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A consecutive controlled case series of 13 performance-based interview informed synthesized contingency analyses in Saudi Arabia

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ABSTRACT

The empirical support for the interview informed synthesized contingency analysis (IISCA) has grown over the last eight years. This study explored the clinical application of a novel variation of functional analysis, termed the performance-based IISCA. Following tele-consultation and virtual professional development training. 15 behavior analysts implemented this approach with 13 consecutive clients with autism spectrum disorder (ASD). These clients were admitted to an intensive daycare center in Saudi Arabia due to their different challenging behaviors. The study reports on successful implementation and differentiated outcomes achieved, and social validity questionnaires provided by the behavior analysts. This might be the first study that may corroborate the ecological and cultural acceptability of IISCA procedures in Saudi Arabia.

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Consecutive controlled case series; cultural validity; functional analysis; problem behavior; trauma-informed

Autism spectrum disorder (ASD) has been the focus of attention in Saudi Arabia for the past several years. One reason for this focus is that the number of people in the country with ASD greatly outweighs those who are qualified to provide treatment. For example, according to the statistics of King Salman Centre for Disability Research, in 2017 there were 53,465 people with ASD in Saudi Arabia (King Salman Center for Disability Research, n.d.) and only 183 individuals certified by the Behavior Analyst Certification Board (including 8 BCBA-Ds, 55 BCBAs, 20 BCaBAs, and 100 RBTs) to implement ABA therapy. This meant that there were 292 children for every individual certified by the BACB (BACB, 2022). According to a study that was conducted by AlBatti et al. (2022),

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the prevalence of ASD in Riyadh, Saudi Arabia was estimated to be as high as 2.51% (1:40, 25 per 1000).

In addition to the defining features of ASD including deficits in communication and social interactions in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (2013), many individuals with ASD exhibit problem behavior. This can include, but is not limited to, non-severe topographies such as excessive screaming, crying, or whining and can range to far more severe topographies such as aggression or self-injurious behavior (SIB). Although this problem behavior can be potentially debilitating and interfere with an individual's quality of life, behavior intervention has been found to effectively reduce problem behavior (Kahng et al., 2002; Scotti et al., 1991) and decrease the need for more intrusive procedures such as pharmacological, physical, or mechanical restraint (Trader et al., 2017). In addition, behavioral interventions that focus on the identification of the environmental contributors to problem behavior prior to treatment, labeled function-based interventions, have been known to improve efficacy further (Campbell, 2003; Heyvaert et al., 2014).

Functional assessment refers to the formal process of identifying antecedents that are likely to evoke problem behavior and consequences that are likely to reinforce problem behavior and can include various methods such as interviews with caregivers, direct observations, or systematic manipulation of environmental events (Hagopian, Dozier, et al., 2013). While interviews and direct observations can provide important qualitative information regarding contingencies, the systematic manipulation of environmental events (i.e., the functional analysis) is often considered the most conservative approach to functional assessment because it can provide information regarding causal relations between antecedents, behaviors, and consequences (Iwata & Dozier, 2008). Empirical demonstrations of functional analyses have existed since the 1960s (e.g., Iwata et al., 1982/1994) with an impetus in the 1990s on developing a standard approach.

The standard approach to functional analysis includes multiple test conditions assessing general classes of isolated reinforcement (e.g., attention, escape, tangible) compared to a single free play control condition. The standard approach was originally designed in an inpatient unit for individuals who exhibited severe SIB and required around 7.5 hrs to conduct across an average of eight days (Iwata et al., 1994). However, more recent evaluations of functional analysis procedures have focused on elements of practicality (e.g., Bloom et al., 2011; Hanley et al., 2014; Thomason-Sassi et al., 2011) to improve dissemination and implementation among different professionals (e.g., clinicians, teachers), in a variety of settings (e.g., outpatient clinic, school, home), and assessing different topographies of problem behavior (e.g., severe and non-severe).

Hanley et al. (2014) introduced the practical functional assessment in a study conducted with three participants who received outpatient services for their problem behavior. The practical functional assessment began with an open-ended interview with the participants' caregivers. The information gathered from the interview was then used to inform the design of an individualized contingency evaluated during the interview-informed, synthesized contingency analysis (IISCA)[1] for each participant. The IISCA is a functional analysis that includes a single test condition, where the contingency for problem behavior is arranged, and a matched control, where the reinforcers are provided

noncontingently. A socially mediated function for problem behavior is implicated when higher rates of problem behavior are observed during the test condition in comparison to the control condition. Following the IISCA, Hanley et al. implemented the function-based interventions and problem behavior was eventually eliminated while the participants were taught communication, tolerance, and cooperation skills.

Jessel et al. (2018) provided further support of the practical functional assessment when they collected 25 consecutive applications of the IISCA for the problem behavior exhibited by individuals admitted to an intensive outpatient clinic. The results of all 25 IISCAs supported the identification of a socially mediated function for problem behavior and the IISCAs were completed in a median of 25 min. Of particular interest was the collection of applications in what is termed a consecutive controlled case series (CCCS; Hagopian, 2020). The CCCS is characterized by the inclusion of consecutive participants who experience common procedures in a single-subject experimental design with all outcomes, positive or negative, reported. The use of the CCCS among the 25 applications of the IISCA provided evidence of generality in that differentiated outcomes in a brief amount of time was not only possible but highly probable.

To date, multiple formats of the practical functional assessment have been developed with distinct clinical purposes (Metras & Jessel, 2021). For example, many individuals diagnosed with intellectual and developmental disabilities are likely to experience adverse childhood events that contribute to trauma (Berg et al., 2019; Hoover & Kaufman, 2018), which is important to consider because functional analyses arrange contingencies to specifically evoke problem behavior. The *performance-based IISCA* was developed with the expressed intent of acknowledging the potential for trauma and reducing the probability of re-traumatization during a functional analysis. The performance-based IISCA specifically addresses the core commitments of trauma-informed care by (a) allowing assent to be withdrawn at any point during the assessment, (b) extending access to preferred events until the individual is calm and prepared for the onset of an evocative events, and (c) reduces the assessment period to a maximum of five exposures to potentially aversive events. For a detailed description of how a trauma-informed framework was integrated into the performance-based IISCA, please refer to Table 1 in Jessel et al. (2023).

The procedural characteristics of the performance-based IISCA is unique from the traditional IISCA in multiple ways (see Table 1) named procedural characteristics and comparison of the performance-based IISCA. First, the performance-based IISCA differs in that access to reinforcement is not solely dependent on the passage of time (e.g., 30 s). Instead, the duration of access to reinforcement is defined by a period of calm. Typically, this will be set to 30 s of continuous calm behavior and any disruption of that calm will result in the resetting of the reinforcer interval. Second, each instance of problem

Table 1. Procedural characteristics and comparison of the performance-based IISCA.

Procedural Characteristics	Traditional IISCA	Current Study	Performance-Based IISCA
(1) Removal of time requirements from reinforcement interval	No	No	Yes
(2) Problem behavior recorded as a rate	No	Yes	Yes
(3) Inclusion of indices of happiness and relaxation	No	Yes	Yes

As defined by Metras and Jessel (2021).

behavior is visually displayed rather than relying on a more traditional measure of rate. This approach allows for detailed examination of the temporal relationship between problem behavior and environmental events. Third, the performance-based IISCA differs from other functional analyses in that the measures are not restricted to instances of severe problem behavior (i.e., closed-contingency class). All problem behaviors (non-severe behavior and severe behavior) are measured in an open-contingency class and measures of appropriate behavior are even included as indices of happiness or relaxation.

In one of the first empirical demonstrations, Iovino et al. (2022) conducted the performance-based IISCA with five Italian children diagnosed with ASD who exhibited problem behavior. Following the open-ended interview with the caregivers, the therapists presented the participants with at least 3-min access to the individualized reinforcers. Following which the therapists instructed the participants to discontinue their activity and transition to an academic table. If at any point problem behavior occurred, the reinforcers were returned, and the transition was discontinued. The therapists replicated the pattern of alternating between evocative events and reinforcers following problem behavior at least three times before the performance-based IISCA was considered complete. The performance-based IISCAs implicated a socially mediated function for the problem behavior of all five participants within a mean of 17.6 min.

