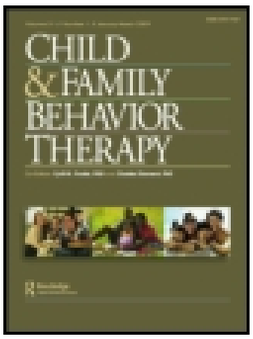

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Predicting and Managing Risk during Functional Analysis of Problem Behavior

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ABSTRACT

Maintaining participant safety during the assessment of problem behavior is of upmost importance. The performance-based, interview-informed synthesized contingency analysis (IISCA) is a functional analysis that incorporates an open-ended interview with caregivers. We introduced additional questions to the interview to identify participants who are prone to escalation. We found that the percentage of dangerous problem behavior and the probability of a burst were correlated with reports of quick escalation. The results suggest that questions regarding escalation speed may be helpful for predicting any safety concerns. Researchers should consider procedural modifications when safety concerns are anticipated to ensure individuals feel physically secure.

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Functional analysis; problem behavior; risk; safety; severity

Problem behavior, such as aggression, self-injury, or property destruction, tends to be prevalent among individuals diagnosed with Autism Spectrum Disorder (ASD) and related developmental disabilities and often has a negative impact on the lives of all those involved (e.g., caregivers, siblings, teachers). For example, many studies have suggested a strong correlation between children's problem behavior and parental stress (e.g., Beck et al., 2004; Hassall et al., 2005; Hastings, 2003) and quality of life (Emily & Grace, 2015). In order to target problem behavior for reduction, behavioral treatments are implemented that arrange for environmental variables to support appropriate alternative skills and repertoires to replace the target problem behavior (Hagopian et al., 2013).

The most effective behavioral treatments begin with some empirical understanding of the environmental contributors to problem behavior, what is referred to as a functional analysis (Campbell, 2003; Heyvaert et al., 2014).

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The functional analysis is a process whereby hypothesized reinforcers for problem behavior are systematically arranged in a test condition and compared to a control condition of non-contingent reinforcement. That is, the test condition recreates the difficult situation in which problem behavior is believed to occur. The functional analysis is said to successfully identify environmental contributors to problem behavior when elevated rates are observed in the test condition and low or no problem behavior is observed in the control. What makes the functional analysis so important for informing behavioral treatments is that it identifies the context in which problem behavior reliably occurs and the reinforcement contingency in need of modification to support alternative appropriate behavior.

The national certification board, who establishes the professional standards of behavioral practices, has deemed the functional analysis as a "precise, effective, and client-centered approach" (BACB, 2014, Section 3.01, p. 11). Despite the evident importance of conducting a functional analysis, many clinicians may avoid its use due to concerns of risk to the safety of those involved (Hanley, 2012; Oliver et al., 2015; Roscoe et al., 2015). That is because the functional analysis requires the systematic arrangement of reinforcement contingencies that could momentarily worsen problem behavior. Furthermore, repeatedly presenting events that historically evoked severe problem behavior has the potential to re-traumatize individuals who are engaging in such behavior to avoid exposure to those situations (Rajaraman et al., 2022). The functional analysis technology developed by researchers, therefore, has to be safe and efficient for clinicians to use in the home, school, or clinic.

Multiple recommendations for reducing risk during the functional analysis have been suggested in the research literature. For example, Kahng et al. (2015) advised clinicians to (a) establish a medical and behavioral termination criterion to eliminate escalation to dangerous levels, (b) incorporate only well-trained personnel implementing functional analysis procedures, (c) ensure the blocking of more severe self-injury, and (d) make protective equipment available to staff. Other recommendations include using brief session durations (Northup et al., 1991; Wallace & Iwata, 1999) and the targeting of less dangerous problem behavior that precedes any escalation (i.e., precursors) of which places the individuals and clinicians at risk of harm (e.g., Smith & Churchill, 2002; Warner et al., 2020).

Many of these aforementioned recommendations for maintaining a safe environment have been recently incorporated into a comprehensive functional analysis modeled termed, the interview-informed, synthesized contingency analysis (IISCA; Hanley et al., 2014; Jessel et al., 2016). The IISCA is a brief functional analysis that includes only a single test condition

representing the natural ecology in which problem behavior occurs based on the qualitative information obtained from an open-ended interview with caregivers. This is to ensure that nothing is introduced beyond that which is already currently experienced by the individual. In addition, all caregiver-informed precursors to severe problem behavior (e.g., whining, crying, yelling) are included in the contingency class to reduce unmanageable escalation and exposure to dangerous topographies of problem behavior. This is compared to the more traditional approach to functional analysis that involves a standardized set of multiple test conditions including generic reinforcement (i.e., escape, attention, tangible) without the inclusion of precursors (Hanley et al., 2003; Iwata et al., 1994). In fact, a recent review suggests the IISCA to be an 83% improvement in efficiency to the traditional approach while maintaining higher levels of control over problem behavior (Jessel et al., 2022), likely creating a safer environment with less instances of severe problem behavior.

