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A Translational Evaluation of Potential Iatrogenic Effects of Single and Combined Contingencies during Functional Analyses of Target Responses

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A TRANSLATOINAL EVALUATION OF POTENTIAL IATROGENIC EFFECTS OF SINGLE AND COMBINED CONTINGENCIES DURING FUNCTIOANL ANALYSES OF TARGET RESPONSES

by

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The interview informed synthesized contingency analysis (IISCA) is controversial, with some extolling its benefits relative to traditional functional analysis (FA; e.g., efficiency; Slaton, Hanley, & Raftery, 2017) and others focusing on its shortcomings (e.g., false-positive outcomes; Fisher, Greer, Romani, Zangrillo, & Owen, 2016). One limitation of prior comparisons is investigators could not ascertain with surety the true function(s) of the participants' problem behavior for use as the criterion variable. In Chapter 1, we developed a translational study to circumvent this limitation by training a specific function for a surrogate destructive behavior prior to conducting an FA and synthesized contingency analysis (SCA) of this response. In Chapter 2, we used single-subject experimental designs to evaluate iatrogenic effects during FA and SCA. The FA correctly identified the function of the target response in all six cases and produced no iatrogenic effects. The SCA produced differentiated results in all cases, and produced iatrogenic effects in three of six cases. Finally, in Chapter 3 we discuss these finding in terms the mechanisms that may promote iatrogenic effects.

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LIST OF ABBREVIATIONS

ASD	autism spectrum disorder
FA	functional analysis
IISCA	interview informed synthesized contingency analysis
SCA	synthesized contingency analysis

INTRODUCTION

Functional Analysis of Problem Behavior

The first line intervention for severe problem behavior typically involves the prescription of psychoactive medications (30% to 70% of children with autism spectrum disorder (ASD) receive psychoactive medications and 30% receive two or more medications; Goin-Kochel, Meyers, & Mackintosh, 2007; Mandell et al. 2008; Oswald and Sonenklar 2007; Rosenberg et al. 2010). One effective alternative or adjunct to medication is function-based intervention in which the behavior analyst conducts a functional analysis (FA) and then uses the results to prescribe a treatment that matches the function of the individual's problem behavior (Beavers, Iwata, & Lerman, 2013; Greer, Fisher, Saini, Owen, & Jones, 2016). Functional analysis allows clinicians to identify the variables that evoke and maintain destructive behavior, and FA has increased the prevalence of reinforcement-based interventions and decreased the reliance on medications and punishment procedures to treat problem behavior (e.g., Aman et al., 2009; Greer et al., 2016). Nevertheless, few children with ASD who could benefit from FA actually receive it (Roane, Fisher, & Carr, 2016).

Traditional FA methods (i.e., methods first described by Iwata, Dorsey, Slifer, Bauman, and Richman, 1982/1994; henceforth called FA) use controlled, single-case experimental designs to manipulate systematically and independently variables that potentially reinforce problem behavior, such as attention (e.g., Fisher, DeLeon, Rodriguez-Catter, & Keeney, 2004), escape (e.g., Zarcone et al., 1993), or access to tangibles (e.g., Mace & Lalli, 1991). This allows clinicians to (a) determine the influence of each environmental variable on problem behavior and (b) develop effective and individualized treatment (Fisher, Betz & Saini, in press; Lerman & Toole, in press; Vollmer, Athens, & Fernand, in press; Vollmer, Iwata, Zarcone, Smith, & Mazaleski, 1993).

Researchers have recommended that practitioners use FA to guide treatment selection for problem behavior whenever possible rather than indirect or direct assessments (e.g., Iwata &

Dozier, 2008). This is because multiple studies have shown indirect assessments to be unreliable, and because descriptive assessments, though generally more reliable than indirect methods, do not distinguish well between positive and negative reinforcement and often implicate attention as a reinforcer when it is a correlated but nonfunctional consequence of problem behavior (Lerman & Iwata, 1993; Thompson & Iwata, 2007). Despite the limitations of indirect and descriptive assessments, most behavioral practitioners continue to use these methods rather than FA, in part because they view FA procedures as overly time-consuming and requiring highly trained staff (Iwata et al., 1982/1994; Oliver, Pratt, & Normand, 2015).

Synthesized Contingency Analyses

Recently, researchers have recommended that practitioners use an alternative to an FA called the interview informed synthesized contingency analysis (IISCA), in part due to its brevity (Hanley, Jin, Vanselow, & Hanratty, 2014; Jessel, Ingvarsson, Metras, Kirk, & Whipple, 2018). With the IISCA, the behavior analyst interviews the caregivers using a structured interview (Hanley, 2012) and, in some cases, conducts informal observations under conditions similar to an FA. Based on the results of these preassessments, the behavior analyst then develops a single test condition that combines all of the identified putative reinforcers for problem behavior (e.g., escape to tangibles) and a single control condition in which the same putative reinforcers are provided freely and continuously (e.g., no demands and free access tangibles).

