Received: 26 April 2018 | Revised: 4 October 2018 | Accepted: 14 October 2018

DOI: 10.1002/bin.1650

RESEARCH ARTICLE

WILEY

An evaluation of the single-session interview-informed synthesized contingency analysis

Joshua Jessel[1] | Gregory P. Hanley[2] | Mahshid Ghaemmaghami[3] | Rachel Metras[2]

[1] Psychology Department Queens College, Queens, New York, USA

[2] Department of Psychology Western New England University Springfield, Massachusetts, USA

[3] Department of Psychology University of the Pacific Stockton, California, USA

Correspondence
Joshua Jessel, Queens College, 65-30 Kissena Boulevard, Flushing, NY 11367.
Email: joshua.jessel@qc.cuny.edu

Functional analysis can often be a lengthy process requiring time and resources not readily available to practitioners working with children who exhibit severe problem behavior. The interview-informed synthesized contingency analysis (IISCA) was recently developed as an alternative functional analysis format that improved analytic efficiency by requiring only 25 min to conduct. Furthermore, a within-session analysis of the first test session of the entire IISCA could reduce the process to as little as a single 5-min session. We extended this previous research by conducting what was termed the *single-session IISCA* with three boys who exhibited severe problem behavior. A function-based treatment package, including reinforcement thinning, informed by the results of the single-session IISCA nearly eliminated problem behavior for all three participants. We suggest that the single-session IISCA could be a viable alternative to other functional analysis formats when time is limited.

KEYWORDS

functional analysis, interview-informed synthesized contingency analysis, problem behavior, reinforcement thinning, single test session

1 | AN EVALUATION OF THE SINGLE-SESSION INTERVIEW-INFORMED SYNTHESIZED CONTINGENCY ANALYSIS

Functional analysis is a tool used by clinicians to empirically demonstrate control over problem behavior via suspected environmental factors. Its results then inform subsequent function-based treatment recommendations. Iwata, Dorsey, Slifer, Bauman, & Richman (1982/1994) designed one of the most replicated formats of functional analysis to determine the sensitivity of the self-injurious behavior (SIB) of nine individuals to common environmental

events. This *standard* format arranges for environmental events to be presented in isolated conditions creating an analysis of, typically, three test conditions (i.e., attention, escape, and alone) compared with a single play control. The functional analyses from the Iwata et al. study were conducted in an inpatient hospital across an average of 8 days, requiring around thirty 15-min sessions to complete. It may only be viable to conduct this functional analysis in settings that allow for a lengthy assessment process.

In a review of 277 publications spanning 40 years of research, Hanley, Iwata, and McCord (2003) found that nearly half of the functional analyses are conducted in different settings where resources and time may be of a general concern (e.g., schools, home, outpatient clinics, and vocational programs). In a more recent update, Beavers, Iwata, and Lerman (2013) found a staggering 87% increase in published functional analyses in these clinically driven locations. Although functional analysis *research* in these clinically-driven locations have expanded, the same cannot be said about its use with practitioners, a large proportion of whom reported avoiding the use of functional analyses because of time constraints (Oliver, Pratt, & Normand, 2015; Roscoe, Phillips, Kelly, Farber, & Dube, 2015). It may be beneficial then to provide clinicians with more efficient functional analysis formats.

Northup et al. (1991) found that the standard format could be made more efficient by reducing the number of sessions conducted. The intended goal was to condense the assessment process into a 90-min outpatient visit for three individuals with intellectual disabilities who exhibited severe problem behavior. The brief format included the same isolated test conditions from the standard format and was able to identify likely environmental variables influencing the participants' problem behavior in one fifth of the time of the average analysis duration reported in the Iwata et al. (1982/1994) study.

Unfortunately, these improvements in assessment brevity may have come at the cost of accuracy in identifying influencing events. Kahng and Iwata (1999) compared with the interpretations from the first test sessions—analogous to the brief format—with the entire data set of 50 different standard functional analyses. They found that the results of the brief format did not correspond with the full standard format 34% of the time. Within-session analyses of minute-to-minute periods in the single sessions during the brief format, did slightly improve correspondence with the standard format; however, the limitation of reduced accuracy still remains a concern.

Analysis clarity may be improved during within-session analyses if problem behavior is evaluated in relation to the fluctuations of programed establishing (EO) and abolishing (AO) operations during the session. For example, Roane, Lerman, Kelley, and Van Camp, (1999) used within-session analyses of problem behavior when the reinforcers were present AO and absent EO to improve the interpretability of the standard functional analyses of five individuals with intellectual disabilities. Problem behavior that was more likely to occur during the reinforcer-absent periods provided within-session support of the functional relation implicated by the results aggregated into sessions.

Although Roane et al. (1999) intended for the within-session analysis to be conducted as supplementary to the standard functional analysis, it is possible to abbreviate the analysis procedures to a within-session analysis of problem behavior exhibited during the programed EOs and AOs of a single test session. Jessel, Hanley, and Ghaemmaghami (2016) reanalyzed the first test session of 10 functional analyses to determine the relative rates of responding when problem behavior should be evoked and abated during a session. Figure 1 depicts this within-session analysis using hypothetical data. Problem behavior per min is presented in the full functional analysis in the top panel. Problem behavior per second in the within-session analysis of the first test session in the bottom panel is calculated for each interval in which the reinforcer is absent (reinforcer-absent interval [RAI]) and present (reinforcer-present interval [RPI]). Control over problem behavior is obtained when higher rates are observed during the RAIs in comparison with the RPIs.

The above format was termed the single-test, or single-session, interview-informed synthesized contingency analysis (single-session IISCA) because it was conducted using a single test session from the full IISCA format developed by Hanley, Jin, Vanselow, & Hanratty, (2014). The IISCA format usually tests for problem behavior sensitivity to multiple and simultaneously presented contingencies in a single condition that are informed by an open-ended interview and compared rates of problem behavior in this test condition to a matched control in a multi-element design. The utility of the full IISCA was initially evaluated in the design of a treatment package for the severe problem

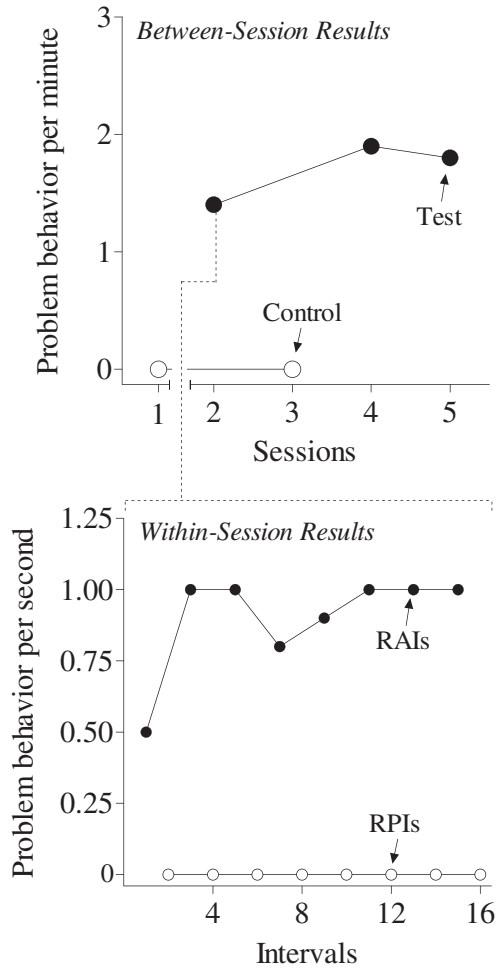

FIGURE 1 Hypothetical example of the within-session analysis of reinforcer-absent intervals (RAIs) and reinforcer-present intervals (RPIs) during the first test session (bottom panel) of a full functional analysis (top panel)

