
AFFIRMING CONTROL BY MULTIPLE REINFORCERS VIA PROGRESSIVE TREATMENT ANALYSIS

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It is common to isolate reinforcement contingencies across several test conditions in functional analyses of problem behavior; however, synthesizing all reinforcement contingencies in a single test condition may also have merit and even be necessary in some cases. Following a differentiated functional analysis, which relied on an interview-informed synthesized test condition, functional communication training (FCT) was applied across the three suspected contingencies of reinforcement, partly in an attempt to understand the relevance of each. Communication responses were acquired for all three reinforcers, and problem behavior ceased only when all contingencies were addressed via FCT, suggesting that problem behavior was controlled by multiple contingencies of reinforcement. These analyses suggest that control by multiple contingencies of reinforcement can be understood during the treatment development process following a highly efficient functional analysis. Copyright © 2015 John Wiley & Sons, Ltd.

The prevalence of emotional and behavioral problems in young children has been reported to be as high as 26% in the general population (Brauner & Stephens, 2006), and for many children, these problem behaviors continue into adolescence and adulthood (Loeber, 1991; Schaeffer et al., 2006). The short-term and long-term negative side effects of aggressive and disruptive behavior on the overall quality of life, academic success, and social well-being of children and their families have been well documented (Card, Stucky, Sawalani, & Little, 2008; Herring et al., 2006). Schaeffer et al. (2006) found that a chronic pattern of aggressive–disruptive behavior in elementary school children is highly predictive of antisocial outcomes in adulthood. Other researchers have found a strong positive correlation between children’s problem behavior and parental mental health problems and family dysfunction (Herring et al., 2006).

Behavioral interventions based on a functional analysis of problem behavior have been shown to be efficacious treatments that significantly reduce various

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topographies of severe problem behavior, such as aggression, disruption, self-injury, and extreme emotional outbursts (Campbell, 2003; Heyvaert, Saenen, Campbell, Maes, & Onghena, 2014). There is, however, considerable variability in the speed and success of functional analyses in detecting the variables responsible for problem behavior and in promoting practical function-based treatments (Jessel, Hanley, & Ghaemmaghani, 2015).

Functional analysis is an assessment procedure that requires direct observation of behavior, while an environmental event, usually a reinforcement contingency, is manipulated (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994). A functional analysis requires at least two conditions: (i) a test condition in which a contingency is arranged between problem behavior and the environmental events suspected of maintaining the problem behavior and (ii) a control condition in which the contingency between problem behavior and the environmental event in question is absent (Hanley, Iwata, & McCord, 2003). This environmental event, however, does not need to be a single and isolated reinforcement contingency. It can be a combination or synthesis of reinforcement contingencies. Nevertheless, behavior analysts typically attempt to isolate single contingencies of reinforcement suspected of influencing problem behavior in functional analyses (Beavers, Iwata, & Lerman, 2013; Hanley et al., 2003). For example, in a typical isolated attention condition, the child is in a room with some neutral toys, and no adult interaction, all mands, and social bids for attention are ignored until the target problem behavior occurs. Following each instance of problem behavior, the adult delivers a brief statement of concern or a reprimand for approximately 5 s. In a typical escape condition, the child is placed in an empty room and the adult presents academic demands, again, all mands and social bids for attention are ignored, compliance is followed by a brief praise statement, and three-step prompting is used to ensure compliance. Each instance of problem behavior, however, results in 30 s of removal of demands, while no other reinforcers are delivered during this interval (i.e., the therapist removes demands and ignores the child for 30 s). These tests of isolated contingencies are often compared to a play control condition in which both contingencies are simultaneously removed. In this play condition, the child has continuous access to highly preferred toys and escape from demands (none are presented), and attention in the form of praise is usually provided on a fixed time schedule (e.g., every 30 s).

In a functional analysis using synthesized contingencies, by contrast, two or more classes of reinforcement are combined such that all putative reinforcers are simultaneously withheld and subsequently delivered contingent on problem behavior (Ghaemmaghani, Hanley, & Jessel, 2015; Hanley, Jin, Vanselow, & Hanratty, 2014). For example, in a synthesized escape to attention test condition, a child is in a room with an adult, and demands are presented, while attention is withheld; once the child engages in problem behavior, demands are removed, and attention such

as conversation about favorite topics is delivered for 30 s. This synthesized test condition is then compared to a control condition in which escape from demands and access to conversations are freely and continuously available throughout the session, and no other factors differ (i.e., the same materials are used in both conditions).

