessions in 23 (7.88%) analyses, and 100% of sessions in 7 (2.40%) analyses. The average IOA value for these studies was between 80 and 89% for 37 (12.67%) analyses, between 90 and 99% for 242 (82.88%) analyses, and 100% for 13 (4.34%) analyses.

Procedural Integrity. Procedural integrity for the SCA procedures was collected for 68 (23.29%) analyses, while it was not collected for 225 (77.05%) analyses. For all 68 (100%) of those analyses for which procedural integrity was collected, direct observation was used as the data collection method. Procedural integrity was collected in 20 to 29% of sessions for 1 (1.47%) analysis, 30 to 39% of sessions for 27 (39.71%) analyses, 40 to 49% of sessions for 34 (50.00%) analyses, and 80 and 89% of sessions for 3 (4.41%) analyses. The average value of procedural integrity was 90 to 99% for 41 (60.29%) analyses and 100% for 24 (35.29%) analyses. The percentage of sessions during which procedural integrity was collected and the average procedural integrity value were not reported for 3 (4.41%) analyses.

Treatment

Items related to the treatment analyses are summarized in Table A5. Out of the 232 participants, treatment was conducted for 107 (45.53%) participants, while no treatment was conducted for 128 (54.47%). Across these 107 participants, there were 111 treatment analyses, as some participated in more than one treatment analysis.

Intervention. Functional Communication Training (alone) was used for 34 (30.63%) participants who participated in treatment. In comparison, Functional Communication Training plus Delay and Denial Tolerance were used for 71 (63.96%) of participants, while some other intervention (i.e., token economy, differential reinforcement plus extinction, shaping) was used for 6 (5.41%) of participants.

Single-Case Design. 24 (21.62%) treatment analyses used a withdrawal, reversal, or pairwise design to test the treatment's effectiveness. In comparison, 27 (24.32%) of treatment analyses used a multiple baseline or multiple probe design, 4 (3.60%) used an alternating treatments design or multi-element design, and 57 (51.35%) used a changing criterion's design. The single-case design used for treatment was not reported for 1 (0.90%) analysis.

Implementer. Treatment was implemented by a behavior analyst or behavior therapist for 91 (81.98%) treatment analyses. Nine treatment analyses (8.11%) were implemented by a BCBA, 6 (5.41%) by the participant's parent, 3 (2.70%) by the participant's teacher, 3 (2.70%) by the participant's tutor, and 4 (3.60%) by a graduate student. The implementer was not reported for 1 (0.90%) analysis. Implementer training for 8 (7.21%) analyses utilized behavior skills training, four (3.60%) implementers received live coaching, and three (2.70%) implementers were reported to have prior

training conducting functional analyses. However, implementer training for 97 (87.39%) analyses was not reported.

Interobserver agreement. Interobserver agreement (IOA) was reported for all 111 (100.00%) treatment analyses. IOA was collected for 20 to 29% of sessions in 64 (57.66%) analyses, 30 to 39% of sessions in 23 (20.72%) analyses, 40 to 49% of sessions in 3 (2.70%) analyses, 50 to 59% of sessions in 6 (5.41%) analyses, 60 to 69% of sessions in 14 (12.61%) analyses, and 70 to 79% of sessions in one (0.90%) analysis. The value of IOA was between 80 and 89% for two (1.80%) analyses, 90 and 99% for 102 (91.89%) analyses, and 100% for seven (6.31%) analyses.

Treatment Integrity. Treatment integrity (TI) for the treatment analysis was collected for 40 (36.04%) treatments, while it was not collected for 71 (63.96%) treatments. For those 40 treatments in which treatment integrity was collected, direct observation was used as the data collection method for all 40 (100.00%) analyses. Treatment integrity was collected in 20 to 29% of sessions for 1 (2.50%) analysis, 30 to 39% of sessions for 7 (15.50%) analyses, 40 to 49% of sessions for 18 (45.00%) analyses, 50 to 59% of sessions for one (2.50%) analysis, 60 to 69% of sessions for two (5.00%) analyses, and 100% of sessions for eight (20.00%) analyses. The average value of procedural integrity was 90 to 99% for all 40 (100.00%) treatment analyses.

Methodological Quality Analysis

Methodological Quality results are summarized in Table A6. Overall, nine (8.11%) treatments met all four What Works Clearinghouse (WWC) research design standards without reservations, 45 (40.54%) met WWC standards with reservations, and 41 (36.94%) did not meet WWC standards. The primary researcher could not determine

if 16 (14.41%) treatment analyses met WWC design standards. However, all 111 (100.00%) treatments met the systematic manipulation design standard. Eighty-six (77.48%) of the treatments met the IOA design standard, while 25 (22.52%) did not meet this standard. One hundred five (94.59%) of the treatments met the attempts of intervention design standard, three (2.70%) did not, and three (2.70%) could not be determined. Eleven (9.91%) treatments met the phase length standard without reservations, 49 (44.14%) met with reservations, and 13 (11.71%) did not meet standards. Whether analyses met the phase length design standard could not be determined for 28 (34.23%) of treatment analyses.

Outcome Analysis

The primary researcher extracted X and Y coordinates from every SCA line graph and treatment graph published in the included studies. Unfortunately, participants' SCA analyses in Curtis et al. (2020) and treatment analyses in Gover (2020) were not displayed as line graphs, and therefore data could not be extracted for these participants. Likewise, SCA graphs for participants in some participants (n=22) in Jessel et al. (2021) were not published, and Sidwell et al. (2021) did not publish graphs for SCA analyses or treatment analyses for any participant. Additionally, Fiani & Jessel (2022); Jessel, Ingvarsson, Ghaemmaghami, & Metras (2018); Rajaraman, and Hanley, Grover, Ruppel, & Landa (2022) published treatment data for only some of the participants. Therefore, the primary researcher extracted data for 259 of the 293 SCA analyses and 73 of the 111 treatment analyses.

Tau-U

A summary of the outcome analyses for the SCA and treatment analyses are displayed in Figure 3 and Figure 4, respectively. Two hundred fifty-nine Tau-U coefficients were calculated for SCAs and ranged from -0.33 to 1.0. On the other hand, as many treatments were conducted with more than one baseline condition, 263 pairs of baseline and treatment conditions were able to be extracted from the treatment analyses. Therefore, 264 Tau-U coefficients were calculated for treatment analyses and ranged from -0.71 to 1.0. Average Tau-U coefficients per study were calculated and are displayed in Table A.1.