behavior of three children diagnosed with autism. The treatment was separated into multiple phases. The first phase involved functional communication training (FCT; Carr & Durand, 1985) in which the participants were taught different functional communication responses (FCRs) of increasing complexity. Tolerance responses to denials were then taught using the maintaining reinforcer. Compliance with instructions and independent play were then shaped and communication and tolerance responses were maintained via intermittent and unpredictable reinforcement of all adaptive responses. Finally, the caregivers were trained to implement the procedures and asked to rate the treatment package in terms of helpfulness, appropriateness, and meaningfulness of behavior change (i.e., social validity). The results of the entire assessment and treatment process yielded a comprehensive and socially validated treatment that nearly eliminated problem behavior for all participants.

Although treatments informed by the IISCA have been replicated and validated in similar studies (Ghaemmaghami, Hanley, & Jessel, 2016; Ghaemmaghami, Hanley, Jin, & Vanselow, 2016; Jessel, Ingvarsson, Metras, Whipple, Kirk, & Solsbery, 2018; Jessel, Ingvarsson, Kirk, Whipple, & Metras, 2018; Santiago, Hanley, Moore, & Jin, 2016), across multiple research groups (Chusid & Beaulieu, in press; Herman, Healy, & Lydon, 2018; Strand & Eldevik, 2017), and large-scale consecutive controlled case studies (Jessel, Ingvarsson, Kirk, et al., 2018; Slaton, Hanley, & Raftery, 2017), the single-session IISCA has only been suggested as a possible option during the reanalysis of the full

IISCA format (Jessel et al., 2016). We conducted this study to determine if the single session IISCA could inform the effective function-based treatment of three children who exhibit severe problem behavior.

2 | METHOD

2.1 | Participants and setting

Three boys admitted to an outpatient clinic for their severe problem behavior participated in this study. Aaron was a typically-developing 5-year-old boy who could speak in full sentences. Sessions were conducted at a university-based clinic in a 3 × 3 m room with a one-way mirror. Aaron was admitted because of problem behavior reported by his foster family including screaming and yelling, throwing objects, elopement, and hitting others. The assessment and treatment process for Aaron required four 1-hr visits conducted in a two-week period.

Liam was a 4-year-old boy diagnosed with autism and unspecified disturbance of conduct. Liam could speak in one to two word utterances; however, he typically refused to speak and any form of communication was likely a negation of an imitated word. For example, if the therapist asked Liam to put his hands up he would say, "No. Hands down." Sessions were conducted in an outpatient clinic in a 6 × 3 m room. Liam was admitted because of problem behavior reported by his mother including screaming, kicking others, and scratching self and others. Liam's sessions were conducted during a 2.5-hr period in the morning and in the afternoon (5 hr a day total) for five consecutive days in a single week.

Graham was a typically developing 4-year-old boy who could speak in full sentences. Sessions for Graham were conducted at a university-based clinic in a 3 × 3 m room with a one-way mirror. Graham was admitted because of the reports by his mother and father of aggressive and destructive tantrums (e.g., hitting parents, kicking doors, and walls) that seemed unresponsive to their treatment efforts (e.g., time out). Graham's sessions were conducted during 1-hr visits three times a week for the first week of treatment. For the next 6 weeks of treatment, Graham's sessions were moved to two visits a week (a 1-hr visit and a 2-hr visit) to better accommodate his family's work and school schedules.

2.2 | Measurement

Problem behavior for Aaron was recorded as any instance of loud vocalizations (e.g., swearing, screaming, and yelling), aggression (e.g., hitting, kicking, or scratching others), disruption (e.g., throwing, tearing, or swiping objects), and elopement. Elopement was defined as any attempts or successfully moving more than an arm's length away from the therapist without their consent. Liam's problem behavior included loud vocalizations, aggression, SIB (e.g., hitting or scratching self), and dropping his body to the floor. Graham's problem behavior included dropping his body to the floor, screaming, crying, and property destruction (e.g., throwing or swiping objects and kicking or hitting walls and furniture), and aggression (e.g., scratching, hitting, kicking, and grabbing and pulling on the clothing of others). Problem behavior was counted and converted to a rate. During the single-session IISCA, the total instances of problem behavior within a specified interval (RAI or RPI) was divided by the duration of the interval to calculate a rate of responses per second (RPS). During the treatment evaluation, the total instances of problem behavior within a session was divided by the duration of the session to calculate a rate of responses per min (RPM).

Appropriate communication was categorized into two (Liam and Graham) or three (Aaron) different complexities of FCRs and a tolerance response. The simple FCR was the initial complexity and was "My way" for both Aaron and Liam. The simple FCR for Graham was "More time, please." The complex FCR was the terminal complexity for Liam and Graham. Liam's complex FCR was recorded as any instance of Liam saying, "My way, please" with appropriate tone and orientation towards the listener. For Graham, the complex FCR was recorded as any instance of Graham saying, "May I please have more time?" with appropriate tone and orientation toward the listener. There were two variations of the complex FCR for Aaron. Complex FCR1 involved Aaron saying, "May I have my way please?" Aaron's

terminal complexity, complex FCR2, involved Aaron first saying, "Excuse me," then waiting for the therapist's reply before continuing with "May I have my way please?" with appropriate tone and orientation towards the listener. The tolerance response was an appropriate form of acceptance of denials of reinforcement (e.g., "not right now") following an FCR. The tolerance response for Liam was looking at the therapist and saying "okay." The tolerance response for Graham included looking at the therapist and saying, "okay," while placing his hands in his lap (if seated) or at his sides (if standing). The tolerance response for Aaron was placing his hands together and saying "Okay, no problem." Appropriate communication was measured as a rate by dividing the number of responses by the duration of the session.

During the single-session IISCA, the RPI was measured by recording the duration the reinforcers were in the participants' presence. The RPI durations were programed at 60 s for Aaron and 30 s for Liam and Graham. Aaron's programed delivery was longer because his interactive games often required some setup time. The RAI was measured once the reinforcers were removed. This duration could vary depending on the occurrence of problem behavior. Tasks were included in both participants' treatment evaluations. Compliance was scored if the participant emitted the specified response within 10 s of the first or second instruction during the three-step instruction sequence (i.e., verbal, model, and full physical). Percentage of compliance for each session was calculated by dividing the number of times the participant complied with an instruction by the number of instructions provided.

