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ANALYSIS OF PRECURSORS TO MULTIPLY CONTROLLED PROBLEM BEHAVIOR: A REPLICATION

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We replicated Fritz, Iwata, Hammond, and Bloom (2013) by evaluating the efficacy of an experimental methodology to identify precursors to aggression displayed by an adolescent with autism spectrum disorder. Using their trial-based precursor analysis, we identified seven precursors to aggression. Next, we compared the outcomes of separate precursor and aggression functional analyses and showed that both precursors and aggression were multiply controlled by the same variables.

Key words: aggression, functional analysis, precursor behavior

Researchers have evaluated procedures aimed at identifying precursors to problem behavior in an attempt to address some of the limits of functional analysis (FA) methodology (e.g., Borrero & Borrero, 2008; Dracobly & Smith, 2012; Fritz, Iwata, Hammond, & Bloom, 2013; Herscovitch, Roscoe, Libby, Bourret, & Ahearn, 2009; Smith & Churchill, 2002). Precursors are behaviors (e.g., vocalizing negatively, feet stomping, hand flapping) that reliably occur prior to, and are functionally related to, target problem behavior. Thus, conducting FAs of precursors rather than target behavior may require fewer resources, be less dangerous for the consumer and therapist, and be more acceptable in certain environments (e.g., schools).

Some researchers have largely relied on caregiver report and informal observations to initially determine potential precursors (e.g., Borrero & Borrero, 2008; Dracobly & Smith, 2012). These methods may be problematic as they may result in potential false positives or false negatives (Dracobly & Smith, 2012; Fritz et al., 2013). A false positive occurs when a procedure incorrectly identifies a behavior as a precursor, whereas a false negative occurs when a procedure fails to identify a behavior as a precursor. False positives and false negatives are problematic if practitioners treat behaviors that are not precursors or fail to treat those that are, which in turn may have minimal impact on the problem behavior targeted. In an attempt to address this potential limitation, Fritz et al. (2013) developed and evaluated an experimental method for identifying precursors. The experimenters conducted a trial-based analysis with conditions similar to an FA. During each trial, observers collected data on potential precursors and target behavior and then calculated conditional probabilities to determine likely precursors (i.e., behaviors that were followed by the target behavior and did not occur in the absence of the target behavior). Next, the experimenters conducted independent FAs of the identified precursors and target behaviors for each participant and found the same function for seven of eight participants, whose target behavior was maintained by a single function. However, for one participant, the outcome was only a partial match (i.e., the precursor FA showed a tangible function, whereas the target behavior FA showed both a tangible and an escape function).

The outcomes of Fritz et al. (2013) suggest that their trial-based analysis was a valid experimental method for determining precursors to target behavior maintained by a single function;

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however, it is less clear whether this method is also effective for determining precursors to target behavior that is multiply controlled. Therefore, the purpose of the current study was to replicate the precursor analysis with an adolescent with autism spectrum disorder (ASD) who engaged in aggression that was multiply controlled.

METHOD

Participant and Setting

Brandon was a 13-year-old male diagnosed with ASD whose target behavior was aggression. We conducted sessions in a room in a center for individuals with ASD that contained materials necessary for the session.

Precursor Analysis

We conducted a precursor analysis using procedures similar to those described by Fritz et al. (2013). We conducted three different test trials (attention, demand, tangible) in which we manipulated relevant antecedents and consequences for aggression (i.e., hitting, pinching, hair pulling, and biting others) in a similar manner to an FA. After conducting the first 11 test trials, we observed aggression in 10 trials. Therefore, similar to Fritz et al., we conducted an additional play trial to create an approximately equal duration of trials with and without aggression for which to do our analyses. Following the occurrence of aggression during each attention, demand, and tangible trial, the therapist delivered the trial-specific consequence. Once aggression was not observed for 30 s following the delivery of a consequence or if aggression was not observed within 5 min of the onset of a trial, the next trial started. During attention trials, Brandon had access to moderately preferred items while the therapist engaged in an activity; however, if aggression occurred, the therapist delivered attention. During demand trials, the therapist used three-step prompting to instruct Brandon to complete a cleaning task; however, if aggression occurred the therapist terminated instructions. Prior to tangible trials, the therapist provided Brandon access to high preference items for 30 s then removed the items. The removal of the items initiated the tangible trial, and if aggression occurred, the therapist returned the items. During play trials, the therapist provided Brandon noncontingent access to preferred items and attention and did not present demands.