Jessel et al. (2023) conducted one of the first treatment validations of the performance-based IISCAs. The authors collected the assessment and treatment data of 11 participants from the United States and Brazil. The performance-based IISCA and traditional IISCA were conducted with all participants and both analyses resulted in differentiated outcomes for all participants. This supported the convergent validity of the performance-based IISCA with more traditional IISCA methods. A subset of those participants then experienced a function-based treatment teaching increasingly complex communications skill. Problem behavior was nearly eliminated across all participants with high percentages of calm behavior during the treatment. The results of Jessel et al. provide strong evidence that the performance-based IISCA can inform efficacious interventions for problem behavior.

It is important to point out that Iovino et al. (2022) demonstrated the viability of conducting the performance-based IISCA with Italian clients and Jessel et al. (2023) demonstrated that the performance-based IISCA can inform effective treatment among American and Brazilian clients; however, social validity questionnaires asking clinicians about the acceptability of the procedures were not administered in either study. An individual's culture can play a major role in the preference for and selection of specific assessment and treatment procedures (Beaulieu & Jimenez-Gomez, 2022). It is unknown how culturally acceptable the performance-based IISCA procedures are among clinicians in three different countries, let alone other entirely different cultures, such as those living in Saudi Arabia. There is reason to believe that caregiver and teacher perspectives of autism services in Saudi Arabia may not always be particularly positive (Almalky & Alrasheed, 2023; Almasoud & Ain, 2023). It may be because public services to support children with ASD are a relatively new development in Saudi Arabia and caregivers and teachers may, therefore, not have much exposure to applied behavior analysis. It is, therefore, pertinent to incorporate some form of

social validity questionnaires to ensure that our procedures are culturally responsive to the specific needs of our clients.

While significant advancements have been made in the field of applied behavior analysis (ABA) and autism spectrum disorder (ASD), several gaps remain in the literature regarding the assessment and treatment of problem behaviors in individuals with ASD. One such gap is the need for more rigorous and standardized approaches to functional analysis, which is a crucial step in identifying the environmental factors that maintain problem behaviors. Additionally, there is a lack of research on the effectiveness of performance-based interview-informed synthesized contingency analyses (PB-IISCA) in addressing problem behaviors in individuals with ASD from diverse cultural backgrounds, such as Saudi Arabia.

To address these gaps, this study aimed to systematically replicate the procedures and outcomes of the performance-based IISCA. By replicating the core elements of previous research (e.g., Jessel et al., 2023), we aim to provide further evidence for the effectiveness of this intervention. The performance-based IISCA has only recently been introduced as a variation to the IISCA procedures (Metras & Jessel, 2021) and, to date, there have only been a handful of empirical demonstrations (Canniello et al., 2023; Iovino et al., 2022; Jessel et al., 2023). Additionally, this study sought to extend the literature on the performance-based IISCA to include participants from a cultural distinct population. From our understanding, this is the first study on the performance-based IISCA conducted in Saudi Arabia. Additionally, we will explore variations in IISCA procedures, such as reinforcement duration based on fixed time and extended session durations, to examine their impact on treatment outcomes.

This study was conducted as a prospective case series, a type of CCCS, which involved following participants with direct observation and collecting data in real-time. This approach allowed us to observe changes and outcomes as they occurred, providing a more comprehensive understanding of the PB-IISCA's effectiveness in a real-world setting. The study utilized a within-session reversal design across evocative and preferred events, a type of single-subject experimental design. This design allowed for the repeated alternation of conditions within a single session, providing strong evidence for a functional relationship between the target behavior and the experimental manipulations. By using a CCCS that included all patients who were admitted to our intensive daycare center, regardless of outcomes. Using the CCCS helps draw conclusions that the findings from the performance-based IISCA are likely to be applicable to a wider range of cases, leading to differentiated results. Finally, therapists who implemented the procedures were asked questions regarding the acceptability, safety, and representativeness of the procedures.

Method

Participants & settings

Thirteen consecutive participants from an intensive daycare center participated in this study. We selected all participants due to severe behavior problems such as aggression towards therapists and parents, SIB, and property disruption at home or the center. Parents at home and therapists at the center reported that all participants engaged in severe problem behaviors on a daily basis. We suspect severe problem behaviors to be maintained by socially mediated reinforcement in all cases. Severe problem behavior was

likely to occur either during transitioning from break (playing with preferred items) to work time or when the participant requested a desired item.

All but one of the participants were male. The median age was 8 years old (range, 3 to 10 years old). All participants were diagnosed with ASD. Two participants had an additional diagnosis of Attention Deficit Hyperactivity Disorder (ADHD). Three participants had an additional diagnosis of intellectual disability and four participants had an additional diagnosis of global developmental delay. Most participants were non-verbal but were augmentative and alternative communication (AAC) users ($n = 9$). The remaining four participants spoke in one-word utterances ($n = 1$), two-word utterances ($n = 1$), and two could speak in fully fluent sentences. We also assessed participant verbal skills using the *Verbal Behavior Milestones Assessment and Placement Program* (VB-MAPP; Sundberg, 2008). The VB-MAPP provided a categorization of skills as represented by typically developing peers from Level 1 (representing the age of 0 to 18 months), Level 2 (representing the age of 18 to 30 months), and Level 3 (representing the age of 30 to 48 months). We identified nine of the participants as being on Level 1 of the VB-MAPP and the remaining four of the participants as being on Level 2. All participants were Arabic speakers except for two participant who communicated in English. The demographic information of each participant is presented in Table 2.

To ensure participant safety, all staff received crisis prevention training through Quality Behavioral Solutions (QBS), and the physical environment was modified to minimize hazards. A thorough screening process was conducted for all participants to assess underlying medical conditions, identify the severity and frequency of problem behaviors, and evaluate risk factors such as trauma history, medication side effects, and environmental stressors. Staff closely monitored participants throughout the study to identify any changes in behavior or emerging safety concerns. ($n = 7$) participants

Table 2. Participant characteristics.

	Age	Sex	Diagnosis	Language level	VB-MAPP
1	8	M	ASD	3	Level 1
2	8	M	ASD, ADHD, Dev. Delay	1	Level 2
3	8	M	ASD	1	Level 1
4	6	M	ASD	1	Level 1
5	10	M	ASD	1	Level 1
6	6	M	ASD	4	Level 2
7	7	M	ASD, Intellectual dis.	1	Level 2
8	5	M	ASD	1	Level 1
9	9	F	ASD, Global Dev. Delay, ADHD	1	Level 1
10	5	M	ASD	4	Level 2
11	3	M	ASD Intellectual dis.	2	Level 1
12	4	M	ASD, Dev. Delay, Intellectual dis.	1	Level 1
13	5	M	ASD, Global dev. delay	1	Level 1

1 = non-vocal; 2 = one-word utterances; 3 = two-words utterances; 4 = full fluency. ASD is autism spectrum disorder. Dev delay is developmental delay.

received medications such as Risperdal, Concerta, Depakine, Cobra, Aripiprex, or Ridon at varying dosages.

Participants would typically attend the center every day for five hrs. During that time, the participants would receive three hours of ABA services, one hour of speech therapy,

and one hour of occupational therapy. However, services were reduced during the COVID-19 pandemic from September (2021) to June (2022). Participants attended the center twice a week and were provided with three hours of ABA services, one hour of speech therapy, and one hour of occupational therapy.