In a review of published functional analyses, Beavers et al. (2013) found a slight increase in the percentage of undifferentiated (8.3%) and multiply-controlled (24.3%) outcomes as compared to those described by Hanley et al. (2003) 4.1 and 14.6%, respectively. Beavers et al. proposed that the prevalent use of multiple response topographies in functional analyses may be responsible for this increase. An alternative or additional explanation may be that as functional analyses are being applied to the problem behavior of higher functioning individuals, the typical practice of attempting to isolate reinforcement contingencies in functional analyses is producing undifferentiated analyses of multiply-controlled behavior. For example, most children in a typical classroom setting do not escape to nothing; nevertheless, negative reinforcement is isolated in most functional analyses wherein the child escapes to a barren context. When children escape work demands in a classroom, they often engage in other more preferred activities instead. They might go for a walk, play on the computer, listen to music, talk to other peers, or talk to the teacher. Many school protocols detailing responses to problem behavior involve removing the child from the work environment into a calming area that can entail access to paraprofessionals' undivided attention as well as various calming activities such as exercise balls, fine-motor, or sensory activities. In some cases, ignoring interactions regularly occurring in the child's typical environment by de-coupling the co-occurring reinforcers in a functional analysis may result in an undifferentiated analysis because deprivation from other reinforcers not provided in an isolated test condition may yield elevated responding across all conditions. By taking into account that which is reported or observed to co-occur following problem behavior, a synthesized test condition can be designed in which the child escapes instruction to tangibles and attention contingent on problem behavior while these same reinforcers are continuously provided in a matched control. Because all reinforcers suspected of maintaining problem behavior are simultaneously delivered in the test condition, and freely available in the control condition, a clearly differentiated functional analysis may result.

Attempting to isolate the main effect of a reinforcer in a typical functional analysis and then reporting overall rate of responding may also overestimate the extent to which main effects of reinforcers are demonstrated in traditional-functional analyses. Within-session analyses of response patterns were initially used to clarify behavioral function when undifferentiated analyses were obtained (Roane, Lerman, Kelley, & Van Camp, 1999; Vollmer, Marcus, Ringdahl, & Roane, 1995). For instance, Roane et al. (1999) analyzed within-session patterns of responding in relation to the

presence or absence of the putative reinforcer and found that in some cases of undifferentiated functional analyses, problem behavior was mostly occurring during the reinforcer present interval suggesting that problem behavior was likely not maintained by the reinforcer under investigation. For example, although some problem behavior was occurring during the escape condition for the participant named Tacita in the work of Roane et al., the within-session analysis indicated that these responses were mainly occurring during times that escape was provided. By contrast, most of the problem behavior during the materials condition was occurring during the reinforcer absent interval, leading the authors to conclude that Tacita's problem behavior was maintained by social positive reinforcement in the form of access to materials. An alternative interpretation of these results implicates a synthesis of both escape and tangibles as maintaining reinforcers. It may be that providing escape alone was an incomplete reinforcer for Tacita's problem behavior, maintaining the establishing operation (EO) related to tangible reinforcement and thus continuing to evoke problem behavior maintained by tangibles; perhaps, escape from demands to access preferred materials was the relevant contingency. Given that noncontingent escape is provided within the materials condition, we are not able to rule out this alternative explanation. In sum, the focus on isolating a putative reinforcement contingency in a single test condition may lead us to overlook unprogrammed EOs that may be influencing problem behavior outside of the programmed and isolated contingencies.