Proponents of the IISCA assert that it produces more differentiated responding, and that it is more individualized, contextually and ecologically valid, and efficient relative to an FA (Hanley et al., 2014; Jessel, Hanley, & Ghaemmaghami 2016; Jessel et al., 2018). There is strong evidence supporting the assertion that the IISCA produces rapid and clearly differentiated results between the test and control condition (Fisher, Greer, Romani, Zangrillo, & Owen, 2016; Greer, Mitteer, Briggs, Fisher, & Sodawasser, submitted; Hanley et al., 2014; Jessel et al., 2016; 2018; Slaton, Hanley, & Raftery, 2017). Whether the IISCA is more individualized and ecologically valid remains unknown because its test and control conditions are constructed based on a structured interview of unknown reliability and validity (Hanley, 2012; also see the discussion of conflicting informant reports associated with the IISCA on pp. 259-260 in Slaton et al., 2017). Finally, the efficiency of the IISCA derives primarily from the fact that it tests a single, combined contingency. For example, Saini, Fisher, & Retzlaff (accepted) compared the efficiency of a variety of FA formats in terms of the number of sessions required to identify one or more functions of problem behavior. They found the IISCA to be more efficient than an FA when comparing the total number of sessions but not when comparing the two analyses on a per-function basis (each one required an average of 5.3 sessions per function tested; although technically, the IISCA does not identify any specific function of problem behavior).

Potential Risks of Contingency Synthesis

Combining multiple putative reinforcers into a single contingency has at least two potential risks. One risk is that because the putative reinforcers of the IISCA are selected based on an indirect assessment of unknown reliability and validity, the potential for false-positive outcomes (i.e., identifying a function that does not in fact maintain the target behavior) is substantial. Fisher et al. (2016) evaluated this risk of the IISCA by examining the results of an FA and an IISCA in five consecutive patients admitted to a university-based program for the treatment of severe problem behavior. The results showed that the IISCA identified multiple consequences that did not maintain problem behavior when they evaluated those consequences in isolation during the FA (i.e., false-positive outcomes). Fisher et al. also tested whether the results of the FA and the IISCA supported the assumption of an FA that problem behavior is typically reinforced by contingencies operating independently, or the assumption of the IISCA that multiple simultaneous consequences interactively reinforced problem behavior (e.g., higher levels of aggression when it simultaneously produces attention and escape than when it produces either of these consequences in isolation). Results indicated that four of five participants displayed patterns of problem behavior consistent with the assumption of an FA but not the assumptions of the IISCA. That is, these four participants showed sensitivity to an individual contingency (e.g., tangible reinforcement) but not increased levels of problem behavior or more differentiated results when the investigators combined multiple reinforcers (e.g., escape to tangible items) using the IISCA. The fifth participant never displayed problem behavior. Greer et al. (submitted) replicated and extended these findings with 12 consecutive cases.

The second potential risk of an IISCA is that combining a functional reinforcer (e.g., escape) with a nonfunctional, but highly preferred stimulus (e.g., an iPad) has the potential to induce a novel function (e.g., teaching the individual to access the iPad via problem behavior). In medicine, when the implementation of a procedure results in a new symptom or condition, they refer to this untoward result as an iatrogenic effect (Centorrino et al., 2004). The IISCA may be more susceptible to an iatrogenic effect in the form of inducing a novel function of problem behavior than an FA because the previously nonfunctional, but preferred stimulus (e.g., iPad) is delivered multiple times contingent on problem behavior due to its inclusion in the combined contingency (e.g., escape to iPad). By contrast, the nonfunctional, but preferred stimulus is not likely to be delivered multiple times contingent on problem behavior in an FA because introduction of a single putative establishing operation should primarily evoke responses that have produced the conseque in the past (e.g., removal of iPad should primarily evoke problem behavior if access to iPad has previously reinforced problem behavior).

Slaton et al. (2017) also conducted a within-subject comparison of the IISCA and an FA with nine individuals with various problem behaviors (e.g., aggression). Although they did not directly test for iatrogenic effects of the IISCA, the results suggest this assessment has the potential to induce new behavior functions. All nine participant showed differentiated responding during the IISCA, whereas only four showed differentiated responding during the FA. However, the investigators (a) conducted the IISCA prior to the FA in all nine cases and (b) reinforced both precursor and target responses during the IISCA, but reinforced only target responses during the FA. Precursor responses are responses that reliably precede the target response (e.g., crying that reliably precedes aggression; e.g., Borrero & Borrero, 2008). Because Slaton et al. reinforced precursor responses only during the IISCA, it is possible that prior exposure to the IISCA adversely affected the results of the subsequent FA by inducing precursor responses (that failed to produce reinforcement) during the FA. Results for three of the participants (Mason, Riley, and Kyle) are consistent with this interpretation (i.e., participants primarily displayed precursor responses and their responding received few, if any, reinforcers).

For example, for the participant named Riley in Slaton et al. (2017), the investigators reinforced whining and body tensing (precursor behaviors) and aggression, SIB, and disruptions (target responses) with escape to a tangible item during the IISCA (i.e., the first analysis). By contrast, they reinforced only the target responses with individual consequences in the FA (i.e., the second analysis). During the IISCA, Riley exclusively displayed precursor responses during the test condition and displayed neither precursor nor target responses in the control condition. During the subsequent FA, Riley exclusively displayed precursor responses (at variable rates) in all of the test conditions, and these precursor responses may have been induced by prior exposure to the IISCA. That is, prior exposure to the IISCA may have increased the probability of precursor behavior and decreased the probability of the target responses occurring and contacting the contingencies in the subsequent FA. Finally, in a third analysis, the investigators conducted an FA of the precursor responses with Riley, and precursor responses extinguished in all of the test conditions except the demand condition, thereby showing a relatively clear escape function for the precursor responses. These results suggest the putative inductive effects of the IISCA may have decreased either with the passage of time or with the delivery of differential reinforcement for precursor responses in the third analysis. Overall, these results indicate it is imperative that research evaluate whether the IISCA produces iatrogenic effects in the form of novel function of problem behavior.