The therapists conducted all performance-based IISCAs between the month of October 2021 and September 2022 onsite at the intensive daycare center in Saudi Arabia. The therapist conducted sessions in four different rooms all 3.5 m x 5.5 m. During the assessment, there were two therapists in the room, one conducted the session (primary implementer) and the second therapist collected data (data collector). We recorded all sessions. The therapists involved in the study were all from Saudi Arabia, aged between 25 and 34. There were 10 female therapists and 5 male therapists. All therapists held undergraduate degrees in special education. Seven of the therapists were Board Certified Behavior Analysts (BCBAs), seven were Registered Behavior Technicians (RBTs), and one was a non-certified ABA therapist. All therapists were supervised and trained by an expert Board-Certified Behavior Analysts with a doctoral degree (BCBA-D).

All primary implementers and supervisors who were involved in the study attended seven hours of web-based, recorded workshop with mastery-based progression through topics on the practical functional assessment and skill-based treatment model developed by FTF Behavioral Consulting. In addition, they attended a 2-hrs training via zoom video conference with an expert credentialed in practical functional assessment and skill-based treatment (Level 7).[2] The expert provided consultative support regarding the open-ended interview and analysis planning, feedback following analysis implementation, and data interpretation for three participants. Consultative support for a maximum of three participants was included in the contract. Therefore, the entire assessment and treatment process was completed independent of consultative support for the remaining 10 participants (i.e., therapists trained in Saudi Arabia designed and implemented all procedures without support or feedback).

Measurement

During the assessment, we classified problem behavior as severe behavior or non-severe behavior. The criteria for classifying behavior were designed by the intensive daycare center based on the management level and used for all clients who were admitted. We considered behaviors severe if they were reported to be dangerous (i.e., causing immediate physical harm to others or the individual) or if they had the potential to disrupt the environment for at least 5 min. The criteria were not topography specific and some topographies of problem behavior could be considered severe for some participants and non-severe for others given their particular situation. For example, we classified the elopement for Participant 5 non-severe because it was easy for the therapists to manage; however, we classified elopement for Participant 10 as severe because it was reported that this behavior escalated quickly to a burst with far more dangerous behavior (aggression, slamming doors near fingers) occurring simultaneously.

Common severe topographies problem behavior the therapists measured included aggression (directed toward others), property disruption (directed toward objects), and SIB (directed towards oneself). We defined aggression as hitting, kicking, scratching, biting, or

Table 3. Description of problem behavior and individualized contingency.

	Problem Behavior		Individualized Contingency	
	Non-Severe	*Severe*	*Evocative Event*	*Hypothesized Reinforcing Event*
1	Loud voc	Agg	Transitions	Escape to access toys
2	Dis	Agg	Therapist instructions	Escape to access puzzles
3	Dis	Agg	Transitions	Escape to access cars
4	Flopping	Loud voc	Transitions	Escape to access toys
5	Elopement	Dis, pica	Therapist instructions to work	Escape to interactive play with therapist
6	Squeeze cheek	Dis, Tantrum	Therapist instructions	Escape to playing with toys and eating favorite candy
7	Loud voc, Dis	SIB	Therapist instructions	Escape to access camera on phone
8	Tantrum	Agg	Transitions	Escape to access toys
9	Loud vo.	Dis, SIB, Agg	Therapist instructions	Escape to access toys
10	Loud voc	Dis, Agg, Elopement	Transitions	Escape to access games on watch
11	Loud voc, Dis	SIB	Transitions	Escape to access toys
12	Loud voc, Dis	Elopement	Transitions	Escape to watching videos on YouTube
13	Loud voc, mouthing, Inapp. touching	Dis, Agg	Therapist instructions and blocked access to private area	Escape to access trampoline and private area

Agg is aggression. Dis is property disruption. SIB is self-injurious behavior. Loud voc is loud vocalizations. Inapp. touching is inappropriate touching.

throwing objects at others. We defined property disruption as throwing (away from others), hitting, breaking, grabbing or objects. We defined SIB as hitting, scratching, or biting oneself. Non-severe topographies of problem behavior included loud vocalizations. We defined loud vocalizations as screaming, crying, whining, or swearing. Some topographies of problem behavior could be categorized as either severe or non-severe (i.e., tantrums and elopement), depending on the particular case and if the behavior placed the individual or others in immediate danger. Tantrums included a combination of loud vocalizations and flopping to the floor. We defined elopement as leaving an area without permission. In addition, we measured more idiosyncratic problem behavior for some participants including inappropriate touching of their genitals (non-severe), rubbing or squeezing their own cheeks (non-severe), flopping to the floor (non-severe), pica (severe), or mouthing objects (non-severe).

The specific topographies of the problem behavior targeted and the individualized contingencies for each participant are presented in Table 3. Most participants exhibited some form of property disruption ($n = 10$), loud vocalization ($n = 8$), aggression ($n = 7$), or some other idiosyncratic problem behavior ($n = 13$). SIB was exhibited in a few participants ($n = 3$) and tantrums were reported in only a couple cases ($n = 2$). We recorded problem behavior as a count and represented each occurrence, severe or non-severe, across time. Instances of problem behavior were represented as a count because they were discrete events with negligible durations.

We also collected data on the duration of calm behavior and reinforcement. We defined calm behavior as the participant exhibiting positive or neutral effect without any indications of distress, including engaging in problem behavior. Calm included relaxed facial expressions, controlled movements during play, and vocalizations matching or below volume with others in the room. We did not consider a participant calm if they were frowning, yelling, frantically looking for caregivers or a way to leave, or exhibiting problem behavior. We measured calm as an immediate onset and offset

throughout the session. The measurement of reinforcement began with the immediate removal of the evocative events and presentation of preferred items and ended with the removal of the preferred items and presentation of evocative events.

Interobserver agreement (IOA)

We video recorded all sessions, and a second observer independently collected data for 100% of the performance-based IISCAs. That is because the performance-based IISCA only required one session. We calculated IOA as a mean count per interval by splitting sessions into 10-s intervals (Cooper et al., 2007). We divided the smaller number of recorded instances of problem behavior by the larger number in each interval. We then summed the results of each interval and divided them by the total number of intervals to get a mean. The mean IOA for severe problem behavior was 96.61% (range, 88.33%-100%) and the mean IOA for non-severe problem behavior was 96.05% (range, 90.24%–100%). The mean IOA of calm behavior was 89.19% (range, 89.6%-96.28%). The mean IOA of reinforcement was 92.18% (range, 87.85%-98.39%).

Experimental design

Functional control was demonstrated during the performance-based IISCA when problem behavior (severe or non-severe) occurred more reliably when the evocative events were present in comparison to when the hypothesized reinforcers were present. Each occurrence of problem behavior was depicted on a second-by-second graph, and the data were visually analyzed by the BCBAs. The therapist terminated the performance-based IISCA after three to five instances of problem behavior were observed. To supplement interpretations of functional control, problem behavior was categorized as occurring during the evocative event or reinforcing event (Jessel et al., 2016). A differentiated outcome was supported if the majority of problem behavior was observed during the evocative event in comparison to the reinforcing event. Furthermore, for all participants, 84% of the differentiated problem behaviors observed occurred during the performance-based IISCA. This was calculated by combining the 53 problem behaviors observed during IISCA with the 10 problem behaviors observed during the reinforcement event. This study was conducted as a Consecutive Case Series (CCCS) in which all participants who enrolled in the intensive daycare center were recruited as participants. The CCCS was utilized to reduce selection bias and improve the generality of our findings (Hagopian, 2020).

Procedure

Before conducting any sessions with clients, a consent form was signed by the parents and all procedures were IRB-approved. All performance-based IISCAs were preceded by an open-ended interview with caregivers conducted in Arabic over a virtual meetings service or via phone. The interview required around 15 to 30 min to complete. The BCBAs supervising the cases conducted the interview, which included open-ended questions regarding the evocative and reinforcing events. The supervisor asked questions regarding (a) antecedents that evoke the problem behavior, (b) topographies of severe

problem behavior and non-severe behaviors, and (c) consequences following problem behavior that could potentially serve as reinforcers for the problem behavior. Also, the open-ended interview included questions regarding self-stimulatory behaviors that are maintained by automatic reinforcers. The interview was originally developed by Hanley and subsequently translated into Arabic by Alnemary et al. (n.d.). For access to all versions, see practicalfunctionalassessment.com.