We videotaped all precursor trials, which were 5 min in duration (if no aggression occurred) or shorter (if aggression occurred). We used the videos to identify and define potential precursors and to score the occurrence or nonoccurrence of precursors across assessment trials. We completed the following steps to accomplish these tasks (similar to Fritz et al., 2013): (a) two experimenters independently viewed the videos and recorded potential precursors using a data sheet containing groups of response topographies (e.g., vocalizations, locomotion); (b) the experimenters compared their recordings and created definitions of each potential precursor; and (c) the experimenters independently viewed each video, recorded whether or not each potential precursor occurred during the trial, and compared their recordings until 100% agreement was attained for each potential precursor. If any discrepancies occurred between experimenters, they reviewed the video, modified the potential precursor definitions, and rescored the trial.

We calculated the following probabilities following the completion of the precursor analysis: (a) the probability of the precursor given the target [p(P|T)] by dividing the number of trials with aggression and the precursor by the number of trials with aggression, (b) the probability of the precursor given the absence of the target [p(P| ~ T)] by dividing the number of trials without aggression that contained the precursor by the number of trials without aggression, (c) the probability of aggression given the

precursor [p(T|P)] by dividing the number of trials with the precursor and aggression by the number of trials with the precursor, and (d) the probability of aggression given the absence of the precursor [p(T| ~ P)] by dividing the number of trials without the precursor that contained aggression by the number of trials without the precursor. We also calculated the unconditional probabilities of the precursor behaviors [p(P)], by dividing the number trials containing the precursor by the number of total trials, and of the target behavior [p(T)], by dividing the number of trials containing aggression by the number of total trials.

We selected precursors, if (a) the probability of aggression given the precursor [p(T|P)] was greater than the probability of aggression given the absence of the precursor [p(T| ~ P)] and the unconditional probability of aggression [p(T)], and (b) the probability of the precursor given aggression [p(P|T)] was greater than the probability of the precursor given the absence of aggression [p(P| ~ T)] and the unconditional probability of the precursor behaviors [p(P)] (Fritz et al., 2013).

Functional Analysis

Following the precursor analysis, we conducted independent FAs to confirm the functional relation between the seven identified precursors and aggression. Sessions lasted 10 min, and conditions were conducted in the following order: attention, tangible, play, and demand (Hammond, Iwata, Rooker, Fritz, & Bloom, 2013) using procedures similar to Iwata, Dorsey, Slifer, Bauman, and Richman (1994). Brandon was seated at a table and the therapist was positioned approximately 90–150 cm away from Brandon at the beginning of all sessions. We conducted the precursor FA first, during which condition-specific consequences were provided contingent on the occurrence of precursors and aggression was on extinction. Next, we conducted the aggression FA during which the condition-specific consequences were provided contingent on the occurrence of aggression and precursors were on extinction. Materials, therapist interactions, and condition-specific consequences were identical to those implemented during trials in the precursor analysis.

During each FA, we collected data on the frequency of aggression (as defined above in the precursor analysis) and the frequency of the seven precursor behaviors identified in the precursor analysis, which included standing up, heavy breathing, approaching instructor, folding hands, knee hitting, rubbing face, and negative vocalizing. Operational definitions of all precursors are available from the first author.

We calculated exact interval agreement percentages during 50% of FA sessions by comparing the primary and secondary data collectors' recorded frequencies of responses during 10-s intervals during the FAs. Overall, mean IOA scores were 97% (range, 90%–100%) and 95% (range, 90%–100%) for the precursor and aggression FAs, respectively.