2.3 | Interobserver agreement

The entire session of the single-session IISCA and at least 30% of sessions during the treatment evaluation were video recorded for each participant with at least one session from each phase included. A secondary observer independently scored the videotaped sessions. During the single-session IISCA, interobserver agreement (IOA) for problem behavior was calculated by dividing the larger count by the smaller count during each RPI and RAI. An agreement for RPI and RAI duration was counted if the interval duration scored by each observer was within 5 s of each other. The 5 s window was used because it often took the therapist 3 to 5 s to deliver the synthesized reinforcement. A disagreement was scored if the interval difference was larger than 5 s. The number of agreements was then divided by the total number of intervals to calculate the IOA for RPI and RAI intervals. During the treatment evaluation, IOA for problem behavior and appropriate communication was calculated by dividing the larger count by the smaller count within 10-s intervals for each session. IOA for task compliance was calculated by dividing the larger percentage by the smaller percentage for each session. We used a total count agreement during the treatment evaluation due to clinical constraints of training therapists on more conservative IOA measures.

IOA for problem behavior during the single-session IISCA was 100% for all three participants. In addition, IOA for RPI and RAI duration for all three participants was also 100%. IOA was assessed during 37% of treatment evaluation sessions with Aaron. The mean IOA for problem behavior, appropriate communication, and task compliance for Aaron was 100%, 100%, and 93% (86–100%), respectively. IOA was assessed during 35% of sessions with Liam. The mean IOA for problem behavior, appropriate communication, and task compliance for Liam was 100%, 97% (94–100%), and 100%, respectively. IOA was assessed during 33% of treatment evaluation sessions with Graham. The mean IOA for problem behavior, appropriate communication, and task compliance for Graham were 99.9% (range 99.2–100%), 94.6% (range 80.65–100%), and 100% respectively.

2.4 | Experimental design

The RPI and RAIs from the single-session IISCA were rapidly alternated with the presentation and removal of the reinforcers. Response rates (i.e., problem behavior per second) were compared across intervals, and functional control was determined if higher rates of problem behavior were observed during the RAIs in comparison with the RPIs. After the reinforcers were identified in the single-session IISCA, the reinforcement contingency was evaluated in a

stepwise fashion across multiple behaviors during the treatment evaluation. Following stable response rates during the reinforcement of a target response, the effect of the contingency was replicated with the subsequent target response. This meant that, following problem behavior, the effects were replicated across four responses (i.e., simple FCR, complex FCR1, complex FCR2, and tolerance response) for Aaron and three responses (i.e., simple FCR, complex FCR, and tolerance response) for Liam and Graham. In addition, Graham's treatment evaluation included reversals to the baseline condition following each phase of FCT (i.e., simple FCR phase and complex FCR phase).

2.5 | Procedure

2.5.1 | Interview and Observation

An open-ended interview (Hanley, 2012) was conducted with the caregivers of all participants. The interview lasted 20 to 30 min and included questions regarding possible antecedents and consequences relevant to problem behavior as well as specifics about the topography of problem behavior to be targeted. Aaron's caregiver reported that it was difficult to discontinue interactive play and to transition to parent-directed activities or tasks. Any attempt to provide instructions unrelated to play was reported to result in a tantrum and throwing the items before running away. In order to mitigate tantrums, Aaron's caregivers reported provided extra time with the preferred activities.

Liam's caregiver reported that any direction during his independent play, with items such as the iPad, would result in Liam dropping to the floor and yelling a negation of the instructions. In addition, Liam's caregiver reported that it was especially problematic to provide him with instructions to leave the area or room where he was independently engaged with his activities. In addition, Liam's caregiver reported that common tactic for pacifying him during a tantrum involved allowing him to return to uninterrupted access to the activities.

Graham's caregivers reported that he often exhibited tantrums in response to being given instructions to transition away from any preferred activity to complete a nonpreferred task. For example, Graham's caregivers reported that the entire family plays board games together every night between dinner time and bedtime. When Graham would be given instructions to help clean up the game and get ready for bed, he would scream, hit his parents or siblings, and run away from his family. Once in another room, he would often begin kicking walls or throwing toys. Graham was also reported to emit similar tantrums when asked to put away his iPad and set his place at the dinner table, or put away his toys and get dressed for school. Graham's caregivers reported that they were most likely to sit and talk with Graham individually or help him find something else to do in response to a tantrum.

Following the interview, the therapist casually interacted with each child for 5 min. No data were collected during this observation, however, the therapist used this time to unsystematically probe the hypothesized contingencies developed from the open-ended interview. The therapist attempted to accomplish three goals when arranging environmental events during the observation. First, the therapist refined the operational definitions of the target problem behavior and included any additional less severe topographies that may not have been previously identified during the interview. Second, the therapist attempted to reliably evoke the problem behavior using the informed antecedents and abate the problem behavior using the putative consequences. The third goal was accomplished once the therapist could confidently design the procedural arrangements of the test condition of the subsequent analysis. Caregivers were present during the observation and, if no problem behavior was exhibited, they would have been asked follow-up questions regarding the contextual features of the probe. However, all participants exhibited at least one instance of problem behavior during the 5-min period.

2.5.2 | Single-session interview-informed synthesized contingency analysis

The single-session IISCA was a 5-min, systematic test of the evocative events and contingent presentation of the putative reinforcers following problem behavior. Prior to the start of the session, participants were given 30 s to

2 min of access to the putative reinforcers. Once the session began, the reinforcers were removed and some form of instructions were provided (i.e., the RAI was initiated). If problem behavior occurred during the RAI, instructions were terminated and the reinforcers returned for 30 s (i.e., the RPI was initiated). Any problem behavior during the RPI would have been ignored and would not have affected the duration of the RPI.

For Aaron, the reinforcement period included interactive play with the therapist with child-selected activities. In addition, the therapist complied with any requests or bids for attention. When the activities with Aaron were discontinued (i.e., the RAI was initiated), requests were no longer honored and the therapist brought out a different activity that Aaron had not previously selected. The therapist then provided discrete instructions to engage with the activity (e.g., putting in puzzle pieces, handing the therapist specific objects) using the three-step instructional sequence.

The reinforcement period for Liam involved providing him with at least an arm's length of space and independent access to his activities. When the activities were removed (i.e., the RAI was initiated), the therapist approached Liam and provided him with different fine-motor and gross-motor tasks (e.g., finding body parts, standing up, and walking with the therapist).

The reinforcement period for Graham involved access to his preferred toys and games, as well as attention from his mother and the therapist contingent upon his bids (e.g., if Graham said, "Mom, look!" and showed her a video on the iPad, she would say, "Cool!" and look at the video). When the RAI was initiated, the therapist removed Graham's toys and games and gave him a combination of gross motor instructions (e.g., stand up, push in your chair) and instructions to clean up various toys in the room (e.g., putting board games back in their boxes).

2.5.3 | Treatment evaluation

The one session from the single-session IISCA served as the baseline for the treatment evaluation. However, the problem behavior during the single session was converted to an aggregate rate over the entire session (RPM) rather than multiple rates within the RAIs and RPIs of the session (RPS). This was done to make the rate of the single-session IISCA comparable with that of the treatment evaluation to be conducted across many sessions.