The supervising BCBA used the results of the open-ended interview to systematically design the evocative events and contingent presentation of the hypothesized reinforcers following problem behavior. For example, one caregiver reported screaming when preferred play was discontinued in order to begin a transition from the reinforcing event (play time) to the workstation. In addition, the screaming was said to escalate to hitting others and tantrums if the participant continued to be denied access to the return of the hypothesized reinforcing events. Specific evocative events and hypothesized reinforcing events for each participant are presented in Table 3.

We used a similar procedure described by Iovino et al. (2022) to conduct the performance-based IISCA. Prior to the performance-based IISCA, the therapist provided the participant with access to the hypothesized reinforcing events identified during the open-ended interview (i.e., pre-analysis non-contingent reinforcement). The therapist did this to build rapport and make sure the child was initially comfortable. A child may be hesitant to play with items or interact with others when introduced to a new environment. We were looking for the child to indicate that they were feeling comfortable when they began to play without hesitation and no longer searching for support caregivers. The therapist ignored any problem behavior (severe or non-severe) during this time and reinforcement was freely available. The supervising BCBA instructed therapists to provide a minimum of 1-min and a maximum of 5-min access before beginning the performance-based IISCA; however, when they began within that range it was dependent on their comfort level and how calm the participant appeared.

The performance-based IISCA began with the removal of preferred items and the simultaneous presentation of evocative events. These evocative events involved a combination of removing preferred items and presenting instructions. For example, a participant might have been told, “It is work time” while toys were being removed. The therapist then presented a verbal instruction to transition away from the play area towards the work area. If the participant did not initiate the transition within 5 seconds, the therapist repeated the instruction with a gestural prompt. This was repeated if the participant continued to not cooperate. During the transition, the therapist walked with the participant within arm’s reach and provided brief praise upon successful completion. If any problem behavior (severe or non-severe) occurred during the evocative event (i.e., the open-contingency class), the therapist immediately discontinued all instructions and returned the participant to the hypothesized reinforcing events for approximately 30 seconds.

Reinforcers were synthesized by simultaneously removing all evocative events when presenting preferred items. The therapist ignored any problem behavior (severe or non-severe) during the reinforcer access period, and the duration of access to preferred items remained unaffected by the occurrence of problem behavior. Although the original IISCA typically involves presenting reinforcement for 30 seconds of calm behavior, this study utilized a time-based presentation of reinforcement for ease of implementation.

This modification was more representative of the traditional IISCA, allowing for easier immediate application for newly trained therapists who lacked prior experience with conducting functional analyses or the performance-based IISCA. However, all other core features of the performance-based IISCA were maintained (See Table 1).

To determine the appropriate number of instructions for each participant during the performance-based IISCA, we consulted with caregivers to ascertain an acceptable workload for the individual. The therapist presented instructions to the participant and discontinued them, returning hypothesized reinforcing events, if the participant completed the set number of instructions without engaging in problem behavior. This ensured that (a) the participant only experienced a workload deemed socially acceptable during the assessment and (b) unnecessary provocation of bursts of problem behavior (i.e., three or more consecutive instances of problem behavior within 5 s) was avoided. Sessions were closely monitored by a supervising BCBA and would have been terminated at any point if the safety of the participant or therapist was deemed at risk. However, no such instances occurred. The mean duration of the performance-based IISCA, including the pre-analysis non-contingent reinforcement phase, was 8.07 minutes (range, 4.83 to 10 minutes). Excluding this phase, the mean duration was 4.14 minutes (range, 1.82 to 5.7 minutes). The therapist repeated the process of presenting and removing hypothesized reinforcing and evocative events until five instances of problem behavior occurred or 10 minutes (600 seconds) had elapsed, whichever occurred first.

Social validity

We provided a questionnaire following the completion of the performance-based IISCA to therapists. Therapists completed the questionnaires independently. In addition, the questionnaires were anonymous and the therapists were assured that completion of the questionnaire would not impact their job in any way. The questionnaire contained three numerical rating scale questions about the extent to which the individual found the assessment acceptable, the extent to which they found the assessment to be safe for the child, and how well the assessment represented the context in which they experienced problem behavior at home and therapy sessions. Responders could answer each question on a Likert scale ranging from 1 (lowest score) to 7 (highest score). Those who completed

Table 4. Results of the social validity questionnaire.

Participant	Rate the extent to which you found the assessment acceptable	Rate the extent to which you found the assessment to be safe	How well did the assessment represent the context in which you experienced problem behavior?
1	7	7	6
2	7	7	7
3	6	7	7
4	5	7	5
5	4	7	6
6	7	7	7
7	7	7	6
8	7	7	7
9	7	7	7
10	7	7	7
11	6	7	7
12	7	7	7
13	7	7	6
Mean	*6.5*	*7*	*6.5*

the questionnaire were directly involved in the implementation of the performance-based IISCA. The questionnaires were presented to the responder in Arabic (see Table 4).

Results

The results of each participant's pre-analysis non-contingent reinforcement and performance-based IISCA are presented in Figures 1–3. Problem behavior tended to not occur until the performance-based IISCA began with no problem behavior observed during this time for 11 of 13 participants. The therapist terminated the majority (9 of 13) of the performance-based IISCAs after five instances of problem behavior. Three analyses required a full 10 min before discontinuing (Participants 1, 4, 8). More often than not, the participants tended to be calm when they had access to reinforcement. For example, Participant 7 returned to a state of calm with every delivery of the hypothesized reinforcing event and was no longer calm immediately following the removal of reinforcement. Participant 5 presents an example when this was not the case and the individual was not calm, regardless of when the evocative or hypothesized reinforcing event was present, for an extended period of time.

Figure 4 presents the problem behavior categorized by its occurrence during the evocative events or reinforcing events. We identified 11 of 13 performance-based IISCAs being differentiated because they all indicated patterns of problem behavior occurring when reinforcement was discontinued. Problem behavior was exclusively observed during the evocative events for 10 of the participants with more problem behavior (80%) observed during the evocative events for the remaining participant (Participant 2). We considered Participant 13 undifferentiated because we observed only two instances of problem behavior before the therapist discontinued the performance-based IISCA and there were instances of non-severe behavior during pre-analysis access to reinforcement. We identified the results of Participant 10's performance-based IISCA to be undifferentiated because the severe problem behavior only occurred when reinforcement was available during both the pre-analysis non-contingent reinforcement and performance-based IISCA. Furthermore, both Participant 10 and 13 displayed just as much problem behavior (50%) during the evocative events as the reinforcing events (see Figure 4).

Participant 10 and Participant 13 both exhibited undifferentiated problem behaviors, suggesting that multiple factors might be maintaining these behaviors. For Participant 10, the cursing behavior occurred both during reinforcement events (play and work time) and evocative events. For Participant 13, the undifferentiated problem behaviors included mouthing and inappropriate touching of private areas, which also occurred during both reinforcement and evocative events. Possible factors maintaining these behaviors might be self-stimulatory, attention seeking, anxiety or stress, and underlying medical issues. Further investigation is needed to determine the specific factors maintaining these behaviors and develop appropriate interventions.

