Original Research

Functional Analysis Contingencies on Precursors: Response Hierarchy Relationship Hypotheses

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Function-based interventions are effective in the treatment of severe problem behaviors. Functional analyses methodologies may present risks associated with behaviors under investigation. Researchers continue to explore alternatives for eliminating these risks. Identification of potential functions of less severe behaviors (i.e., precursors) that reliably precede more severe behavior may facilitate in the development of effective interventions (Smith & Churchill, 2002). In the current study, two experiments were conducted to treat challenging behaviors displayed by a 20-year-old woman with autism. Hypothesized maintaining consequences of precursor to the participant's more severe behavior (self-injurious behavior; SIB and aggression) were identified in Experiment 1. Prior functional analysis contingencies of the participants SIB and aggression guided the development of a treatment package consisting of differential reinforcement, functional communication training- FCT, extinction, and response interruption and redirection (RIRD). The treatment package was utilized in experiment 2 to treat precursors hypothesized to belong in the same response class as the participant's SIB and aggression. Results indicated a decrease in the frequency of SIB and aggression suggesting precursor analysis to be a promising alternative for reducing risks associated with FAs.

INTRODUCTION

Iwata, Dorsey, Slifer, Bauman, and Richman[7] described the analogue functional analysis (FA) methodology for analyzing problem behavior. Currently, FAs are the standard for experimentally establishing variables influencing problem behavior displayed by people with disabilities.[5] Information derived from these analyses can be used to develop effective interventions focused on altering the response–reinforcer parallel associated with the target problem behaviors.[10] In order to evoke behavior and provide potential reinforcement, conditions are systematically presented and manipulated.[7] Manipulating experimental conditions may expose the participant to risks associated with the occurrence of problem behavior under investigation.

More often, severe behaviors are reliably preceded by behaviors that are less severe, and are very often reinforced by the same variables.[4,6,12] Smith and Churchill identified these behaviors as precursors further defining them as any responses that tended to reliably occur immediately before severe problem behavior. Several researchers[11,12] report that identifying the potential functions of precursor behavior may aid in situations where the behavior of interest is associated

with notable risk or if the behavior occurs rarely. In their study, Lalli, Mace, Wohn, and Livezey[9] reported that these temporal relationships suggest that the responses may be class-members. Lalli and colleagues reported that intervening on another class member could change the likelihood of occurrence of another response-class member. In the case where a response class hierarchy existed, Lalli and colleagues presented a propitious procedure of reducing the probability of a rapid increase to more severe challenging behavior. They concluded that the more severe topographies of interfering behavior might not be emitted when less severe ones in the response class hierarchy are reinforced.[9] Futhermore, several researchers[11,12] reported that identifying the potential functions of precursor behavior may aid in situations where the behavior of interest is associated with the notable risk or if the behavior occurs rarely.

Iwata and Fahmie[5] conducted a review of seventeen articles reporting data on thirty-four participants who engaged in precursors to severe interfering behavior. The authors aimed at determining the number of times these behaviors (i.e., the precursor behaviors to severe problem behavior) had been investigated. To determine the frequency on reported topographies Iwata and Fahmie[5] started by categorizing the precursors reviewed. Three precursor topographies were identified to be the most frequently reported for certain behaviors. Iwata and Fahmie[5] found that, unintelligible vocalization was reported as the most frequent precursor to

aggression (26.7%), self- or non-directed movements were the most frequent reported precursor to self-injurious behavior, (31.86%), whereas, unintelligible and nonspecific vocalizations were the most reported precursors to less severe behavior to reliably precede property destruction (29%). In their conclusion, Iwata and Fahmie[5] suggested that the results of precursor analyses might lead to the development of effective interventions for problem behavior. Additionally, they mentioned that researchers who conducted the studies they reviewed, reported an absence or decrease in severe behavior throughout treatment.

Herscovitch and colleagues [6] delineated a more efficient procedure for identifying potential precursor behaviors. Their procedure began with staff interviews, followed by a descriptive analysis, which was followed by two functional analyses, for head hitting and finger biting respectively. The data collected data from the descriptive analysis identified three potential precursors from the ones proposed as indicated on the probability analysis. The two FAs (i.e., for the target and precursor behaviors) identified the same maintaining variables. Additionally, these data indicated a decrease in head hitting (i.e., target response) during the FA of finger biting (i.e., precursor behavior). The authors [6] reported that their findings supported the validity of FAs of precursor behavior as an alternative approach for decreasing the risk associated with FAs of severe problem behavior, additionally they reported that their findings replicated previous studies where outcomes of the FAs of both the target and precursor behavior showed the same outcome, and the FAs of precursor behavior resulted in decreased occurrences of the target response. According to the comparative probability analyses conducted by Herscovitch and colleagues, the strongest relation was found in the response that had been the top-ranked precursor identified by the indirect assessment.