It is also important to point out that treatments informed by the IISCA have been known to result in socially significant reductions in problem behavior (e.g., Jessel et al., 2018), suggesting that a safer functional analysis format can inform effective treatment procedures. The ability to use functional assessments to inform effective action on the part of the clinician is often referred to as treatment utility (Hayes et al., 1987; Kratochwill & Shapiro, 2000) and, in direct comparisons with the traditional approach to functional analysis, the use of the IISCA is likely to result in improved treatment outcomes (Slaton et al., 2017).

More recently, a variation of the IISCA has been introduced including additional modifications with the expressed purpose of establishing a functional analysis incorporating a trauma-informed framework (Metras & Jessel, 2021). Although trauma can occur at any point in an individual's lifetime, adverse childhood experiences are more likely to contribute to trauma and are far more prevalent among individuals diagnosed with intellectual and developmental disabilities (Darnell et al., 2019; Hibbard & Desch, 2007). Furthermore, problem behavior is one of many possible indicators that an individual has experienced trauma (Jiang et al., 2019; Oh et al., 2018). Therefore, it is important for clinicians to acknowledge trauma and its potential impact when working with children diagnosed with intellectual and developmental disabilities who exhibit problem behavior.

Incorporating a trauma-informed framework involves commitments to (a) acknowledging trauma, (b) ensuring safety and trust, (c) promoting shared governance, and (d) emphasizing skill building (see Rajaraman et al., 2022 for more information). With these commitments in mind, the new functional analysis format, termed the performance-based IISCA, focuses on the child's

performance, extending periods of reinforcement as needed to maintain a level of calm and control over problem behavior. In addition, the entire analysis period could last only for five presentations of the putative evocative event to avoid any potential for re-traumatization associated with extended exposure to any adverse events. Iovino et al. (2022) introduced the first empirical demonstration of the performance-based IISCA for the problem behavior exhibited by five Italian children diagnosed with ASD. The authors found that the performance-based IISCA could be safely completed in <20 min. In fact, three of the five participants did not exhibit any dangerous problem behavior during the analysis and the remaining two participants exhibited more instances of the minor precursors. In addition, the information obtained about the contingencies contributing to problem behavior during the performance-based IISCA are intended to be used to build skills, such as communication, toleration, and cooperation skills during the subsequent treatment process (c.f., Hanley et al., 2014).

The results of Iovino et al. (2022) do suggest that a trauma-informed framework can be incorporated into the functional analysis process with positive outcomes. However, this is not to say that the results of every performance-based IISCA will be safe because there will always be an inherent risk when systematically manipulating environmental events that are said to evoke problem behavior. For example, individuals with more chronic issues of reported severe instances of problem behavior may be more likely to exhibit these behaviors even with precautions taken. That being said, other individuals may exhibit bursts of emotional behavior that are difficult to de-escalate. Understanding the probability of these risks occurring during the performance-based IISCA is an important consideration to maintain a commitment to ensuring a child's safety and trust during the functional analysis.

The purpose of the current study was to determine if information gathered from caregivers could help predict, and eventually avoid, the occurrence of dangerous problem behavior during the performance-based IISCA. Questions included in the current open-ended interview (see Appendix of Hanley, 2012 for full list) were aimed at defining the contingencies contributing to problem behavior and the topographies (less dangerous precursors and dangerous behavior) of problem behavior to target during the functional analysis. We believe the inclusion of additional questions in the open-ended interview may help define factors predictive of individuals who are more prone to escalation. In addition, we conducted a consecutive case series of 11 patients referred for behavioral services to provide an indication of how probable these outcomes are regarding safety during the performance-based IISCA.

Methods

Participants and setting

Ten children and one adult, nine males and two females, between the ages of 3 and 24 participated in this study. All were diagnosed with ASD and engaged in various topographies of severe problem behavior. Most participants were receiving some level of behavior analytic and psycho-educational interventions anywhere from 2 to 15 h per week in home-, center-, or school-based programming in Italy. One participant, Dario, lived in a residential setting. All participants were referred to this study due to a history of severe problem behavior that occurred multiple time per day, varied in intensity and duration, and had not improved in response to various behavioral procedures. We included and reported on the data of every participant who was referred for inclusion in this study (i.e., consecutive case series; Hagopian, 2020).