Synthesized contingencies are not new; several different researchers have combined contingencies in published functional analyses (e.g., Bowman, Fisher, Thompson, & Piazza, 1997; Call & Lomas Mevers, 2014; Call, Wacker, Ringdahl, & Boelter, 2005; Fisher, Adelinis, Thompson, Worsdell, & Zarcone, 1998; Hagopian, Bruzek, Bowman, & Jennett, 2007; Laraway, Snyckerski, Michael, & Poling, 2003; Piazza, Hanley, Fisher, Ruyter, & Gulotta, 1998; Piazza et al., 1997; Poling, 2001; Zarcone, Fisher, & Piazza, 1996). For instance, following an undifferentiated analysis relying on procedures described by Iwata et al. (1982/1994), Bowman et al. (1997) conducted an analysis using only two conditions. In the test condition, each instance of problem behavior resulted in the therapist complying with all child mands for 30s, while in the control condition, the therapist continuously complied with all of the child's mands. This analysis can be conceptualized as a synthesis of positive and negative reinforcers as children could request items, attention, termination of one activity, resumption of another, or a change in the manner in which items and activities are presented or manipulated during the reinforcement interval. Another example of a synthesis of positive and negative reinforcers can be found in a study by Hagopian et al. (2007) in which interruption analyses were conducted, following inconclusive traditional analyses. In the control condition, the child was given access to a preferred activity, and the therapist complied with all child

mands. In the test condition, the therapist issued a demand that required the child to do something incompatible with his ongoing activity, removed the child's access to this activity, and stopped complying with the child's demands. Problem behavior, however, resulted in the child escaping the demand, and resuming his ongoing activity while having all his demands met for 30 s. These syntheses of positive and negative reinforcers resulted in clearly differentiated analyses in both cases.

Although researchers have sometimes moved beyond analyzing the main effects of generic classes of social positive and social negative reinforcement, these analyses have always been conducted following undifferentiated outcomes of traditional-functional analyses in which generic contingencies are assessed in isolation from one another. In order to increase the ecological validity and efficiency of the assessment process, Hanley (2010, 2011, & 2012) suggested that open-ended interviews with caregivers be used to help design a single test analysis, which may include a single contingency or any combination of suspected contingencies and that this test/control analysis be conducted in lieu of a standard functional analysis involving multiple and isolated tests of generic contingencies. This sort of assessment model was evaluated in a recent study by Hanley et al. (2014). The model proved to be an efficient process for identifying the unique synthesized contingencies influencing each of the three children's severe problem behavior and for developing effective function-based treatments. Socially validated outcomes were achieved as children's problem behavior was eliminated and replaced with functional communication and compliance chains during intervals in which reinforcers were unavailable.

The necessity of the synthesized contingency was evident for one of the children named Bob from the work of Hanley et al. (2014). In Bob's case, isolating the suspected contingencies of reinforcement was not possible as the event maintaining his problem behavior involved a simultaneous contingency of negative and positive reinforcement. For example, in one context, Bob preferred to do his math work in a very particular manner and engaged in problem behavior to escape all adult instruction to do his math work differently. It was not possible to tease out *escape* from *access* in this case because the action by the adult to stop redirecting necessarily provided uninterrupted access to his math materials. A synthesized contingency was not necessary in this same sense with a second participant named Gail, instead, the necessity of the synthesized contingency was empirically demonstrated with Gail. When the effects of tangible and attention reinforcement contingencies were assessed separately in distinct test conditions, neither appeared to influence problem behavior (i.e., zero or near-zero rates of problem behavior were observed in test sessions). By contrast, differentiated results were obtained when these contingencies were synthesized in a single test condition. In this test condition, both attention and preferred toys were initially unavailable to Gail, and both were simultaneously provided following instances of problem behavior or their reported precursors. It appeared that the

presence of toys freely available in the isolated condition testing for problem behavior sensitivity to attention diminished the value of attention and that the presence of attention freely available in the isolated condition testing for problem behavior sensitivity to tangibles diminished the value of the toys such that problem behavior was evoked when and only when both reinforcers were withheld and subsequently delivered following problem behavior in the test condition with the synthesized contingency.

Although the synthesized contingencies used in the analysis described by Hanley et al. (2014) led to effective and socially validated treatment outcomes, questions may sometimes arise as to the relevance of each class of reinforcers included in synthesized contingency analyses. For instance, the functionality of all synthesized contingencies was not demonstrated with their third participant named Dale. In addition, given that Hanley et al. (2014) taught an omnibus mand that resulted in the simultaneous delivery of all putative reinforcers, treatment did not illuminate whether problem behavior was sensitive to one or multiple reinforcers with this participant. This problem could be resolved by testing each contingency separately. But because, in some cases, important interactive effects of reinforcement contingencies may remain unknown when contingencies are assessed in isolation (e.g., as with participant Gail), isolated tests may be inefficient and imprecise means of determining control by one or more reinforcement contingencies. As an alternative, this problem may be addressed by teaching function-specific communication responses in a sequential manner following differentiated results of synthesized analyses. If following the introduction of each reinforcer-specific communication response and simultaneous extinction of that reinforcer for problem behavior, we see a rise in the use of the communication response and a corresponding reduction in problem behavior; we may conclude that problem behavior is at least partially maintained by that reinforcer. This procedure of understanding specific control by each reinforcer in the treatment analysis is consistent with the notion of *affirming the consequent* (Sidman, 1960).