Purpose of the Current Study

An unavoidable limitation of previous comparisons of the IISCA with FA is that it is not possible to know with surety what the true function of problem behavior was in the participants' natural environment prior to conducting the analyses. One way to address this limitation is through a translational investigation in which the researchers program particular functions for a target response with no history of reinforcement for that response prior to conducting the comparison. In so doing, the experimenters would know the history of reinforcement and the true function of the target response at the outset of the investigation. In Chapter 1, we describe a translational preparation that is well-suited to circumvent these issues with previous studies. In Chapter 2, we use single-subject experimental designs to use this approach to evaluate (a) the extent to which an FA accurately identifies the function programmed by the researchers for the target response and (b) whether the FA or synthesized contingency analysis (SCA) induce new functions for the target response when they expose this response to additional consequences not previously correlated with the target response. In Chapter 3, we discuss our outcomes in terms of the potential risks of FA and SCA when used in practice.

CHAPTER 1: GENERAL METHOD

Participants and Setting

Participants

Six children diagnosed with ASD who attended a university-based early intervention program participated in this study. We recruited participants who were compliant with therapist requests and for whom their caregivers reported that the children did not display clinically significant levels of destructive behavior. Molly was a 7-year-old female and Tylor was a 4-year-old male who each communicated using 2- to 3-word phrases. Bobby was a 9-year-old male, Doug and Adam were 4-year-old males, and Kathy was a 6-year-old female. Bobby, Doug, Adam, and Kathy all communicated using multi-word sentences.

Setting and Materials

We conducted sessions at the early intervention clinic in small cubicles (measuring approximately 2.5 m by 1.8 m) or in individual therapy rooms (measuring approximately 3 m by 3 m). Each space contained a small table, chairs, and work or leisure items relevant to the condition.

We identified preferred leisure items based on therapist nomination and a paired-stimulus preference assessment (Fisher, Piazza, Bowman & Amari, 1996; Fisher, et al, 1992). We included these items in certain conditions of the FA and SCA (as specified below). High-preference tangible items included an iPad (Molly, Doug, and Adam), an Angry Birds sticker book (Bobby), coloring materials (Kathy), and puzzles and animal figurines (Tylor). Low-preference tangible items included a dollhouse (Molly and Kathy), a toy treehouse and an Angry Birds stuffed animal (Bobby), books (Doug), an iPad (Tylor), and a soccer ball (Adam). We also identified demand materials based on therapist nomination, which we included in relevant test conditions (as specified below). Demands included receptive object identification (Molly, Tylor, and Adam), site-word reading (Bobby), answering intraverbal questions (Doug and Kathy), gross-motor imitation (Tylor and Adam), and expressive object identification (Tylor and Adam). We created two foam cushions that were small (19 cm x 21 cm), rectangular, and covered with colored felt to serve as the target of the surrogate destructive response.

Response Measurement

Data collectors used laptop computers with a specialized data-collection program (Bullock, Fisher, & Hagopian, 2017) to collect frequency data on the surrogate destructive behavior and (actual) destructive behavior, which we later converted to rate measures (responses per minute). The *surrogate destructive behavior* consisted of the participant contacting the top of the colored cushion with his or her hand from a distance of 7.6 cm or greater. *Destructive behavior* included aggression, disruptions, and SIB. *Aggression* included hitting or kicking the therapist from a distance of 15.2 cm or greater. *Disruptions* included swiping or throwing work materials and hitting or kicking furniture from a distance of 15.2 cm or greater. *Self-injurious behavior* included self-hitting from a distance of 7.6 cm or greater. However, we observed no instance of SIB during the study.

Interobserver Agreement

A second observer collected data throughout the study via recorded video and did so on at least 34% of all sessions to assess interobserver agreement. We kept the second data collector blind to the purpose and hypotheses of the study for at least 42% of these observations for each participant with the exception of Adam. For Adam, we kept the primary data collector blind to the purpose and hypotheses of the study for all sessions. We divided each session into 10-s intervals and recorded an agreement for each interval in which both observers measured the same number of responses (i.e., exact agreement within the interval). We then divided the number of agreement intervals by the total number of intervals of the session and converted the resulting quotient to a percentage. Agreement coefficients for the surrogate destructive behavior averaged 99% or greater for each participant and equaled or exceeded 90% in every individual session. Agreement coefficients averaged 100% for aggression for all participants except for Adam, for whom the mean agreement coefficient averaged 99.8% (range 96.7% to 100%). Agreement coefficients for disruptions averaged 100% for Molly, 98.2% (range, 63.3% to 100%) for Bobby, 100% for Doug, 100% for Kathy, 99.9% (range, 96.7% to 100%) for Tylor, and 99.8% (range, 96.7% to 100%) for Adam.

Procedures

Pretraining an operant function. We randomly assigned each participant, with counterbalancing, to one of three common social functions of destructive behavior (i.e., tangible, attention, escape). We used a progressive-prompt delay to teach the participant to engage in the surrogate destructive behavior to access either a tangible item (Bobby and Kathy), attention (Tylor and Adam), or escape from demands (Molly and Doug). Sessions consisted of ten 30-s trials. Each trial began with the presentation of the establishing operation (i.e., removing attention or the high-preference tangible item, or presenting demands) until the participant engaged in the surrogate destructive behavior. We used physical guidance to teach the response and progressively delayed (up to 20 s) the presentation of physical guidance to establish independent responding. During pretraining, two response options (i.e., two different colored cushions) were available. Initially, we correlated one response with extinction and the other response with a fixed ratio 1 schedule of reinforcement for the specified function. Once the participant independently engaged in the response producing reinforcement for 90% of trials for two consecutive sessions, we reversed the contingencies for each response option. Pretraining ended when the participant independently engaged in the response producing reinforcement (i.e., the one previously correlated with extinction) for 90% of trials for two consecutive sessions. We used two similar responses during pretraining to ensure that each participant could discriminate when we correlated a particular response with reinforcement versus extinction.