Based on caregiver reports and observations, problem behavior was grouped into two categories, dangerous or severe problem behavior and associated non-dangerous or mild problem behavior. The majority of the participants exhibited some combination of aggressive and self-injurious behavior (seven of 11), whereas the remaining individuals exhibited one topography of severe problem behavior (two of 11) or some combination of aggression and self-injury with disruptive behavior (two of 11). In terms of mild problem behavior, five of the participants exhibited a combination of tantrums and loud vocalization. The remaining six participants were split evenly between those who exhibited just loud vocalizations (three of 11) and those who exhibited just tantrums (three of 11). In addition, we recorded reported language abilities based on a four-point scale ranging from non-verbal to fully fluent (see Jessel et al., 2016 for more information). Eight of the 11 participants were non-verbal, two could speak in one-word utterances, and one could speak in short disfluent sentences. Individual participant demographics are summarized in Table 1.

Sessions were conducted in 3-m × 4-m rooms in a specialized clinic for children with ASD. All session rooms were equipped with video recording equipment, two tables, chairs, and participant-specific material (e.g., toys, activities, electronics, teaching material). All sessions were supervised by Board Certified Behavior Analysts (BCBAs), all with experience conducting functional analyses. Those implementing the analyses had at least one year of experience working directly with persons with an ASD.

Measurement and interobserver agreement

We collected second-by-second data using IISCA+, an application produced by Garage94 and FTF Behavioral Consulting.[1] Each occurrence of

Table 1. Participant characteristics.

					Problem behavior	
Participant	Age	Sex	Diagnosis	Language ability	Severe	Minor
Sandro	16	M	ASD	3	SIB, AGG	Louds Vocs, Tantrums
Dario	24	M	ASD	1	AGG	Louds Vocs, Tantrums
Tulio	4	M	ASD	1	SIB	Louds Vocs
Emilio	3	M	ASD	1	AGG, SIB	Louds Vocs, Tantrums
Angelo	4	M	ASD	1	SIB, AGG	Loud Vocs
Tony	8	M	ASD	2	Disruption, AGG	Louds Vocs, Tantrums
Mattia	3	M	ASD	2	SIB, Disruption	Louds Vocs
Giuseppe	6	M	ASD	1	SIB, AGG	Louds Vocs, Tantrums
Marco	5	M	ASD	1	SIB, AGG	Tantrums
Marianna	6	F	ASD	1	SIB, AGG	Tantrums
Francesca	6	F	ASD	1	SIB, AGG	Tantrums

SIB: self-injurious behavior; AGG: aggression; Louds Vocs: louds vocalizations.
Language ability: 1 = non-verbal; 2 = 1-word utterances; 3 = short disfluent sentences; 4 = full fluency.

the target topographies of problem behavior were counted, and categorized, as an instance of dangerous or mild behavior. The dangerous behavior represented the most concerning instances of problem behavior, whereas the mild behavior were reported by caregivers to be precursors that precede escalation to the dangerous behavior. Dangerous problem behavior could include any aggression (i.e., hitting, kicking, scratching, pulling hair, squeezing the hands or arms or biting others), disruption (i.e. tearing, throwing, and hitting items), and SIB (i.e. hitting, scratching, slapping ears, slamming knees into the ground, biting or pinching self). Mild problem behavior could include any tantrums (i.e. whining, crying) and loud vocalizations (i.e. yelling, screaming, or swearing).

Duration data were collected on the mutually-exclusive prevailing interval when the reinforcers were present or absent (i.e., establishing operation; EO). The duration of the reinforcement interval began when all preferred activities with adult attention were made available to the participant. The duration of the reinforcement interval was discontinued and the EO interval started when the implementer stood up and said "Basta," which means "Stop" in English. and continued while the implementer removed preferred activities and introduced instructions. We also recorded the duration of engagement during the reinforcement interval. We defined engagement as the participant presenting positive affect, relaxed posture, and active manipulation of available preferred activities.

Sessions were video recorded, and a second observer independently scored all videos to obtain interobserver agreement (IOA). IOA was calculated as partial agreement within 10-s intervals (i.e., the smaller number was dived by the larger number per interval and divided by the total number of intervals. We obtained IOA for 100% of sessions. The mean IOA for severe problem behavior and mild problem behavior averaged 98% (range, 91–100%) and 94% (range, 91–97%), respectively. The mean IOA across participants for reinforcement intervals, EO intervals and engagement

intervals was 96% (range, 92–99%), 95% (range, 89–99%), and 89% (range, 79–96%), respectively. See Supplementary Material for individual calculations of IOA.

Experimental designs

The reinforcement and EO intervals were rapidly alternated allowing for visual analysis of the frequency of problem behavior when it is hypothesized to occur (EO interval) and not occur (reinforcement). Functional control during the performance-based IISCA was demonstrated when problem behavior occurred more reliably during the EO intervals in comparison to the reinforcement intervals.

Participant protections

We took several measures to protect the safety of participants in this study. An Internal Evaluation Committee for Quality of Research and a university-based institutional review board were reviewed and approved all procedures. In addition to environmental modifications, such as the availability of padding for children reported to engage in head banging SIB and inclusion of furniture with rounded edges, expert professionals trained in safety management procedures were present for all sessions and the lead author and supervising clinician of each participant determined session termination criteria. At least one parent was present for and observed the analysis for every participant, and as mentioned earlier, a supervising BCBA was present at all times for all analyses. Parents, supervising BCBAs, and implementers each had the authority to terminate analyses at any time.