RESULTS AND DISCUSSION

The results of Brandon's precursor analysis are in Figure 1. Seven (denoted by the asterisks) of the 25 potential behaviors were identified as precursors based on the criteria described above. Four of the precursors (knee hitting, rubbing face, heavy breathing, and folding hands) were perfectly correlated with aggression [i.e., p(T|P) = 1.0] and never occurred in trials in which aggression was not observed [i.e., p(P| ~ T) = 0]. However, aggression still occurred in the absence of these four precursors and the probability of these precursors occurring given aggression was low. The other three precursors (standing up, negative vocalizing, and approaching instructor) occurred less frequently [i.e., p(T|P) < 1.0] but the relative conditional probabilities showed

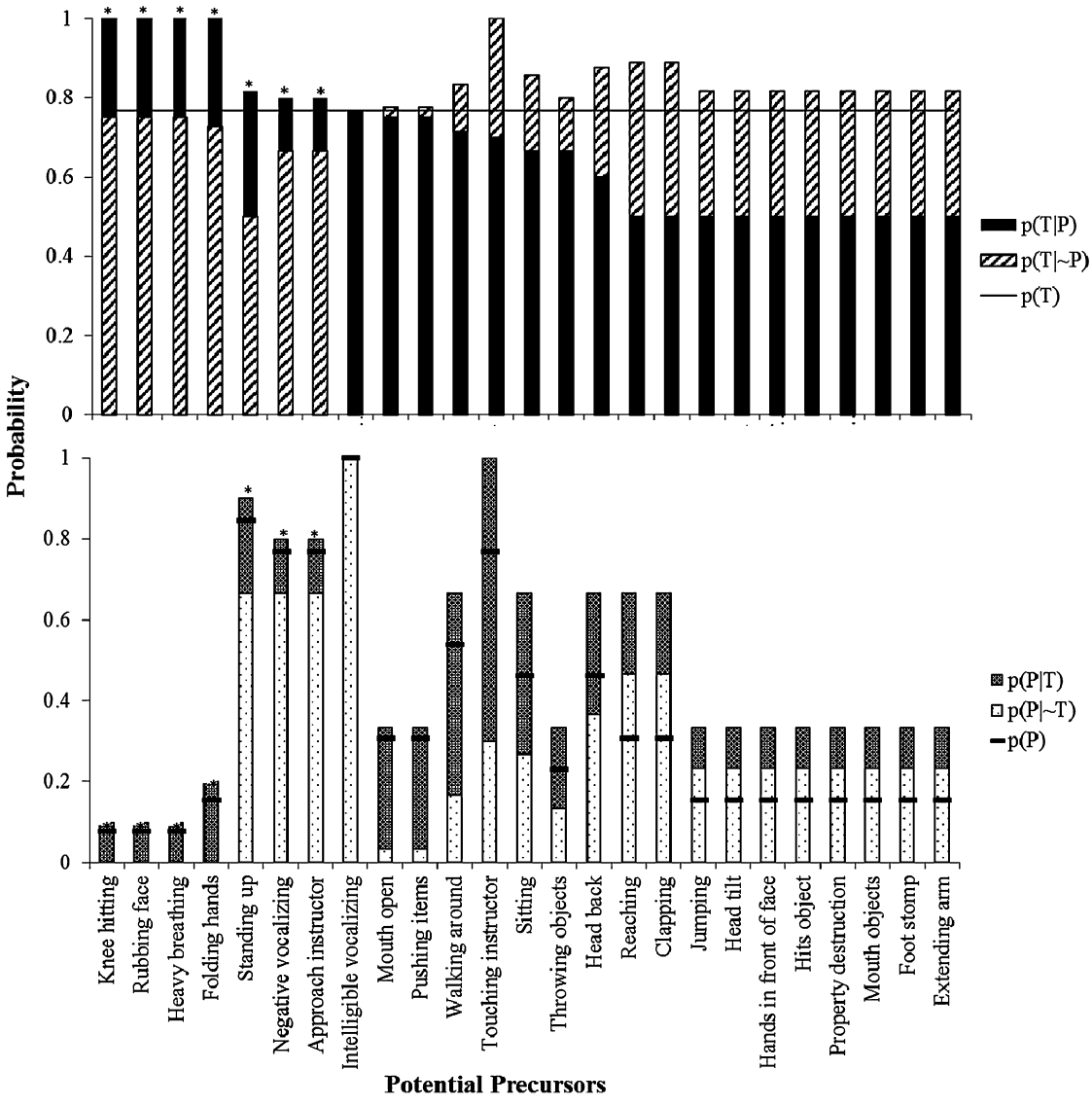

Figure 1. The top panel depicts the conditional probability of the target (T) given the presence [p(T|P)] and absence [p(T| ~ P)] of potential precursors (P) and the unconditional probability of the target [p(T)]. The bottom panel depicts