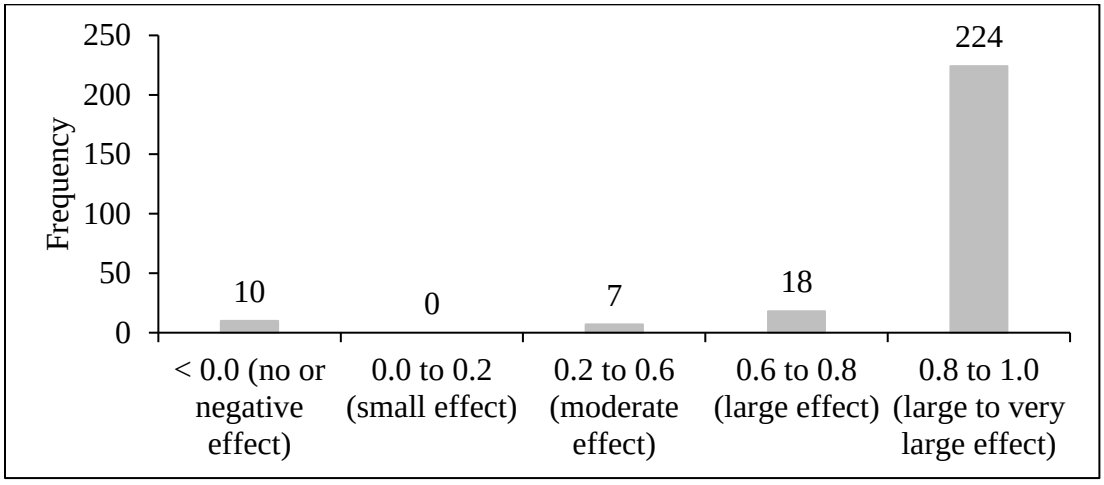


Figure 3. Summary of Tau-U Coefficients for Synthesized Contingency Analyses

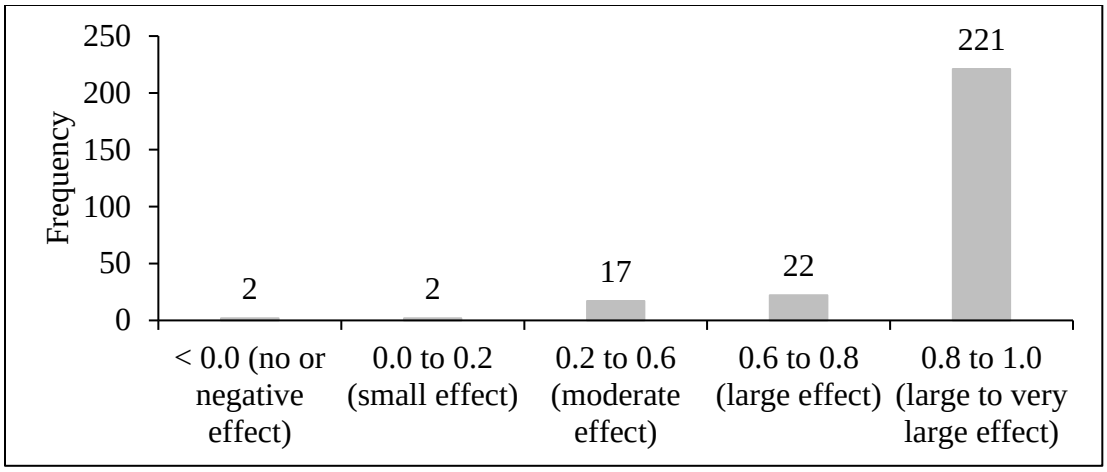


Figure 4. Summary of Tau-U Coefficients for Treatment Analyses

Hedge's g Effect Size

An omnibus Hedge's g coefficient was calculated for the SCAs and treatment analyses. The omnibus effect size using Hedge's g for the SCAs was 2.427, $p < .0001$, which is considered a large effect size. However, 12 of the 28 IISCA studies (i.e., Beaulieu et al., 2018; Boyle et al., 2019; Coffey, Shawler, Jessel, Bain et al., 2020; Dowdy & Tincani, 2020; Ferguson et al., 2020; Ghaemmaghami et al., 2015; Herman et al., 2018; Jessel, Ingvarsson, Metras, Kirk, & Whipple, 2018; Rose & Beaulieu, 2019; Santiago et al., 2016; Strand & Eldevik, 2016; Taylor et al., 2018) were excluded as they did not provide data for at least 3 participants. Additionally, 184 IISCA comparisons were not included in the Hedge's g calculation as their standard deviation for at one of the conditions (i.e., control or test) was zero (i.e., all data points in the condition were the same value).

The omnibus effect size for the treatment analyses was 2.007, $p < .0001$, which is also considered a large effect size. Similarly, 13 of 29 articles (i.e., Beaulieu et al., 2018; Boyle et al., 2019; Coffey, Shawler, Jessel, Bain et al., 2020; Dowdy & Tincani, 2020;

Ferguson et al., 2020; Fiani & Jessel, 2022; Ghaemmaghami et al., 2015; Herman et al., 2018; Rajaraman et al., 2022; Rose & Beaulieu, 2019; Santiago et al., 2016; Strand & Eldevik, 2016; Taylor et al., 2018) that conducted a treatment analysis were not included in the omnibus Hedge's g calculation for treatments analyses as they did not publish data for at least 3 participants. Furthermore, 32 treatment analyses were not included as one the condition's standard deviations was zero.

Interobserver Agreement (IOA)

Search Process

Two researchers conducted the initial literature database search to confirm the primary researcher's reliability of the initial literature database search. IOA was collected on whether the second researcher's search included the first 170 articles (i.e., out of 346; 49.13%) displayed in the primary researcher's search. All 170 articles were included in both researchers' database searches, resulting in 100% IOA for this step.

Two researchers independently conducted the title and abstract review for all 346 articles (i.e., 100% of articles) generated from the initial database literature search. Both researchers agreed on whether 199 articles passed (i.e. or did not pass) the screening criteria. However, for 7 articles, one researcher decided that the article passed the screening criteria, while the other did not. Therefore, IOA for this step was 96.60%.

Additionally, two researchers independently conducted the full-text review of the 63 articles (i.e., 20.63%; selected at random) identified via the database search (n=43), citation searches (n=17), and other sources (n=3). Researchers agreed on whether an article met inclusion criteria for 12 articles, while they disagreed on 1 article. For the one

disagreement, the two researchers met and decided to follow the primary researcher's decision to exclude the article. IOA for the full-text review averaged 92.31%.

Coding

Two researchers independently completed the variable coding for 8 of 39 articles (i.e., 20.51%). The primary researcher calculated IOA for variable coding using a mean count-per-interval method for each participant on each item coded. IOA was calculated for each variable and then averaged. IOA was 86.60% (range: 72.22%-94.44%) for the variable coding.

Outcomes Assessment-Data Extraction

Two researchers independently completed the raw data extraction for 10 of 37 articles (i.e., 27.03%) that had data extraction for SCA graphs, with seven articles out of 27 (i.e., 25.93%) including treatment analyses (i.e., 27.59%). IOA averaged 97.67% (range: 87.88-99.75%) for SCA graphs and 96.74% (range 89.55-99.65%) for treatment graphs.

CHAPTER IV DISCUSSION

The IISCA was developed by Hanley et al. (2014) and provides an efficient, standardized method to assess synthesized functions of behavior. Function-based interventions developed from the results of IISCA appear to lead to decreased levels of problem behavior. To date, thirty-nine studies have been published in which an IISCA was conducted. This included 29 studies that also implemented a function-based intervention developed from the results of an IISCA. The purpose of the current study was to systematically review the literature on the IISCA and its subsequent treatments and test the effectiveness of the IISCA to provide differentiated results and effective treatments across various participants, settings, and procedures.

Research Questions

Question 1: What are the demographics of participants included in IISCA research?