During the FA and SCA (described below), we included only one pad so that only one topography of surrogate destructive behavior could be emitted by the participants (i.e., we presented only the most recently reinforced response option during the FA and SCA sessions). If at any point during the assessment there was a break of more than a week between any two sessions, we conducted a booster session using the pretraining described above to re-establish the surrogate destructive behavior. The booster session consisted of 10 trials in which we faded within-sessions prompts to engage in the response, starting with 0-s prompt delay and rapidly increasing to a 10-s prompt delay. Only Doug required a booster session.

FA. We implemented the FA based on the procedures described by Iwata et al. (1982/1994) with the modifications suggested by Fisher, Piazza, and Chiang (1996). The FA continued for at least three series and until the FA resulted in differentiated responding according to the structured criteria described by Saini, Fisher, and Retzlaff (2018). All sessions lasted 5 min, and we delivered no programmed consequences for destructive behavior (i.e., extinction) during the FA. We correlated each condition with a uniquely colored smock worn by the therapist for all participants except Kathy (due to therapist error).

Attention. Prior to the attention condition, the therapist provided attention to the child for approximately 30 s. The session began with the therapist stating, "I have some work to do" and then the therapist began to read a magazine (i.e., restricted attention). The therapist provided 20-s access to attention (i.e., interactive play) after each instance of the surrogate destructive behavior. Throughout attention sessions, the participant had continuous access to a low-preference tangible item.

Toy play. The therapist provided continuous access to attention and a high-preference tangible item in the toy-play condition. We delivered no programmed consequences for the surrogate destructive behavior (i.e., extinction) during this control condition.

***Escape*.** The therapist presented successive vocal, then model, then physical prompts until the participant displayed compliance or the surrogate destructive behavior. The therapist provided descriptive praise for compliance following the vocal or the first model prompt (e.g., "You're right, that is the dog"). The therapist provided a 20-s break from demands by saying, "Okay you don't have to," removing any demand materials, and turning away from the participant after each instance of the surrogate destructive behavior. One variation from this procedures was that for demands that required a vocal response (e.g., reading), during which the therapist repeated the model prompt until the participant either (a) displayed compliance or (b) engaged in the surrogate destructive behavior.

Tangible. Prior to the session, the therapist allowed the participant to interact with the preferred tangible item for approximately 30 s. The session began with the therapist saying, “My turn,” and restricting access to the item. While the item was restricted, the therapist interacted with the item (e.g., played games on the iPad) but did not allow the participant to engage with the item or view the screen (iPad only). The therapist provided 20-s access to the preferred tangible item after each instance of the surrogate destructive behavior.

SCA. Synthesized contingency analyses described in the extant literature tend to develop the test and control condition based on some combination of caregiver report and observation of the individual (e.g., Hanley et al., 2014). Given that we selected children who did not engage in destructive behavior according to caregiver report and we chose a target response for which we controlled the history, we were unable to use caregiver report or observation of the individual to construct the synthesized test condition. Therefore, we examined published examples of SCAs in order to create a representative standard synthesized test condition. Jessel et al. (2016) reported on 30 IISCAs and found that 23 of the 30 analyses included both a positive- and negative-reinforcement contingency. Additionally, at least 16 of the 30 analyses included multiple positive reinforcers, indicating that the majority of SCAs included all three common social functions of destructive behavior (i.e., escape, access to attention, and access to tangibles). Similarly, Greer et al. (submitted) included an IISCA test condition that included escape to attention and tangibles in 6 out of 12 cases. Given this information, we decided to include all three common social functions in our synthesized test condition as this represents the most common form of SCA published in the extant literature.

During the SCA, all sessions lasted 5 min, and we delivered no programmed consequences for destructive behavior (i.e., extinction). We correlated each condition with a uniquely colored smock worn by the therapist for all participants except Kathy (due to therapist error).

***Control*.** The therapist provided the participant with continuous access to attention and a high-preference tangible item in the SCA control condition. We programmed no consequences for the surrogate destructive behavior (i.e., extinction) during this control condition.

Test. Prior to the SCA test condition, the therapist provided attention to the participant and allowed the participant to interact with the high-preference tangible item for approximately 30 s. The session began with therapist simultaneously removing access to the preferred tangible item, terminating their attention delivery, and presenting demands to the participant using the same procedures described for the escape condition of the FA. The therapist provided a 20-s break from demands by saying, “Okay you don’t have to” and removing any demand materials after each instance of the surrogate destructive behavior. During the escape interval, the therapist delivered continuous attention and access to the preferred tangible item.

CHAPTER 2: EXPERIMENTAL OUTCOMES

Design

We used a multielement design to compare the test and control conditions during the FA and the SCA. We used a reversal design (ABCB) to evaluate whether the FA and SCA produced iatrogenic effects in the form of inducing novel, untrained functions of the surrogate destructive behavior (with A = pretraining an operant function, B = FA, and C = SCA). The FA tested for multiple functions and if any new functions emerged it would be evident during the FA (e.g., if we trained an attention function and a tangible function emerged, we would observe high levels of responding in the attention and tangible conditions in comparison to the control condition). By contrast, the contingencies combined in an SCA are, by design, confounded. Therefore, it is not possible to determine if the SCA induced any new functions based on the SCA data. In order to evaluate iatrogenic effects for the SCA, we conducted another FA following the SCA to determine whether any new functions of the surrogate target response emerged following exposure to the SCA. We also introduced the SCA following the initial FA in accordance with a nonconcurrent, multiple-baseline design across participants.