the conditional probability of potential precursors (P) given the presence [p(P|T)] and absence [p(P| ~ T) of the target and the unconditional probability of each precursor [p(P)]. The asterisks denote behaviors identified as precursors.

that these behaviors predicted the occurrence of aggression.

Figure 2 depicts the results of precursor and aggression FAs. We observed high rates of precursors (left panel) and high rates of aggression (right panel) during the three test conditions during precursor and aggression FAs, respectively. This pattern of behavior suggests that combined precursors and aggression were multiply controlled by the same variables. In addition, Brandon demonstrated reduced rates of aggression during the precursor FA, which replicates similar findings reported in previous studies (e.g., Fritz et al., 2013).

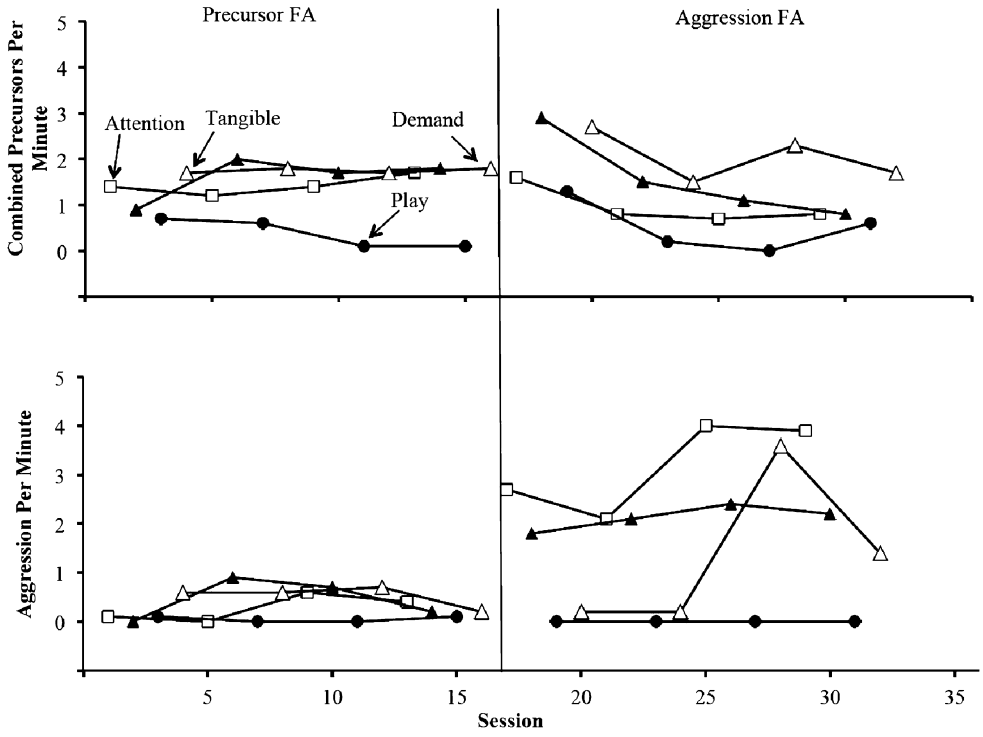

Figure 2. This graph depicts the precursor (left panel) and aggression (right panel) FAs. The top and bottom panels display the rate of combined precursors and aggression, respectively.

