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RESEARCH ARTICLE

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Use of synthesized analysis and informed treatment to promote school reintegration

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Severe problem behavior within a school can result in exclusion from education. A practitioner providing school-based services must plan an effective treatment, while mitigating safety risks to the child and others. In this study, we sought to replicate the interview-informed synthesized contingency analysis and treatment procedures developed by Hanley and colleagues in a school setting for a 12-year-old boy with autism and severe problem behavior. However, due to a severe burst in behavior, we increased treatment intensity and introduced procedures across increasing academic demand contexts to promote safety. During a treatment extension, procedures were implemented by teacher aides, across the entire school day. Treatment resulted in meaningful reductions in problem behavior, sustained improvements in compliance, and the student was fully integrated into the regular classroom. In addition, improvements in functional communication and tolerance persisted across contexts and the intervention received high social validity scores from those involved.

KEYWORDS

Interview-informed synthesized contingency analysis, public school, severe problem behavior, functional communication training, social validity

1 | INTRODUCTION

Challenging behavior in children, such as aggression or property destruction, may occur at such intensity, frequency, or duration that the physical safety of the child, or others, can be placed in serious jeopardy. As a result, the challenging behavior may seriously limit the child's access to ordinary community facilities (Emerson & Bromley, 1995). In an educational setting, severe challenging behavior can lead to a child being excluded from learning opportunities due to the risk to other students or teaching staff, (e.g., taught in an isolated room; Allman & Slate, 2012). In the most severe cases, the child may be suspended or expelled from school, which is associated with multiple negative outcomes

including increased risk of academic failure, delinquency, and drug use (American Academy of Pediatrics Committee on School Health, 2003; Sheryl, Stephanie, Herrenkohl, Toumbourou, & Catalano, 2014).

Behavioral interventions, especially those based upon functional assessment, have a strong evidence-base demonstrating their efficacy (National Autism Center, 2009, 2015). However, the majority of research publications focus on specific aspects of assessment and interventions conducted in controlled settings (Hanley, 2012; Smith, 2013). This increased focus has resulted in fewer publications that report the entire course of treatment, the sustainability of behavior change in natural environments, and the extent to which behavior change is meaningful (Hanley, Jin, Vanselow, & Hanratty, 2014). The lack of comprehensive assessment and intervention in the natural environment suggests a lack of evidence for effectiveness (see Chambless & Hollon, 1998, and APA Presidential Task Force on Evidence-Based Practice, 2005, for a discussion of efficacy vs. effectiveness).

Despite the limitations of the research, functional analysis and function-based treatments can be performed in school settings. Austin, Groves, Reynish, and Francis (2015) demonstrated that interventions informed by classroom-based functional analyses lead to a greater reduction in problem behavior in three boys, when compared with interventions not informed by functional analyses. Although this well-designed study was conducted in the natural environment, sessions were only 10 min in duration, and this does not represent comprehensive programming. The paucity of publications demonstrating comprehensive assessment and intervention may be due to the difficulty in implementing best-practice procedures within natural settings when the severity of challenging behavior could put the child or others at risk (Bambara, Goh, Kern, & Caskie, 2012; Hanley, 2012; Kasari & Smith, 2013).

Hanley et al. (2014) developed a caregiver-informed functional analysis that relied on synthesized (combined) reinforcement contingencies, now known as the Interview Informed Synthesized Contingency Analysis (IISCA; Jessel, Hanley, & Ghaemmaghami, 2016; Jessel, Ingvarsson, Metras, Kirk, & Whipple, 2018; Slaton, Hanley, & Raftery, 2017). The initial IISCA was implemented for three children with autism who exhibited challenging behavior. An open-ended interview informed the design of an individualized functional analysis. The functional analysis involved a test condition in which *all* of the potential contingencies were present and a control condition in which *all* of the potential contingencies were removed. Assessment results highlighted varied behavioral functions: including access to attention and tangible items and access to control over a situation (e.g., compliance with mands; Bowman, Fisher, Thompson, & Piazza, 1997). The IISCA results then informed an intervention that taught functional communication, tolerance (i.e., an appropriate response to having the maintaining reinforcer delayed or denied), and compliance. Hanley et al. were able to demonstrate that the IISCA informed a cost-effective, socially valid intervention that eliminated challenging behavior and increased social skills.

Since Hanley et al.'s (2014) publication, the IISCA and informed treatments have been applied in natural settings. Santiago, Hanley, Moore, and Jin (2016) demonstrated behavior change in the client's school or home. In addition, Beaulieu, Van Nostrand, Williams, and Herscovitch (2018); Chusid and Beaulieu (in press); and Strand and Eldevik (2017) demonstrated behavior change in client's homes during behavior therapy sessions. These replications in natural settings were able to demonstrate that nonexperts, such as a teacher with training in applied behavior analysis (ABA; Santiago et al.), support workers (Santiago et al.), and ABA therapists (Beaulieu et al., 2018; Chusid & Beaulieu; Strand & Eldevik, 2017), were able to implement the IISCA-informed treatment procedures. Chusid and Beaulieu, and Beaulieu et al. were able to demonstrate generalization of the child's behavior change to novel stimuli, therapists, settings, and parents. In all of the above replications, challenging behavior decreased by more than 90% from baseline.