Procedures

Prior to the performance-based IISCA, the supervising BCBA conducted an open-ended interview in Italian with the parents in order to discover potential reinforcement contingencies influencing problem behavior. The interview lasted about 45 min and it included questions about the participant's language skills, favorite activities and items, concerning topographies of problem behavior, antecedents to problem behavior, and any consequences or strategies to manage problem behavior. In addition to the questions listed in Hanley (2012), we added a number of additional questions to the interview regarding safety and risk (see Supplementary Material for full interview). First, caregivers were asked to provide more information on the approximate frequency of problem behavior as occurring once per hour, once a day, once a week, or once a month. Second, we added a question about the history of occurrence of problem behavior in terms of years,

months, or weeks. Third, additional information about the severity of problem behavior was obtained through questions about types of injuries caused (no injury, bruises, wounds, fractures, scars) and the approximate cost of the destroyed property (none, 100–500, 550–1000, 1000–3000, >3000 euros). Fourth, we added questions regarding the number of topographies of dangerous behavior, and the speed of escalation of the behavior (fast *vs.* slow).

The implementer then conducted the performance-based IISCA using the information obtained from the open-ended interview. That is, each participant experienced a unique contingency representative of the context in which their problem behavior occurs as reported by the caregivers. The performance-based IISCA began with all putative reinforcers being placed on one table and all materials related to the putative EO being placed on another (i.e., worktable). During the first reinforcement period, the implementer provided at least 3 min of free access to all putative reinforcers, did not provide any instructions, refrained from initiating any interactions but made themselves available to the participant and responded to all social bids. The duration of this pre-analysis access to non-contingent reinforcement was dependent on the perceived comfort of the participant. For many participants, this was the first time interacting with the implementer and they required some time to get acquainted. In addition, the implementer did not respond differentially to problem behavior (dangerous or mild) if it occurred during the pre-analysis access to non-contingent reinforcement; however, the duration was extended for at least another 3 min (i.e., Giuseppe). Access to reinforcement any other time during the performance-based IISCA was contingent on problem behavior (dangerous or mild).

The implementer signaled the start of the EO by standing up, softly clapping his or her hands, moved closer to the participant and instructed them to stop what there were doing by saying "Basta!" Cooperation to the instruction led to further instructions to relinquish any held materials, transition to the worktable, and complete the tasks reported to evoke problem behavior in the open-ended interview. The implementer also prevented any access to preferred items and stereotypy while instructing the participant to complete the adult-led activities (e.g., academic or play-based instructions). Contingent upon the first instance of any problem behavior (dangerous or mild), the implementer immediately stopped the EO interval and delivered all reinforcers suspected of influencing the participants' problem behavior, while signaling the reinstatement of the reinforcement interval by sitting down or kneeling and appearing available to the participant. Each subsequent return to the EO was initiated following at least 30 s in which no problem behavior was observed, and the child appeared engaged and calm

during the reinforcement interval. The implementer signaled the start of each EO interval by standing up, softly clapping his or her hands and saying, "Basta." The implementer terminated the performance-based IISCA following a sufficient demonstration of functional control or when the therapy hour was over.

Table 2 provides a more detailed description of the idiosyncratic reinforcers and EOs included in the performance-based IISCAs for each participant. For example, the performance-based IISCA for Sandro began with access to her favorite videos on the tablet. During this time, Sandro could freely engage in stereotypy and the implementer would provide physical or verbal attention at any point she expressed interest. After no problem behavior was observed for 3 min the tablet and attention was removed and she was provided with writing and reading tasks while any stereotypy was blocked. All instructions were terminated after any problem behavior and Sandro was returned access to her tablet with attention and the ability to engage in stereotypy for at least 30 s. The implementer repeated this process until functional control was demonstrated.

Data analysis

We conducted post-hoc correlational analyses following the performance-based IISCA including the information obtained from the new questions of the open-ended interview. We used the correlational coefficient to determine the relation between the answers to these questions and several outcomes of the performance-based IISCA that could impact safety or risk of harm. There were four factors we identified for analysis. First, we calculated the percentage of severe problem behavior that occurred during the performance-based IISCA by dividing the instances of severe problem behavior by the total instances of problem behavior. Second, the duration of the performance-based IISCA could vary depending on the participant behavior. Therefore, we recorded the time needed to demonstrate functional control (i.e., when the performance-based IISCA was considered complete and discontinued). Third, we counted the number of EO presentations. Although the goal is to demonstrate control within four or five EO presentations, this may be reduced or extended depending on when problem behavior is occurring (i.e., during the reinforcement or EO interval). Fourth, we calculated a burst probability by counting all EOs with at least two instances of dangerous problem behavior occurring within 5 s and dividing the sum by the total EOs. A burst probability >0.3 is considered critical in signaling a high probability of escalation of behavior and therefore considered a measure of dangerousness (Iovino et al., 2022).