Smith and Churchill[12] conducted a study where they compared results of FAs of severe problem behavior with FAs of precursor behavior. They started by conducting a precursor analysis that made it possible to deduce the variables maintaining the target problem behaviors. Functional analyses of SIB for the four participants were then conducted. Results showed that maintaining contingencies identified by the two FAs (i.e., for precursor behavior and FA for severe problem behavior) were similar suggesting that the participant's precursor behaviors and SIB had the same functions. The authors concluded that indirectly identifying consequences that maintain severe problem behavior via an analysis of precursor behavior might be a strategy for reducing risk associated with FAs.[12]

As previously described in the studies reviewed (including Iwata & Fahmie)[5,6,9,12] the researchers indirectly revealed the functional properties of severe problem behavior through analysis of precursor behavior. These studies mainly compared results from FAs and indirect analysis to examine the relationship between less severe precursor behaviors that reliably preceded more severe behaviors. All studies reviewed, report a decrease in the more severe problem behaviors during

FAs for less severe precursor behaviors concluding that, the analysis of precursor behaviors might be beneficial in the treatment of more severe behavior even when these behaviors differ in form or shape or both (Iwata & Fahmie).[5,6,9] Research evaluating the effects of treating precursors is still lacking. Two experiments were conducted in the current study. The purpose was to examine the efficacy of an intervention on precursor behaviors so as to treat more severe behaviors. This was done by (a) evaluating the effects of a multi-element procedure (Extinction, reinforcement contingencies, and FCT) on precursor behavior hypothesized to be in the same response-class as more severe behaviors (i.e., SIB and aggression) to further reduce and maintain low or zero levels of SIB and aggression, and (b) through teaching responses that were functionally equivalent to precursors and problem behaviors so as to expanding the participant's response class. Further, this study aimed at extending the research literature analyzing the relations between more severe problem behavior and their precursors.

METHOD
Participant
The participant, Lisa, was a 20-year-old female diagnosed with autism and intellectual disabilities. Lisa received individualized instructions in a 1:1 teacher to student ratio in a sub-separate program for transition-age students with autism, housed in a public high school. Record review indicated that Lisa presented with limited social and self-care skills. Behavior data collected prior to the current study indicated that Lisa's, SIB, aggression, and property destruction were decreasing, however levels of these behaviors continued to pose a safety risk for Lisa and her support staff. Lisa's primary teachers reported that these target behaviors (i.e., SIB, aggression, and property destruction) frequently occurred in close temporal succession to other less interfering behaviors (i.e. vocalizations, grabbing, foot stomping and finger biting). Taken together, these behaviors were noticeably stigmatizing, detrimental to her social adjustment, and a dominant educational concern identified by her primary teachers and job coaches.

Previously, a functional analysis utilizing the procedure described by Iwata and colleagues (1982/1994) revealed that Lisa's problem behaviors were reinforced by attention and escape from demands (i.e., schoolwork or non-preferred tasks). The results directed the development of Lisa's behavior program that was in place at the time of the current study. The intervention utilized multiple reinforcement-based interventions (differential reinforcement of other behaviors-DRO; differential reinforcement of alternative behaviors-DRA and Functional communication training -FCT)) and escape-extinction.

Functional Communication Training was utilized to teach replacement responses (function communication responses, FCRs) functionally equivalent to Lisa's problem behaviors. Lisa earned tokens throughout the day following her DRA program, where the observer provided reinforcement contingent on display of an appropriate alternative to her

problem behavior. FCRs were the selected alternative behavior. The observer provided opportunities for these to occur naturally at a rate that provided sufficient opportunities for reinforcement. Lisa's FCRs included requesting for break, help and all done (emitted verbally or by the use of a card). Additionally, Lisa followed a 10-minute DRO interval schedule where the observer delivered reinforcement (a 3-minute break from work) at the end of a 10-minute interval if her problem behavior did not occur during the interval. Tokens were awarded during the 10min interval for the absence of SIB, aggression and for using appropriate functional communication responses (FCRs). Lisa traded her earned tokens for a selected edible.

An escape-extinction procedure (as described later in this paper) was implemented contingent on SIB or aggression.

Setting
Sessions were conducted during the participant's school day across three settings: Her classroom, at vocational sites, and during van rides. The participant shared the classroom with four other students where she sat at an individual table during her instructional activities. The classroom contained a television, video player, magazines, computer, card and board games, and puzzles, which the participant and other students accessed for reinforcement. The participant travelled on the school van to her community outings with two other students and two teachers. She attended various vocational sites where she sat at a large table with other students and two or three teachers/job coaches.