Based on the review conducted, participants included in IISCA research tended to be male (80.43% of participants) rather than female (19.57%). This proportion of male to female participants is fairly consistent with other functional analysis research. For example, Bruni et al. (2017)'s review on the effects of functional behavior analyses on school-based interventions found that 78.3% of their participants were identified as male while 21.7% were identified as female. Similarly, Lloyd et al. (2016) found that 80.7% of participants in their review of functional analyses conducted in public schools were male while 19.3% were female.

Additionally, for most participants (85.53%) in the current review, ethnicity/race was not reported. For participants with an ethnicity/race reported, most participants were White or Caucasian (n=22) compared to participants of color (i.e., Hispanic/Latino,

Black/African American, and Asian, n=14). Similarly, Severini et al. (2018) found that ethnicity/race was not reported for 64% of participants in their review on problem behavior interventions. Of those participants that had ethnicity/race reported, 45% were identified as Caucasian, 23% were identified as African American; 13% were identified as Hispanic, and 19% were identified as Asian/Indian/Middle Eastern.

This lack of participant ethnicity/race reporting is troubling as, an important facet of research evaluation is knowing not only what works, but who does the assessment or intervention work for and under what conditions. Future research must include better documentation of participant demographics so that researchers can better judge the external validity of findings.

Most participants also tended to be preschool or school-aged (i.e., between the ages of 3 and 10; 71.49%), with a smaller percentage being adolescent or teenager-aged (i.e., ages 11-19; 19.09%), and an even smaller percentage were adults (i.e., age 20 or older; 3.41%). Similarly, a small percentage of participants were infants or toddlers (i.e., between 0 and 2; 5.96%). Similarly, Beavers et al. (2013), combined with data from Hanley et al. (2003), found that 75.9% of participants were identified as children while 32.6% were identified as adults.

Verbal abilities were somewhat evenly distributed across the three vocal verbal levels (i.e., non-verbal, one-word utterances, and short-disfluent sentences; 14.89%, 19.57%, and 19.57%, respectively), while a larger percentage of participants were reported to be fully fluent (i.e., 31.06%). However, only a small percentage of participants (10.22%) were reported to use Alternative and Augmentative

Communication (AAC) systems, including speech-generating devices, picture exchange systems, and sign language.

Additionally, 87% of the participants had a mental, behavioral, physical, or cognitive disability, while 13% did not. Additionally, approximately 76% of participants had a diagnosis of Autism Spectrum Disorder. Many participants also had a diagnosis of Intellectual Disability (19.57%) or ADHD (16.17%). On the other hand, fewer participants were diagnosed with a behavioral disorder (5.11%; e.g., Oppositional Defiant Disorder, Conduct Disorder) or mood/anxiety disorders (4.68%; e.g., Generalized Anxiety Disorder, Depression, Bipolar). In contrast, the Beavers et al. (2013) review found that only 26.9% of participants were diagnosed with autism spectrum disorder, which is a significantly smaller percentage of participants when compared to the current review. Despite this, Beaver et al. (2013) did find a similar percentage of participants that did not have a diagnosed disability (13.6%). However, 57.8% of the participants in Bruni et al. (2017)'s review did not have a diagnosed disability.

Question 2: What elements of the original IISCA study (Hanley et al., 2014) are still being used in the IISCA literature, and what elements have been modified?

Metras and Jessel (2021) discussed many adaptations to the IISCA that have been made, including a latency-based IISCA, a trial-based IISCA, and a single-session IISCA. However, many studies continue to use the procedures designed by Hanley et al. (2014). Essential elements of the Hanley et al. (2014) IISCA included conducting their IISCAs in an outpatient clinic, having the researchers conduct an open-ended FAI with the participants' parents, and conducting an unstructured direct observation. Additionally, except where modifications were made for low levels of problem behavior, the

researchers in Hanley et al. (2014) had behavior therapists implement the IISCA procedures, collected data on levels of problem behavior measured the frequency of such behaviors, conducted five sessions following a Control-Test-Control-Test-Test sequence, and did not include precursor behaviors.

Surprisingly, an exact replication of the Hanley et al. (2014) procedures was not observed for any participant in the current review. Despite this, the elements described in Hanley et al. (2014) are still used by most studies. For example, 73.04% of IISCA analyses have been conducted in clinical settings (i.e., outpatient and university-based clinics), and 80.33% of participants participated in a direct observation. Additionally, 93.17% SCAs were implemented by behavior therapists or analysts (i.e., including BCBAs and BCBA-Ds), and 66.89% followed the Control-Test-Control-Test-Test sequence.

On the other hand, just over half (i.e., 51.88%) of the SCAs included a modification. For example, 36.18% of studies included more than five sessions, while 2.05% included less than five sessions. Additionally, 35.15% of SCAs included (or attempted to include) precursor behaviors in the SCA. Based on the information gathered, it is surprising that no studies to-date have completed an exact replica of the original Hanley et al. (2014) IISCA. Despite this, the majority of research is following at least some of the same IISCA procedures with at least half of identified studies making at least one modification.

Question 3: Does the IISCA produce differentiated results?

Previous reviews on functional analyses have reported that approximately 94% of functional analyses published in peer-reviewed journals, including synthesized functional

analyses, have produced differentiated results (Beavers et al., 2013; Slaton & Hanley, 2018). Using visual analysis methods (i.e., visually analyzing data based on the trend, level, and variability of data; Gast & Ledford, 2014), 95.56% (n=280) of IISCAs in the current study were reported to be differentiated. This indicates that the IISCA is equally, if not more, likely to produce differentiated results compared to functional analyses in general.

Similarly, results of the Tau-U calculations show that 93.44% of IISCAs included in the outcomes analysis produced large to very large effect sizes (i.e., Tau-U coefficients of 0.6 to 1.0). Conversely, 96.14% produced moderate to very large effect sizes (i.e., Tau-U coefficients of 0.2 to 1.0). Overall, the average Tau-U coefficient for the IISCA in the current study was 0.92, which represents a large to very large effect size. Results of the omnibus effect size calculation provided a Hedge's g of 2.428 which indicate a large effect size for the IISCA as a whole.

Question 4: What types of treatments and treatment components are being used in function-based interventions developed from the results of the IISCA?

Approximately half (i.e., 45.53%) of the participants included in the current review participated in a function-based intervention designed from the results of their respective IISCAs. Like Hanley et al. (2014), a large majority of studies (i.e., 94.59%) are reporting that they are using Functional Communication Training (FCT) or a variant of FCT like FCT+ Delay and Denial Tolerance (FCT+DDT). Similarly, McKenna et al. (2016), a review on function-based replacement behavior interventions in schools, found that 93.75% of their treatment analyses and 91.67% of the treatment analyses in Rispoli et al. (2014) included FCT. Despite the similarities with other reviews of school-based

functional assessment interventions and interventions designed from the results of trial-based functional analyses, it is possible that other interventions including other differential reinforcement procedures (e.g., differential reinforcement of other behaviors), schedules of reinforcement (e.g., chained schedules, multiple schedules), or antecedent-based interventions (e.g., noncontingent reinforcement) may be equally effective in reducing problem behavior following functional analyses.