Results

All participants completed the pretraining phase within 10 sessions. Figure 1 shows the surrogate destructive behaviors per minute across sessions for each participant.

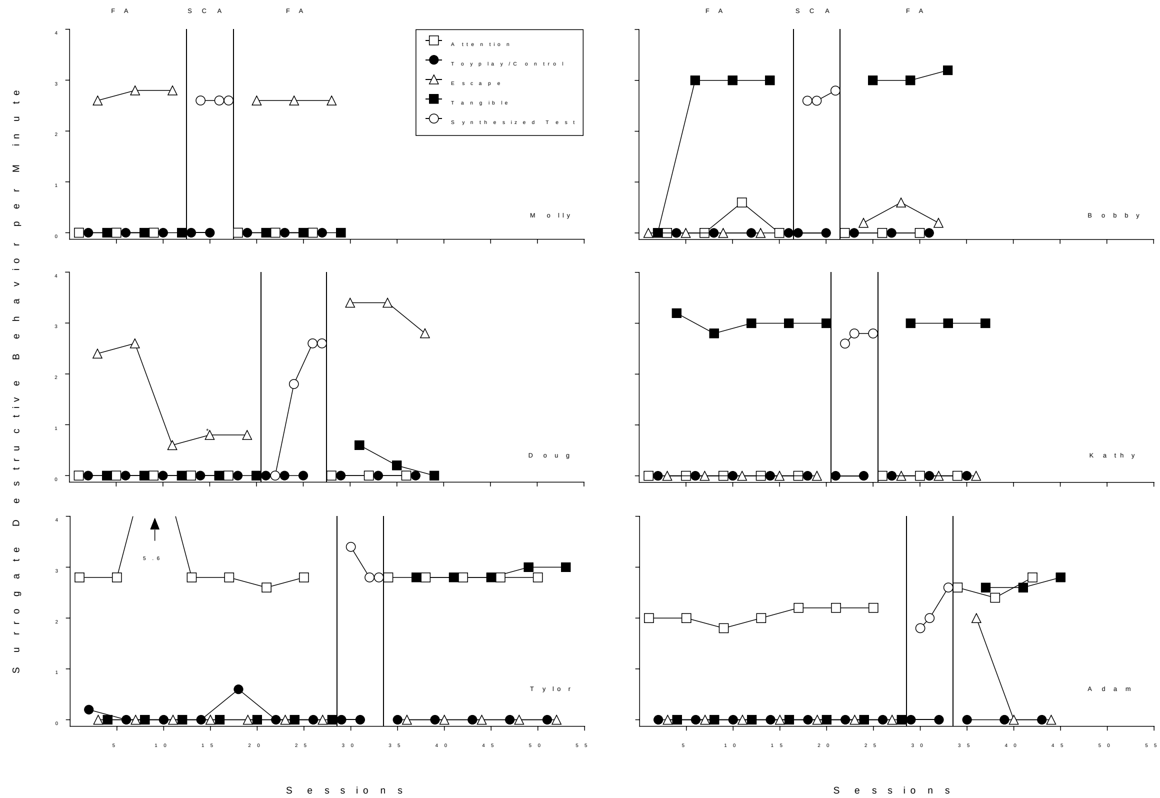

Figure 1. Surrogate destructive behavior per minute across sessions for each participant during the initial functional analysis (FA), the synthesized contingency analysis (SCA), and the second FA. A booster session occurred prior to the session marked with an asterisk for Doug.

Molly learned to engage in the surrogate destructive behavior to escape demands. During the initial FA, Molly reliably engaged in the surrogate destructive behavior during the escape condition and did not engage in the surrogate destructive behavior during any other condition. That is, the FA correctly identified the programmed function of the target response and produced no iatrogenic effects in the form of induction of novel functions for the target response.

During the SCA, Molly reliably engaged in the surrogate destructive behavior only during the test condition. Because the three contingencies of the SCA are confounded, it is not possible to determine if the SCA induced any new functions based on the SCA data. Therefore, following the SCA, we conducted another FA to determine whether any new functions of the surrogate target response emerged following exposure to the SCA. When we reintroduced the FA, Molly again emitted the surrogate destructive behavior only during the escape condition. When we applied the structured criteria from Saini et al. (2018) to Molly's first and second FAs, the criteria identified escape as the only function of the surrogate destructive behavior. When we applied these same structured criteria to the SCA, the criteria indicated that the test condition differed from the control condition, thereby leading to the typical conclusion of an SCA that the included contingencies (i.e., escape, tangible, and attention) combined to reinforce the surrogate destructive behavior. Thus, for Molly we observed no iatrogenic effects of the SCA in the form of induction of novel functions of the target response.