Materials
Materials were, a clipboard, her selected reinforcers, a timer, tokens and token board, instructional materials, her FCR cards (i.e., break, help, all done, more), pen, and data sheets (see Appendix A & B).

Dependable Variable and Measurement Method
Operational definitions for all target behaviors including precursors were developed. *Self-injury* included head hitting, and nose hitting was defined as any behavior that resulted or had the potential to result in injury to Lisa. *Head hitting* was any instance of audible contact of the head to any stationary surface (examples included head to wall, or head to desk). *Nose hitting* was defined as audible contact of the hand to nose (either open or closed hand). *Aggression* was defined as behavior that produced or had the potential to produce injury to others. Aggression included hitting and kicking. Hitting was defined as any occurrence of audible contact of another person's body part with an open or closed hand. Hitting also included pushing or throwing objects from their original location by movement at least a foot way with her hand, foot or leg towards another person (non-example was when she was games such as catch), biting was defined as contact between Lisa's teeth and another person's body, scratching was defined as digging in fingernails onto another person's skin and/or moving them across another person's skin or clothing.

Precursor behaviors were, *vocalizations* (including vocal stereotypy), grabbing, and finger biting. *Vocalizations* were defined as any vocalization non-contextual including repetitive grunts or requests (e.g., "home" "home" or "mommy, mommy, mommy", "hi, hi" after a response has been provided). *Grabbing* was defined as closure of Lisa's hand around another person's body part. Lisa's *finger biting* was defined as any instance of opening and closing of her jaw with upper and/or lower teeth making contact with her fingers (one or more).

Two of Lisa's teachers were trained to collect and record data on target behaviors. Data were collected on data sheets on a clipboard. Occurrence (frequency) and non-occurrence data were collected on precursor behaviors, SIB and aggression, and use of FCRs using 90-s partial interval recording.

Experimental Design
Two experiments were conducted. Following an indirect and descriptive assessment, a multiple baseline across settings, (i.e., classroom, van rides, and vocational sites) with an embedded reversal (ABAB) strategy (Sidman, 1960??). After obtaining a stable baseline in the classroom the first intervention was initiated while baseline data collection continued during van rides and at vocational sites. The intervention during van rides began when the data in the classroom showed desired behavior change as measured by three consecutive data points. Baseline data collection continued during vocational sites van rides. The intervention was introduced at vocational sites after the data in the van rides showed a consistent trend. A reversal to baseline condition was implemented in two conditions (i.e., the classroom and during van rides) for three sessions before returning to treatment conditions. A total of 120 sessions were run across three target settings; classroom, vocational sites, and during van rides. The effects of the independent variable were analyzed effectively across the three settings due to the flexibility of this method.

Experiment 1
Method
Indirect Assessment. Phase one of this experiment began with an indirect assessment to identify potential precursor behaviors displayed by the participant. The researcher started by reviewing Lisa's severe target behavior (i.e., SIB and aggression) with her select staff (seven staff who worked with Lisa across the three settings were preselected). The researcher then explained that precursors tend to predict aberrant behavior and that they certainly precede the occurrence of aberrant behavior. This was followed by the staff interview. Lisa's staff completed the questions individually (see Appendix C), they were required to identify and describe precursors to Lisa's severe target behaviors. Four probable precursors were identified, a presumed precursor behavior was omitted if the teacher's description was too broad and vague. Staff were then asked to rank their identified probable precursor behaviors, as primary, secondary, and tertiary. Temporal relationships among the problem behaviors were evaluated by calculating percentages of staff reports in which vocalizations preceded problem behavior, grabbing preceded

problem behavior, or finger biting preceded problem behavior.

Descriptive analysis. Lisa was observed in 3 settings across her school day. Observation sessions were terminated after 6 instances of target problem behavior (i.e., SIB or aggression). During data collection observers indicated when SIB and aggression occurred alone and when it occurred within 10 s of the three identified precursor behaviors. Four conditional probability (two conditional and two unconditional) analyses were utilized to calculate conditional and unconditional probability. These analyses were conducted following a procedure identical to that described by.[13]

Experiment 2
Method
Procedures
The procedure consisted of multiple components; differential reinforcement (DRO & DRA), FCT, extinction, and RIRD. Two sessions were conducted in each setting (classroom, vocational sites, and during van rides), per day, four days a week. A total of 120 sessions were conducted (i.e., 40 in the classroom, 40 on van rides, and 20 at vocational sites)

Baseline: Baseline data were collected in each setting simultaneously. Baseline conditions were those that had been in effect before commencement of the current study. The intervention for SIB and aggression consisted of multiple components; differential reinforcement (DRO & DRA), FCT and extinction were implemented across the three settings as follows: In the classroom condition, the observer sat with the participant at her table and presented her regular scheduled task and said "it is time to do work and with good hands". The tasks were those currently being taught in her regular curriculum. The observer then set the timer to beep after 90s to mark the beginning of the next data collection interval. During van rides, the observer waited for the participant to sit at her seat in the van then said, "it is time to go to grocery store" (this direction was specific to the destination where the participant was going). You need to seat with good hands." The observer then set the timer to beep after 90s to mark the data collection interval. During vocational tasks the observer waited for the participant to sit at her table and then said, "it is time to do your work with good hands". The observer set the time to beep after every 90s interval for the data collection interval.