Most of the participants (10 of 13) exhibited more non-severe problem behavior in comparison to severe problem behavior during the performance-based IISCA. In fact, four of the participants did not display any of the reported severe problem behavior at all (Participants 4, 5, 7, 11). For the remaining three participants, one exhibited the same amount of non-severe and severe problem behavior (Participant 13) and the other two

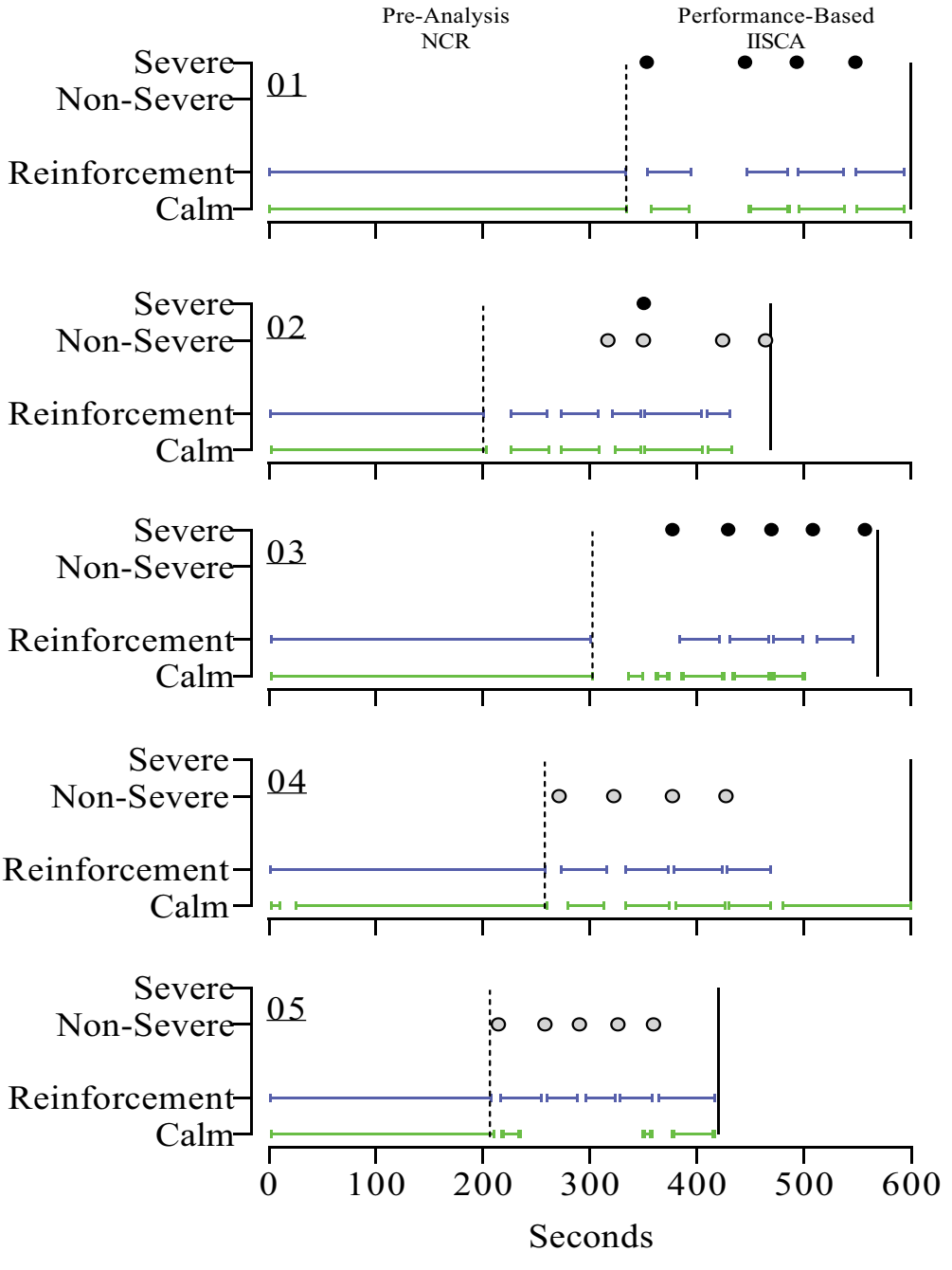

Figure 1. Results of the performance-based IISCA for participants 1 through 5. The solid vertical line on the right indicates the termination of the analysis. NCR refers to non-contingent reinforcement.

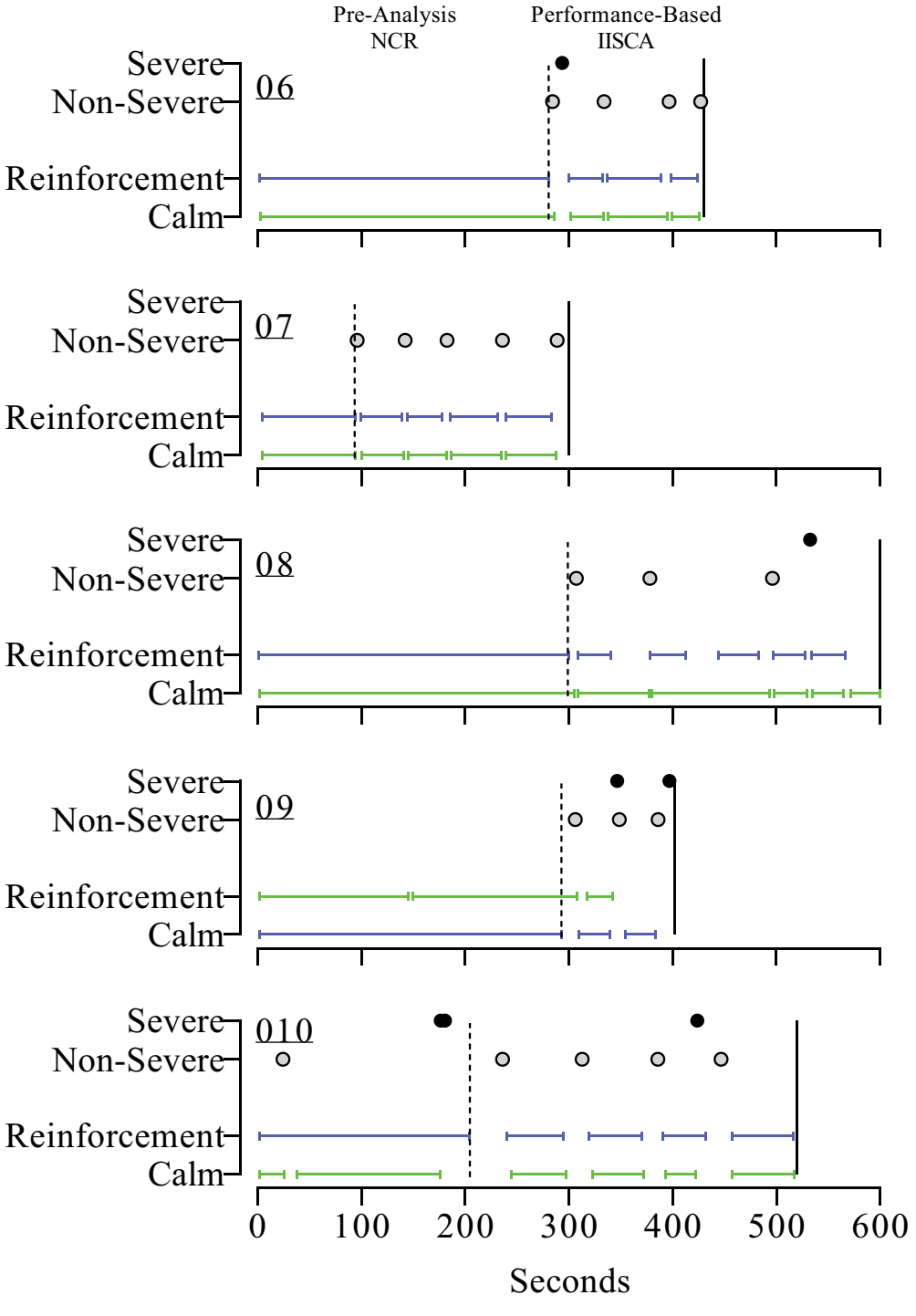

Figure 2. Results of the performance-based IISCA for participants 6 through 10. The solid vertical line on the right indicates the termination of the analysis. NCR refers to non-contingent reinforcement.