Additionally, most of the interventions (i.e., 90.09%) were implemented by behavior analysts (i.e., including those identified as being behavior therapists, BCBAs, and BCBA-Ds). The other 9.01% of analyses were conducted by other individuals such as parents, teachers, and graduate students. In contrast, Gardner et al. (2012) found that 60.98% of participant's brief functional analyses were conducted by parents, 19.51% were conducted by teachers, 14.63% were conducted by inpatient clinical staff, and 4.88% were conducted by graduate students. Rispoli (2014) also found that 44.90% of trial-based functional analysis implementers were teachers or paraprofessionals, 20.41% were graduate students, 18.37% were house managers, 10.20% were therapists, and 6.12% were residential behavior staff. Therefore, compared to other functional analysis methods, it appears that a significantly higher percentage of IISCAs were implemented by therapists rather than natural change agents (e.g., parents, teachers, residential staff).

Question 5: Do function-based interventions developed from the results of IISCAs produce meaningful reductions in destructive problem behaviors?

Reductions in the levels of problem behavior were seen in all 111 treatment analyses, regardless of treatment modality, and identified functions of behaviors. On average, behavior was reduced by 97.04% (range 60.28%-100%) when the levels of

problem behavior in the last five treatment sessions were compared to baseline levels. Thirty-five (31.53%) treatment analyses showed a 100% reduction in problem behavior. Additionally, 92.02% of Tau-U coefficients were indicated in the large to very large effect size range (i.e., coefficients between 0.6 and 1.0), while 98.48% of coefficients were in the moderate to very large effect size range (i.e., 0.2 to 1.0). The overall average Tau-U coefficient for treatments developed from the results of IISCAs was .89, indicating a large effect size. Similar coefficients were seen with the omnibus Hedge's g of 2.007 which indicate a large effect size.

These results are similar to an average Tau-U score of 0.86 calculated by Walker et al. (2018) in their review of function-based interventions in schools. Additionally, effect size calculations completed by Slaton & Hanley (2018) in which the percentage of nonoverlapping data (PND) was 88.60%. Therefore, treatments developed from the results of IISCA are comparable to other function-based interventions such as synthesized treatments and function-based interventions in schools.

Questions 6: To what extent do function-based interventions developed from the results of IISCAs meet research design standards as defined by What Works Clearinghouse?

Only 8.11% of treatment analyses (n=9) met all four research design standards without reservations. 40.54% of the analyses met with reservations, while 36.94% (n=41) of analyses did not meet standards. For those analyses that did not meet design standards, over half of those did not meet the IOA design standard of having IOA collected for at least 20% of sessions in each condition. The systematic manipulation design standard was the only standard met by all 111 treatment analyses. Additionally, 94.59% of analyses also met the attempts of intervention effect design standard, which required at

least three attempts to show the intervention effect. However, only 54.05% of analyses met design standards (i.e., with or without reservations) for phase length by having at least 3 data points per condition (i.e., withdrawal, reversal, pairwise, changing criterion designs, multiple baseline, or multiple probe designs) or at least four repetitions of each condition (i.e., for alternating treatments or multi-element designs). The primary therapist could not determine whether 38 analyses met the phase length design standards due to the lack of published graphs for those analyses.

Additionally, one limitation of the IISCA itself is that it does not meet What Works Clearinghouse design standards as it is designed. The IISCA follows a multi-element design which requires 5 data points per phase to meet design standards without reservations and 3 data points per phase to meet design standards with reservations. The IISCA is designed to be implemented in five sessions, two control sessions, and 3 test sessions. Therefore, for the IISCA to meet design standards with reservations, it would need to include at least three control sessions and 3 test sessions, and 5 for each to meet design standards without reservations. Therefore, without modifications to the IISCA design, IISCA studies cannot meet all design standards.

Perhaps the most troubling finding in regard to the design standards evaluation is that findings from this study shine a light on the frequent failure of researchers testing IISCA to collect procedural integrity data during IISCA analyses and treatment integrity data during treatment analyses. In fact, just over 77% of IISCA analyses and nearly 64% of treatment analyses did not include procedural integrity or treatment integrity data, respectively. Nearly 30 years ago Gresham, Gansle, and Noell (1993) reported that only 16% of studies published in the *Journal of Applied Behavior Analysis* between 1980 and

1990 measured and reported accuracy of implementation of the independent variable. Follow-up reviews have found minimal improvement in the extent to which behavior analytic researchers provide empirical evidence for the extent to which the independent variable was implemented as planned (Falakfarsa et al., 2021; McIntyre, Gresham, DiGennaro, & Reed, 2007). Related, this study indicates that approximately 94% of IISCA studies did not report information pertaining to implementer training. As a result, researchers cannot be certain that IISCA analyses or treatments were implemented as intended because there are limited data objectively demonstrating implementation and no description of the rigor with which implementers were trained to implement procedures. In sum, these design flaws constitute monumental threats to the internal validity of IISCA studies. It would certainly behoove behavior analytic researchers to take up the call that Gresham et al. made nearly 30 years ago; that is, provide direct evidence of the extent to which the independent variable was implemented as planned.

Limitations

Several limitations were noted in the current study. First, many articles did not provide graphs for all of their participants' SCA and treatment analyses. Jessel et al. (2021) did not publish SCA graphs for 22 of 26 participants. Sidwell et al. (2021) did not publish SCA or treatment graphs for their 8 participants. Additionally, Fiani and Jessel (2022); Jessel, Ingvarsson, Metras, Kirk, and Whipple (2018); and Rajaraman, Hanley, Grover, Ruppel, and Landa (2022) did not publish treatment data for 10 of 11, 22 of 25, or 3 of 4, participants, respectively. Similarly, Curtis et al. (2020; n= 3) and Gover (2020; n=7) did not display participants' SCAs using line graphs. Because these articles failed to publish data, 18 and 43 SCA and treatment participants, respectively, could not have data

extracted to be included in their respective outcome analyses (i.e., Tau-U and Hedge's g coefficient calculations). Additionally, the primary researcher could not determine if these treatment analyses met What Works Clearinghouse designs as they could not assess how many data points were in each phase. Therefore, outcome analyses were only performed using data from 88.40% of IISCA analyses (i.e., 259 of 293) and 65.77% of treatment analyses (i.e., 73 of 111).

Furthermore, due to the assumptions needed to calculate an omnibus Hedge's g for the IISCA and treatments developed from the results of IISCAs, many additional articles and participants (i.e., in addition to participants that did not have their data displayed via a line graph, n= 18) were excluded from the Hedge's g analyses. For example, 12 of the 38 IISCA studies (31.58%) and 13 of the 29 treatment analysis studies (44.83%) were excluded as they did not provide data for at least 3 participants. Additional IISCA comparisons (n=184) and treatment comparisons (n=32) were also not included in their respective Hedge's g calculations as the standard deviation for at least one of the conditions was zero. Therefore, the omnibus Hedge's g effect sizes were calculated using only 91 of 293 (31.06%) IISCA condition comparisons and 22 of 73 (30.14%) treatment condition comparisons.