During all baseline sessions the observer interacted with the participant (i.e., there was no prompting or direct reinforcement provided) as per the nature of the scheduled task allowing the participant to behave freely. No intervention was utilized for precursor behaviors during baseline. When precursor behaviors (i.e., vocalizations, grabbing, finger biting, and foot stomping) occurred, teachers continued to interact with the participants as guided by the task at hand as they did before the current study began. For instance, teachers provided directions about the task with a suggestion such as, "Why don't you use your words if you need something?"

Multi-element package (DRA and DRO, extinction, RIRD, and FCT). Conditions were the same as in those in the baseline condition except that the intervention was now applied to precursor behaviors as well as to SIB and aggression. Differential reinforcement of alternative behaviors was utilized during FCT. The observer delivered verbal praise (e.g., "Nice job having good hands and using your card) paired with a token for correct responding when Lisa used her FCR cards (i.e., break cards, all done) either independently or prompted during acquisition phase. Lisa exchanged these tokens for an edible. New FCRs were introduced across the day via incidental teaching. Lisa also earned a 3-minute break at the end of a 15-minute work interval.

Immediately following the occurrence of precursor behaviors (i.e., vocalizations, grabbing, and finger biting) escape-extinction was implemented in a manner similar to that described by Iwata and colleagues.[8] Escape-extinction was implemented to ensure these behaviors did not produce escape. When *grabbing or finger biting* occurred an isolated non-preferred physical activity (i.e., sorting socks) was utilized. Lisa was presented a pile of differently colored socks with the direction "sort socks". The observer provided immediate physical guidance intermittently pairing with a verbal statement, "Lisa you need to have good hands or sort socks." This activity was chosen because it was a non-preferred mastered skill, it was safe to implement given that the stimuli (socks) are soft and weightless, and it was portable, thus providing the needed consistency to increase effectiveness. Response interruption and redirection (RIRD) similar to that utilized by Ahearn and others,[1] was implemented when vocalizations (including vocal stereotypy) occurred. For instance, when *vocalizations* occurred, Lisa's teacher established eye contact and said, "Lisa, say red, say fish" up to five words. This was immediately followed with a statement redirecting her to the task at hand paired with the observer holding and showing her a card with a picture symbol for quiet voice similar to her communication pictures. For instance, during classwork immediately following the five words the observer would say "it is class time you are doing work you can use your words once or then have a quiet voice". The observer repeated the sequence until *vocalizations* no longer occurred. In the current study RIRD was a punishment procedure with some variation of sensory-extinction. In that the vocalizations were "blocked" because it was interrupted by requesting Lisa to say a series of words and then redirecting her to the appropriate task. The idea behind RIRD is to decrease the probability of the vocal stereotypy and increase appropriate behaviors (i.e. answering social questions, vocal imitation).[1]

The treatment phase was followed by a brief return to baseline. Baseline conditions were considered because as previously described, implementation of intervention continued for severe problem behavior thus risks associated to the participant's behaviors were effectively minimized.

Table 1. Probable Precursors as Identified by 7 Staff: Indirect Assessment Results.

Respondent	Primary	Secondary	Tertiary
1	Vocalizations	Grabbing	Finger biting
2	Vocalizations	Finger biting	Finger biting
3	Vocalizations	Grabbing	Foot stomping
4	Vocalizations	Grabbing	Finger biting
5	Vocalizations	Grabbing	Finger biting
6	Grabbing	Vocalizations	Finger biting
7	Vocalizations	Grabbing	Finger biting
Total	Vocalizations 86%	Vocalization 14%	Vocalizations 0%
	Foot stomping 0%	Foot stomping 0%	Foot stomping 14%
	Grabbing 14%	Grabbing 78%	Grabbing 0%
	Finger biting 0%	Finger biting 28%	Finger biting 86%

