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A PROCEDURE FOR IDENTIFYING PRECURSORS TO PROBLEM BEHAVIOR

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We describe a procedure for differentiating among potential precursor responses for use in a functional analysis. Conditional probability analysis of descriptive assessment data identified three potential precursors. Results from the indirect assessment corresponded with those obtained from the descriptive assessment. The top-ranked response identified as a precursor according to the indirect assessment had the strongest relation according to the probability analysis. When contingencies were arranged for the precursor in a functional analysis, the same function was identified as for target behavior, supporting the utility of indirect and descriptive methods to identify precursor behavior empirically.

DESCRIPTORS: descriptive assessment, functional analysis, precursors, problem behavior, response-class hierarchies

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Functional analysis (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994) involves manipulating antecedents and consequences for the target behavior of interest. Because a functional analysis requires the repeated occurrence of a target response, it may not be appropriate for response topographies that pose risk of harm to others (e.g., severe aggression) or the client (e.g., self-injury). One modification that has addressed this concern involves a functional analysis of precursor behavior (i.e., arranging contingencies for responses that reliably precede the target behavior) based on previous research showing that response topographies that occur in close temporal proximity are often members of the same response class, and by providing differential reinforcement for earlier responses in the response-class hierarchy, later more severe responses occur less often (Harding et al., 2001; Lalli, Mace, Wohn, & Livezey, 1995; Richman, Wacker, Asmus, Casey, & Andelman, 1999).

Smith and Churchill (2002) conducted a functional analysis of precursor behavior and found similar outcomes from a functional analysis of the target behavior and a functional analysis of the hypothesized precursor behavior. A study by Najdowski, Wallace, Ellsworth, MacAleese, and Cleveland (2008) extended this work by demonstrating that an intervention based on a functional analysis of precursor behavior was effective in eliminating participants' precursor behavior. The implication of these findings is that outcomes from functional analyses of precursor responses may be used to infer the function of more severe topographies that occur later in the response-class hierarchy. A potential limitation associated with both of these studies is that indirect assessments alone were used to identify precursor responses. Such assessments have sometimes been found to have poor reliability and validity for identifying the function of problem behavior (e.g., Zarcone, Rodgers, Iwata, Rourke, & Dorsey, 1991). However, because an advantage of indirect assessments is their ease of use and efficiency, it may be useful to evaluate their utility for identifying precursors by comparing the out-

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comes of an interview regarding precursor behavior with those obtained from direct observation.

In a related study, Borrero and Borrero (2008) evaluated the utility of comparative probability analyses of descriptive assessment data for confirming the predictive relation between a hypothesized precursor response (vocalizations) and the target behavior (aggression and property destruction). Although this study demonstrated the utility of direct observation for confirming this predictive relation, the authors did not evaluate the utility of this approach for differentiating among several potential precursor responses. Therefore, the purpose of the present study was to extend previous research by identifying a number of possible precursors using an indirect assessment, using a descriptive assessment to identify the precursor with the strongest relation to targeted problem behavior, and then conducting a functional analysis on both this precursor and the more severe targeted problem behavior.

METHOD

Participant and Setting

Jay, a 10-year-old boy who had been diagnosed with autism and attended a residential program for students with developmental disabilities, participated in this study. He used a picture exchange communication system and demonstrated a wide range of receptive skills, including discrimination of multiple-step directives. His primary problem behavior was head-directed self-injury (head hitting). He was included in this study because staff reported that his head hitting often occurred in close temporal succession to several other response topographies. Descriptive assessment sessions were conducted in Jay's classroom, which included a table and two individual-sized desks to accommodate four students. He sat at one of the desks with his teacher while the other students and teachers were present and engaged in typical classroom activities. Functional analysis sessions were conducted in a room (1.5 m by 3 m) equipped with a wide-angle video camera and a table with two chairs.

Response Measurement and Interobserver Agreement

Jay's target response was *head hitting* (any instance of Jay's head coming into contact with another body part or object from a distance of 8 cm or more). Staff-reported precursor responses included *finger biting* (Jay's upper and lower teeth coming into contact with one or more of his fingers simultaneously), *loud vocalizations* (vocalizations above conversational level), *tailbone hitting* (Jay forcefully dropping his weight onto his tailbone, from a distance of 8 cm or more), *hand clasping* (Jay's fingers clasped with palms together simultaneously for any duration of time), and *elbow hitting* (Jay's elbow forcefully striking a surface from 8 cm or more). Although some of these potential precursor responses were also forms of problem behavior, none were as intense or were as likely to result in tissue damage as was head hitting.