The replication of the IISCA and informed treatments in natural environments provide a significant step forward regarding the publication of comprehensive assessment and interventions that demonstrate the clinical utility of these processes. However, these studies are not without their limitations. Chusid and Beaulieu (in press) is the only study to report maintenance, with a 6-week follow-up. There also remains a question regarding the generalization of the treatment effects if the IISCA-informed treatment extends over the participant's entire day. One recent study (Herman, Healy, & Lydon, 2018) did not replicate Hanley et al.'s (2014) treatment procedures but demonstrated the effects of an IISCA-informed multicomponent intervention over 75% of a child's school day. The function-based intervention included a token economy, high-probability instruction sequence, and escape extinction. As yet, the

current replications of Hanley et al.'s (2014) treatment procedures have only been shown to be effective for up to 2 hr of intervention. In addition, there are limited data indicating sustained generalization of behavioral improvements across other people, settings, and contexts.

The current study was designed to replicate and extend the research of Hanley et al. (2014) and subsequent replications by implementing an IISCA-informed intervention for a 12-year-old boy with autism who displayed severe challenging behavior. However, we were required to conduct modified intensive treatment procedures to promote safety. We evaluated the longer-term progress of the intervention during a treatment extension over the entire school day in naturally occurring settings and continued to advance treatment goals towards a socially valid outcome (i.e., integration back into the general classroom).

2 | METHOD

2.1 | Participant and personnel

Adam was a 12-year-old boy, diagnosed with autism spectrum disorder, attention-deficit/hyperactivity disorder, and dyspraxia, referred to the first author for the treatment of challenging behavior within school. Following the transition from elementary school to middle school, Adam had engaged in multiple episodes of aggression, property destruction, and elopement. These behaviors resulted in Adam being gradually isolated from the classroom, his mother being phoned to collect him on approximately 20 occasions, and his school day reduced from 6 to 4 hr.

According to school records in the 2 months prior to assessment, Adam spent a mean of 80% of academic periods (range, 67% to 98%) and 100% of break periods (e.g., recess) in a room at the other end of the school from his classroom, seated on a mattress on the floor, playing games on his iPad®. Occasionally, Adam would complete brief periods of work relating to a preferred topic (e.g., caving), join the classroom to watch a video, or play alone on the playground when peers were absent. Despite Adam being able to engage in age-appropriate conversation, and follow complex instructions in the home environment, the teachers reported that they avoided placing demands because of his challenging behavior. Historically, and at the time of services, Adam was not receiving any form of ABA therapy.

Functional analysis and intensive treatment sessions were conducted by two Board Certified Behavior Analysts (BCBA®) with experience in functional analysis and interventions for challenging behavior. Intensive treatment and treatment extension sessions were conducted by three trained teacher aides (TA) employed in the school setting. Initially, one TA was a Masters-level ABA student and the other was an undergraduate business studies student. A second ABA student replaced the business studies student toward the end of the treatment extension. Adam's classroom teacher/s conducted treatment in generalization sessions. Services of the BCBAs® and TAs were funded via by the High and Complex Needs Unit, a national organization that coordinates intensive services across multiple agencies for individual children (High and Complex Needs Unit, 2017). Adam's mother provided informed consent for services.

2.2 | Setting

All sessions took place within a public middle-school. Functional analysis and initial treatment sessions were conducted in the usual room assigned to Adam (hereafter referred to as the 1:1 room), which contained a table, chairs, and general educational materials. During the treatment extension, treatment continued in the 1:1 room, then progressed to the general classroom (with 25 other children) and other learning areas as appropriate for the classroom curriculum (e.g., music room, outside for physical education, or school hall for assembly).

2.3 | Response definition and measurement

The analysts or TAs scored data on functional communicative responses (FCRs), tolerance responses, compliance, and problem behavior. During the functional analysis and intensive treatment, behaviors were initially scored using pen

and paper recording during 5-min sessions. A stop watch was used to time sessions. FCR, tolerance, and problem behavior were summarized as responses per min. Compliance was summarized as the percentage of session duration. During the treatment extension, behaviors were scored within academic periods with durations between 60 to 75 min (total academic time was 260 min) and summarized by mean values per day.

The FCR was defined as Adam verbally requesting to escape a task demand and/or access a preferred tangible. Initially, the FCR was "can I take a break please." During the treatment extension, further FCRs included "can I have my choice please," or "can I go to my room please." Tolerance was scored when Adam stated "okay" while calm (e.g., not stated in a whining tone), and paused his current activity (e.g., pausing the iPad® game). FCR and tolerance responses were scored as prompted if an adult provided a partial or full vocal model prior to Adam making the response. The observers scored compliance when Adam engaged in behavior consistent with adult instruction (e.g., sitting down) or the ongoing task (e.g., continuing a math worksheet). Compliance within the general classroom continued to require Adam to engage in behavior consistent with adult instruction; however, due to the decreased structure of the classroom, this was further defined as (a) Adam participating in tasks consistent with the general teacher's instructions or (b) following instructions related to any school-required activity, such as attending assembly, changing uniforms, or field trips. Problem behavior included whining or crying (e.g., "noooo, but I don't want to" and "I want to go home"), property destruction, and aggression. Property destruction was defined as forcefully pushing materials off desks, throwing items, or ripping books. Aggression included forcefully hitting, kicking, or pushing an adult or peer.

A second observer independently scored behaviors during 67% of functional analysis sessions and 31% of intensive treatment period sessions. Interobserver agreement (IOA) for FCR, tolerance, and problem behavior was calculated by dividing the smaller number of responses by the larger number of responses in each 5-min session, and multiplying by 100%. For compliance, IOA was calculated by dividing the smaller duration by the larger duration of each occurrence, multiplying by 100%, and averaging the result for each session. During the functional analysis, IOA for FCR, tolerance, and compliance was 100%, and for problem behavior averaged 94% (range, 77 to 100%). During the intensive treatment period, agreement on FCR was 99% (range, 86 to 100%), tolerance was 99% (range, 80 to 100%), compliance was 99% (range, 98 to 100%), and problem behavior was 99% (range, 88 to 100%). During the treatment extension, IOA was probed during biweekly visits or by video review, equating to 6% of sessions. Agreement on FCR was 98% (range, 78 to 100%), tolerance was 98% (range, 81 to 100%), compliance was 98% (range, 86 to 100%), compliance within class was 99% (range, 94 to 100%), and problem behavior was 97% (range, 67 to 100%).