Note: Percentages were calculated by dividing the number of times a response was reported by the total number of respondents.
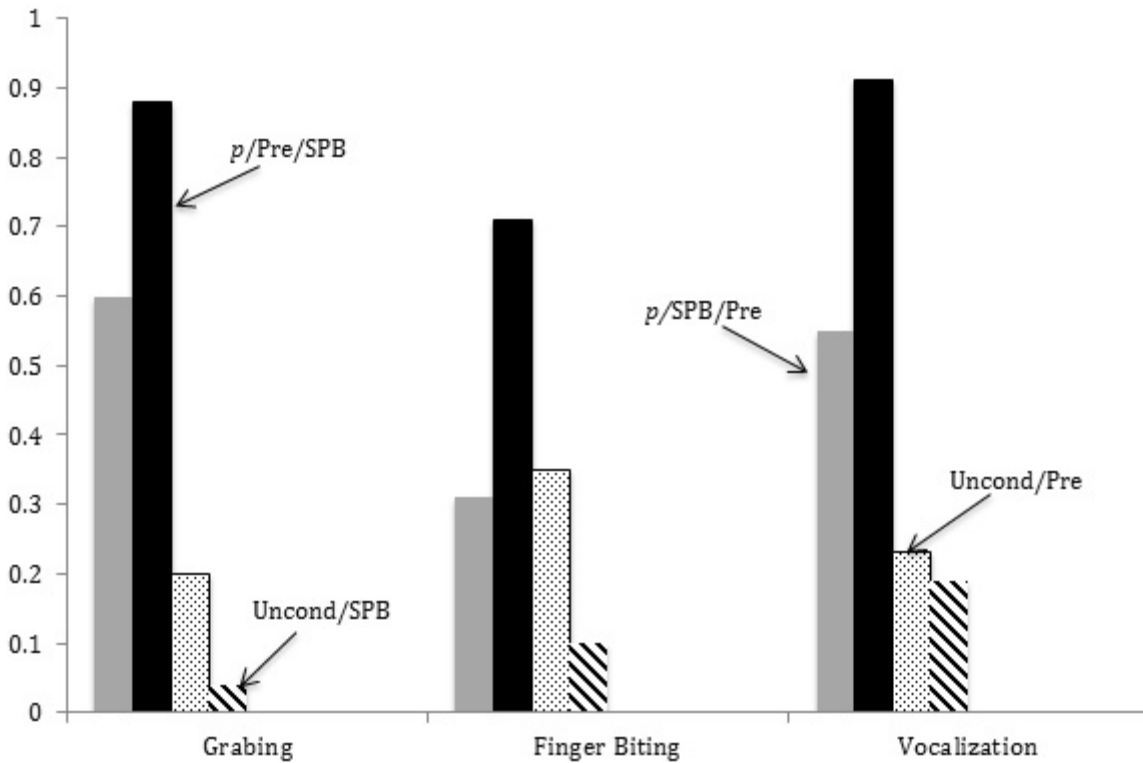