Table 2. Individualized details of participant experience during the performance-based IISCA.

Participants	Establishing operation (EO) interval	Reinforcement interval
Sandro	Interruption of specific video on tablet and stereotypy; no attention; no hand holding; instructions to perform writing and reading tasks	Escape from academic instructions to access specific video on tablet; stereotypy allowed; attention and hand holding available
Dario	Interruption of access to preferred items and stereotypy; instructions to perform self-care activity	Escape from self-care activity to access newspapers, tear-off cards and stereotypy
Tulio	Interruption of access to items used to perform stereotypy; instructions to perform incompatible behaviors with stereotypy	Escape from instructions to access items used to perform stereotypy
Emilio	Interruption of access to preferred items and stereotypy; instructions to perform imitation and visual performance tasks	Escape from tasks to access small bricks, cars, animal toys, music, video, stereotypy and attention
Angelo	Interruption of access to preferred items and stereotypy; caregiver guided play	Escape from caregiver guided play to access stereotypy and play his way with wooden geometric shapes, finger paints, bubbles
Tony	Interruption of access to preferred items, stereotypy and attention from the mother; instructions to perform writing and reading tasks	Escape from academic instructions to access cartoons, tires, chewing gum of specific characters, mother attention, and stereotypy
Mattia	Interruption of access to preferred activities and attention; instructions to perform imitation, visual performance tasks	Escape from tasks to access magic sand, marshmallows, sugar paste, bath toys, slime, Playdoh and paints
Giuseppe	Interruption of access to preferred activities, stereotypy and attention; instructions to perform writing tasks	Escape from academic instructions to access wires, big ball, little toys (cars, animals), video, stereotypy, and attention
Marco	Interruption of access to preferred items and stereotypy; instructions to perform visual performance task	Escape from instructions to access telephone, tablet, penguins and bright objects
Marianna	Interruption of access to tablet, stereotypy, and mother attention; instructions to perform daily activity	Escape from daily activities to tablet, stereotypy, and mother attention
Francesca	Interruption of access to preferred activities and stereotypy; instructions to perform daily activity	Escape from daily activities to access to tablet, pacifier, blanket, and stereotypy

Results

The results of the additional information obtained during the interview on the frequency, history, severity, and topography of problem behavior for each participant is summarized in Table 3. Caregivers reported a mean of 5.36 (range, 2–8) different topographies of severe and minor problem behavior. The majority of caregivers reported some level of injury caused by the problem behavior (eight of 11) with four reporting wounds, three reporting bruises, and one reporting scars. Reports of the speed of escalation was somewhat mixed with six of 11 caregivers suggesting escalation to be slow and the remaining five suggesting escalation to be quick. All participants had months of experience with severe problem behavior with caregivers reporting for seven of 11 to have years of experience. Few caregivers reported any

Table 3. Data on questions regarding safety and risk from the open-ended interview.

Subjects	Number of topographies Count of severe and minor problem behavior	Severity 0 = no injury 1 = bruises 2 = wounds 3 = fractures 4 = scars	Escalation speed 1 = fast 2 = slow	History of SPB 1 = years 2 = months 3 = weeks	Destroyed property cost 0 = nothing 1 = 100–500 2 = 500–1000 3 = 1000–3000 4 = >3000 (in Euros)	Base rate of SPB 1. Once x hour 2. Once x day 3. Once x week 4. Once x month
Sandro	5	0	2	1	0	1
Dario	8	4	1	1	0	1
Tulio	2	0	2	2	0	1
Emilio	3	1	2	2	0	1
Angelo	4	1	2	2	0	1
Tony	7	1	2	1	1	1
Mattia	6	2	1	1	0	1
Giuseppe	7	2	1	1	3	1
Marco	4	0	1	2	0	1
Marianna	5	2	1	1	0	1
Francesca	8	2	1	1	0	1