2.4 | Design

During the functional analysis, we used a multielement design to compare responding during control and test conditions. During treatment phases, we used a multiple baseline across three levels of task requirements: (a) preferred tasks, (b) academic tasks 1:1, and (c) academic tasks within the classroom.

2.5 | Functional assessment

The first author conducted an open-ended interview (Hanley, 2009) with Adam's teacher and former TA together, and a separate interview with Adam's mother. Each interview lasted between 20 and 30 min. The analyst also conducted a brief school observation for approximately 30 min. During the observation, the analyst observed Adam's responses to social or academic demands from herself or the TA, as well as his verbal language abilities. Interviews and observation suggested that Adam's problem behavior occurred when task demands were presented and when access to the iPad® was denied.

The IISCA was then conducted to test these potential contingencies. In the control condition, Adam had free, uninterrupted access to his iPad®. At the start of the sessions the analyst stated "I'm here if you need me" and planned to grant any reasonable request that occurred (e.g., assistance with the iPad®). No demands were placed.

In the test condition, the analyst instructed Adam to "finish iPad®" and sit at the table to complete tasks every 30 s (e.g., writing, reading, and math worksheets). If Adam engaged in problem behavior, the analyst stated "okay take a break" and provided a 30-s break from demands where Adam could continue to access his iPad®. If Adam failed to comply with the request to finish the iPad® and come to the table in the absence of problem behavior (e.g., ignored the instruction), a three-step prompting hierarchy was planned. The hierarchy included the analyst repeating the instruction, gesturing to the table, then providing physical guidance to remove the iPad® and guide Adam to the table. The same prompting hierarchy was planned for task completion (e.g., repeating the instruction, gesturing to the worksheet, and physically guiding responses).

2.6 | Baseline

The data from the IISCA test condition served as an initial baseline phase across all behaviors. We also applied baseline conditions to academic 1:1 tasks and academic classroom tasks prior to intervention. Specifically, academic 1:1 tasks were always available and classroom based tasks were available during the treatment extension (when school was in effect). Adam was reminded that he could choose to participate in these contexts; however, no programmed consequences were in effect.

2.7 | Intensive treatment procedure

Prior to the intensive treatment, two 1-hr treatment sessions were implemented with Adam. Adam mastered FCR and tolerance responses but engaged in severe problem behavior following extinction in the compliance phase (when instructed to sit at the table to complete academic tasks). The extinction burst lasted 45 min in duration, involving severe aggression toward the first author and property destruction within public school areas. Due to the risks of further extinction bursts (particularly to peers nearby), and the upcoming summer vacation, further treatment sessions were suspended until the following school year (8 weeks later, including 5 weeks of vacation).

During the intensive treatment, Adam returned to the school a week prior to other students, where only the BCBAs®, TAs, and senior school staff were present. He attended school between 4 and 6 hr. Treatment sessions were 5 min and were conducted back-to-back within academic periods of between 60 and 75 min. A total of 16 to 33 sessions were conducted per day and covered the entire school day.

Treatment consisted of functional communication training (FCT), tolerance training, and compliance training initially applied to compliance with preferred tasks. Table 1 outlines the procedures applied in the intensive treatment phase. Prior to intensive treatment, the analyst identified preferred tasks via a task preference survey, similar to the negative-reinforcement assessment described by Zarcone, Crosland, Fisher, Worsdell, and Herman (1999). The survey listed variations of all academic tasks available within the school setting (e.g., reading out loud, silent reading, and listening to an adult read; survey available from first author). For each item Adam was required to indicate his preference on a scale from "no way" to "I don't mind" to "I like it."

We followed school-wide safety protocols throughout all treatment phases. Upon the occurrence of property destruction or aggression, we notified senior school staff by phone call (who would arrive and monitor the safety of Adam and the analysts, help to clear the room of breakable items, or guide peers away if they were present).

2.7.1 | Preferred tasks + FCT + tolerance training

Adam's most highly rated tasks on the task preference survey informed the initial list of preferred tasks. Before sessions began, the analyst showed Adam that his "task choices" were present on the table and that he would be instructed to sit and choose a task. The analyst then used instructions, modeling, role-play, and feedback (i.e., Behavioral Skills Training, BST) to teach Adam the FCR statement "Can I take a break please" to have a break from instruction and continue iPad® access. We did not require "excuse me" as part of the initial FCR response (e.g., Hanley et al., 2014) because the analysts were clearly available in the 1:1 room.