Figure 1. Depicts results from four comparative probability analyses utilized to calculate conditional and unconditional probability. These include, the probability of target behavior (SIB and aggression) given precursor behavior (p/Pre/SPB), the probability of precursor behavior (Vocalization, finger biting, grabbing) given target behavior (p/SPB/Pre), unconditional probability of precursor behavior (Uncond/Pre), and unconditional probability of severe problem behavior (Uncond/SPB).
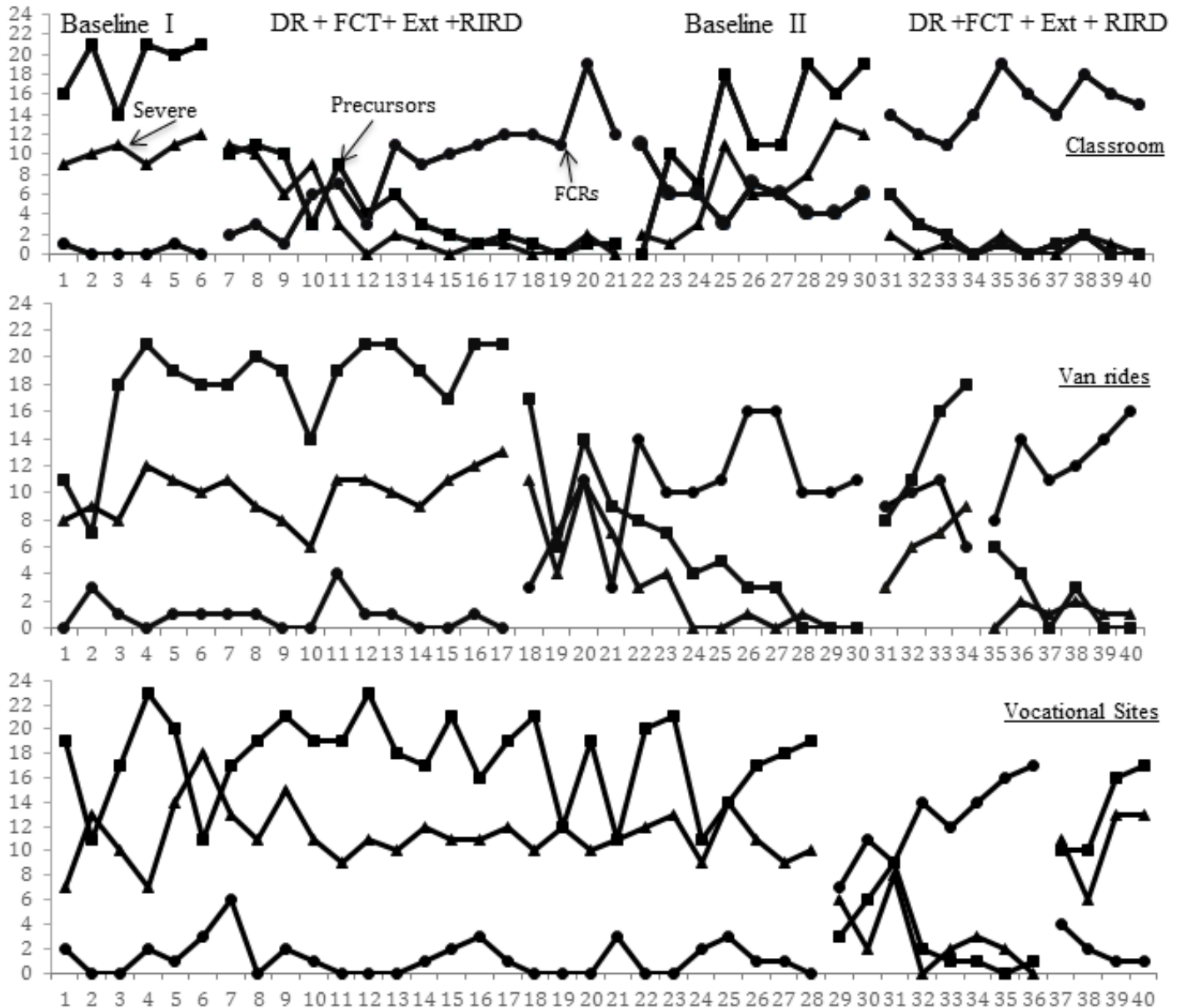
Figure 2. Frequency data collected across three settings are displayed. Multiple-baseline across settings graph depicting the effects of a multi-element package consisting of differential reinforcement (DR), FCT extinction (Ext) and response interruption and redirection (RIRD), on the participant's target behaviors (i.e., SIB, aggression, precursor behaviors, and functional communication responses).

RESULTS

Experiment I

Data from the staff interview are presented in **Table 1**. Staff reports suggested that the four probable precursors identified were a hindrance to her wellbeing, however they were not as intense as her SIB or aggression, and they were less likely to result in tissue damage as with SIB or aggression. The results of the indirect assessment indicated that majority of the staff (86%), identified vocalization as the most reliable precursor behavior (primary precursor) followed by grabbing (14%). These data were consistent with the data from the conditional probability analysis presented in **Figure 1**, which shows that the probability of vocalizations, grabbing, and finger biting

was greater preceding (SIB or Aggression) than it was unconditionally. These analyses suggest that Lisa's vocalizations, grabbing and finger biting may be considered precursors for her target problem behavior, the most apparent relation being between vocalizations and grabbing.

Based on findings from Experiment 1, the second experiment evaluated the effect of Lisa's behavior intervention on the three precursor behaviors with the aim of preventing the occurrence of her more severe problem behaviors. This intervention was developed based on a prior FA where escape

and attention were indicated to be the maintaining variables for Lisa's SIB and aggression.

Experiment II
Figure 2 depicts the effects of a multi-element package (differential reinforcement, FCT extinction, and RIRD) on precursor behavior, to improve the participant's severe problem behavior, and use of alternative appropriate responses (FCRs) across three settings. These data indicated lower rates of aberrant behavior during the treatment condition compared with the baseline condition for each setting. Similar trends were observed across the three settings during baseline. Precursors were observed to occur at the highest levels when compared to severe problem behavior and use of FCRs. Another similarity was with the variability that occurred when treatment was introduced. For instance, the first treatment sessions across all three conditions did not indicate a clear trend when treatment was introduced, a clearer trend was observed after treatment was in place for more than three sessions. For tier one (classroom), high rates of precursor behavior were observed occur (averaging at 19.6 responses per observation interval) during initial baseline. Similarly, Lisa's use of her FCR cards was observed to occur at low levels averaging 0.7 responses per observation interval during baseline and reversal conditions. When treatment was placed on precursor behavior in the classroom data showed a gradual decrease in rates of problem behavior (SIB & aggression), which eventually reached zero levels. By contrast, van ride's and community data show more rapid reduction in rates of aberrant behavior. Lisa's precursor behavior data indicated a decreasing trend (averaging at 3.1 responses per observation interval) during van rides, while use of the FCR cards increased (12.39 responses per observation interval) during the treatment phases.