Future Directions

Future studies on the IISCA might consider continuing to expand the types of participants recruited, increase the ecological validity of the IISCA and its subsequent treatments, collect and report procedural and treatment integrity, and describe IISCA and treatment implementer training. As mentioned above, 75.74% of participants in the current review have a diagnosis of Autism Spectrum Disorder. Other developmental

disorders such as Intellectual Disabilities and ADHD are also common disorders seen among the participants of IISCA. Therefore, future studies on IISCA may consider recruiting participants without Autism or developmental disabilities. Instead, more research should be conducted on the IISCA and its effectiveness with the typically developing population (i.e., 13.19% of the current participant pool). They may also consider recruiting older participants (i.e., teenager-aged and adults), as 92.34% of IISCA participants have been below the age of 15.

Additionally, as 73.04% of SCAs have been conducted in a clinical setting (i.e., outpatient clinic or university-based clinic), future studies should seek to increase ecological validity by conducting more analyses in the participants' natural environments (i.e., home, school, and community settings). While 15.36% of SCAs have been conducted in a school setting, only one participant had their IISCA conducted in their non-specialized school classroom. All other school-based IISCA analyses were conducted in a specialized school (i.e., a school designed for children with autism) or in a separate room (e.g., a therapy room) within their school. Similarly, based on the studies included in the current review, only one teacher (i.e., 0.34% of implementers) and nine parents (3.07%) have implemented an IISCA. Therefore, future studies should consider using more natural change agents (i.e., individuals in the participant's natural environments) to implement the IISCAs to further extend the ecological validity of the assessment.

Furthermore, in the current review, 77.05% of IISCAs and 63.96% of treatment analyses did not report procedural integrity and treatment integrity data, respectively. Similarly, 83.96% of IISCAs and 87.39% of treatment analyses did not report how

implementers were trained on assessment and treatment components. An additional 15.02% of IISCAs and 2.70% of treatment analyses only reported that implementers had previous training in functional analysis or conducting function-based interventions. Therefore, future IISCA researchers should also make it a priority to collect and report procedural and treatment integrity data and report implementer training methods during IISCAs and treatment analyses.

APPENDIX A – Open-Ended Functional Assessment Interview

Appendix

Open-Ended Functional Assessment Interview

Date of Interview: _____

Child/Client: _____

Respondent: _____

Respondent's relation to child/client: _____

Interviewer: _____

RELEVANT BACKGROUND INFORMATION

1. **His/her date of birth and current age: ____-_____-_____ ____yrs ____mos**
   Male/Female
2. **Describe his/her language abilities.**
3. **Describe his/her play skills and preferred toys or leisure activities.**
4. **What else does he/she prefer?**

QUESTIONS TO INFORM THE DESIGN OF A FUNCTIONAL ANALYSIS

To develop objective definitions of observable problem behaviors:

5. **What are the problem behaviors? What do they look like?**

To determine which problem behavior(s) will be targeted in the functional analysis:

6. **What is the single-most concerning problem behavior?**
7. **What are the top 3 most concerning problem behaviors? Are there other behaviors of concern?**

To determine the precautions required when conducting the functional analysis:

8. **Describe the range of intensities of the problem behaviors and the extent to which he/she or others may be hurt or injured from the problem behavior.**

To assist in identifying precursors to dangerous problem behaviors that may be targeted in the functional analysis instead of more dangerous problem behaviors:

9. **Do the different types of problem behavior tend to occur in bursts or clusters and/or does any type of problem behavior typically precede another type of problem behavior (e.g., yelling preceding hitting)?**

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

10. **Under what conditions or situations are the problem behaviors most likely to occur?**
11. **Do the problem behaviors reliably occur during any particular activities?**
12. **What seems to trigger the problem behavior?**
13. **Does problem behavior occur when you break routines or interrupt activities? If so, describe.**
14. **Does the problem behavior occur when it appears that he/she won't get his/her way? If so, describe the things that the child often attempts to control.**

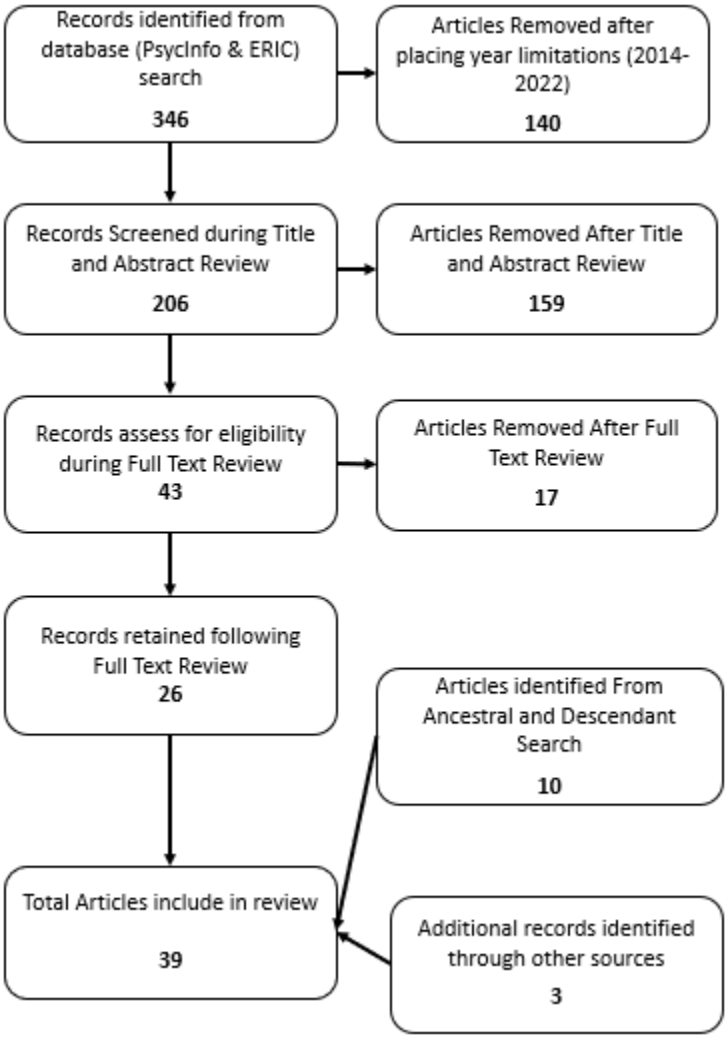
To determine the test condition(s) that should be conducted and the specific type(s) of consequences that may be incorporated into the test condition(s):

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

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

18. **What do you think he/she is trying to communicate with his/her problem behavior, if anything?**
19. **Do you think this problem behavior is a form of self stimulation? If so, what gives you that impression?**
20. **Why do you think he/she is engaging in the problem behavior?**

APPENDIX B Literature Search Process



APPENDIX C Article Coding Key

Category	**Description**
Author(s)	Last names only, in citation format (e.g. "Dart, Gresham, Ysseldyke, & Fagan, 2014)
Date of Publication	4-digit year
PARTICIPANT CHARACTERISTICS	
Enter for each participant	
Pseudo-name	Participant's pseudo-name as indicated in the study
Ethnicity/Race	1 – Black (non-Hispanic) 2 – Asian 3 – Hispanic 4 – Native American 5 – White 9 – Other (specify) 888 – Not specified
Gender	1 – Male 2 – Female 9 – Other 888- – Not specified
Age of Participant	Value (whole numbers only-round down) 888 – Not specified
Diagnosis of Participant	1 – ASD/Asperger's/Autism 2 – ID 3 – ADHD 4 – GAD (generalized anxiety disorder) 5 – PDD-NOS 6 – ODD 7 – CD 8 – Down Syndrome 9 – Other 10 – No diagnoses/Typically Developing 888 – Not specified
Verbal Abilities	1 –Nonverbal 2 –One-word utterances 3 –Short disfluent sentences 4 –Full fluency 5 –Speech generating device (SGD)/Talker 6 –Picture Exchange