The treatment package included FCT and delay and denial tolerance training. Aaron's session duration was dependent on the number of programed FCR opportunities. The sessions were set at five trials to ensure that Aaron adequately contacted the contingencies and could experience longer durations of reinforcement. Liam and Graham's sessions were initially set at 5 min and were extended to 20 min by the end of their participation.

FCT involved the participant being taught multiple FCRs of increasing complexity to produce the reinforcers identified during the single-session IISCA. Training was conducted prior to the sessions of each FCR phase. Because Aaron could speak in full fluent sentences, behavior skills training (BST) was used to teach him the targeted FCRs. The training began with the therapist explaining when to use the FCR. The appropriate use of the FCR was then modelled with a confederate and Aaron was given an opportunity to practice a few times. During the practice trials, Aaron was provided with in situ feedback, praise, and access to the reinforcers.

Liam could only respond to some simple one-step instructions. Therefore, training for Liam involved 10-trial sessions using the most-to-least prompting procedure. Once the items were removed, he was immediately prompted to emit the FCR. Following the FCR, Liam was provided 30 s to uninterrupted access to his activities with the therapist moving an arms-length away. The verbal prompt was progressively delayed. Training was complete for Liam following two sessions in which 80% of responding in each session was independent and there were zero instances of problem behavior.

During the single-session analysis, Graham used hardly any language when presented with the evocative context (i.e., he did not ask for his items back or request that the therapist stop). Instead, he would immediately grab the therapist or his removed items and whine or scream. So although Graham could speak in full fluent sentences, his training procedures were identical to Liam's.

All prompts were removed following training and participants were provided with a reminder every 30 s if they were not emitting the FCR during an RAI (e.g., "Remember you can always say [FCR] if want to do things your way"). The target FCR, depending on the complexity phase, resulted in the termination of the demands and the representation of the participant's preferred activities. Problem behavior and all previous FCRs were placed on extinction. In other words, the instructions continued to be presented and the activities not returned. Training was considered complete for each level of FCR complexity after three sessions of no problem behavior and high rates of the target FCR.

Liam and Graham's sessions during delay and denial tolerance training were progressively increased from 5 min to the terminal goal of 20 min. During 50% of the trials, the therapist presented a denial cue (e.g., "not right now") following the FCR. If the participant emitted the tolerance response (i.e., saying "ok" or "ok no problem") following the denial cue, the reinforcers were represented. Following three sessions without problem behavior, the percentage of trials with denial cues was increased to 80% and instructions were introduced.

Once the instructions were introduced, there were five possible outcomes following occurrences of the terminal FCR. The FCR sometimes (20% of the time) resulted in the delivery of the reinforcer. During the occasions when the FCR was denied, the tolerance response resulted in the delivery of the reinforcer 20% of the time. During all other occasions, the tolerance response was acknowledged and the instructions presented (60%). Furthermore, there were three possible levels of instructions that the participant experienced: easy (20%), moderate (20%), and difficult (20%). The easy level involved the least number of instructions to complete, whereas the difficult level required the most instructions to complete before reinforcement was represented. Contingency-based reinforcement thinning was used during delay and denial tolerance training (Ghaemmaghami, Hanley, & Jessel, 2016). Contingency-based reinforcement thinning involves the participant completing a programed number of tasks before the delay is terminated and reinforcers are represented. The experienced delay period, therefore, is dependent on the completion of the tasks and not on a priori delay duration. If problem behavior ever occurred during the presentation of the instructions, the specified number of instructions to complete was reset and the participant had to complete the behavioral requirement without problem behavior before reinforcers were reinstated.

The five possible outcomes following an FCR were entered into a random number generator prior to the start of session. The order of the outcomes were selected based on the number generator. However, no levels of instruction were repeated until participants were exposed to all five levels. The participants were never informed of what level of instructions they were completing or even if instructions were going to be provided. The number of instructions in each of the levels progressively increased following every two sessions without problem behavior. For example, Aaron was presented with one, three, or six instructions to complete when reinforcement thinning began. By the terminal thinning phase, Aaron was presented with 4, 12, or 24 instructions in a single trial. Reinforcement thinning with Liam began with the completion of only one 1 instruction and ended with a possibility of 6, 24, and 30 instructions per trial. Graham's reinforcers were originally provided contingent on the completion of one instruction with the terminal goal being the completion of 4, 12, and 24 instructions. In other words, the final treatment consisted of the intermittent and unpredictable reinforcement of functional communication, tolerances responses, and compliance with instructions (Hanley et al., 2014; Santiago et al., 2016).

2.5.4 | Social validity

A social validity questionnaire was completed by Liam and Graham's caregivers. Aaron's caregiver was not administered the questionnaire because she was unable to observe his progress during sessions and had to remain in a separate room to care for other siblings. The caregivers were asked questions specifically related to treatment such as the caregiver's satisfaction with the improvement observed, the helpfulness/acceptability of the treatment, and the comfort in encountering previously problematic situations at home (e.g., interrupting preferred activities, providing instructions to complete tasks). Each question was scored on a 7-point scale with one representing the lowest score and seven representing the highest.

3 | RESULTS

The results of the single-session IISCA are presented in Figure 2. Problem behavior was exclusively observed during the RAIs for Aaron and Liam. For Graham, one instance of problem behavior was observed during one RPI. This indicates that problem behavior was nearly eliminated with each 30-s presentation of the reinforcer and evoked when those reinforcers were removed. Functional control over problem behavior was demonstrated in this differentiated responding in the rapid alternation of RPIs and RAIs. In addition, an increasing trend in the rate of problem behavior with the repeated exposure to RAIs was observed for all three participants. This suggests that problem behavior was beginning to occur in closer proximity to the removal of the reinforcers resulting in shorter RAIs. Higher rates of problem behavior were observed during Aaron's analysis (M = 0.53 RPS, SD = 0.3) in comparison with Liam's (M = 0.13 RPS, SD = 0.05) and Graham's analyses (M = 0.11 RPS, SD = 0.07). Aaron experienced fewer overall RAIs and RPIs (nine intervals) in comparison with Liam (14 intervals) and Graham (13 intervals). This was due to Aaron's reinforcement duration being twice as long. The results of the single-session IISCAs identified a socially-mediated function for the problem behavior of the three participants and the single session served as the baseline for the treatment evaluation.

Aaron's treatment evaluation results are presented in Figure 3. Aaron was engaging in 1.4 instances of problem behavior per min when problem behavior was aggregated from the single-session IISCA into the baseline session.