Severe problem behavior data remained stable during baseline while the use of FCR cards never occurred during van rides. Severe problem behavior increased (averaging at 5.3 responses per observation interval) and Lisa's use of FCRs decreased (0.6 responses per observation interval) during the reversal condition. During vocational activities, baseline data showed that precursor behaviors occurred at high levels (averaging 21 responses per observation interval). The implementation of treatment yielded notable lower levels of precursor behavior (highest number scored was 7 at the beginning of treatment, this eventually dropped and stayed at zero responses per observation interval). Increased use of FCRs was observed (15.5 responses per interval with a high of 20 responses).

During treatment precursor behavior occurred at near zero levels across all settings while independent use of FCRs increased. For instance, in tier one, the classroom condition, Lisa's independent FCRs (e.g., all done, I need a break) gradually increased from 1 to 19, in tier two and three (during van rides and vocational sites), Lisa's use of FCRs increased from 1 to 14, and 1 to 20 respectively. This is an increased level when compared to baseline where Lisa's independent FCRs in the classroom averaged 7% across all baseline sessions. Lisa did not use any FCRs on the van or in the community during baseline conditions. During a brief reversal to baseline (i.e., baseline II) in two settings (classroom and van rides), the target behaviors rapidly returned to near baseline I levels, further suggesting the effects of the intervention.

DISCUSSION
A treatment package based on contingencies from a prior FA was effective in treating Lisa's precursors. Interestingly no terminable increase in rates of severe problem, was observed when the initial treatment was introduced across all settings behavior as expected when extinction implemented. Instead, Lisa's rates of severe problem behavior decreased steadily. This observation could be attributed to the reinforcement component in the package. Lisa's response levels rapidly returned to near baseline levels during the brief baseline phase, further suggesting the effects of the intervention. Researchers (Albin, O'Brien & Horner, 1995; Lilli et.al. 1995) have reported that identification of precursor behaviors is profitable in improving treatment outcomes. Data from the current study indicated an absence or decrease in severe behavior throughout treatment, suggested that treating less severe precursor behavior belonging in the same response class with more severe problem behavior was an effective treatment for Lisa's SIB and aggression.

Interobserver Agreement
A second staff (graduate student) independently collected interobserver agreement during 36% of the sessions for each setting. For a sample of the data summary sheet used see Appendix B. Total interval agreement was scored by adding the number of times observers agreed on occurrence or non-occurrence and dividing it by the number of agreements plus disagreements, then multiplied by 100 for a percentage score. Mean agreement was 92% (range, 88% to 100%). Additionally, agreement on non-occurrence was scored by adding the number of intervals in which either observer scored non-occurrence and dividing it by the number of intervals with agreement on non-occurrence plus the intervals with disagreement and multiplying that number by 100 for a percentage score. The interobserver agreement calculation (for occurrences and non-occurrences of SIB, aggression and precursor behaviors), yielded a mean occurrence agreement of 87%; and a mean nonoccurrence agreement was 97%.

Treatment Integrity
An independent observer filled out a procedural integrity checklist during 37.5% of sessions. The observer indicated on a checklist, whether the therapists implemented the intervention components. For a copy of the checklist used to determine procedural integrity see Appendix D. The procedural integrity data showed that the observers followed the prescribed procedure in 97% of measured opportunities. One observer was retrained on two steps of the escape-extinction (physical guidance) procedure.

Summary and Concluding Discussion
Effects of a multi-element treatment package on precursor and severe problem behavior were evaluated using a multiple

baseline design with a brief return to baseline phase in two conditions. The treatment package was placed on precursor behavior that had been identified to reliably follow more severe behavior (SIB and aggression) in Experiment 1. Experiment 2 was conducted based on the prediction that precursor behavior and problem behavior served the same function. By examining the effects of the treatment package on probable precursor behaviors without conducting an analogue functional analysis of the identified precursor behaviors the current study was able to directly evaluate the contribution of this procedure. In order to identify precursor behaviors, descriptive observations of severe problem behavior were conducted. All behaviors that were scored across observations were predefined. Descriptive data were utilized to conduct comparative probability analyses. Results indicated that the probability of the probable precursor was higher when interfering behavior occurred when compared to the unconditional probability of probable precursor. The data from the current study suggested that temporal relationships such as the as the ones observed among the five behaviors (i.e., SIB, aggression, vocalizations, grabbing and finger biting) may be a promising variable in predicting the likelihood of less severe behaviors (such as vocalizations) escalating to more severe ones. These data extended the findings by Borrero and Borrero[4] and Herscovitch and colleagues,[6] which identified respective functions (of problem behaviors and the precursor behaviors by conducting separate functional analyses. Results of the functional analyses conducted by Herscovitch and colleagues revealed that the same reinforcers maintained both problem behavior and precursor behavior. Additionally, the current study extended the research literature researcher [11,12] where the benefits of utilizing quantitative methodology to identify probable precursors to more severe problem behavior to guide treatment development were evaluated. The current study together with others previously cited, suggest that precursors are mostly innocuous responses, if identified they could notify caregivers of an increased probability of more severe problem behavior occurring thus facilitating more proactive strategies. Researchers (Richman et al., 1999; Smith and Churchill, 2002.) who have analyzed multiple topographies of severe problem behavior (e.g., SIB, and aggression) have indicated that these behaviors may belong to the same response class with less severe ones. These researchers, just cited, have also demonstrated that these behaviors may be hierarchically associated resulting in the behaviors occurring in a foreseeable pattern, less severe topographies progressing to more severe ones.