Sidman (1960) introduced the tactic of *affirming the consequent* as an alternative to direct replication and called it 'very nearly the life blood of science' (p. 127). Although he recognized the risks involved with this tactic, he also highlighted the power of this tactic for increasing our confidence in the reliability and generality of our data. It is for this reason that the tactic of affirming the consequent is commonly used in science, including behavior analysis. An example of applying the tactic of affirming the consequent in the context of identifying the function of problem behavior can be found in a study by Smith, Iwata, Vollmer, and Zarcone (1993) in which a sequential evaluation of treatments appropriate for different functions was used to confirm the results of functional analyses. The application of this tactic is also evident in a seminal study by Iwata, Pace, Edwards Cowdery, and Miltenberger (1994) in

which the importance of implementing function-based extinction procedures was affirmed through treatment analyses.

Similar to that described by Smith et al. (1993) and Iwata et al. (1994), the hypothesis of multiple controlling contingencies, which were implicated in an interview-informed synthesized-contingency analysis (IISCA), was more precisely examined in a progressive treatment analysis in the current study. Functional communication training (FCT), an efficacious treatment for problem behavior (Tiger, Hanley, & Bruzek, 2008), was applied sequentially across three suspected reinforcement contingencies to determine if each was relevant to problem behavior.

METHOD

Participant and Setting

Dan, a 7-year-old boy with no formal psychiatric diagnosis, was referred by public school personnel for treatment of severe problem behavior including aggression and motor disruptions. At the time, Dan was being taught in a self-contained classroom with three other children all with developmental disabilities. Dan reportedly engaged in problem behavior when his preferred leisure activities were interrupted or terminated and he was asked to complete the necessary academic tasks in the classroom. He also had trouble playing independently, while his teacher was busy with other students. Disruptive and aggressive episodes could last 30 min and occurred multiple times per day. Dan communicated in full sentences and could follow multi-step vocal instructions.

All functional analysis and treatment sessions were conducted in an oval-shaped meeting room in Dan's school, which contained a child-sized table, two chairs, and academic and play materials. Sessions were conducted one to two days per week, three to eight times each day, and were 5 min in duration.

Measurement and Interobserver Agreement

Trained observers collected data via computers that provided a second-by-second account of responses and relevant contextual features. The number of problem behavior and functional communication responses (FCRs) was recorded. *Problem behavior* included aggression (e.g., hitting, biting, kicking, hair pulling, spitting, head-butting, and pushing) and motor disruption (e.g., throwing items/furniture, knocking/swiping materials off of the table, and banging/pushing items/furniture together). FCRs included break responses ('May I have a break please?' and 'Will you give me some time please?'), responses for tangible items ('Will you give me [item] please?' and 'May I have my stuff please?'), and responses for adult attention ('Will you play with

me?’ and ‘May I talk to you please?’). FCRs were considered prompted if the analyst provided a vocal model of any part of the FCR before Dan independently emitted the response correctly. Independent FCRs included any close approximation of the target FCR in a mand frame. Only independent FCRs are reported. Duration data were collected on the presence of an EO for three possible reinforcers: *escape* (considered present when academic work materials were in front of Dan and/or when a verbal demand was issued), *tangible* (considered present if preferred items were present but were out of reach), and *attention* (considered present when the analyst turned or walked away or ignored social bids and excluded when attention was delivered as part of a prompt). An abolishing operation (AO) was considered in effect when the related EO was not in place. The rate of responses in the presence of an EO or AO was then calculated by dividing the number of responses that occurred during each specific EO and AO time period by the total duration of EO and AO time, respectively.