All sessions were videotaped. Trained observers scored dependent variables using handheld computers with software designed for behavioral data collection, the calculation of conditional probabilities, and interobserver agreement. Observers recorded head hitting, finger biting, tailbone hitting, and elbow hitting using frequency measures and loud vocalizations and hand clasping using duration measures. During the functional analysis, data were summarized as responses per minute by dividing the total number of responses that occurred during each session by the total number of minutes in each session. Interobserver agreement datat were collected during the entire 56-min descriptive assessment and during 36% of the functional analysis sessions. For the descriptive assessment, mean agreement was 98% for head hitting, 97% for finger biting, 89% for loud vocalizations, 97% for tailbone hitting, 94% for hand clasping, and 98% for elbow hitting. Mean agreement during the functional analysis was 96% (range, 89% to

Table 1
Reported Precursors during Indirect Assessment

Respondent	Primary	Secondary	Tertiary
1	Finger biting	Loud vocalizations	
2	Finger biting	Loud vocalizations	Tailbone hitting
3	Loud vocalizations	Tailbone hitting	
4	Finger biting	Loud vocalizations	Tailbone hitting
5	Finger biting	Loud vocalizations	
6	Finger biting	Loud vocalizations and clasping hands	Elbow hitting
7	Finger biting	Loud vocalizations	Clasping hands
8	Finger biting	Clasping hands	Loud vocalizations
9	Finger biting	Loud vocalizations	
10	Loud vocalizations	Finger biting	
11	Loud vocalizations	Finger biting	
12	Loud vocalizations	Finger biting	
13	Loud vocalizations		
14	Finger biting		
15	Elbow hitting	Finger biting	
16	Finger biting		
Total	Finger biting = 62.5% Loud vocalizations = 31.3% Elbow hitting = 6.3% Clasping hands = 0% Tailbone hitting = 0%	Loud vocalizations = 43.8% Finger biting = 25% Clasping hands = 12.5% Tailbone hitting = 6.3%	Tailbone hitting = 12.5% Loud vocalizations = 6.3% Elbow hitting = 6.3% Clasping hands = 6.3% Finger biting = 0%

100%) for head hitting and 96% (range, 84% to 100%) for finger biting.

Indirect Assessment

Interviews were conducted individually with 16 respondents who worked as Jay's teachers on a daily basis. During the interview, the experimenter explained that a precursor was a reliable predictor of problem behavior and then asked respondents if they could identify precursors to Jay's head hitting. If respondents identified more than one response topography as a precursor behavior, they were asked to rank precursors as primary, secondary, and tertiary. Results of the survey are depicted in Table 1. Finger biting and loud vocalizations were identified most often as precursors, with finger biting being reported by the largest number of respondents as a primary precursor followed by loud vocalizations. Four of the six respondents who did not identify finger biting as a primary precursor identified it as a secondary precursor.

Descriptive Assessment

Jay was videotaped in his regular classroom setting, Monday through Friday, 10 a.m. to 3 p.m., in 5- to 12-min observation periods. Materials that were present included a desk and chair, academic supplies, and leisure items. Taping continued until 20 instances of problem behavior had been captured; the total observation length of the descriptive assessment was 56 min. Tapes were scored for the occurrence of head hitting alone and within 10 s of the five putative precursor responses, using handheld computers as previously described. A data-analysis program calculated conditional and unconditional (background) probabilities, using a method similar to that described by Vollmer, Borrero, Wright, Van Camp, and Lalli (2001).

Similar to the Borrero and Borrero (2008) study, two conditional probability analyses and two unconditional probability analyses were conducted. To calculate the probability of target behavior given precursor behavior, the number of occurrences of the precursor response that were followed by an occurrence of the target response (head hitting) within 10 s was divided by the total number of occurrences of that precursor response. To calculate the probability of precursor behavior given target behavior, the number of occurrences of the target behavior