TABLE 1 Outline of treatment steps by session (intensive treatment) or day (treatment extension)

	Step	Description	Session/Day
Intensive treatment		Preferred tasks + FCT	
(Date: January 23 to 27, 2017	1.1	FCR: "Can I take a break please"	4–14
		Preferred tasks + tolerance training	
	2.1	State "okay" [TA: FCR only]	15–18
	2.2	State okay while analyst touches iPad®	19–27
	2.3	State okay while analyst pulls iPad®	28–30
	2.4	State okay, release iPad®, and headphones to analyst	31–32
	2.5	State okay and analyst places iPad® into tray	33
	2.6	State okay and Adam places iPad® into tray	34
		Preferred tasks + Compliance training	
	3.1	Sit [TA: FCR + tolerance]	35
	3.2	Make choice	36–37
	3.3	Compliance with preferred tasks [TA: Compliance]	38–119
Treatment extension	3.4	School in session, day extended day [TA implementation]	1–5
(Date: January 31 to		Academic tasks 1:1 + FCT + tolerance + compliance training	
August 04, 2017)	3.5	Compliance with simple instructions (FCR: "Can I have my choice please")	6
	3.6	Compliance with varied academic tasks	7–29
		Academic tasks in the classroom + FCT + tolerance + compliance training	
	3.7	Leave 1:1 room, enter classroom (FCR: "Can I have my room please")	30
	3.8	Sit and watch in classroom	31
	3.9	Compliance with classroom tasks	32–60
		Generalization to classroom teacher/s	
	3.10	[Teacher: FCR]	65, 1 week[a]
	3.11	[Teacher Compliance]	74, 2 weeks[a]
	3.12	[Teacher implementation, TA fading]	78–85, 3–5 weeks[a]

Note. Behavioral skills training were conducted with Adam prior to each step, with the exception of 3.4 and generalization (3.10–3.12). Square parentheses indicate TA or teacher training at the relevant step. Round parentheses indicate the new FCRs taught in the treatment extension.

[a]Reported as weekly probes in Figure 2.

The analyst presented the instruction "Come sit and choose an activity" approximately every 30 s. An immediate verbal prompt ("say Can I take a break please") was provided on the first trial, then was only provided if Adam did not respond within 5 s on subsequent trials. Upon the FCR (prompted or independent) the analyst removed demands and provided immediate access to the iPad® for 30 s. If Adam did not state the FCR (following the prompt), did not comply with the instruction, or engaged in problem behavior, the three-step prompting hierarchy as detailed for the IISCA was implemented. If an FCR response occurred concurrently with problem behavior (e.g., Adam stated the FCR in a whining tone), the analyst restated the expectation and waited for problem behavior to cease for 5 s before prompting the FCR. The criterion to progress to teaching tolerance included independent correct responding on at least 80% of opportunities across three consecutive sessions or 100% correct responding in one session. In any case problem behavior was required to be zero.

Adam was then taught to tolerate the delay or denial of his FCRs. Tolerance was separated into a series of teaching steps described in Table 1. The analyst conducted BST prior to sessions relevant to the teaching step. For example, at Step 2.1, the analyst taught Adam to state "okay" upon denial of his FCR. At Step 2.2, BST included the analyst stating "now when I say not right now, I'm going to put my hands on your iPad® like this (model), and I need you to stay calm and say okay". The terminal tolerance response (Step 2.6) was for Adam to state "okay," remove his headphones, turn his iPad® off, and place his iPad® away, while remaining calm for the duration of these responses.

The analyst denied Adam's FCR on 60% of trials, stating "no" or "not right now." On the remaining trials (40%) the analyst provided access to the break upon the FCR. The schedule of trials was preplanned prior to sessions using a random number generator. When the FCR was denied, and Adam engaged in his tolerance response at the relevant teaching step, the analyst provided immediate access to the iPad®. Prompting was conducted in the same manner as

for FCRs. The three-step prompting hierarchy was applied if Adam did not engage in his tolerance response, did not comply with the instruction, or engaged in problem behavior. The same performance criteria previously described (80% correct responding in three consecutive sessions or 100% correct in one session), informed the progression of tolerance teaching steps and progression to the next treatment phase.

2.7.2 | Preferred tasks + compliance training

The goal of this phase was for Adam to spend at least 80% of academic blocks participating in alternative activities to his personal iPad®. The delay to iPad® access was gradually increased by requiring Adam to comply with adult instructions. Prior to training sessions, the analyst explained the current expectation to Adam (e.g., "I'm going to tell you to come and sit, sometimes when you ask for a break I'll say not right now, and you will still need to come and sit").

Instructions initially remained the same as the previous phase: for Adam to sit at the table and choose a task. The analyst provided a break upon the FCR on 20% of trials and upon the terminal tolerance response (place iPad® in tray) on 20% of trials. On the remaining 60% of trials, the analyst denied the FCR and repeated the relevant instruction. We continued to preplan the schedule of trials prior to sessions using a random number generator. On a compliance trial, if Adam complied with the instruction and met the task requirements (e.g., coming to sit), he received access to a break and the iPad® for 30 s. If Adam did not comply with the instruction or engaged in problem behavior, the analyst implemented the three-step prompting hierarchy as previously described.

Over the course of sessions, the response or duration requirement for compliance was gradually increased before providing reinforcement. The initial response requirement was compliance with between one and three simple instructions related to the chosen task (e.g., if Adam selected to read an online article, the analyst asked "What is the article about?" or "Who is in the picture?"). The response requirement varied on each compliance trial, predetermined by a random number generator. If Adam chose to continue participating in a task, he could do so until a regular break occurred (e.g., recess) or he engaged in an independent FCR. When Adam met the previously described performance criteria with the initial response requirement, we advanced to a variable duration requirement, starting between 30 s and 1 min. We then advanced the duration requirement based on Adam's mean duration of compliance in the preceding three sessions.

Following lengthier periods of compliance prior to an FCR, we increased the reinforcer duration to approximately 50% of the duration spent on-task. For example, if Adam followed instructions for 40 min then requested a break, we provided the break and iPad® for approximately 20 min, which included recess time. However, we did not provide any rules to Adam regarding the on-task requirement or length of breaks. We did not advance compliance further during the intensive treatment as it was of interest to first observe stability in performance during the treatment extension.

During this phase onwards, the occurrence of aggression or property destruction also resulted in subsequent sessions returning to FCT only, then progressing to tolerance, then compliance, using the performance criteria previously described. This regression criterion was applied to reduce the likelihood of further problem behavior.