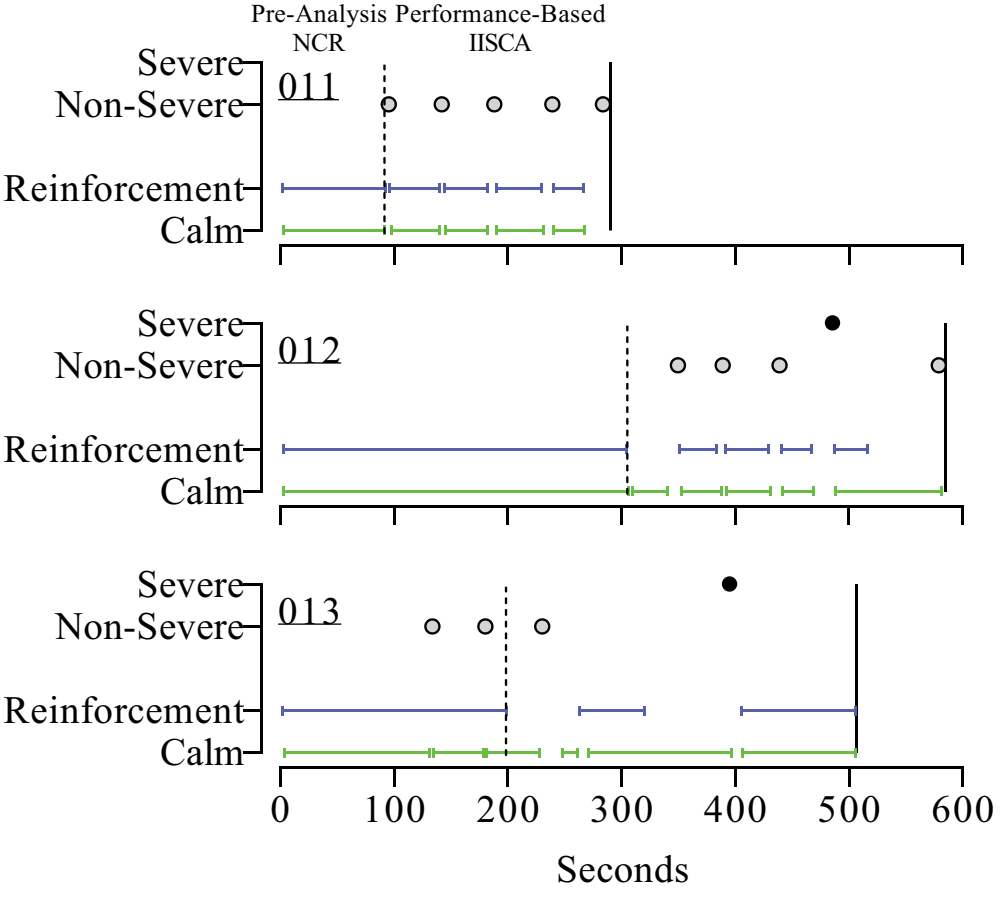

Figure 3. Results of the performance-based IISCA for participants 11 through 13. The solid vertical line on the right indicates the termination of the analysis. NCR refers to non-contingent reinforcement.

participants exclusively only engaged in severe problem behavior (Participants 1 and 3). Problem behavior as a whole occurred more often during the evocative events in 10 of the 13 participants with only two participants exhibiting problem behavior when reinforcement was available during the performance-based IISCA (Participants 2 and 10).

The results of the social validity questionnaire are presented in Table 4. Overall, the responders rated the performance-based IISCA to be highly acceptable ($M = 6.5$; range = 4 to 7) and all responders providing the highest possible rating for perceived safety ($M = 7$). Finally, the responders found the contingency evaluated during the performance-based IISCA to be very representative of the context in which they experienced problem behavior ($M = 6.5$; range = 5 to 7).

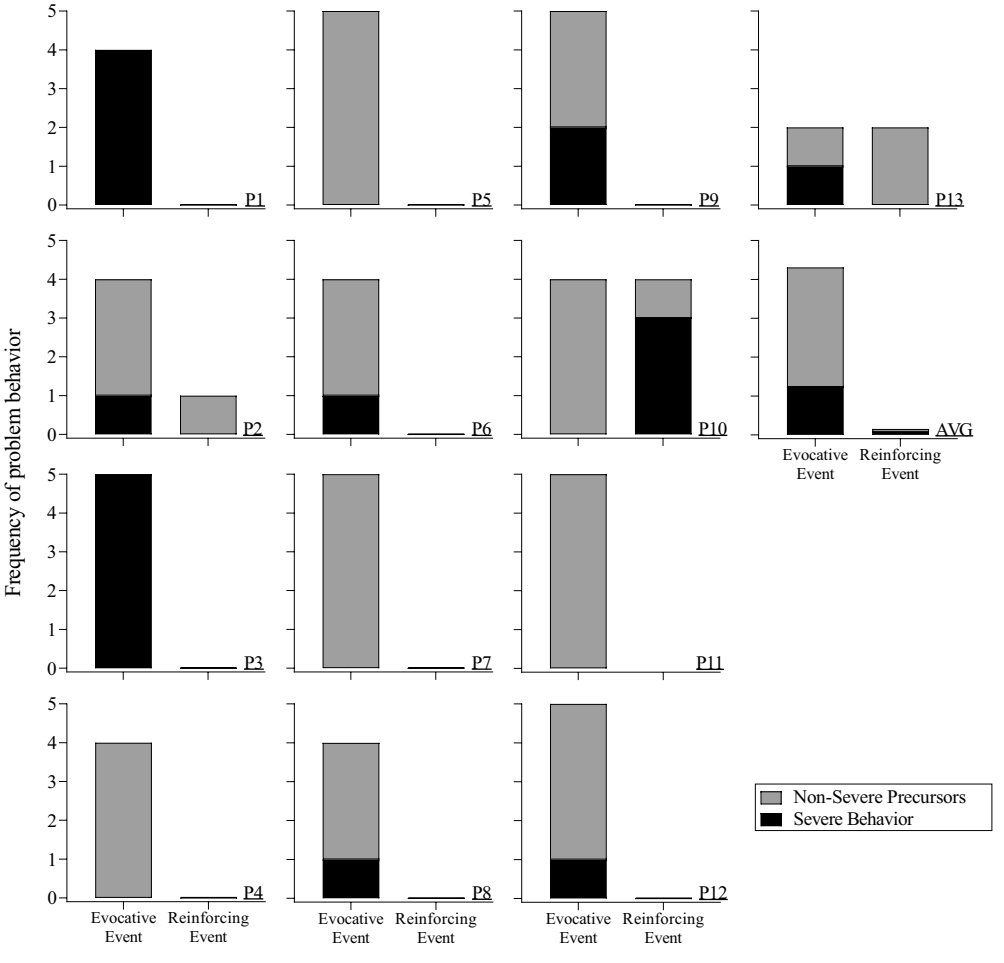

Figure 4. Frequency of problem behavior during evocative events and reinforcement.

Discussion

This study aimed to precisely replicate the methods and results of prior research on the performance-based IISCA (PB-IISCA). Furthermore, the study-maintained core components that ensured the validity and reliability of the findings. Specifically, we incorporated elements of IISCA by conducting structured interviews to gather detailed information about the target behavior, its antecedents, and consequences; observing the behavior in natural settings to identify potential contingencies; systematically manipulating environmental variables to determine the impact of different conditions on the behavior; collecting and analyzing data to identify functional relationships; defining and measuring calm behavior using observational tools; identifying and delivering effective reinforcers contingent upon calm behavior; and implementing time-based contingencies to remove demands or provide reinforcement after specified durations of calm behavior.

Our findings closely matched those of previous PB-IISCA studies, confirming that most participants exhibited socially influenced problem behaviors. This aligns with the

idea that social reinforcement is a common factor in problem behavior for individuals with autism (Coffey et al., 2020). A notable strength of our study was its inclusion of participants with limited language abilities, broadening the applicability of the PB-IISCA to a wider range of individuals with autism. While our study did not completely replicate all aspects of previous PB-IISCA studies, minor differences in procedures, such as the reinforcement schedule, might have affected the outcomes. Future research should aim to replicate the PB-IISCA using its exact methods, including ending reinforcement after 30 seconds of calm, to further validate its reliability and applicability. It is difficult to pinpoint the reasons for any inconsistencies between our study and prior research. Factors like participant characteristics, research setting, and specific implementation details might have contributed to the differences. More research is needed to investigate these potential factors and refine the PB-IISCA procedures to improve their effectiveness.