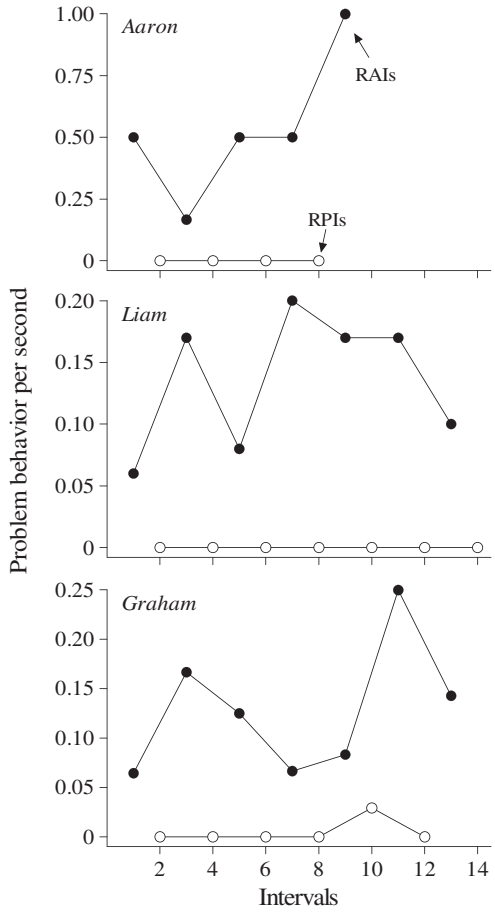

FIGURE 2 Results of the single-session interview-informed synthesized contingency analysis (IISCA). RAI refers to reinforcer absent interval. RPI refers to reinforcer present interval

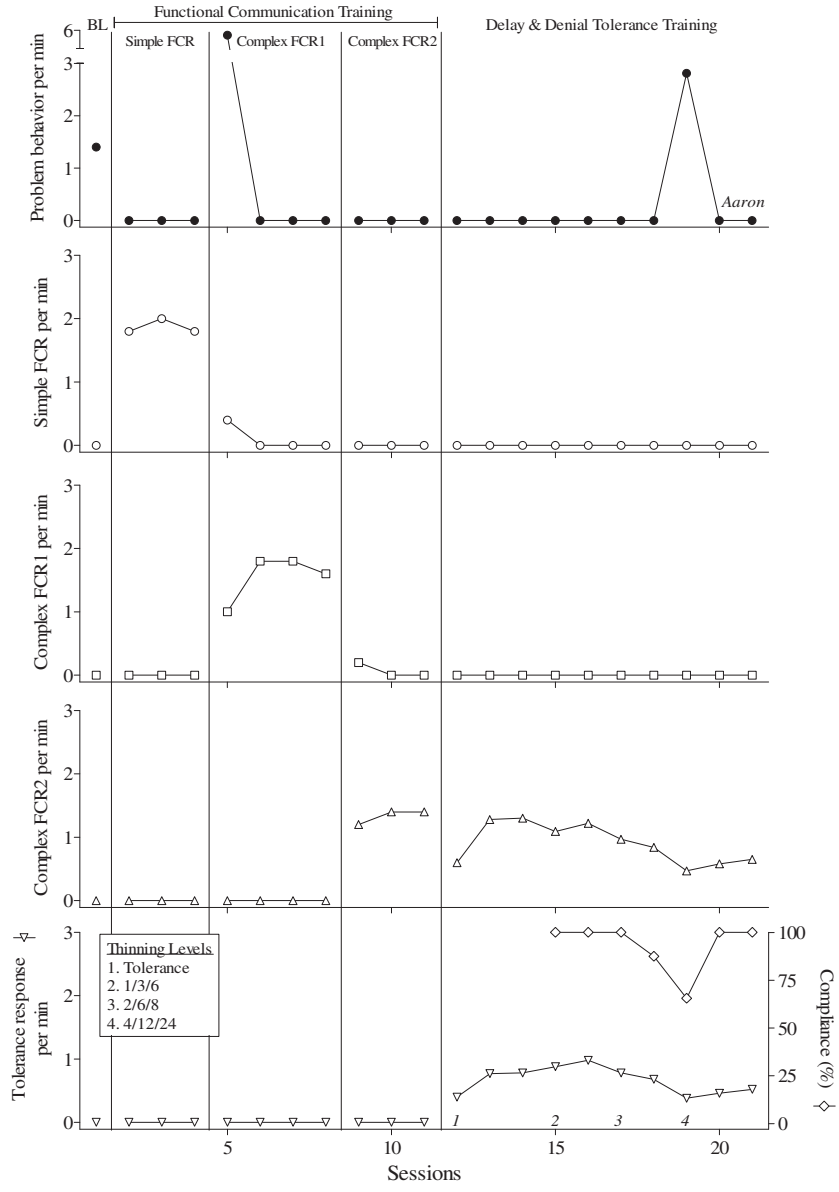

FIGURE 3 Results of the treatment evaluation for Aaron

Problem behavior was eliminated during FCT initially. When the complexity of his FCR was increased, we observed one session with problem behavior and then problem behavior remained at zero during the rest of his FCR training. Elevated rates of the simple FCR, complex FCR1, and complex FCR2 were observed when the contingency was arranged for each response. With the exception of one session at the terminal schedule, problem behavior remained at zero as the tolerance response and instructions were introduced. Compliance was high across sessions (M = 95%) with Aaron reaching a terminal goal of 24 consecutive tasks prior to receiving reinforcement. In addition, the complex FCR2 and tolerance responses persisted at the last thinning level despite being reinforced only 20% of the time.

Liam's treatment evaluation is presented in Figure 4. When his problem behavior was aggregated into the single baseline session, it was occurring at 1.4 RPM. Problem behavior was then completely eliminated throughout the entire treatment evaluation. Simple and complex FCRs were acquired and occurred at levels similar to that observed