Bobby learned to engage in the surrogate destructive behavior to access the high-preference tangible item. During the initial FA, Bobby reliably emitted the surrogate destructive behavior during the tangible condition and rarely engaged in the surrogate destructive behavior in any other condition. During the SCA, Bobby reliably engaged in the surrogate destructive behavior during only the test condition. When we reintroduced the FA, Bobby engaged in the surrogate destructive behavior most often during the tangible condition; however, Bobby also reliably engaged in the surrogate destructive behavior during the escape condition, albeit at lower rates than during the tangible condition. When we applied the structured criteria from Saini et al. (2018) to Bobby's first FA, the criteria identified tangible reinforcement as the only function of the surrogate destructive behavior. When we applied the same structured criteria to Bobby's second FA, the criteria identified both tangible and escape as functions of the surrogate destructive behavior, suggesting induction of one novel function (i.e., escape) following exposure to the SCA. When we applied these same structured criteria to the SCA, the criteria indicated that the test condition differed from the control condition, thereby leading to the typical conclusion of an SCA that the included contingencies (i.e., escape, tangible, and attention) combined to reinforce the surrogate destructive behavior. Thus, the results for Bobby suggest that exposure to the SCA produced an iatrogenic effect in the form of induction of a new function (i.e., escape) not taught during the pretraining and not observed during the initial FA.

Doug learned to engage in the surrogate destructive behavior to escape demands. During the initial FA, Doug reliably emitted the surrogate destructive behavior during the escape condition, never emitted the response in the attention condition, and rarely (i.e., 3 instances across 5 sessions) emitted the response during the tangible condition. During the SCA, Doug engaged in the surrogate destructive behavior during only the test condition. When we reintroduced the FA, Doug reliably engaged in the surrogate destructive behavior during the escape condition. Rates of the surrogate destructive behavior were higher during the escape condition of the second FA, compared to the initial FA. This increase in rate reflects an increase in response efficiency (i.e., during the second FA Doug reliably emitted the surrogate destructive behavior almost immediately following the initial instruction), as well as an increase in responding during the break interval during Sessions 30 and 34 (separated data not shown). When we applied the structured criteria from Saini et al. (2018) to Doug's first and second FAs, the criteria identified escape as the only function of the surrogate destructive behavior. When we applied these same structured criteria to the SCA, the criteria indicated that the test condition differed from the control condition, thereby leading to the typical conclusion of an SCA that the included contingencies (i.e., escape, tangible, and attention) combined to reinforce the surrogate destructive behavior. Thus, for Doug we observed no significant iatrogenic effects in the form of induction of novel functions of the target response for either the FA or the SCA.

Kathy learned to engage in the surrogate destructive behavior to access the high-preference tangible item. During the initial FA, Kathy reliably engaged in the surrogate destructive behavior during the tangible condition and did not engage in the surrogate destructive behavior during any other condition. During the SCA, Kathy reliably engaged in the surrogate destructive behavior during only the test condition. When we reintroduced the FA, Kathy again only engaged in the surrogate destructive behavior during the tangible condition. When we applied the structured criteria from Saini et al. (2018) to Kathy's first and second FAs, the criteria identified tangible reinforcement as the only function of the surrogate destructive behavior. When we applied these same structured criteria to the SCA, the criteria indicated that the test condition differed from the control condition, thereby leading to the typical conclusion of an SCA that the included contingencies (i.e., escape, tangible, and attention) combined to reinforce the surrogate destructive behavior. Thus, for Kathy we observed no iatrogenic effects of either the FA or the SCA in the form of induction of novel functions of the target response.

Tylor learned to engage in the surrogate destructive behavior to access attention from the therapist. During the initial FA, Tylor reliably emitted the surrogate destructive behavior during the attention condition and never engaged in the surrogate destructive behavior during any other condition, except on three occasions in the toy-play condition. During the SCA, Tylor reliably engaged in the surrogate destructive behavior during only the test condition. When we reintroduced the FA, Tylor reliably engaged in surrogate destructive behavior during both the attention and tangible conditions. When we applied the structured criteria from Saini et al. (2018) to Tylor's first FA, the criteria identified attention as the only function of the surrogate destructive behavior. When we applied the same structured criteria to Tylor's second FA, the criteria identified both attention and tangible reinforcement as functions of the surrogate destructive behavior, suggesting induction of one novel function (i.e., tangible) after exposure to the SCA. When we applied these same structured criteria to the SCA, the criteria indicated that the test condition differed from the control condition, thereby leading to the typical conclusion of an SCA that the included contingencies (i.e., escape, tangible, and attention) combined to reinforce the surrogate destructive behavior. Thus, the results for Tylor suggest that exposure to the SCA produced an iatrogenic effect in the form of induction of a new function (i.e., tangible) not taught during the pretraining and not observed during the initial FA.

Adam learned to engage in the surrogate destructive behavior to access attention from the therapist. During the initial FA, Adam reliably emitted the surrogate destructive behavior during the attention condition and never engaged in the surrogate destructive behavior during any other condition. During the SCA, Adam reliably engaged in the surrogate destructive behavior only during the test condition. When we reintroduced the FA, Adam emitted the surrogate destructive behavior during the initial escape session, and reliably emitted the surrogate destructive behavior during both the attention and tangible conditions. When we applied the structured criteria from Saini et al. (2018) to Adam's first FA, the criteria identified attention as the only function of the surrogate destructive behavior. When we applied the same structured criteria to Adam's second FA, the criteria identified both attention and tangible reinforcement as functions of the surrogate destructive behavior, suggesting induction of one novel function (i.e., tangible) following exposure to the SCA. When we applied these same structured criteria to the SCA, the criteria indicated that the test condition differed from the control condition, thereby leading to the typical conclusion of an SCA that the included contingencies (i.e., escape, tangible, and attention) combined to reinforce the surrogate destructive behavior. Thus, the results for Adam suggest that exposure to the SCA produced an iatrogenic effect in the form of induction of a new function (i.e., tangible) not taught during the pretraining and not observed during the initial FA.