Interobserver agreement was assessed by having a second observer collect data on all targets simultaneously but independently during 28% of sessions. Records were compared on an interval-by-interval basis, and agreement percentages were calculated by dividing the smaller number of responses or duration (in seconds) in each interval by the larger number. IOA for problem behavior and FCRs averaged 99.8% (range, 97 to 100%) during the functional analysis and 99% (range, 82 to 100%) during the treatment analysis. IOA for the presence of an EO averaged 92% (range, 72 to 100%).

Experimental Design

A multielement design was used to compare the test and control conditions of the functional analyses. The effects of differential reinforcement of reinforcer-specific communication responses and extinction of problem behavior were evaluated using a multiple baseline design across reinforcement contingencies.

FUNCTIONAL ASSESSMENT PROCESS

Open-Ended Interview

An open-ended functional assessment interview (Hanley, 2012) was arranged with Dan’s classroom teacher to discover potential factors influencing his problem behavior. The open-ended interview lasted 50 min and included questions about Dan’s abilities, preferred activities, problem behavior types, contexts in which behavior problems were likely, and teacher responses to problem behavior. This interview was followed by a 20-min informal observation of Dan in the classroom.

Interview-Informed Synthesized-Contingency Analysis

Informed by the results of the interview, an IISCA was conducted to evaluate the multiple contingencies suspected of influencing Dan's problem behavior. During the control condition, Dan was given uninterrupted access to his highly preferred items (e.g., iPad, blocks, and Lego), no demands were issued, and the analyst delivered attention at least every 30s while responding to all social bids. In the test condition, the analyst removed/blocked Dan's access to preferred items, ignored social bids, and presented instructions to complete a writing task. A combination of verbal and partial physical prompts was used to promote compliance. If Dan complied without problem behavior, the analyst provided brief praise and continued to present demands. If problem behavior occurred at any time, the analyst immediately removed demands, provided access to the highly preferred items, and delivered specific forms of attention (e.g., 'let's calm down', 'let's talk', and 'I like the way you are playing now') for 30s.

Single Test Analysis-Attention

Given the lengthy dialogs that often followed Dan's problem behavior during the 'calm-down' procedures in his regular classroom, we also conducted a single-test analysis of attention. In this single test condition, moderately preferred leisure items were available continuously, and the analyst pretended to be busy with paperwork; if problem behavior occurred at any time, the analyst immediately delivered attention for 30s. The same context was arranged for the control condition except attention was available continuously.

TREATMENT PROCESS

Three classes of FCRs were introduced sequentially across the three suspected contingencies of reinforcement. The synthesized test sessions from the functional analysis plus one additional session served as the baseline to evaluate treatment. A small number of pre-session training trials (up to five) were conducted prior to the introduction of each FCT phase, in which the relevant FCRs were taught using behavior skills training (instructions, modeling, role play, and feedback).

During FCT, all sessions started with the presentation of the specific evocative situation (e.g., the analyst would stop conversing with Dan, interrupt his Lego activity, and present a writing worksheet). During sessions, demands were presented, and delayed verbal, model, and physical prompting was used to ensure compliance. A most-to-least prompting hierarchy was used to teach the target FCR until 80% of FCRs were independent. Once FCRs were independently

occurring, prompts were faded to a vocal prompt every 60 to 90 s, if no FCR was emitted during the evocative trial.

Functional Communication Training-Escape

Two escape FCRs were selected and placed on a fixed ratio schedule of reinforcement whereby each instance of the FCR would result in a 30-s access to a break. All problem behavior prior to the emission of escape FCR was placed on extinction. Dan was taught to say ‘May I have a break please?’ or ‘Will you give me some time please?’ to access the 30-s break from instructions. Once a break was provided, any additional problem behavior resulted in the immediate delivery of attention and tangibles for the remainder of the 30-s break.

Functional Communication Training-Tangible

During this phase, Dan was taught two tangible FCRs to obtain preferred items (‘Will you give me the [item] please?’ and ‘May I have my stuff please?’) following a request for a break. All problem behavior prior to the emission of the escape FCR and the tangible FCR was placed on extinction. Escape and tangible reinforcers were withheld unless target FCRs for these reinforcers occurred. Once the break and tangibles were provided, any additional problem behavior resulted in the delivery of attention for the remainder of the 30-s break.