	7 –Sign Language 9 –Other 888 – Not specified
Problem Behaviors	1 –Aggression 2 –Disruption 3 –Property Destruction 4 –Self-injurious behavior 5 –Inappropriate vocalizations (crying, whining, screaming, cursing, yelling, etc.) 6 –Tantrums/meltdowns 7 –Flopping/dropping to ground 8 –Eloping 9 –Other 888 – Not specified
FBA COMPONENTS-enter for each participant	
Interviewer	1 –Behavior Analyst/therapist 2 –BCBA/BCBA-D 3 –Graduate Student 4 –Teacher 5 –Tutor 6 –Experimenter/Researcher (level of expertise not specified) 9 –Other (specify) 888 – Not specified
Interviewee	1 –Caregiver 2 –Parent 3 –Therapist 4 –Teacher/other educational staff 5 –BCBA/BCBA-D 6 –Tutor 9 –Other (specify) 888 – Not specified
Direct Observation conducted?	0 –No 1 –Yes, structured 2 –Yes, unstructured 3 –Yes, not specified 888 – Not specified
IISCA Functional Analysis	
Setting	1 –Outpatient Clinic 2 –University-Based Clinic 3 –School, participant's classroom 4 –School, Separate meeting or therapy room 5 –School, Specialized

	6 –Participant's home 7 –Day habilitation center 8 –Residential Center 9 –Other (specify) 888 – Not specified
Measurement method for primary DV	1 –Frequency/Rate 2 –Duration 3 –Latency 4 –Discontinuous measurement 9 –Other (specify) 888 – Not specified
Session Length	Value 888–Not specified
Total Number of Sessions	Value 888–Not specified
Hypothesized synthesized function	1 –Escape 2 –Attention 3 –Tangible 4 –Automatic 5 –Mand/request compliance 9 – Other (specify) 888 – Not specified
Precursors consequated in the FA?	0–No 1 –Yes 2 – *[option removed]* 3 –Separate/second analysis 4 –Considered, but no precursors identified 9 – Other (specify) 888 – Not specified
IISCA implementer	1 –Behavior analyst/therapist 2 –BCBA/BCBA-D 3 –Parent 4 –Teacher 5 –Tutor 6 –Graduate student 9 – Other (specify) 888 – Not specified
Implementer Training	0 – No training 1 –Didactic (only) 2 –Behavioral Skills Training 3 –Live Coaching 4 –Prior Training 9 – Other (specify) 888 – Not specified

Reliability Data (IOA) Reported	0–No 1–Yes
IOA Percent of Cases (how many observations received IOA coding)	0- No IOA Value 888 – Not specified
IOA Value Reported	0- No IOA Value 888 – Not specified
Procedural Integrity Reported?	0–No 1–Yes
Procedural Integrity Method	0–No procedural integrity 1 –Direct Observation 2 –Permanent Product 3 –Self-Report 9 – Other (specify) 888 – Not specified
Procedural Integrity Percent of Sessions	0–No procedural integrity Value 888 – Not specified
Procedural Integrity Reported	0–No procedural integrity Value 888 – Not specified
Was the IISCA differentiated	0–No 1–Yes
Did the IISCA need to be modified during assessment? If so, why?	0–No 1 –Yes, switched implementer 2 –Yes, contingencies (function) 3 –Yes, additional sessions 4 –Yes, but reason not specified 5 –Yes, had less than 5 sessions 9 – Yes, other reason (specify) 888 – Not specified
Differentiation (visual analysis)	0–No 1–Yes
TREATMENT ***If no treatment, leave these blank***	
Intervention	1 –FCT 2 –FCT+DDT 3 –Token Economy 9 – Other (specify) 888 – Not specified
SCD	1 –Withdrawal/Reversal/Pairwise 2 –Multiple Baseline/Probe 3 –Alternating Treatments/Multi-element

	4 –Changing Criterion Design 5 –AB Design (only) 9 – Other (specify) 888 – Not specified
Treatment implementer	1 –Behavior analyst/therapist 2 –BCBA/BCBA-D 3 –Parent 4 –Teacher 5 –Tutor 6 –Graduate Student 9 – Other (specify) 888 – Not specified
Implementer Training	0– No training 1 –Didactic (only) 2 –Behavioral Skills Training 3 –Live coaching 4 –Prior Training 9 – Other (specify) 888 – Not specified
Reliability Data (IOA) Reported	0–No 1–Yes 888- Not specified
IOA Percent of Cases (how many observations received IOA coding)	0–No IOA/No treatment Value 888 – Not specified
IOA Value Reported	0–No IOA Value 888 – Not specified
Treatment Integrity (TI) Reported	0–No 1–Yes 888- Not specified
Treatment Integrity Method	0– No treatment integrity 1 –Direct observation 2 –Permanent product 3 –Self-Report 9 – Other (specify) 888 – Not specified
Treatment Integrity Percent of Sessions	0–No TI Value 888 – Not specified
Treatment Integrity Reported	0–No TI Value 888 – Not specified
STUDY QUALITY (What Works Clearinghouse, 2020)-for TREATMENT ONLY	

If no treatment, leave these blank		
Systematic Manipulation	IV systematically changed by experimenter	0–Does not Meet 1–Meets Standards
IOA	IOA should be collected for 20% of **EACH** condition	0–Does not Meet 1–Meets Standards
Attempts of Intervention Effect	Need 3 attempts: Examples include ABAB designs, multiple baseline designs with at least three baseline conditions, alternating/simultaneous treatment designs with either at least three alternating treatments compared to baseline or two treatments compared to each other. For CCD, need 3 different criteria	0–Does not Meet 1–Meets Standards 888=Not specified/unable to be determined
Phase Length	Phase Change (i.e., withdrawal/reversal/pairwise) & CCD Meets: 4 phases per case, 5 data points per case Meets w/ res: 4 phases per case 3 data points per case	0–Does not Meet 1–Meets Standards 2–Meets with Reservations 888=Not specified/unable to be determined
	Alternating/Multi-element: Meets: 5 repetitions Meets w/ res: 4 repetitions	0–Does not Meet 1–Meets Standards 2–Meets with Reservations 888=Not specified/unable to be determined
	Multiple baseline/probe: Meets: 5 data points per phase Meets w/ res: 3 data points per phase	0–Does not Meet 1–Meets Standards 2–Meets with Reservations 888=Not specified/unable to be determined
Overall	0= If any of the above have a 0 1= All above must have 1's 2= No 0's but at least one 2	0–Does not Meet 1–Meets Standards 2–Meets with Reservations 888=Not specified/unable to be determined

APPENDIX D Study-Level Information

Table A1. *Study Level Information Including Overall Treatment Quality and Outcome Analyses*