2.7.3 | Teacher aide training

One of the TAs was present during all intensive treatment sessions and the analysts provided instructions and modeled procedures in-situ with Adam. As the analyst advanced through treatment levels, the TA implemented procedures only for responses from the previous treatment level. For example, during tolerance training, the analyst interspersed the TA reinforcing the FCR responses only (see Table 1). Then during compliance training, the TA reinforced both FCR and tolerance responses only. By the end of the week, the TA conducted all procedures with in-vivo coaching by the analysts.

2.8 | Treatment extension

Compliance with further task requirements was targeted when the regular school term started in the following week, with peers returning and the usual school timetable in place. Table 1 outlines further procedures conducted in the

treatment extension. During the first week, the school day was extended for Adam, from 8:45 to 3:00 pm (Step 3.4; see Table 1). The TAs implemented all procedures with weekly visits from the analysts as well as frequent email and phone support. Preferred tasks initially continued in the 1:1 room, but Adam was regularly advised of tasks occurring in the regular classroom and academic materials were provided by the classroom teacher. Adam could choose to engage in an academic task 1:1 or join the classroom at any point. We progressed to the next compliance phase when Adam participated in alternative activities to his personal iPad® for at least 80% of two consecutive academic periods (60 to 75 min).

2.8.1 | Academic tasks 1:1 + FCT + tolerance + compliance training

At this task requirement level, the goal was for Adam to comply with varied adult-led academic tasks, for 70% of academic period durations, similar to the criteria in previous literature (Hanley et al., 2014). Academic instructions were equivalent to the current classroom demands (e.g., topics aligned with the class schedule and materials obtained from teacher).

We applied the same procedures to teach FCR, tolerance, and compliance in this context. First, the analyst and TA taught Adam a novel FCR ("my choice please") in order to return to preferred activities. We selected this new reinforcement contingency because data in the previous phase indicated that preferred activities could act as a reinforcer (e.g., Adam chooses to continue participating even when a break was available). Upon mastery of the novel FCR, we targeted tolerance in the same manner as the previous phase. Then, compliance was targeted by increasing the duration or response requirement using the same method as described in the previous compliance phase. For example, if Adam had chosen to read, the TA presented the classroom academic demands (e.g., math worksheet) every 30 s. If Adam engaged in the FCR ("my choice please"), the TA then provided the reinforcer (removal of demand, access to reading for 30 s) upon the FCR, tolerance, or compliance. If Adam chose to keep working on academic tasks, the TA allowed him to do so until it was completed, recess occurred, or he engaged in an independent FCR. We progressed to the final compliance phase when Adam complied with academic tasks for at least 70% of two consecutive academic periods.

2.8.2 | Academic tasks in the classroom + FCT + tolerance + compliance training

The final goal of the treatment extension was for Adam to comply with varied academic demands within the general classroom alongside peers, for 70% of academic period durations. Training of the FCR, tolerance, and compliance were completed as had been done previously. We first taught Adam one further FCR ("my room please") in order to escape the classroom and return to 1:1 academic activities. We applied the same logic as in the previous phase; that accessing a less-demanding context could act as a reinforcer. During a session, the TAs interspersed demands to go to the classroom with the 1:1 academic demands. For example, if Adam was completing a math worksheet in his 1:1 room, the TA would state "it's time to go to class now" every 1 min. If Adam engaged in the FCR "my room please," the TA would provide the reinforcer (staying in the room and continuing the previous task) upon the FCR, tolerance, or compliance. A preferred task or the iPad® was still provided if Adam engaged in his previously taught FCRs ("Can I take a break please" and "Can I have my choice please"). Expectations gradually progressed from leaving the 1:1 room, to entering the classroom and watching, to staying in the classroom for variable durations and completing relevant tasks.

2.8.3 | Generalization to classroom teacher/s

As Adam increased his time spent in the classroom the general teacher implemented more of the intervention. This was vital as funding for Adam's TAs was due to be reduced later in the year. First, Adam's general questions were deferred to the teacher (e.g., those regarding assigned work or requests for assistance). Then, Adam was taught to state "excuse me" and wait for teacher attention prior to the FCR. The teacher was trained using the same process previously implemented for TA training. For example, upon an FCR, the TA directed Adam to the teacher on a variable

schedule (e.g., "I don't know, check with ____"). The teacher initially reinforced all FCRs, then gradually increased instructions during the denial. The TA's physical presence was also faded, with initial steps including (a) sitting at a greater distance, (b) helping other students, and (c) leaving the room for 5 to 10 min periods.

2.9 | Social validity

We measured social validity via surveys provided to Adam, his parents, and school staff (teacher and leadership staff) at the end of the intensive treatment period and at the end of the first school term (at 10 weeks of treatment extension). Each survey contained five to seven questions with a 7-point Likert scale. Questions related to assessment procedures (first survey only), goals, treatment procedures, general support provided by the team, and whether the respondent would recommend this intervention for others. In addition, Adam was asked to rate school out of 10. Questions can be found in Table 2.