Functional Communication Training-Attention

Two attention FCRs to access adult attention were taught last. These were ‘Will you play with me?’ and ‘May I talk to you please?’ During this phase, problem behavior was on extinction at all times. The analyst withheld access to all reinforcers and reinforced each FCR with the specified reinforcer.

RESULTS

Functional Assessment

The open-ended functional assessment interview suggested that Dan’s problem behavior was evoked when (i) he was instructed to complete a task; (ii) teachers were not available to play or talk with him; or (iii) preferred items were removed. We hypothesized that Dan’s problem behavior served to escape teacher instructions to then access tangible items and teacher attention (in the form of discussions of his problem behavior and compliments of his play). Therefore, a

synthesized reinforcement contingency of escape to tangibles and attention was tested in the IISCA.

During the IISCA, problem behavior was observed exclusively in the test sessions when Dan's problem behavior terminated adult instruction and allowed him to gain access to his highly preferred items and adult attention (Figure 1).

Given Dan's teacher's report and our subsequent observation of the amount of attention that would often follow Dan's problem behavior, we also tested an attention function in isolation. Dan's problem behavior was insensitive to attention as reinforcement when attention was exclusively tested as a maintaining variable (Figure 2).

TREATMENT

Introduction of FCT-escape resulted in a reduction of problem behavior and some FCRs for escape (left column of Figure 3), but problem behavior persisted. When FCT-tangible was added, FCRs for tangible occurred at high levels, an increase in FCRs for escape was observed, and the level and variability of problem behavior were further reduced. The addition of FCT-attention resulted in a high level of FCRs for attention, maintenance of the other FCRs, and elimination of problem behavior.

Higher rates of responding in the presence of the putative EO rather than AO would suggest that deprivation from the putative reinforcer was evoking responding and that the particular reinforcer was controlling problem behavior. The right column of Figure 3 shows that 94% of FCRs for escape were emitted during the escape EO, 97% of FCRs for tangibles were emitted during the tangible EO, and 95% of FCRs for attention were emitted during the attention EO; and problem behavior (bottom right panel) was almost exclusively observed (97%) when at least one of the three EOs were present.

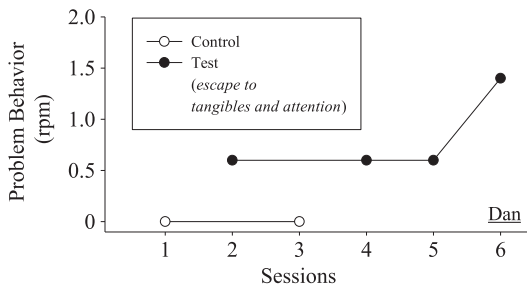


Figure 1. Interview-informed synthesized-contingency analysis results for Dan.

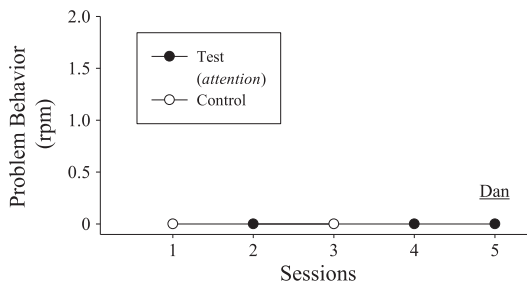


Figure 2. Attention analysis results for Dan.

DISCUSSION

When multiple reinforcement contingencies were implicated by Dan's teachers during an open-ended interview, we designed and implemented a synthesized test condition, rather than three distinct test conditions, because it appeared that the reinforcers were often simultaneously provided. In other words, the teacher did not report that Dan was given a break from instruction for problem behavior and was then ignored and not allowed to play with the toys available in the classroom. Instead, the teachers described, and we observed that when Dan was asked to complete academics whether in a group or one-on-one with a teacher, he would engage in problem behavior and then continue playing with toys or play with different toys while the teacher either provided comments aimed at relaxing Dan or praising his play behavior. Through this synthesized contingency analysis, we were able to (i) emulate the conditions described as occurring prior to and following problem behavior in his classroom; (ii) demonstrate control over problem behavior; (iii) produce a reliable baseline from which to evaluate the effects of treatment; and (iv) identify a highly motivating context in which replacement behaviors could be taught. The synthesized model presented here proved to be efficient and effective for detecting what appeared to be multiply-controlled problem behavior, replicating the results of Hanley et al. (2014).