Overall, for each participant the initial FA correctly identified the function of the surrogate destructive behavior taught during pretraining, and the initial FA produced no iatrogenic effects in the form of induction of novel functions. All participants reliably emitted the surrogate destructive behavior in the test condition, but not the control condition, of the SCA, thus showing clearly differentiated results, as in prior research on the IISCA (e.g., Fisher et al. 2016; Hanley et al., 2014). However, during the second FA, Bobby, Tylor, and Adam reliably engaged in the surrogate destructive behavior in one additional test condition of the FA, suggesting that exposure to the SCA produced an iatrogenic effect in the form of induction of a novel function of the surrogate destructive behavior.

In addition to measuring the frequency of the surrogate destructive behavior, we also measured the frequency of each participant's (actual) destructive behavior, despite the caregivers of each participant reporting that such destructive behavior was not of concern. Figure 2 shows destructive behavior per minute across sessions for each participant.

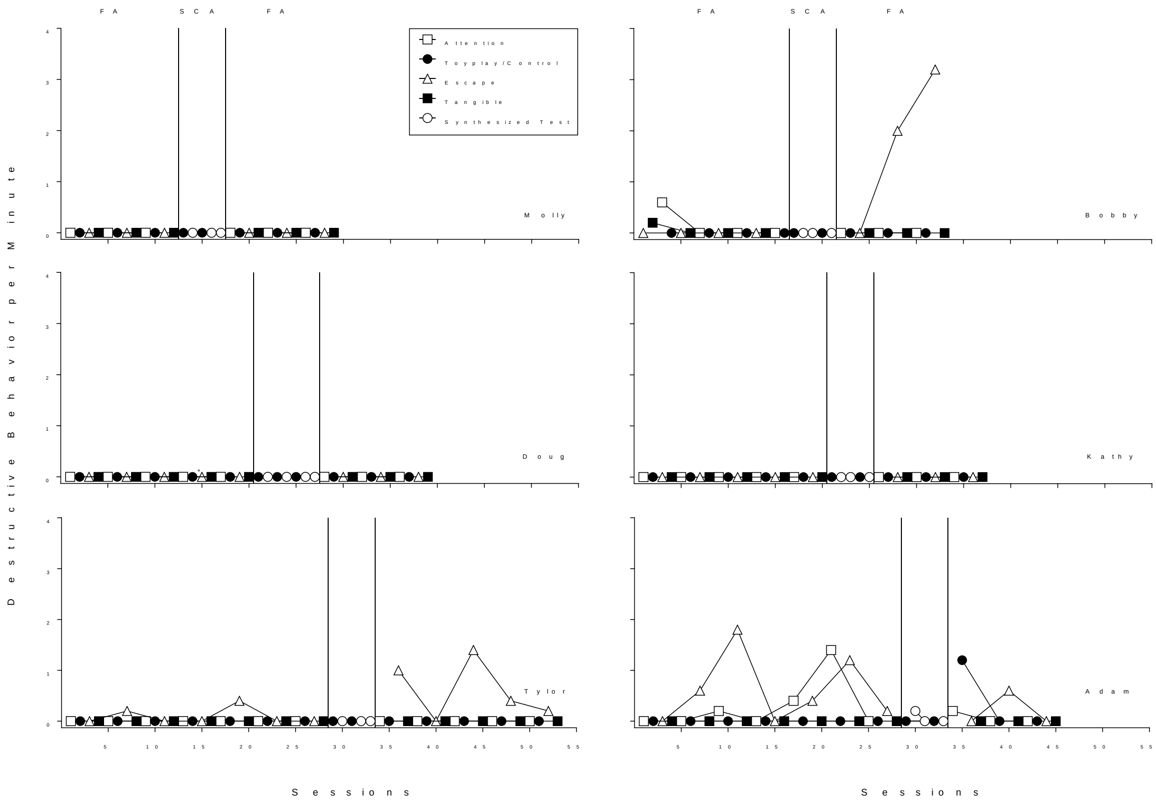

Figure 2. Destructive behavior per minute across sessions for each participant during the initial functional analysis (FA), the synthesized contingency analysis (SCA), and the second FA. A booster session occurred prior to the session marked with an asterisk for Doug.

Molly, Doug, and Kathy engaged in zero instances of destructive behavior during the study. Bobby rarely engaged in destructive behavior during the initial FA and never engaged in destructive behavior during the SCA. However, Bobby began to engage in increasing rates of destructive behavior during the escape condition of the second FA, which resulted in us terminating Bobby's participation in the study and initiating clinical treatment of his destructive behavior. Tylor rarely engaged in destructive behavior during the initial FA and never engaged in destructive behavior during the SCA. However, Tylor reliably engaged in destructive behavior during the escape condition of the second FA, despite never contacting a break for the surrogate destructive behavior or destructive behavior in the escape condition of either the first or the second FA. Adam engaged in variable levels of destructive behavior throughout the initial and second FA. The majority of instances of destructive behavior were disruptions (i.e., kicking the wall) and occurred in escape sessions.

CHAPTER 4: GENERAL DISCUSSION

Summary

In this translational investigation, we trained an escape (n = 2), an attention (n = 2), and a tangible (n = 2) function for a surrogate destructive behavior in six children with ASD and then evaluated this preprogrammed response using an FA and an SCA to test their beneficial and iatrogenic effects. The initial FA identified the specific function of the surrogate destructive behavior in all six cases, and the initial FA did not show iatrogenic effects in the form of induction of new functions of the response when this analysis exposed the response to multiple putative reinforcers. These results provide strong evidence for the validity of the FA. By contrast, after exposing the surrogate destructive behavior to an SCA, three of the six participants showed an iatrogenic effect in the form of induction of a new function of the surrogate destructive behavior during the second FA. Although preliminary, these results suggest exposure to the synthesized contingencies of an SCA can result in the induction of novel functions of behavior with some individuals.