TABLE 2 Social validity scores for each question and respondent

	Ratings								
	Survey 1			Survey 2					
Questions	Mother	Adam	Mean	Mother	Adam	Father	School 1	School 2	Mean
1. Rate the extent that you were satisfied with assessment of Adam's behavior at school	7	-	7	-	-	-	-	-	-
2. Rate the extent to which you are satisfied with the goals for Adam's intervention Being at school/in class for learning is a good goal for the job I want when I'm older	7	7	7	7	7	6	6	6	6.4
3. Rate the extent to which you are satisfied with the behavioral techniques used with Adam so far I am happy with how the TAs (a) taught me to ask for a break and choose to work this week; (2) ask me to work and go into class but also allow me to take breaks when I need them	7	7	7	7	7	7	6	6	6.6
4. Rate the extent to which you are satisfied with the general support and communication by the team	7	-	7	7	-	7	6	6	6.5
5. Rate the extent that you are satisfied with improvement in behaviors at school so far My behavior has been better (a) this week than last year; (b) in the last few weeks than at the start of the term	7	7	7	7	6	7	6	6	6.4
6. Would you recommend similar services for a child in a similar situation to Adam? I think other young people could be helped (a) by having a week like I have had; (b) in the same way I am being helped	7	4	5.5	7	7	7	7	7	7
7. Please rate school right now from 1 to 10, with 1 being the worst ever, and 10 being the best ever	-	10	10	-	10	-	-	-	10

Note. Survey 1 (postintensive treatment) was only completed by Adam and his mother. Survey 2 was administered at Week 10 of the treatment extension and did not include Question 1. Questions administered to Adam are represented in italics for surveys 1 and 2. We did not administer Questions 1 or 4 to Adam. Ratings ranged from 1 = *not satisfied*, *definitely no* (Adam) to 7 = *highly satisfied*, *definitely yes* (Adam).

3 | RESULTS

Figure 1 displays Adam's IISCA results. No problem behavior occurred during the control condition. In test conditions, problem behavior increased between 2.4 and 2.8 responses per minute. These results suggested that Adam's problem behavior was sensitive to escape from demands and continued access to his iPad®. Adam's problem behavior may also have acted as a mand for compliance (e.g., for adults to comply with requests for escape and/or access to tangibles).

Figure 2 presents compliance across levels of task requirements, problem behavior, combined FCRs, and tolerance responses. Compliance with academic classroom tasks (third panel) is empty during intensive treatment, as class was not in session. In the problem behavior panel, a gap in the data path indicates where bursts of problem behavior occurred, with durations noted. In these cases we recorded the duration of the bout as we could not reliably measure rate due to following safety procedures.

At the start of intensive treatment, Adam immediately complied with a preferred task (reading in library) and requested to continue for the duration of the academic period. Therefore, problem behavior, FCR, and tolerance responses were 0, and compliance was 100%. Adam later met performance criteria for FCR, then tolerance, but responses were variable due to consecutive sessions with 100% compliance. However, compliance was variable and reduced to 0% across consecutive sessions. Upon the implementation of compliance training, Adam intermittently engaged in FCR and tolerance responses, and compliance was 100% for most sessions. Problem behavior was zero in most sessions, but a burst occurred during Session 90 (first session of the day) due to an extension of that school day to 3:00 pm. The regression criteria were applied on this day (see above).

During the treatment extension, compliance with preferred tasks showed a decreasing trend as Adam chose to participate in some academic tasks 1:1 and in the classroom (e.g., physical education); however, compliance did not reach clinically significant levels. A burst in problem behavior occurred on Day 5 (first period of the day), when Adam was denied the ability to finish the day at 1:00 pm (regression criteria were applied). On Day 6, Adam then met criteria for FCR, tolerance, and initial compliance (see Table 1, Step 3.5). Compliance with academic tasks 1:1 reached clinically significant levels over subsequent days before showing a decreasing trend when Adam started to increase compliance in the classroom.

Similarly, compliance with academic tasks in the classroom did not reach clinically significant levels of performance until compliance training was implemented. On Day 30, Adam mastered FCR, tolerance, and initial compliance (entering the classroom; see Table 1, Step 3.7). Adam then gradually increased compliance durations in the classroom (range, 74 to 96% of academic periods). During the teacher generalization phase, data are reported from a randomly selected day of each week (weekly probes). Compliance maintained at clinically significant levels.

FCR and tolerance responses persisted at variable rates when compliance was targeted with academic tasks 1:1, then reduced to low rates when compliance increased with academic tasks in the classroom. Problem behavior