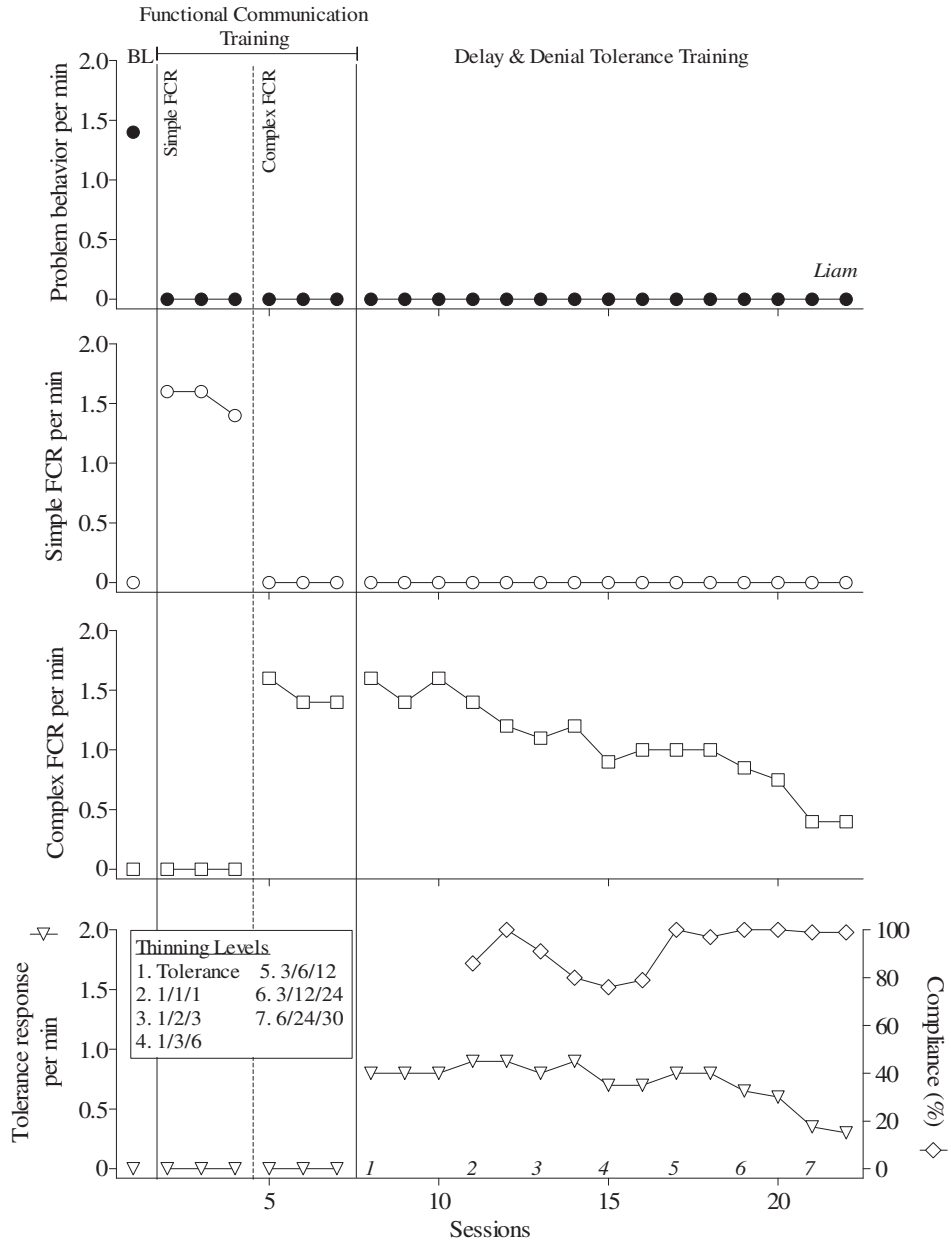

FIGURE 4 Results of the treatment evaluation for Liam

for problem behavior in baseline. Compliance remained high (M = 92%) as the number of instructions was progressively increased and his complex FCRs and tolerance responses persisted at the last thinning level despite being reinforced only 20% of the time. At the end of treatment, Liam reached a terminal goal of 30 consecutive tasks prior to receiving reinforcement.

The results of Graham's treatment evaluation are presented in Figure 5. Problem behavior was elevated during the initial baseline session (1.8 RPM). When FCT was introduced teaching Graham the simple FCR, problem behavior was eliminated and an increase in the simple FCRs was observed. Following the training of the simple FCR, a baseline session was reintroduced and problem behavior returned to an elevated rate of 1.2 RPM. In addition, a burst of the

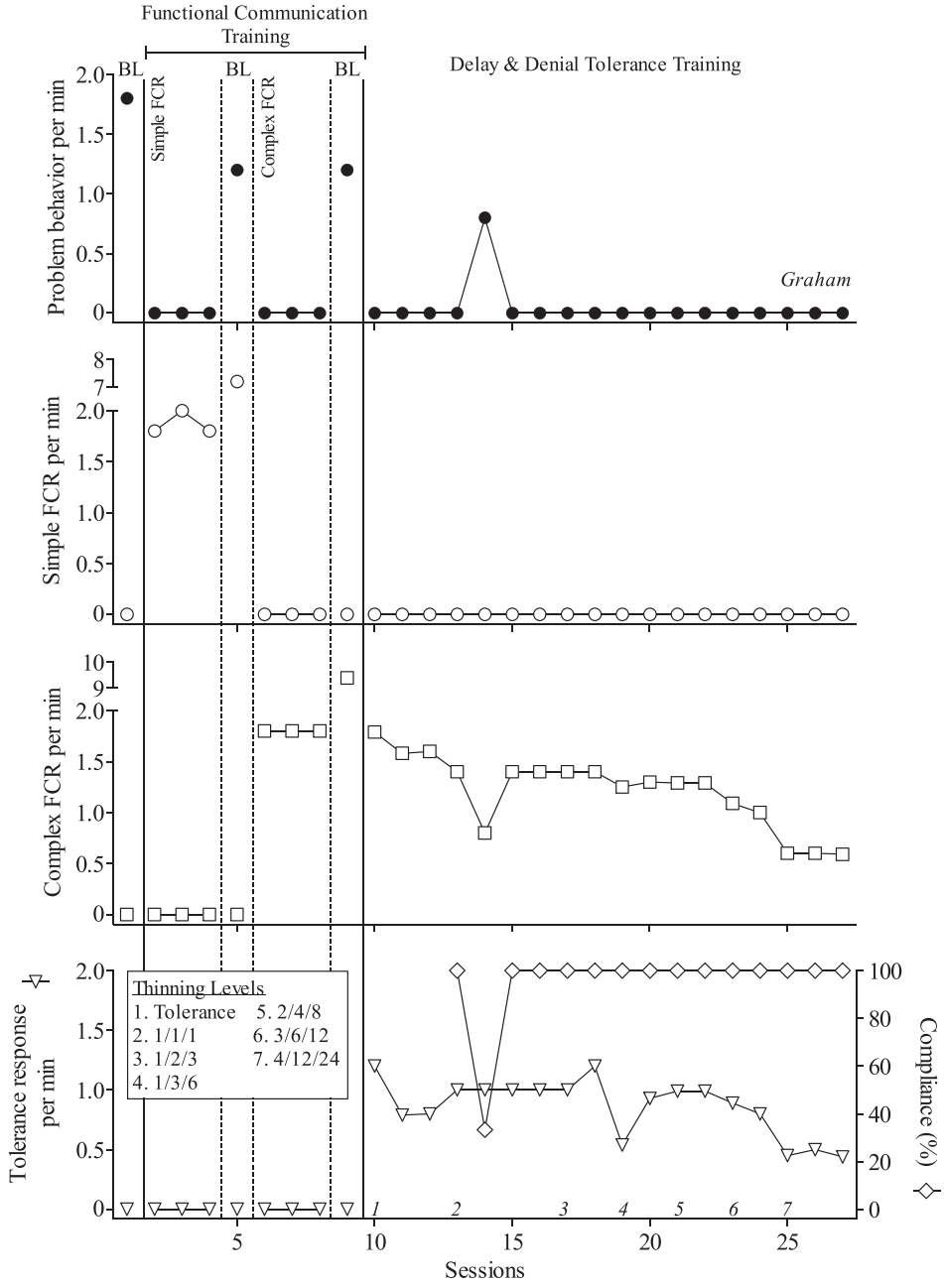

FIGURE 5 Results of the treatment evaluation for Graham

simple FCR was observed (7.2 RPM). Problem behavior was again eliminated when the second phase of FCT was introduced and elevated rates of the complex FCR was observed. The second reintroduction of the baseline session resulted in a similar burst of the complex FCR and a re-emergence of the problem behavior. During delay and denial tolerance training, problem behavior was eliminated and Graham complied with all instructions, with the exception of one session. By the end of treatment Graham was complying with as much as 24 consecutive instructions and experiencing a session of 60% reinforcement.