This study aimed to expand the existing knowledge on the performance-based IISCA (PB-IISCA) by including participants from Saudi Arabia, a culturally distinct population. By examining how the PB-IISCA procedures can be adapted and implemented in a different cultural context, this study contributes to our understanding of the intervention's cross-cultural applicability. The findings suggest that negative perceptions about autism services in Saudi Arabia may be attributed to a lack of familiarity with Applied Behavior Analysis (ABA) procedures. By demonstrating the effectiveness of the PB-IISCA in this context, the study provides evidence that ABA-based interventions can be successfully implemented in Saudi Arabia, even in culturally distinct settings. Furthermore, the researchers emphasized the importance of cultural sensitivity in conducting this research. By acknowledging and respecting the cultural values and beliefs of the participants, the researchers were able to foster a trusting relationship and ensure the cultural appropriateness of the intervention. To further explore the cross-cultural generalizability of the PB-IISCA, future research should consider comparing findings with other cultural contexts, examining cultural adaptations made to the PB-IISCA procedures, and identifying cultural barriers and facilitators in Saudi Arabia. By addressing these questions, future research can identify strategies for adapting the PB-IISCA to different cultural contexts and enhance its effectiveness in diverse populations.

Cultural humility is an important topic to consider in research and in practice because issues regarding race, ethnicity, or culture often go ignored. Cultural humility refers to the need for professionals to accept the fluidity and subjectivity of culture and engage in constant self-reflection to address any disparities in services (Fisher-Borne et al., 2015). Jones et al. (2020) conducted a review of research published in the *Journal of Applied Behavior Analysis* and found that less than 10% of studies reported on the participants' race or ethnicity. There is little that can be said about cultural humility within our research practices when the different cultures are not even acknowledged. When reported, every race/ethnicity other than Caucasian and African American made up less than 5% of the participants. This suggests that those who identify as Middle Eastern, such as the participants in the current study, represent only a small fraction of those in the research literature. Thus, our research needs to better inform our practice representing individuals of different cultural backgrounds.

This study aimed to conduct a Consecutive Controlled Case Series (CCCS) that included all patients admitted to the intensive daycare center. By examining all participants, regardless of treatment outcomes, we sought a more thorough evaluation of the

PB-IISCA's effectiveness in a real-world setting. The CCCS design allowed us to draw conclusions regarding the probability of the performance-based IISCA producing differentiated results in 85% of cases. However, the CCCS may have limitations in terms of selection bias and control of extraneous variables. Future research could compare CCCS findings to those from randomized controlled trials. CCCS designs have potential limitations. One such limitation is the potential for selection bias, as the participants may not represent the entire population of individuals with ASD. Additionally, CCCS designs may not allow for strict control of external factors that could influence the outcomes. To further explore the implications of conducting a CCCS, future research should consider generalizability, comparison with randomized controlled trials, and practical implications. By addressing these questions, future research can evaluate the strengths and weaknesses of the CCCS design and identify strategies for optimizing its use in evaluating interventions for individuals with ASD.

In a CCCS of more standard functional analysis procedures, Hagopian, Rooker, et al. (2013)

found that there was less than a 50% chance of initially obtaining differentiated outcomes. Therefore, 85% does appear to be an improvement; however, this may represent a decrease in the abilities of the performance-based IISCA to identify functional relations in comparison to the traditional IISCA approach. It seems obtaining an undifferentiated outcome is highly improbable among the multiple CCCSs including the traditional IISCA (Jessel et al., 2018, 2020; Warner et al., 2020). The arrangement of the applications and procedures using a CCCS allows us to make this comparison across different functional analysis formats and provides evidence that the performance-based IISCA may take less time but that improvement in efficiency might come at the expense of some experimental control.

Although we replicated a previous evaluation of the performance-based IISCA (Iovino et al., 2022) there were some notable differences in the procedures used. First, we did not extend access to reinforcement contingent on problem behavior (i.e., time-based delivery). Proponents of the performance-based delivery often suggest providing reinforcement until the participant is calm to reduce the probability of evoking a burst of problem behavior. That is because there is potential for escalation if the evocative events are presented when the participant is not calm. While we did not tend to observe bursts of problem behavior occur among our participants, this does not necessarily provide evidence to the contrary. Most of the time, calm behavior corresponded with reinforcement and, therefore, evocative events followed this pattern of being presented when the participant was already calm (i.e., the calm criteria would have resulted in nearly identical analyses). It is also possible that some participants are more prone to bursts of problem behavior and these participants were not included in the current study. An example of this possibility was the therapist beginning the performance-based IISCA when Participant 10 was not calm. We observed only a single instance of non-severe behavior during that initial evocative event without escalation to a burst. A component analysis may better inform the importance of resetting access to reinforcement and only introducing evocative events during periods of calm. Any studies specifically interested in addressing bursts of problem behavior may also want to create an empirically derived screening tool for determining behavioral profiles of individuals more prone to engage in bursts.

Second, the demonstration of the performance based IISCA by Iovino et al. (2022) involved sessions that ran from 13 to 22 minutes. In the current study, sessions were 5 to 10 min in duration. We used the time-based approach to simplify the procedures and reduce the workload on therapists, which contributed to achieving the study's goal of increasing the duration of calm behavior in participants. This approach was easier to train new therapists on, ensuring consistent application of the procedures and collecting more reliable data. We recognize that this approach may limit the flexibility of the procedures, but we considered the practical benefits to outweigh these limitations in the context of the current study. Additionally, setting a specific time to remove reinforcement serves as a conditioned stimulus for the desired behavior, which increases its occurrence and repetition. The duration of the performance-based IISCA in the current study depended on three to five occurrences of non-severe and/or severe problem behavior. In order to demonstrate more experimental control, it would have been preferred to see the number of reversals be contingent on the data obtained. For example, the therapist terminated the analysis for Participant 4 after four occurrences of non-severe behaviors and while the hypothesized evocative event was in place for problem behavior. Additional time may have resulted in a clearer demonstration of a functional relation.

Third, while functional control is typically demonstrated after a sufficient number of instances of problem behavior are observed during reinforcer absent intervals (RAIs) compared to reinforcer present intervals (RPIs), the study employed a more structured approach. For the sake of systematizing the procedures, we decided to end after a total of three to five responses during the performance-based IISCA or 10 min. Interestingly, these changes are likely to improve the efficiency of the performance-based IISCA and 85% of the results in our study still supported differentiated outcomes.

Although evaluations of termination criteria are quite common among task acquisition (e.g., Fuller & Fienup, 2018; Wong et al., 2022), the same cannot be said for the functional analysis literature. The dearth in research is probably due to the fact that functional analyses are often conducted sequentially across sessions, requiring clinicians to conduct a set number before visually analyzing the outcomes. Objective termination criteria may need to be evaluated and established specific to the performance-based IISCA, which only requires a single session to conduct. Future researchers can compare these different termination criteria to determine if they impact the validity of the outcomes.

Minor procedural differences are a probable occurrence during early stages of development. Another potential outcome is the convergence on new procedures that were not originally identified as being characteristic of the model. For example, Metras and Jessel (2021) did not mention any pre-analysis non-contingent reinforcement as being a definitive feature of the performance-based IISCA; however, every empirical demonstration has since incorporated this pre-analysis period in some form (Canniello et al., 2023; Iovino et al., 2022; Jessel et al., 2023). This change may have been to further incorporate a trauma-informed framework into the performance-based IISCA procedures as Jessel et al. (2023) suggested that the pre-analysis non-contingent reinforcement, " . . . is aligned with the trauma-informed care commitment to establishing a context in which the individual can trust those around them and feels emotionally and physically

safe" (para. 24). Thus, we believe the pre-analysis period should become part of the definition of what makes this functional analysis a performance-based IISCA.