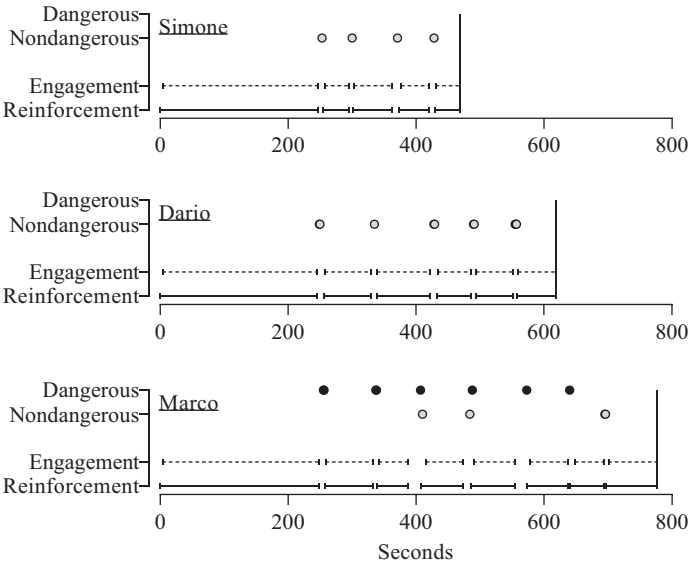

Figure 1. Results of the Performance-Based IISCA for Sandro, Dario, and Marco. *Note*. The vertical line indicates the end of the performance-based IISCA. Black points indicate dangerous behavior. Grey points indicate non-dangerous behavior.

cost of damage to property; however, one reported 100–500 euros and another reported 1000–3000 euros. All caregivers reported severe problem behavior to occur at a rate of once every hour.

The results of the performance-based IISCAs for all 11 participants is presented in Figures 1–4. For example, Simone's performance-based IISCA (top panel of Figure 1) began with over 200 s of access to reinforcement.

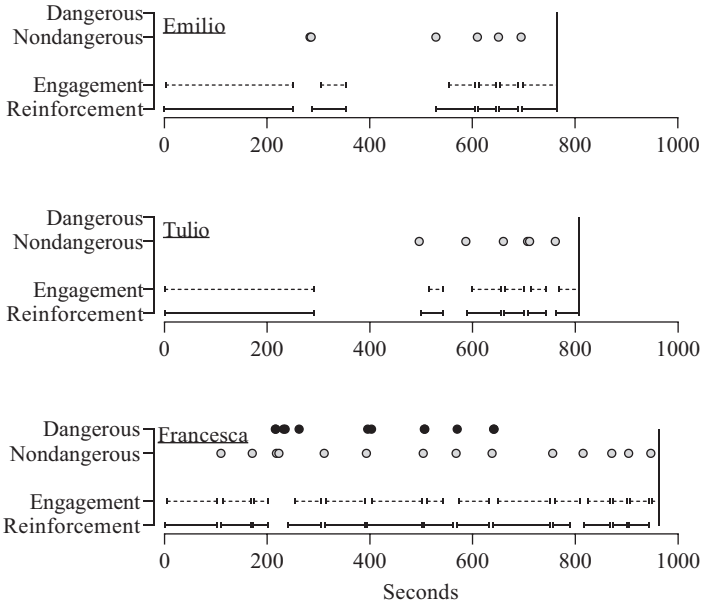

Figure 2. Results of the performance-based IISCA for Emilio, Tulio, and Francesca. *Note.* The vertical line indicates the end of the performance-based IISCA. Black points indicate dangerous behavior. Grey points indicate non-dangerous behavior.

During this time, Simone did not exhibit any problem behavior and was engaged with the preferred activities. Simone immediately exhibited one instance of non-dangerous problem behavior once reinforcement was removed and the EO was introduced. The non-dangerous problem behavior re-initiated the introduction of reinforcement and Simone returned to engaging with the preferred activities without problem behavior. This pattern was reliably repeated three additional times with non-dangerous problem behavior only occurring during the EO interval and the performance-based IISCA was discontinued after the fifth interval with access to reinforcement (7.8 min). A somewhat different pattern was observed during Tulio's performance-based IISCA (middle panel of Figure 2). The performance-based IISCA began with the extended access to reinforcement where Tulio was engaged with the preferred activities. However, the initial introduction to the EO did not result in immediate problem behavior and there was a slight delay. Eventually an instance of non-dangerous problem behavior occurred and the reinforcement was re-introduced. Tulio was not initially engaging with the preferred activities during this time but eventually returned to the items. The second time the EO was introduced the delay to an instance of non-dangerous problem behavior decreased and remained brief with each subsequent EO interval until the performance-based IISCA was discontinued (13.47 min).

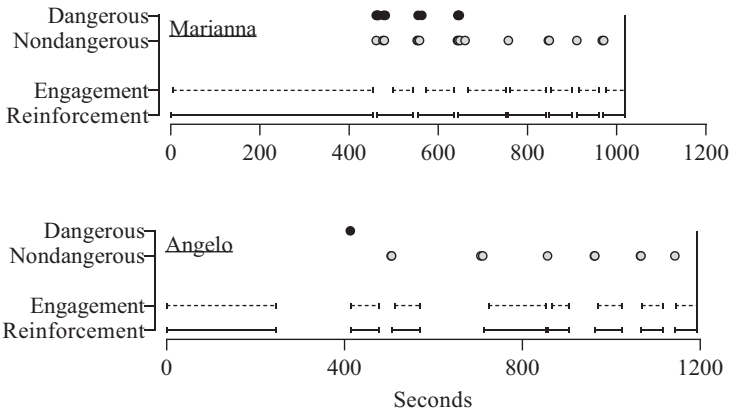

Figure 3. Results of the performance-based IISCA for Marianna and Angelo. *Note.* The vertical line indicates the end of the performance-based IISCA. Black points indicate dangerous behavior. Grey points indicate non-dangerous behavior.