Liam's caregiver reported that she was highly satisfied (7) with the improvement seen in problem behavior, tantrums, and communication skills in the clinic. In addition, she found the treatment to be very helpful (7) and highly acceptable (7). Although Liam's caregiver was previously not comfortable (2) removing preferred activities or providing instructions, she reported that she was now very comfortable (7) and reported using the strategies at home with successful outcomes. Graham's caregivers reported that they were very satisfied (6) with the improvement seen in problem behavior in the clinic, and highly satisfied (7) with the amount of improvement with Graham's tantrums and communication skills. Graham's caregivers found that the treatment procedures were both very helpful (7) and highly acceptable (7). Prior to participation, Graham's caregivers reported that they were not comfortable (2) removing preferred activities or providing instructions. Following participation, Graham's caregivers reported that they were very confident (7) in their ability to apply the strategies used in the clinic at home with Graham.

4 | DISCUSSION

We conducted the single-session IISCA for the problem behavior of three participants to determine sensitivity to social reinforcers within a brief 5-min exposure to the interview-informed contingencies. The differentiated results were used to develop a skill-based treatment consisting of FCT and contingency-based reinforcement thinning. The treatment effectively reduced problem behavior for all participants and increased the rate of compliance during delays to reinforcement. In addition, the results of the treatment were socially validated by the caregiver of two participants with whom social validity was evaluated.

It has recently been reported in multiple surveys (Oliver et al., 2015; Roscoe et al., 2015) that practitioners are choosing to conduct indirect or descriptive assessments in lieu of functional analysis; despite the fact that these functional assessment methods are probably best conceptualized as more complimentary with a functional analysis than they are substitutable for an analysis (Hanley, 2012). Although a majority of the practitioners included in the surveys reported being trained in functional analysis procedures, one of the most common reported barriers to its use was time. In fact, in the web-based survey of 682 practicing Board Certified Behavior Analysts (BCBAs), Oliver et al. (2015) found that a lack of time was the most common barrier reported by 57% of responders. Time constraints in clinical settings may be best considered in two limiting factors. First, practitioners are likely to have multiple clients to attend to and may not be able to devote the time necessary to conduct a functional analysis. Second, practitioners may physically have the time and resources to conduct the functional analysis; however, they may be unwilling to place their client in a context where dangerous problem behavior is reinforced on a rich schedule of reinforcement for extended periods.

The full IISCA has been shown to be an efficient functional analysis format with large clinical case summaries reporting mean analysis durations of 25 min (Jessel et al., 2016) and 36 min (Jessel, Ingvarsson, Metras, et al., 2018). The current study improves on this analytic brevity by reducing the time further to only 5 min. The entire functional assessment process was completed in less than an hour and the subsequent treatment package, informed by the single-session IISCA, resulted in the elimination of problem behavior for all three participants by the end of their one-to-two-week participation. The relative ease to conduct the full IISCA or single-session IISCA and substantially reduced exposure to conditions intended to evoke problem behavior may address concerns expressed by many BCBAs that have prevented the conduct of a functional analysis. The breadth of the conditions under which the single-session IISCA will be efficacious remain unknown; however, future research should be conducted to delineate the conditions under which either single-session or multiple session analyses may be necessary for satisfactory treatment outcomes.

(Vollmer, Marcus, Ringdahl, & Roane, 1995) described a process for maintaining efficiency by progressing from a brief to a standard functional analysis. Because the brief format reduced the number of sessions of the standard format, they suggested conducting a within-session analysis of the first sessions and to discontinue any further assessments if differentiation is observed. The IISCA format could use a similar model in that the single-session IISCA would

either be followed by function-based treatment if differentiation occurred, or a full IISCA if a single session did not yield sufficient control of problem behavior. We therefore recommend that practitioners be highly responsive to the data from the first session, and, if needed, in subsequent sessions, in order to proceed to treatment analyses as soon as adequate control over problem behavior has been evinced.

Much like the brief format developed by Northup et al. (1991), the full IISCA requires a limited number of sessions to conduct (usually five; Hanley et al., 2014; Jessel et al., 2016). However, the within-session analysis of responding during programed EOs and AOs of the single-session IISCA eliminates the need for a separate control condition for comparison or for multiple sessions. In other words, control may be evident within one test session if problem behavior is evoked and then eliminated during the removal and representation of the reinforcers, respectively. Interestingly, this within-session analysis usually allows for a greater number of replications than the typical session-by-session analysis and in less time, which is arguably a strength of the procedure (Jessel et al., 2016). This study extends Jessel et al. (2016) by showing socially validated treatment outcomes when the starting point involved only 5 min of analysis, designed from an interview and observation that collectively required less than an hour of assessment time.

There are several limitations of this study to consider. First, what we have demonstrated with these three participants is that it is possible to develop an effective treatment using the single-session IISCA; however, the probability of an effective treatment outcome from this process requires further investigation. An important next step would be to conduct and report the entire assessment and treatment process across a large number of consecutive patients who experience this assessment and treatment process. This arrangement has been characterized as a consecutive case series design (Phillips, Iannaccone, Rooker, & Hagopian, 2017) and has already been shown to support the effectiveness and treatment utility of the full IISCA across child characteristics, contexts, and topographies of problem behavior for 25 consecutive participants (Jessel, Ingvarsson, Metras, et al., 2018).

A second possible limitation is that the limited experience with the controlling contingency in the single-session IISCA may make it difficult for initial treatment effects to be realized. This did not appear to be the case for these participants, but future research should be conducted to determine whether the speed with which a treatment eliminates problem behavior is affected by the amount of experience with the controlling contingency in the functional analysis.

As noted previously, the conditions under which immediate differentiation is likely to be observed within, and treatment effects realized from, a single test session in not knowable from this study and is another important area for future inquiry. The clarity of the interview or observation are possible considerations for predicting the success of the single-session IISCA, with the former dependent on the confidence of the caregiver and latter dependent on the confidence of the therapist. For example, the caregivers of the three participants described a context with a consistent pattern of problem behavior, and reported confidence in the likelihood of seeing immediate problem behavior if those contingencies were arranged. It is quite possible that designing analyses based on reports from those who are less certain about the contexts in which consistent patterns of problem behavior occur will not yield the same effective action on the part of the analyst. Perhaps questions could be added to the open-ended interview (Hanley, 2012) to assess parental confidence, and this factor could be examined for its relationship to the efficacy of single-session IISCAs for yielding differentiated outcomes and effective treatment baselines.

The clarity of the observation can be of concern if the therapist is unable to reliably evoke the problem behavior within the 5-min period. Without an immediate demonstration of the influence of the environmental events informed by the interview, the therapist may not be confident that the maintaining contingency has been or can be identified within such a brief analytic period. Future researchers may want to evaluate predictive elements (e.g., latency to problem behavior) of the observation probe that could lead to successful implementation of the single-session IISCA over the extended full IISCA alternative. Although the extent to which the effectiveness of the single-session IISCA relies on the individual components of the interview and observation cannot be determined based on this study, we recommend the implementation of all as a comprehensive assessment package until future component analyses suggest otherwise.