The tactic of affirming the consequent (Sidman, 1960) was successfully employed via progressive implementation of FCT, providing additional validation of the hypothesis of multiple control. The treatment results showed that full reduction in problem behavior was only achieved when all putative maintaining contingencies were addressed via separate FCRs and relevant extinction procedures, affirming that problem behavior was controlled by multiple contingencies of reinforcement. Within-session EO analyses, similar to those modeled by Roane et al. (1999), further affirmed the multiple sources of reinforcement, as each FCR class was emitted almost exclusively during periods of relevant deprivation. It is important to note,

Multiply-controlled problem behavior

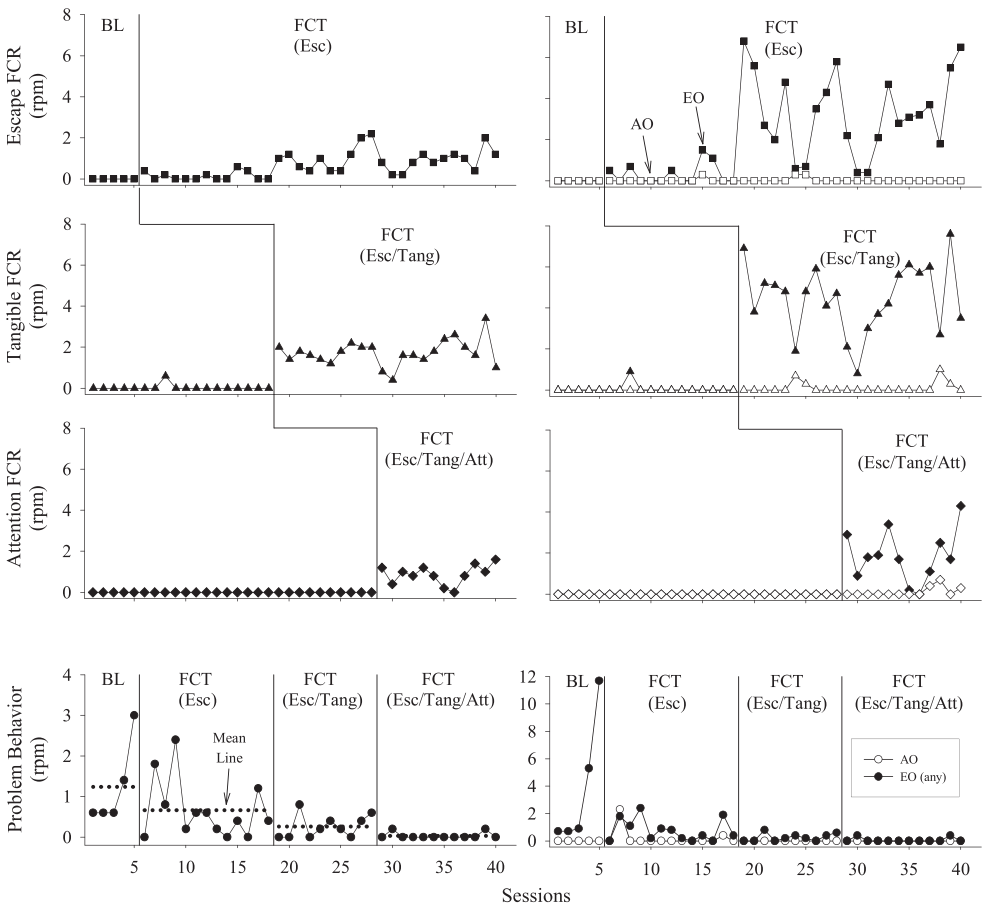


Figure 3. Functional communication responses (FCR) and problem behavior per minute during sequential application of functional communication training (FCT) across the three suspected contingencies of reinforcement (escape, tangible, and attention). Total responses per minute are depicted on the left, and responses per minute during relevant establishing operations (closed symbols) and abolishing operations (open symbols) are depicted on the right. EO, establishing operation; AO, abolishing operation.

however, that the contingencies included in the synthesized contingency analysis and affirmed through sequential treatment analysis were those that were implicated during the open-ended interview with Dan’s teachers, rather than arbitrarily chosen. In fact, the goal of the open-ended interview in this process was to increase the ecological validity of our assessment by allowing us to synthesize contingencies when the information obtained from caregivers suggested that such a synthesis is a norm in the typical environment.