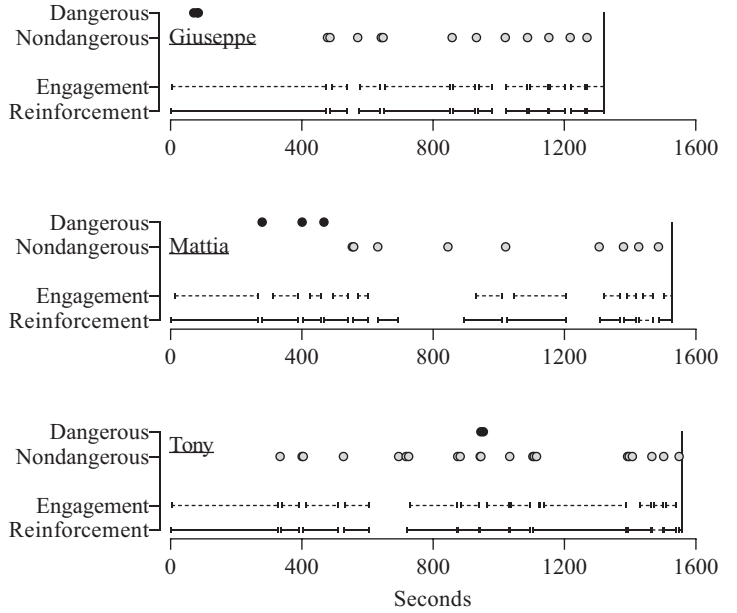

Figure 4. Results of the performance-based IISCA for Giuseppe, Mattia, and Tony. *Note.* The vertical line indicates the end of the performance-based IISCA. Black points indicate dangerous behavior. Grey points indicate non-dangerous behavior.

Safety management procedures were never implemented across the eleven analyses nor were any analyses terminated, despite caregivers and all participating personnel having the authority to do so. The performance-based IISCAs lasted an average of 16.7 min (range: 7.5–26 min) and all 11 analyses were considered differentiated, demonstrating functional control of the caregiver-informed reinforcement contingencies on problem behavior. No property was destroyed and there were no injuries to participants or

Table 4. Correlation data.

	Responses from interview				
IISCA outcomes	# Of topographies	Severity of PB	Escalation speed	History of SPB	Destroyed property cost
% Of severe problem behavior	0.145	0.049	***−0.679***	−0.025	−0.047
Time needed for analysis	0.140	0.140	−0.110	−0.250	0.453
# Of EO presentation	0.284	0.229	−0.369	−0.216	0.368
% Burst probability	0.181	0.136	**−0.522**	−0.216	−0.236

Note. Critical *R* value for $p > .05 = 0.63$.
Noteworthy moderate to large correlations are bolded; the statistically significant correlation is italicized.

implementers during this time. Dangerous topographies of problem behavior was exhibited by 64% (seven of 11) of the participants. However, the percentage of dangerous problem behavior across participants was low ($M = 20\%$; range: 0–67%). Only 27% (three of 11) of the participants were identified as having a probability of bursts of dangerous behavior. The overall mean burst probability was 0.09 (range: 0–0.43).

The results of the correlational analyses are presented in Table 4, with values ranging from 1 (positive correlation) to −1 (negative correlation). The responses on the interview regarding the severity of problem behavior experienced were evaluated in relation to the performance-based IISCA outcomes. Values in the table that are bolded represent noteworthy moderate to large correlations, whereas values that are italicized represent statistically significant correlations. Many of the interview questions (i.e., number of topographies, severity of problem behavior, history of problem behavior, cost of property destruction) were unlikely to be correlated with the specified outcomes that could impact safety or risk of harm. However, escalation speed was negatively correlated with two factors: the percentage of severe problem behavior observed during the performance-based IISCA and the burst probability. That is, participants with parents who reported fast escalation speed were more likely to exhibit dangerous problem behavior and do so in bursts. This suggests that questions regarding escalation from minor to more severe instances of problem behavior may be particularly helpful for predicting any safety concerns.

Discussion

All 11 performance-based IISCA successfully identified socially mediated functions of problem behavior in <30 min. In addition, modifications to the questions of the open-ended assessment proved to be helpful for predicting potential risks to harm. That is, questions regarding the speed of escalation in problem behavior was indicative of the participant exhibiting more dangerous behavior and increased probabilities of bursts during the

performance-based IISCA. This information could provide clinicians with two important opportunities for preventing escalation or avoiding harm during escalation.