A limitation from this study may stem from FCT. It is possible that FCR's acquired more rapidly during van rides and vocational sites may have yielded faster treatment effects in these settings. Future research should explore the rapidity with which FCT occurs in untrained settings once FCRs have been mastered in the treatment setting. Findings may be different across settings depending on the maintaining variables. For instance, a rapid rate in the use of FCRs was observed at the vocational setting, as compared to van rides probably because there were stronger motivating operations at vocational sites making escape (from work tasks, access to social reinforcement) more reinforcing. Additionally, during van rides there might have been abolishing operations for escape and/or attention given than these were readily available in this condition (no work demands, and staff sat next to Lisa). Treatment fidelity may have been compromised due to the required response effort to implement escape extinction, future research should attempt to explore escape-extinction procedures requiring minimal response effort. Additionally, using response blocking (RIRD) or sensory extinction with to block vocalizations becomes challenging given the feasibility of the procedure.

In conclusion, the current study highlighted the importance of identifying response relationships when treating severe problem. Understanding the hierarchical organization of responses, such as identifying events that are discriminative for and maintain problem behavior, may lead to the development of effective interventions. Interventions that address responses in the entire hierarchy, rather than individual topographies of problem behaviors may be more effective.

CONFLICT OF INTEREST

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APPENDIX A
A SAMPLE DATA SHEET
15-min observation Sessions
90 s (1min 30s) Partial intervals

Student: _____ Behavior*:* _____

Date: _____   Primary Observer: _____

(IOA): _____   Day of week: _____

Setting: <u>Classroom</u>   Time_____   Session type: _____

Interval									0	Total
Occurrence										

Setting: <u>Van ride</u>   Time_____   Session type: _____

Interval									0	Total
Occurrence										

Setting: <u>Vocational sites</u>   Time_____   Session type: _____

Interval									0	Total
Occurrence										

X = Occurrence; O = Non-occurrence

APPENDIX B
A SAMPLE IOA SUMMARRY SHEET
15-min observation Sessions
90 s (1min 30s) Partial intervals

Student: _____ Behavior*:*

Date: _____ Primary Observer: _____

(IOA): _____ Day of week: _____

Setting:_____Time_____ Session type: _____

Interval									0	Total
Observer 1										
Observer 2										

Setting:_____Time_____ Session type: _____

Interval									0	Total
Observer 1										
Observer 2										

X = Occurrence; **O** = Non-occurrence; **a** = Agreement; **d**=Disagreement

APPENDIX C
Interview questions to identify probable precursors.

1. What are the top most interfering less severe problem behaviors that may precede Lisa's target behavior?
2. Please describe how they look like
3. What is the most frequent less severe behaviors reliably occurs before Lisa's target behavior?
    Please rank them as Primary, Secondary, Tertiary
4. How do you respond to the less severe problem behavior?
5. Describe the range of intensities of the less severe problem behaviors
6. Has Lisa or others may been hurt or injured from this less severe behaviors.
7. If 'Yes' please describe the injury
8. Under what situations are the less severe problem behaviors most likely to occur?
9. What seems to trigger the less problem behavior? Please describe.

APPENDIX D
A sample for Procedural Integrity Checklist

IOA: _____
Experimenter: _____
Setting: _____
Session Type_____

Question	Yes	No
1. Did the participant choose a reinforcer before beginning the sessions?		
2. Did the staff review the rules for earning the reinforcer by saying, "you can earn 'x' after earning your tokens"?		
3. Before starting the timer did the observer tell the participant that she needed to use her cards and have a quiet voice and good hands		
4. Did the timer sound after 90 s exactly?		
5. Did the experimenter say, implement the RIRD procedure as described		
6. Did the staff say implement the extinction procedure as described		
7. Did the experimenter ignore all precursors During baseline?		
8. Was the session completed or terminated due to participants other challenging behaviors (e.g. Severe SIB resulting in tissue damage)?		