Article Citation	**Journal**	**Number of Participants**	**Treatment Meets WWC Standards?**	**Average Tau Value for IISCA**	**Average Tau-U Value for Treatment**
Anderson et al. (2019)	Advances in Neurodevelopmental Disorders	3	Meets Standards with Reservations	1.00	0.84
Beaulieu et al. (2018)	Behavior Analysis in Practice	1	Meets Standards with Reservations	1.00	0.43
Boyle et al. (2019)	Behavior Analysis in Practice	1	Does Not Meet Standards	1.00	1.00
Coffey et al. (2020)	Behavioral Interventions	2	Meets Standards with Reservations	1.00	1.00
Curtis et al. (2020)	Journal of Applied Behavior Analysis	3	N/A	N/A	N/A
Dowdy & Tincani (2019)	Journal of Applied Behavior Analysis	2	Meets Standards with Reservations	1.00	0.93
Ferguson et al. (2020)	Education & Treatment of Children	1	Meets Standards with Reservations	1.00	1.00
Fiani & Jessel (2022)	Journal of Applied Behavior Analysis	13	Meets Standards with Reservations	1.00	1.00
Fisher et al. (2016)	Education & Treatment of Children	5	N/A	0.81	N/A

Table A1 (continued).

Ghaemmaghami et al. (2016)	Journal of Applied Behavior Analysis	1	Meets Standards without Reservations	0.93	0.39
Ghaemmaghami et al. (2018)	Journal of Applied Behavior Analysis	3	Meets Standards with Reservations	1.00	0.76
Ghaemmaghami et al. (2015)	Behavioral Interventions	4	Meets Standards with Reservations	1.00	0.94
Gover (2020)	Dissertation	7	Meets Standards with Reservations	1.00	N/A
Graley (2019)	Thesis (University of Kentucky)	3	N/A	0.138	N/A
Greer et al. (2020)	Journal of Applied Behavior Analysis	12	N/A	0.54	N/A
Hanley et al. (2014)	Journal of Applied Behavior Analysis	3	Meets Standards with Reservations	0.89	0.80
Helvey & Van Camp (2021)	Journal of Applied Behavior Analysis	3	N/A	0.83	N/A
Herman et al. (2018)	Developmental Neurorehabilitation	1	Meets Standards without Reservations	1.00	0.78
Holehan (2021)	Dissertation	4	Does Not Meet Standards	0.92	0.99
Holehan et al. (2020)	Journal of Applied Behavior Analysis	5	Does Not Meet Standards	0.93	0.86
Jessel et al. (2016)	Journal of Applied Behavior Analysis	27	N/A	0.99	N/A

Table A1 (continued).

Jessel, Hanley, et al. (2018)	Behavioral Interventions	3	Does Not Meet Standards	1.00	1.00
Jessel, Ingvarsson, Metras, Kirk, & Whipple (2018)	Journal of Applied Behavior Analysis	25	Does Not Meet Standards	0.94	0.87
Jessel, Ingvarsson, Metras, Whipple, et al. (2018)	Behavioral Interventions	2	Meets Standards with Reservations	1.00	1.000
Jessel et al. (2020)	Journal of Applied Behavior Analysis	22	N/A	0.98	N/A
Jessel et al. (2021)	Behavior Modification	26	N/A	0.96	N/A
Landa et al. (2021)	Journal of Applied Behavior Analysis	4	Does Not Meet Standards	1.00	0.73
Lundy et al. (2021)	European Journal of Behavior Analysis	3	Meets Standards with Reservations	0.69	0.71
Metras (2021)	Dissertation	3	Does Not Meet Standards	1.00	1.00
Rajaraman et al. (2022)	Behavior Analysis in Practice	4	Does Not Meet Standards	1.00	1.00
Rajaraman et al. (2021)	Behavior Analysis in Practice	5	Does Not Meet Standards	1.00	1.00
Rose & Beaulieu (2019)	Journal of Applied Behavior Analysis	2	Meets Standards with Reservations	1.00	0.89
Santiago et al. (2016)	Journal of Autism and Developmental Disorders	2	Meets Standards with Reservations	1.00	1.00
Sidwell et al. (2021)	Canadian Journal of School Psychology	8	N/A	N/A	N/A

Table A1 (continued).

Slaton et al. (2017)	Journal of Applied Behavior Analysis	9	Meets Standards with Reservations	1.00	1.00
Strand & Eldevik (2017)	Behavioral Interventions	1	Meets Standards with Reservations	0.67	1.00
Taylor et al. (2018)	Behavioral Interventions	1	Meets Standards with Reservations	1.00	1.00
Ward et al. (2021)	Journal of Applied Behavior Analysis	3	Meets Standards with Reservations	N/A	1.00
Warner et al. (2020)	Journal of Applied Behavior Analysis	10	N/A	0.98	N/A

APPENDIX E –Summary of Variable Coding Results

Table A2. *Participant Characteristics*

Category	**Number**	**Percentage**
Gender [a]		
Male	189	80.43%
Female	46	19.57%
Ethnicity/Race *[a]		
Black/African-American	3	1.28%
Asian	3	1.28%
Hispanic	8	3.40%
White	22	9.36%
Not Specified	201	85.53%
Age [a]		
0-2	14	5.96%
3-5	92	39.15%
6-10	76	32.34%
11-14	35	14.89%
15-19	10	4.26%
20-24	3	1.28%
25+	5	2.13%
Verbal Abilities *[a]		
Nonverbal	35	14.89%
One-word utterances	46	19.57%
Short-disfluent sentences	46	19.57%
Full fluency	73	31.06%
AAC/SGD	10	4.26%
Picture Exchange	11	4.68%
Sign Language	3	1.28%
Not specified	17	7.23%
Diagnosis *[a]		
Autism Spectrum Disorder	178	75.74%
Intellectual Disability	46	19.57%
ADHD	38	16.17%
Generalized Anxiety Disorder	8	3.40%
PDD-NOS	4	1.70%
Oppositional Defiant Disorder	4	1.70%
Conduct Disorder	4	1.70%
Down Syndrome	2	0.85%
No Diagnoses	31	13.19%
Other Diagnosis	22	9.36%

Table A2 (continued).

Problem Behaviors *[a]		
Aggression	193	82.13%
Disruption	103	43.83%
Property Destruction	54	22.98%
Self-injurious Behavior	97	41.28%
Inappropriate Vocalizations	78	33.19%
Tantrums	53	22.55%
Flopping/Dropping	21	8.94%
Eloping	22	9.36%
Other	24	10.21%

Note: *=some participants were counted in more than one category; [a]= out of 235 total participants

Table A3. *Functional Analysis Context*

Interviewer [b]		
Behavior analyst/therapist	47	19.67%
BCBA/BCBA-D	74	30.96%
Graduate Student	9	3.77%
Experimenter/Researcher	82	34.31%
Not specified	27	11.30%
Interviewee *[b]		
Caregiver	173	72.38%
Parent	36	15.06%
Therapist	21	8.79%
Teacher/Other Educational Staff	9	3.77%
BCBA/BCBA-D	11	4.60%
Other	173	72.38%
Direct Observation [b]		
No	47	19.67%
Yes, structured	105	43.93%
Yes, unstructured	79	33.05%
Yes, not specified	8	3.35%