Because problem behavior was eliminated only when the final contingency (attention) was addressed, one may conclude that problem behavior may have been exclusively maintained by attention. However, variability was imposed on problem behavior when the escape and tangible reinforcement contingencies were manipulated and Dan acquired FCRs for all reinforcers not just for one to obtain attention. More important, however, is that Dan's problem behavior was insensitive to attention as reinforcement when attention was exclusively tested as a maintaining variable (Figure 2). These results implicate an important interaction that was detected via a synthesized analysis—attention serving as a reinforcer for problem behavior depended on the availability of highly preferred tangibles.

Although the IISCA proved to be an effective assessment of multiply-controlled problem behavior in this case, this approach is not without its limitations. It is possible that one or more of the reinforcement contingencies implicated in an interview and synthesized in an analysis are not functionally related to the problem behavior. The analysis alone, without the confirmation provided by either a sequential treatment analysis as shown in the current study or by additional test/control analyses of isolated contingencies, does not identify the role of each class of reinforcers. The extent to which irrelevant variables are implicated in interviews with caregivers and included in subsequent synthesized contingency analyses is not yet known. Furthermore, the extent to which irrelevant variables would (i) interfere with the identification of a reinforcement contingency for problem behavior; (ii) negatively impact treatment outcomes; or (iii) result in a more cumbersome treatment is also unknown. These are important questions to be addressed in further research.

The more popular method of isolating reinforcement contingencies in a traditional functional analysis using procedures described by Iwata et al. (1982/1994) aims to more clearly identify the role of each reinforcer. The traditional analysis is, however, not well suited to identifying interactional effects of reinforcers. The question then is whether it is important to search for main effects, interactions, or both when determining the function of problem behavior. At this point, it may be best to acknowledge that there is no clear answer to this question. We simply offer that synthesizing multiple reinforcement contingencies in a single test condition may be necessary in many cases for capitalizing on suspected interactions among reinforcement contingencies. A concern with current analytical practice is that when contingencies that typically operate together are assessed in isolation in functional analysis (Iwata et al., 1982/1994), their effects may not be realized. The participant named Gail from Hanley et al. (2014) did not engage in any problem behavior when either attention or tangible reinforcers were available while the other was withheld. However, withholding tangibles and attention simultaneously evoked problem behavior easily. Also, by teaching the replacement skills when all EOs are

programmed (i.e., all reinforcers are withheld), skills are taught under the most challenging set of conditions (when all EOs are active), which may increase the generality of these skills. Nevertheless, the extent to which interactive effects are omitted in the traditional functional analysis and in turn captured by the IISCA should be the subject of future research.

Given the extensive body of literature showing the success of the traditional functional analysis in identifying the relevant variables maintaining problem behavior (Beavers et al., 2013; Hanley et al., 2003) and the impact that such analyses have had in the development of function-based interventions (Campbell, 2003), comparative analyses of the traditional functional analysis with the IISCA seem necessary. It may be the case that one approach to assessment is more appropriate for certain participant characteristics based on level of functioning, language, or the typical environmental contexts experienced (e.g., regular classroom versus institution).

Our results are similar to those demonstrated by previous researchers in that large reductions in multiply-controlled problem behavior were not achieved until all functional reinforcers were addressed via differential reinforcement (e.g., Borrero & Vollmer, 2006; Smith et al., 1993). Our results also support the results of Lalli and Casey (1996) who showed that providing a break alone is not as effective as a break plus tangibles or attention in reducing problem behavior. The process modeled in the current study is unique, however, because an efficient synthesized contingency analysis was sufficient for providing a highly motivating context in which all functionally equivalent responses could be taught.

Although the progressive treatment analysis proved useful for affirming the hypothesis of multiple control in this study, its practical application remains to be evaluated. The sequential introduction of treatment retained undesirable residual problem behavior until all putative reinforcers were addressed. Future investigators should compare the effectiveness of a single omnibus mand allowing simultaneous access to all reinforcers (e.g., 'My way please' as used in Hanley et al., 2014) to the sequential model described herein.

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