In order to prevent dangerous behavior from occurring after receiving the information indicative of escalation, the clinician could attempt to identify as many non-dangerous precursors as possible. Warner et al. (2020) conducted the IISCA for the problem behavior exhibited by 10 consecutive participants and progressively exposed different topographies of problem behavior to extinction beginning with non-dangerous precursors (e.g., whining, covering face) and ending with dangerous behavior (e.g., SIB). Not only were the authors able to identify the non-dangerous precursors that preceded or co-occurred with more dangerous topographies based on questioning during the open-ended interview, the authors determined that all responses were sensitive to the same, caregiver-informed contingencies for 90% of the participants. Therefore, it seems like that the majority of individuals will exhibit some form of precursor before escalation and that the clinicians may want to focus heavily on identifying these non-dangerous precursors when there is any indication of the possibility for risk to safety during the functional analysis.

Of course, some individuals may simply exhibit bursts of dangerous problem behavior without some predictive escalation in severity. For example, Tarbox et al. (2004) conducted functional analyses for the problem behavior of three adults diagnosed with developmental disabilities and were unable to reliably observe problem behavior until bursts of SIB or aggression began to occur. However, much like the current functional analysis, the EO was presented all at one time, potentially arranging the natural situation in which the burst is most likely to occur. To avoid harm during these unavoidable bursts in problem behavior the clinician may want to consider systematically introducing the EO in steps depending on the individuals' reactions and immediately returning to reinforcement (i.e., discontinuing this progression in the EO) once the burst occurs. For example, the contingency arranged during the performance-based IISCA for Dario included the removal of preferred activities while instructions were provided to complete self-care tasks and stereotypy was blocked. The EO could begin with instructions to terminate play with preferred activities and assess participant performance. If a certain period of time elapses without problem behavior, the EO can be progressed to removing the preferred activities. Once again, this will give the clinician the opportunity to assess the individual's performance before moving on to blocking stereotypy, introducing self-care activities, and so forth in manageable steps. Researchers may want to consider comparing simultaneous delivery of the EO *vs.* this progressive EO during the performance-based IISCA to

determine if the latter can improve safety for those of whom are prone to bursts of problem behavior.

Although the non-dangerous topographies of problem behavior were more likely to occur in the majority of performance-based IISCAs, our study was somewhat limited in understanding the caregivers' subjective perception of safety during this time. It is important to obtain this information because caregiver consent or assent is often required before these services can be provided. Thus, social validity questionnaires following participation can help gauge acceptability of the procedures among constituents and to promote feedback on improving our behavioral technology. Coffey et al. (2020) conducted a review of the IISCA literature and found that 53% of studies included some form of questionnaire asking caregivers, teachers, or staff members about effectiveness, feasibility, and overall experience. However, it is important to note that this review was conducted prior to the introduction to the performance-based IISCA. There has yet to be any social validity reported for the performance-based IISCA, including this study and the only other empirical demonstration (Iovino et al., 2022).

It is also important to point out that any social validity obtained has typically only involved secondary sources and not the participants themselves. Following their experience with the performance-based IISCAs, the participants could be asked questions regarding things like how safe they felt, how much they enjoyed their time, and if they experienced any trauma. The latter is especially relevant for those who exhibit bursts of dangerous problem behavior and provides more rationale for designing questions on safety for the open-ended interview. This proves to be somewhat difficult to do with the current participants who were mostly non-verbal individuals. Other more direct forms of measuring happiness and approval may be more appropriate for those individuals. For example, Thomas et al. (2021) developed indices of happiness used during the functional analysis of problem behavior for four children diagnosed with ASD. The authors operationally defined happiness based on the presence of smiling, grinning or laughing and found that higher indices were more likely to be observed during the control conditions when reinforcement was noncontingently available.

While an important development, an index solely dependent on facial expressions may not fully embody an individual's meaningful experiences. Gover et al. (2022) suggested that any emotional indicators of happiness are likely to be highly individualized and could include things beyond facial expressions, such as jumping up and down, hand flapping, or even grunting. In addition, Gover et al. suggested a more comprehensive view of an individual's experiences by focusing on what makes them happy, relaxed, and engaged. While we did include a measure of engagement in the current

study, future researchers may want to consider happy, relaxed, and engaged in its entirety to ensure the individual feel physically and emotionally secure during their experience with the functional analysis.

Note

1. Available for download on Android or Apple operating systems.

Disclosure statement

Floriana Canniello, Luigi Iovino, Rosaria Benincasa, Maria Gallucci, and Salvatore Vita declares no conflict of interest. Gregory P. Hanley declares that he is the owner/founder of FTF Behavioral Consulting. Joshua Jessel declares a part-time consultant position at FTF Behavioral Consulting.

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