Note: *=some participants were counted in more than one category; [b]=out of 232 FBAs (four participants had two completely independent FBAs conducted)

Table A4. *Synthesized Contingency Analysis Results*

Category	Number	Percentage
SCA Setting [c]		
Outpatient Clinic	120	40.96%
University-Based Clinic	94	32.08%
School (Classroom)	1	0.34%
School (Separate Room)	3	1.02%
Specialized School	41	13.99%
Home	22	7.51%
Day Habilitation Center	6	2.05%
Residential Center	2	0.68%
Other	4	1.37%
Dependent Variable Measurement [c]		
Frequency/Rate	277	94.54%
Latency	6	2.05%
Discontinuous Method	10	3.41%
Hypothesized Functions *[c]		
Escape	238	81.23%
Attention	170	58.02%
Tangible	277	94.54%
Mand/Request Compliance	37	12.63%
Other	12	4.10%
Precursor Behavior Included [c]		
No	190	64.85%
Yes	46	15.70%
Separate/second analysis	28	9.56%
Considered, but none ident.	29	9.90%
SCA Implementer *[c]		
Behavior Analyst/therapist	231	78.84%
BCBA/BCBA-D	42	14.33%
Parent	9	3.07%
Teachers	1	0.34%
Tutor	4	1.37%
Graduate Student	8	2.73%
Other	1	0.34%
Not specified	1	0.34%
SCA Implementer Training *[c]		
Behavioral Skills Training	3	1.02%
Live coaching	1	0.34%
Prior Training	44	15.02%
Not specified	246	83.96%

Table A4 (continued).

SCA Session Length *[c]		
2 mins	3	1.02%
3 mins	62	21.16%
4 mins	14	4.78%
5 mins	133	45.39%
6 mins	2	0.68%
10 mins	20	6.83%
15+ mins	1	0.34%
Not Specified	36	12.29%
Other	25	8.53%
Number of Sessions in SCA [c]		
>5	6	2.05%
5	147	50.17%
6	49	16.72%
7	14	4.78%
8	11	3.75%
9	7	2.39%
10-14	19	6.48%
15-19	5	1.71%
20-24	4	1.37%
Not Specified	31	10.58%
Modifications to the SCA *[c]		
No	141	48.12%
Yes, switched implementers	6	2.05%
Yes, contingencies	5	1.71%
Yes, additional sessions (i.e., more than 5)	106	36.18%
Yes, less than 5 sessions	6	2.05%
Yes, not specified	7	2.39%
Yes, other reason	4	1.37%
Not Able to be Determined	28	9.56%
CTCTT Sequence [c]		
Yes	196	66.89%
No	60	20.48%
Not Able to be Determined	37	12.63%
SCA Differentiated? [c]		
No	13	4.44%
Yes	280	95.56%
Interobserver Agreement (IOA) for SCA Reported? [c]		
Yes	292	99.66%
No	1	0.34%

Table A4 (continued).

Percentage of Sessions with IOA [d]		
10-19%	21	7.19%
20-29%	94	32.19%
30-39%	32	10.96%
40-49%	60	20.55%
50-59%	8	2.74%
60-69%	47	16.10%
70-79%	23	7.88%
100%	7	2.40%
Average IOA Value [d]		
80-89%	37	12.67%
90-99%	242	82.88%
100%	13	4.45%
Procedural Integrity for the SCA Reported? [c]		
Yes	68	23.29%
No	225	77.05%
Method of Data Collection for Procedural Integrity [e]		
Direct Observation	68	100%
Percentage of Sessions with Procedural Integrity [e]		
20-29%	1	1.47%
30-39%	27	39.71%
40-49%	34	50.00%
80-89%	3	4.41%
Not Specified	3	4.41%
Average Procedural Integrity Value [e]		
90-99%	41	60.29%
100%	24	35.29%
Not Specified	3	4.41%

Note: *=some SCA analyses were counted in more than one category; [c]= out of 293 total SCA analyses conducted; [d]= out of the 292 SCA analyses that reported IOA; [e]= out of the 68 SCA analyses that reported procedural integrity

Table A5. *Treatment Results*

Category	**Number**	**Percentage**
Treatment Conducted? [a]		
Yes	107	45.53%
No	128	54.47%
Type of Intervention Used [f]		
Functional Communication Training	34	30.63%
Functional Communication Training + Delay and Denial Tolerance	71	63.96%
Other	6	5.41%
Single Case Design Used *[f]		
Withdrawal/ Reversal/Pairwise	24	21.62%
Multiple Baseline/ Multiple Probe	27	24.32%
Alternating Treatments/ Multielement	4	3.60%
Changing Criterion	57	51.35%
Not Specified	1	0.90%
Treatment Implementer *[f]		
Behavior Analyst/ Behavior Therapist	91	81.98%
BCBA	9	8.11%
Parent	6	5.41%
Teacher	3	2.70%
Tutor	3	2.70%
Graduate Student	4	3.60%
Not Specified	1	0.90%
Treatment Implementer Training *[f]		
Behavioral Skills Training	8	7.21%
Live Coaching	4	3.60%
Prior Training	3	2.70%
Not Specified	97	87.39%
Interobserver Agreement (IOA) Reported? [f]		
Yes	111	100.00%
No	0	0.00%
Percentage of Sessions with IOA [g]		
20-29%	64	57.66%
30-39%	23	20.72%
40-49%	3	2.70%
50-59%	6	5.41%
60-69%	14	12.61%
70-79%	1	0.90%
Average IOA Value [g]		
80-89%	2	1.80%
90-99%	102	91.89%
100%	7	6.31%

Table A5 (continued).

Treatment Integrity Reported? [f]		
Yes	40	36.04%
No	71	63.96%
Method of Data Collection for Treatment Integrity [h]		
Direct Observation	40	100.00%
Percentage of Sessions with Treatment Integrity [h]		
20-29%	1	2.50%
30-39%	7	17.50%
40-49%	18	45.00%
50-59%	1	2.50%
60-69%	2	5.00%
100%	8	20.00%
Not Specified	3	7.50%
Average Treatment Integrity Value [h]		
90-99%	34	85.00%
100%	3	7.50%
Not Specified	3	7.50%

Note: *= some treatment analyses were counted in more than one category; [a]= out of 235 total participants; [f]= out of the 111 treatment analyses; [g]= out of the 111 treatment analyses that reported IOA; [h]= out of the 40 treatment analyses that reported TI

Table A6. *Methodological Quality Results*

Category	**Number**	**Percentage**
Systematic Manipulation [f]		
Meets	111	100.00%
Does Not Meet	0	0.00%
Interobserver Agreement [f]		
Meets	86	77.48%
Does Not Meet	25	22.52%
Attempts of Intervention [f]		
Meets	105	94.59%
Does Not Meet	3	2.70%
Could not be determined	3	2.70%
Phase Length [f]		
Meets (without reservations)	11	9.91%
Meets with Reservations	49	44.14%
Does Not Meet	13	11.71%
Could not be determined	38	34.23%
Overall Study Quality [f]		
Meets (without reservations)	9	8.11%
Meets with Reservations	45	40.54%
Does Not Meet	41	36.94%
Could not be determined	16	14.41%

Note: [f]= out of the 111 treatment analyses

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