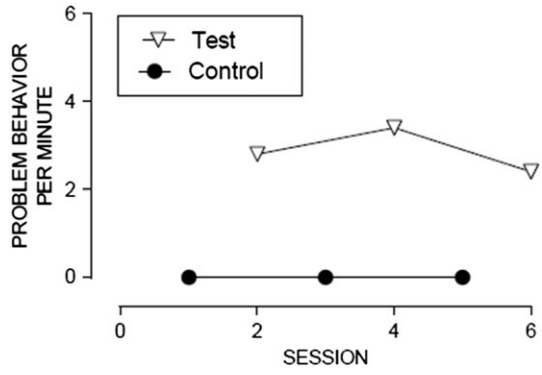

FIGURE 1 Results of the interview-informed analysis for Adam

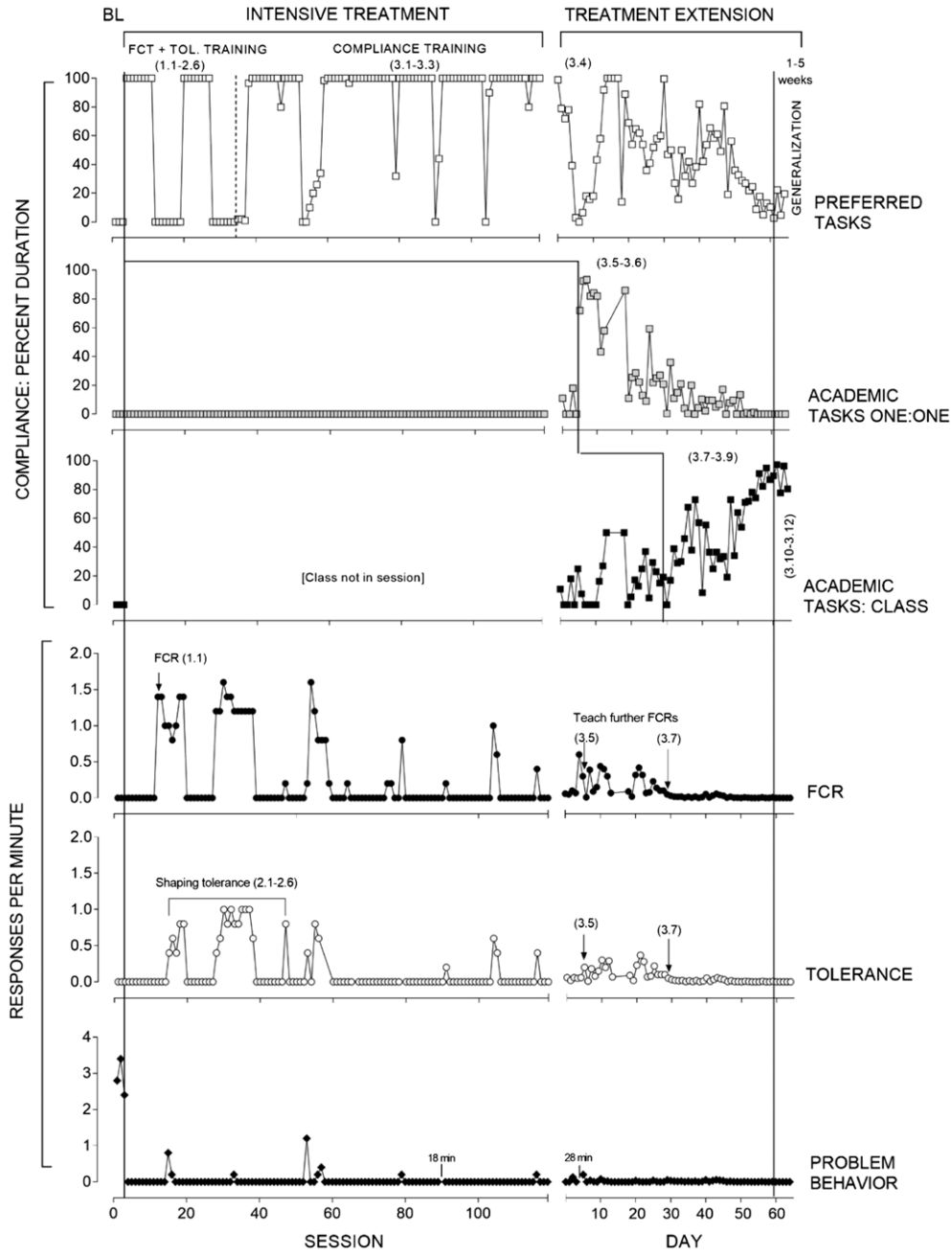

FIGURE 2 Treatment analysis for Adam. The FCR panel displays combined FCRs as detailed in Table 1 ("Can I take a break please," "Can I have my choice please," and "Can I have my room please"). Numbers in round parentheses above panels refer to treatment steps, detailed further in Table 1 and the text. In the problem behavior panel, gaps in the data path indicate bursts in problem behavior, duration in minutes noted above. During the treatment extension, data were summarized as average values per day. During the generalization phase, data were summarized as weekly probes (data from a randomly selected day of the week)

remained at low levels throughout increased task requirements, with the exception of Day 5 (described above). During the generalization phase, FCR and tolerance responses continued to occur at low rates: FCRs ranged from 3 to 17 per day (mean: 9) and tolerance responses ranged from 1 to 12 per day (mean: 5).

3.1 | Social Validity

Social validity scores are presented in Table 2. The first feedback survey was provided to all respondents but was only completed by Adam and his mother. The second feedback survey was completed by Adam, his mother and father, and two school staff. All respondents gave high ratings of satisfaction (6 to 7), with the exception of Adam's response to the question: "I think other young people could be helped by having a week like I've had" (score of 4). On both surveys Adam rated school 10 out of 10. Further qualitative feedback (open-ended comments) is available from the first author.

3.2 | Cost of assessment and treatment services

Actual costs billed throughout the course of services are presented in Table 3. In addition to BCBA® hours, we include additional TA hours required during the treatment extension (e.g., overlap sessions between TAs). Regular TA hours are not included as they were funded regardless of this intervention. At the time of writing, the first author continued to monitor implementation at three-weekly intervals.

4 | DISCUSSION

This study initially aimed to replicate the procedures of Hanley et al. (2014) for a 12-year-old boy with severe problem behavior, in a public school setting. The IISCA identified the potential maintaining contingencies of problem behavior and informed a function-based intervention. However, following an extinction burst during initial treatment, we implemented modified treatment procedures in a 1:1 setting, prior to other children returning to school. During a treatment extension, the intervention was applied to increasing levels of academic demand. The eventual treatment package reduced problem behavior by more than 90%, and increased compliance, which resulted in Adam being integrated back into the regular classroom. Adam's responding was successfully transferred across the analysts, TAs, and multiple classroom teachers. In addition, responding occurred across the varied range of class and school-wide

TABLE 3 Actual costs of services

Service	BCBA® hours	TA hours	Cost ($US)
Interviews	2	-	$190
IISCA	1	-	$95
Initial treatment prior to study	3	-	$285
Planning for intensive treatment[a]	7	-	$665
Intensive treatment[b]	28	22	$2,989
Treatment extension	16	2	$1,550
Report writing, treatment modifications	3	-	$285
Travel costs[c]	-	-	$296
Total	60	24	$6,355

[a]Planning involved demand preference assessment, school and home meetings, and preparation of materials.