Although this assessment and treatment technology may be appropriate for practice at this point, there are some considerations that may limit its application. For one, only problem behavior that is immediately susceptible to the effects of the AO can be evaluated in this within-session arrangement. That is because the AO serves as the control condition in the single-session IISCA and if the problem behavior cannot be quickly "turned off," then differentiation between the EO and AO intervals may not be obtained. Therefore, clinicians may have difficulty applying the single-session IISCA to problem behavior that typically occurs in bursts or over extended periods of time (i.e., tantrums). Repeated sessions may be required for efficient responding to be realized. Furthermore, using the single-session IISCA as the baseline reduces the clinician's ability to visually analyze potential variability prior to the introduction of the treatment. This shift in balance towards efficiency over analytic capability requires that the treatment produce robust effects to eliminate reasonable doubt that confounding variables could have contributed to the results. Practitioners should consider multiple single-session reversals throughout the treatment process, if problem behavior is variable while skills are being acquired in the treatment.

A final limitation is that social validation of the treatment effects was not evaluated with the caregiver of one participant, and the long term and general effects of the process were not examined for all three participants (see Taylor, Phillips, & Gertzog 2018; Herman et al., 2018; or Santiago et al., 2016 for some examples of longer term and more general effects of full-session IISCAs). Demonstrating a large reduction of problem behavior and acquisition of important skills like functional communication, delay toleration, and compliance in short sessions (5 to 20 min) within single subject designs is an important means for developing intervention technology; this methodological process demonstrating the efficacy of functional assessment based intervention (Ghaemmaghami, Hanley, & Jessel, 2018) has a strong precedent in this journal. Nevertheless, the validation of any behavioral intervention ultimately requires proof that relevant caregivers are satisfied with the amount of behavior change they observe over time although they implement it in relevant contexts (Wolf, 1978). Future research should therefore evaluate the long term and general effects of the single test IISCA and skill-based treatment, whereas also consistently evaluating whether the results are meaningful to the parents and teachers of the children who experience this process.

CONFLICT OF INTEREST

All authors declare that they have no conflict of interest.

COMPLIANCE WITH ETHICAL STANDARDS

Informed consent: Informed consent was obtained from all individual participants included in the study.

ETHICAL APPROVAL

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

ORCID


Joshua Jessel http://orcid.org/0000-0002-1649-2834

REFERENCES

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

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

Chusid, J., & Beaulieu, L. (in press). Assessing the generality and durability of interview-informed functional analyses and treatment. *Journal of Applied Behavior Analysis*.

Ghaemmaghami, M., Hanely, G. P., Jin, S. C., & Vanselow, N. R. (2016). Affirming control by multiple reinforcers via progressive treatment analysis. *Behavioral Interventions*, *31*, 70–86. https://doi.org/10.1002/bin.1425

Ghaemmaghami, M., Hanley, G. P., & Jessel, J. (2016). Contingencies promote delay tolerance. *Journal of Applied Behavior Analysis.*, *49*, 548–575. https://doi.org/10.1002/jaba.333

Ghaemmaghami, M., Hanley, G. P., Jessel, J. (2018). Functional communication training: From efficacy to effectiveness. Unpublished manuscript.

Hanley, G. P. (2012). Functional assessment of problem behavior: Dispelling myths, overcoming implementation obstacles, and developing new lore. *Behavior Analysis in Practice*, *5*, 54–72. https://doi.org/10.1007/BF03391818

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

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

Herman, C., Healy, O., & Lydon, S. (2018). An interview-informed synthesized contingency analysis to inform the treatment of challenging behavior in a young child with autism. *Developmental Neurorehabilitation*, *21*, 202–207. https://doi.org/10.1080/17518423.2018.1437839

Iwata, B. A., Dorsey, M. F., Slifer, K. J., Bauman, K. E., & Richman, G. S. (1994). Toward a functional analysis of self-injury. *Journal of Applied Behavior Analysis*, *27*, 197–209. https://doi.org/10.1901/jaba.1994.27-197 (Reprinted from Analysis and Intervention in Developmental Disabilities, 2, 3-20, 1982)

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

Jessel, J., Ingvarsson, E. T., Kirk, H., Whipple, R., & Metras, R. (2018). Achieving socially significant reductions in problem behavior following the interview-informed synthesized contingency analysis: A summary of 25 outpatient applications. *Journal of Applied Behavior Analysis*, *51*, 130–157. https://doi.org/10.1002/jaba.436

Jessel, J., Ingvarsson, E. T., Metras, R., Whipple, R., Kirk, H., & Solsbery, L. (2018). Treatment of elopement following a latency-based interview-informed, synthesized contingency analysis. *Behavioral Interventions*, *33*, 271–283. https://doi.org/10.1002/bin.1525

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

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

Oliver, A. C., Pratt, L. A., & Normand, M. P. (2015). A survey of functional behavior assessment methods used by behavior analysts in practice. *Journal of Applied Behavior Analysis*, *48*, 817–829. https://doi.org/10.1002/jaba.256

Phillips, C. L., Iannaccone, J. A., Rooker, G. W., & Hagopian, L. P. (2017). Noncontingent reinforcement for the treatment of severe problem behavior: An analysis of 27 consecutive cases. *Journal of Applied Behavior Analysis*, *50*, 357–376. https://doi.org/10.1002/jaba.376

Roane, H. S., Lerman, D. C., Kelley, M. E., & Van Camp, C. M. (1999). Within-session patterns of responding during functional analyses: The role of establishing operations in clarifying behavioral function. *Research in Developmental Disabilities*, *20*, 73–89. https://doi.org/10.1016/S0891-4222(98)00033-X

Roscoe, E. M., Phillips, K. M., Kelly, M. A., Farber, R., & Dube, W. V. (2015). A statewide survey assessing practitioners' use and perceived utility of functional assessment. *Journal of Applied Behavior Analysis*, *48*, 830–844. https://doi.org/10.1002/jaba.259

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

Slaton, J. D., Hanley, G. P., & Raftery, K. J. (2017). Interview-informed functional analyses: A comparison of synthesized and isolated components. *Journal of Applied Behavior Analysis*, *50*, 252–277. https://doi.org/10.1002/jaba.384

Strand, R. C. W., & Eldevik, S. (2017). Improvements in problem behavior in a child with autism spectrum diagnosis through synthesized analysis and treatment: A replication in an EIBI home program. *Behavioral Interventions.*, *33*, 1–10. https://doi.org/10.1002/bin.1505

Taylor, S. A., Phillips, K. J., & Gertzog, M. G. (2018). Use of synthesized analysis and informed treatment to promote school reintegration. *Behavioral Interventions*.. https://doi.org/10.1002/bin.1640

Vollmer, T. R., Marcus, B. A., Ringdahl, J. E., & Roane, H. S. (1995). Progressing from brief assessments to extended experimental analyses in the evaluation of aberrant behavior. *Journal of Applied Behavior Analysis*, *28*, 561–576. https://doi.org/10.1901/jaba.1995.28-561

Wolf, M. M. (1978). Social validity: The case for subjective measurement or how applied behavior analysis is finding its heart. *Journal of Applied Behavior Analysis*, *11*, 203–214. https://doi.org/10.1901/jaba.1978.11-203

How to cite this article: Jessel J, Hanley GP, Ghaemmaghami M, Metras R. An evaluation of the single-session interview-informed synthesized contingency analysis. *Behavioral Interventions*. 2018;1–17. https://doi.org/10.1002/bin.1650