Behavioral Mechanism Responsible for Iatrogenic Effects

Two of the three participants in the current study who showed iatrogenic effects following exposure to the SCA showed induction of a tangible function. Previous investigations have produced parallel results except in previous research a tangible function has been found to emerge during an FA. For example, Rooker, Iwata, Harper, Fahmie, and Camp (2011) showed that when they applied the contingencies of an FA to a novel response, five of six participants showed greater sensitivity to tangible reinforcement than to the other programmed contingencies. Similarly, these investigators showed that when they superimposed tangible contingencies identified via a preference assessment on stereotypy maintained by automatic reinforcement, they observed emergence of new, tangible functions for three of three participants. Shirley, Iwata, & Kahng (1999) observed similar effects when hand mouthing maintained by automatic reinforcement also produced a highly preferred tangible.

We hypothesize the same operant mechanism may be responsible for the induction of new functions observed in Rooker et al. (2011), Shirley et al. (1999) and the current investigation. That is, in each case a preexisting contingency maintained the target response, automatic reinforcement in Rooker et al. and Shirley et al. and a pretrained social function in the current investigation. Next, the investigators combined that preexisting reinforcement contingency with one or more additional preferred contingencies (e.g., adding a tangible consequence to automatic reinforcement or adding escape and tangible consequences to attention during the SCA). We hypothesize that adding a nonfunctional, but preferred consequence, to a preexisting reinforcement contingency that maintains the target response at high levels ensures the target response will contact the new, preferred contingency. These multiple response-reinforcer contacts have the potential to induce a new function.

If this hypothesis is correct, the FA may be most susceptible to iatrogenic effects in the form of the induction of new functions when automatic reinforcement maintains the target response and the analysis exposes the response to additional preferred contingencies. That is, the only time an FA combines two or more putative reinforcement contingencies in a single test condition is when automatic reinforcement maintains the target response. By contrast, SCAs may be susceptible to iatrogenic effects in the form of a new function of destructive behavior whenever any single reinforcement contingency maintains the target response and the analysis exposes the response to additional putative reinforcement contingencies, which, based on the extant literature, occurs in the majority of SCAs.

Methods for Minimizing Risk of Iatrogenic Effects in Practice

A potential remedy for the risk of iatrogenic effects hypothesized above for the FA would be to initially conduct a screen for automatic reinforcement using the procedures described by Querim et al. (2013). This screen rules in or out automatic reinforcement through the persistence or extinction of problem behavior during repeated alone or ignore sessions. If the screen identifies problem behavior maintained by automatic reinforcement through persistence of responding, the behavior analyst could proceed to treatment of that automatic function. If the screen rules out problem behavior maintained by automatic reinforcement through extinction of the response, the behavior analyst could proceed to an FA that tests for social positive and negative reinforcement contingencies (attention, escape, and tangible, if indicated). By following this model, the behavior analyst may minimize the risk of iatrogenic effects during an FA.

It is difficult to envision a simple remedy for the potential risks of iatrogenic effects of SCAs, because those risks seem ubiquitous to SCA procedures. That is, in almost all published SCAs, the investigators have combined multiple social reinforcement contingencies into a single test condition. For example, Jessel et al. (2016) conducted 30 replications of the IISCA and combined social contingencies in 27 (90%) of those analyses. In addition, comprehensive reviews of the extant literature suggest that control by a single contingency occurs in 81% to 85% of cases (Beavers et al., 2013; Hanley, Iwata, & McCord, 2003). Thus, when a single contingency maintains problem behavior and the SCA combines that functional contingency with other nonfunctional, but highly preferred contingencies, the risk of inducing new functions of problem behavior may be increased.

In medicine, they typically evaluate medical procedures in terms of the procedure's benefit-risk ratio (e.g., the ratio of cancers prevented to those induced from colonography screening; De González et al., 2011). Researchers typically then compare the resulting benefit-risk ratio to ratios produced by alternative procedures that address the same clinical problem. If we apply this logic to the current results, we find that the SCA produced differentiate results that could be used to develop a treatment in 6 of 6 participants (observed benefit = 100%), but it induced a new function in 3 of 6 participants (observed risk = 50%), resulting in a benefit-risk ratio of 2 to 1. By contrast, the FA not only produced differentiated results but also identified the specific function of the target response in 6 of 6 cases (observed benefit = 100%). Moreover, the FA induced a new function for the target response in 0 of 6 cases (observed risk = 0%). These data suggest that the SCA, relative to an FA, results in increased risk without any increased benefit.

Limitations of Current Study

One limitation of the current study is that we standardized the test and control conditions of the SCA so that all participants experienced the three most common social reinforcers for destructive behavior. We did this because the majority of SCAs published in the literature include these three contingencies. Nevertheless, the use of a standardized test condition during the SCA may limit the generality of the current findings, and future translational research should evaluate the beneficial and untoward effects of including other combinations of contingencies during SCAs. The current investigation taught a single, social function of the target response for each participant. Future research also should test for iatrogenic effects during FA and SCA after training the response using automatic contingencies, synthesized contingencies (e.g., escape to tangible), and multiple isolated contingencies (e.g., training an escape function as well as an attention function for the same participant). Finally, future investigations should also compare levels of benefits and iatrogenic effects of FAs and SCAs with a larger sample of participants.

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