While it is difficult to speculate on the broad change in functional analysis methodology, there does seem to be a growing focus on compassionate care and fitting our applied behavior analytic procedures into a trauma-informed framework (Rajaraman et al., 2022). Rajaraman et al. 2022 suggested that to incorporate a trauma-informed framework we need to acknowledge the potential for trauma, ensure a sense of trust by creating a safe environment, incorporate choice in our procedures, and focus on skill-building. The roots of the performance-based IISCA were designed with this framework in mind by (a) reinforcing problem behavior in an open-contingency class including non-severe problem behavior to reduce the risk of dangerous escalation and re-traumatization, (b) reducing exposure to only five presentations of evocative, potentially traumatizing events, and (c) relinquishing control over reinforcement to participant behavior instead of time-based schedules. In fact, 77% of the participants in the current study exhibited more non-severe behavior during the performance-based IISCA and 31% did not exhibit any severe behavior at all. When severe behavior did occur, it was observed five times at most and only once on average (median) during the entire functional analysis period. The avoidance of severe behavior may indicate that we are able to identify socially mediated functions of problem behavior without exposure to adverse events that have the potential to cause severe escalation and re-traumatize individuals during the assessment period. A clinician may have to concede that problem behavior will occur during a functional analysis but to be trauma-informed holds the clinician accountable to maintain a safe environment and prioritize psychological well-being.

It is important to acknowledge that the performance-based IISCA, as implemented in this study, does not fully encompass all aspects of a trauma-informed framework. Specifically, the modifications made to the IISCA primarily address two of the four commitments to trauma-informed care outlined by Rajaraman et al. (2022): acknowledging trauma and promoting safety/trust. There were multiple limitations in the current study that can inform further improvements in the design of the performance-based IISCA to be more trauma informed. For example, the open-ended interview could be modified to include more questions regarding parental reports regarding safety and risk. Canniello et al. (2023) conducted the performance-based IISCA with 11 Italian participants who exhibited problem behavior. The open-ended interview used to inform the performance-based IISCA had additional questions including (a) the number of topographies the caregivers observe, (b) a Likert scale of the severity experienced, (c) the speed with which problem behavior escalated, (d) historical influence of problem behavior, (e) cost of property damage, and (f) the base rate of severe problem behavior. The authors found that the question regarding escalation speed was correlated with more severe problem behavior during the performance-based IISCA and a greater probability of observing a burst. Questions in the social validity questionnaire following the performance-based IISCA could also be modified to more directly address experienced trauma before and after the performance-based IISCA to ensure that the child's predicament is not worsened. The social validity questionnaire may be best suited to address other difficult constructs such as feelings of trust and shared governance if provided to participant themselves to complete.

This study aimed to gather social validity on the acceptability and appropriateness of the PB-IISCA procedures by administering questionnaires to staff members who received training in the PB-IISCA. The results indicated that staff members found the PB-IISCA procedures to be acceptable, safe, and consistent with their past experiences with problem behavior, suggesting their appropriateness and value within the context of the intensive daycare center. However, the social validity data was limited to the perspectives of trained staff members. Future research should broaden data collection to include caregivers, other healthcare professionals, and individuals with ASD themselves to provide a more comprehensive understanding of the PB-IISCA's perceived acceptability and effectiveness. To gain a more complete picture, future research should incorporate the perspectives of individuals with ASD into social validity assessments, investigate how perceptions of acceptability and effectiveness may change over time, and explore the influence of cultural factors. By addressing these questions, future research can provide a more comprehensive and nuanced understanding of the PB-IISCA's social validity and inform its implementation in different settings and populations.

One limitation of this study is that we only presented the data collected during the performance-based IISCA and not during the subsequent skill-based treatment that targeted building communication, tolerance, and cooperation skills. Unfortunately, all treatments thereafter were conducted as clinical services and did not represent an experimental design. There have been meta-analyses supporting large effect sizes of treatments following the IISCA (Layman et al., 2023) and reinforcement thinning procedures associated with the IISCA (Muharib et al., 2022); however, there has only been one empirical demonstration to date of treatments specifically informed by the performance-based IISCA (Jessel et al., 2023). To further advance the field of applied behavior analysis and autism spectrum disorder, future research should focus on collecting and analyzing treatment data based on PB-IISCA procedures. This would involve implementing PB-IISCA interventions with a larger sample of individuals with ASD and systematically tracking changes in problem behavior, adaptive functioning, and quality of life over time. By conducting rigorous treatment studies, researchers can provide stronger evidence for the effectiveness of PB-IISCA interventions and identify best practices for their implementation. Additionally, this research can help to inform clinical decision-making and improve the outcomes for individuals with ASD.

A second limitation of this study is the potential impact of our inclusion criteria on the generalizability of our findings. While our participant pool included children from diverse backgrounds residing in Saudi Arabia, it was primarily composed of Saudi Arabian children. This geographic focus may limit the applicability of our results to a broader population. Additionally, our participant selection process was based on convenience and availability, which may have introduced some bias. Future research could explore more diverse sampling methods to enhance the external validity of the study.

A third limitation of this study is that the authors did not explicitly describe how participants or their legal guardians provided informed consent to participate in the research. Additionally, the process for withdrawing consent was not clearly outlined. Future research should ensure that informed consent procedures are fully documented and communicated to participants and their families. By addressing this limitation in future studies, researchers can strengthen the ethical integrity of their work and enhance

the generalizability of their findings. Another limitation of this study is the potential impact of the therapists' demographic factors on their responses to the social validity questions. For example, how acceptable is the intervention to participants, caregivers, and other stakeholders? Does the intervention address socially significant behaviors or outcomes? Is the intervention practical and feasible to implement in real-world settings? Is the intervention culturally sensitive and appropriate for the target population? While the questions focused on general acceptability and safety, factors such as race/ethnicity, age, gender, and training may influence their perspectives on cultural responsiveness. Future research could explore these factors in more detail to gain a better understanding of the social validity of the intervention from different perspectives.

A fourth limitation is the lack of procedural integrity. Novel procedures can be difficult to implement, and it is important to ensure that applied research, conducted in clinical settings, can be implemented by therapists with high levels of integrity. The figures do afford some indirect interpretation of procedural integrity in that it is possible to observe the data on the therapist presenting and removing reinforcement in a systematic fashion. For example, the reinforcers do not seem to be presented "immediately" following the first instance of non-severe behavior during the performance-based IISCA of Participant 13. In another example, it is visible that the therapist should have continued the pre-analysis non-contingent reinforcement until Participant 10 was calm. However, these appear to be exceptions, providing credence to the overall procedural integrity of implementing the performance-based IISCA.

A fifth limitation of this study is that we did not explicitly assess the potential impact of prior trauma on the participants' responses to the PB-IISCA procedures. Future research should collect information on participants' history of traumatic experiences to examine whether prior trauma influences the effectiveness of the intervention. This could involve assessing exposure to traumatic events, the severity of the trauma, and the participant's coping mechanisms. By gathering this information, researchers can identify any potential adaptations or modifications that may be necessary to address the unique needs of individuals with a history of trauma.

Notes

1. Term introduced in Jessel et al. (2016).
2. There are 7 credentialing levels. Level 1 refers to the lowest level and only requires the completion of coursework, training, or a workshop. Level 7 refers to the highest level and requires the completion of the entire FTF training program and experience providing consultation services in the practical functional assessment and skill-based treatment model. More information can be found at https://ftfbc.com/credentialing/

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Declaration

I declare that this written submission is original research, has been written by me Noha Almarzooq and my colleagues and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I declare that the work contained herein is my own except where explicitly stated otherwise in the text, and that this work has not been submitted for any other degree or professional qualification.

Data availability statement

The authors confirm that the data supporting the findings of this study are available within the article. Raw data and Supplementary material that support the findings of this study are available from the corresponding author, upon reasonable request.

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