[b]Two BCBAs® were present during the first 3 days of intensive treatment.

[c]Travel costs equated to $US23 per visit (not applicable during intensive treatment). The rate for BCBAs® equated to $US95 per hour; the rate for TAs equated to $US15 per hour.

activities, some of which were unpredictable (e.g., one-off sports days). Adam, his parents, and school staff provided high ratings of satisfaction with goals, procedures, and the outcomes of treatment.

Overall, our findings confirm that the treatment procedures of Hanley et al. (2014) were effective. Although compliance improved prior to intervention, we demonstrated experimental control of the treatment package by demonstrating that compliance did not reach clinically significant levels until compliance training occurred at the relevant task requirement level. The focus on synthesized contingencies may have been the key to this effective and socially valid intervention, but this is a tentative suggestion given that the IISCA may be limited by a lack of functional control over responding (Fisher, Greer, Romani, Zangrillo, & Owen, 2016). That is, we are not certain whether problem behavior was in fact maintained by the interaction between escape (task-related demands) *and* access to the iPad®, given that the IISCA does not evaluate these variables in isolation (i.e., an escape condition versus a tangible condition in a functional analysis). Nevertheless, the use of initial synthesized contingencies (i.e., escape to iPad®) and further synthesized contingencies (i.e., escape from classroom academic tasks to 1:1 academic tasks) were part of an effective multicomponent treatment package. Future naturalistic research applications may benefit from the comparison of the IISCA and other functional analysis methods, with a focus on the long-term effectiveness of interventions informed by each of these assessment formats (Slaton et al., 2017).

Our limitation is that we were unable to replicate experimental control of the FCR or tolerance responses in treatment. These responses were variable, due to improvements in compliance from the outset of intensive treatment. It is likely that the incorporation of preference-based task choices reduced the likelihood of problem behavior and facilitated early compliance during the FCR and tolerance phases (Dunlap et al., 1994; Reid & Green, 2006). Clinically, the increase in compliance was beneficial, as it allowed Adam to contact natural reinforcers (e.g., social praise and completion of tasks). However, the inclusion of preferred tasks resulted in delays in training FCR and tolerance responses due to the absence of part of the establishing operation (i.e., a nonpreferred task). During the treatment extension, pretreatment increases in compliance with 1:1 and classroom academics potentially occurred because some scheduled tasks were preferred (e.g., a physical education activity). It is also possible that Adam came into contact with further natural reinforcers (e.g., praise from the classroom teacher and peer interactions) that again contributed to improvements in compliance.

The current study varied from previous applications by implementing procedures over an *entire* school day. Previous studies have reported 5- to 60-min sessions, and daily session time equating to no more than 120 min (Beaulieu et al., 2018; Chusid & Beaulieu, in press; Hanley et al., 2014; Santiago et al., 2016 & Strand & Eldevik, 2017). In comparison, we implemented treatment during all daily academic periods, totaling 260 min per day, similar to the comprehensive programming shown by Herman et al. (2018). During intensive treatment, we required 5 days to gain compliance. In comparison, Hanley et al. (2014) provided treatment over 19 to 22 visits within a 2-month period before clients reached treatment extension. The actual costs of treatment in this study are similar to those extrapolated by Hanley et al. (average $7150) but are significantly higher than Santiago et al.'s (2016) school-based replication (average $4225). In this study, higher costs were due to the requirement of two BCBAs® during intensive treatment, the preparation of academic resources, and the longer-term planning for classroom reintegration. In future research it will be useful to compare the effectiveness and cost of treatments provided at differing levels of intensity.

The step-wise approach to staff training in this study also presents an interesting area for future research. In order to establish the TA as the discriminative stimuli for FCR, tolerance, and compliance, the analyst faded these personnel in as soon as Adam had obtained independence in the targeted response. For example, once Adam was independently providing the FCR, the TA implemented the FCR trials, and the analyst implemented tolerance trials. This training approach provided multiple opportunities for real time, in-vivo modeling, practice, and feedback and may have facilitated generalization (Stokes & Baer, 1977).

Similar to previous studies, we achieved high ratings of social validity. We measured social validity on two occasions and requested feedback from parents, school staff, and Adam himself. Involving the recipient of behavior change procedures in the social validity process is strongly recommended (Hanley, 2010) and was possible due to

Adam's competent language abilities. The responses of school personnel are also important, considering they are often tasked with determining referrals to behavioral providers.

A further outcome of this study is the extent to which treatment affected Adam's overall academic functioning. During the treatment extension, Adam completed multiple academic assessments. The results compared Adam's performance with national standards and indicated that Adam was "at" age level for reading and science, "below" age level for writing, and "on track" for mathematics. Unfortunately, we cannot make comparisons with pretreatment academic functioning, because Adam did not comply with any previous assessment attempts.

As a final note, the current authors had knowledge of IISCA-informed treatments from the research literature but had not evaluated these until a workshop was provided in New Zealand (Hanley, 2016). Similarly, previous authors highlighted that their adoption of functional analysis occurred following a personal visit by Iwata (Wacker et al., 1994). As a field we concentrate on the dissemination of behavior analysis to "non" behavior analysts but not how to disseminate new technology within our discipline. This is important now that behavior analysts are prevalent in countries with limited access to professional development opportunities. We hope that leading researchers will consider the value in visiting other countries to disseminate new technology, which in turn will allow clinicians to evaluate the effectiveness of such interventions in varied settings.

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CONFLICT OF INTEREST

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ETHICAL APPROVAL

All procedures performed in this study were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

INFORMED CONSENT

Informed consent was obtained from the participant included in the study.

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