We calculated the proportion of each precursor during the precursor FA (Figure 3) which yielded several interesting outcomes. First, similar to Fritz et al. (2013), not all identified precursors occurred during the precursor FA. Knee hits and heavy breathing did not occur during the precursor FA despite being perfectly correlated with aggression in the precursor analysis. It is unclear why this occurred, but several explanations are possible. It is possible that these precursors were associated with increased response effort or did not have as recent a history of reinforcement relative to the other topographies of precursors. Alternatively, it may be the case that the precursor analysis resulted in some false positives.

Second, the most common precursors observed were negative vocalizing, approaching instructor, and standing up. Although these responses were not perfectly correlated with aggression in the precursor analysis, they occurred most frequently during the precursor FA. The inclusion of standing up and approaching instructor as precursor behaviors may be considered a limitation, as these responses may have been part of a response chain to aggression. If these were early responses in the chain, then, if reinforced, they would likely increase levels of aggression (Dracobly & Smith, 2012). However, data from the precursor FA do not support this interpretation, as reduced levels of aggression were observed when precursors were reinforced.

There is currently no established technology to distinguish precursors from links in a chain to a target behavior (Hagopian, Paclawskyj, & Kuhn, 2005). Future research is needed to develop such a technology. Third, a different precursor occurred most frequently in each test condition (e.g., vocalizing negatively in the demand condition). This pattern of responding may suggest different topographies of precursors

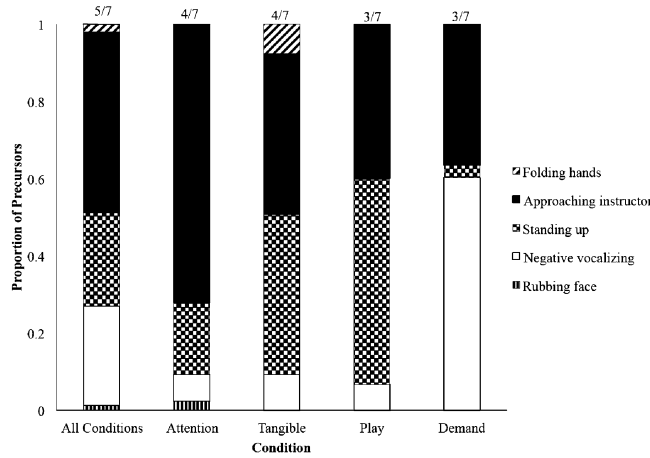

Figure 3. The bottom graph depicts the proportion of precursors that were scored in the precursor FA. Knee hits and heavy breathing were not observed in any precursor FA condition.

precede a multiply controlled target behavior under different evocative situations. Future research could further evaluate this possibility.

Several limitations are worth noting. The current evaluation included only one participant, thus limiting external validity. Future studies should replicate these findings with additional participants. Another mitigating factor was the lack of an *alone* condition during the FAs. The success of the treatment implemented based on the results of the FAs (these data are not included in the manuscript) suggests that Brandon's target behavior was unlikely maintained by automatic reinforcement; however, it is possible that some of the precursor behaviors were. The inclusion of an *alone* condition would have allowed an evaluation of this possibility.

Although we attempted to ensure the opportunity to engage in all responses during the FAs by seating Brandon at a table and positioning the therapist a consistent distance away to begin all sessions, some conditions required therapist behavior that would necessarily restrict Brandon's ability to engage in some responses. This limitation is exemplified by the following situation: If the therapist used physical guidance during the demand condition, Brandon would be unable to approach the therapist. Despite these limitations, the current evaluation provides support for an analysis to identify precursors to a problem behavior.

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