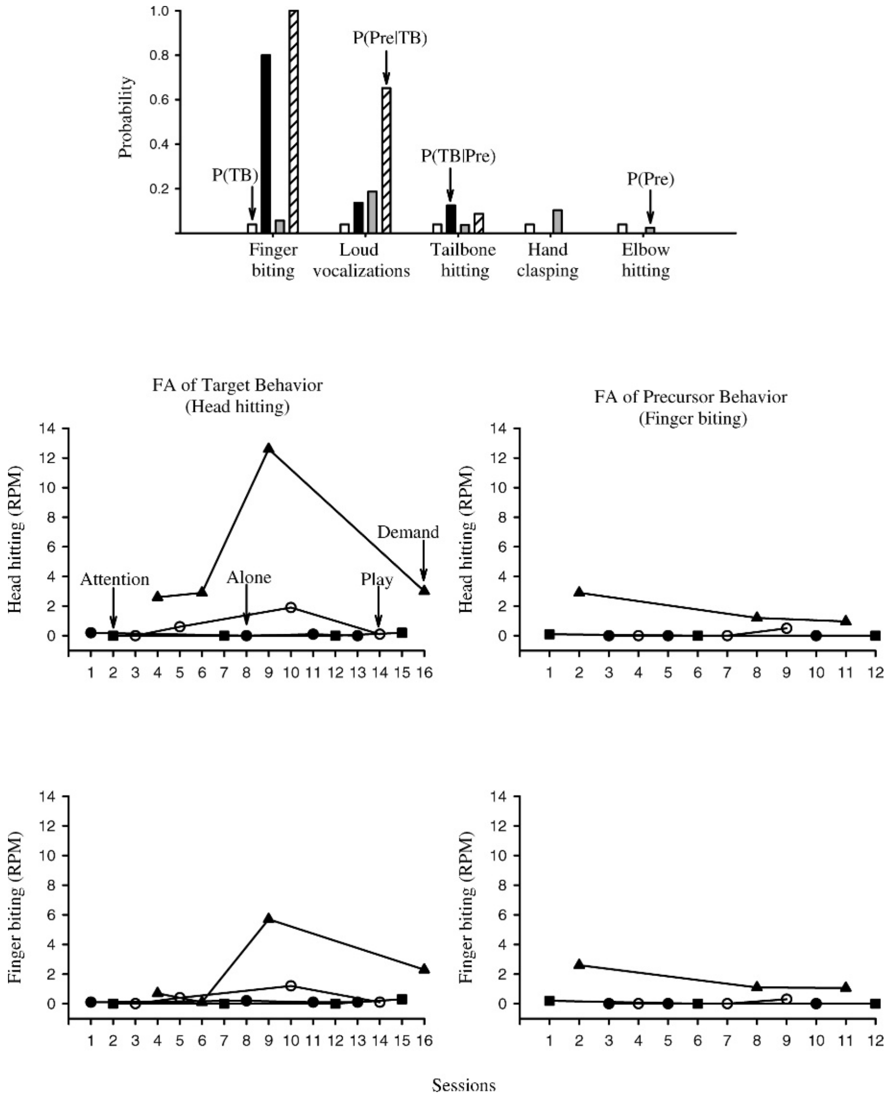

Figure 1. The top panel depicts comparative probability analyses, including the probability of target behavior (head hitting) given precursor behavior (finger biting; *p*[TB|Pre]), the unconditional probability of target behavior (*p*[TB]), the probability of precursor behavior given target behavior (*p*[Pre|TB]), and the unconditional probability of precursor behavior (*p*[Pre]). The middle and bottom left panels show results from the functional analysis of head hitting, and the middle and bottom right panels show results from the functional analysis of finger biting.

that occurred within 10 s following a potential precursor was divided by the total number of occurrences of the target behavior. To calculate the unconditional probability of the target behavior, the number of 10-s intervals that contained the target response was divided by the total number of 10-s intervals in the assessment. To calculate the unconditional probability of the precursor response, the number of 10-s intervals that contained the precursor response was divided by the total number of 10-s intervals in the assessment.

Results of the comparative probability analyses based on the descriptive assessment are depicted in Figure 1 (top). The probability of the target behavior (head hitting) given finger biting was .8, given loud vocalizations was .14, given tailbone hitting was .13, given hand clasping was 0, and given elbow hitting was 0. The probability of finger biting given head hitting was 1.0, given loud vocalizations was .65, given tailbone hitting was .09, given hand clasping was 0, and given elbow hitting was 0. The unconditional probability of head hitting was .04. A comparison of conditional and unconditional probabilities shows that head hitting was more probable given finger biting, loud vocalizations, and tailbone hitting and that this difference was most prominent given finger biting. These data also show that the probability of finger biting, loud vocalizations, and tailbone hitting was greater preceding head hitting than it was unconditionally and that this difference was most pronounced for finger biting. Together, these analyses showed that finger biting, loud vocalizations, and tailbone hitting might be considered precursors for head hitting, with the relation between finger biting and head hitting being the most apparent. This outcome was in agreement with 58% of the respondents who noted that finger biting was the most reliable precursor response.

Functional Analyses

Two functional analyses were conducted. Differential consequences were provided for head hitting during the first functional analysis, and differential consequences were provided for finger biting in the second functional analysis. Less than 1 month had elapsed between the completion of the first functional analysis and the start of the second functional analysis. Functional analyses were similar to those described by Iwata et al. (1982/1994), with alone, attention, play, and demand conditions presented in a multielement design. During the alone condition, Jay was alone in a room with no leisure items. During the attention condition, no leisure items were present, and the therapist pretended to work and diverted attention away from Jay. The therapist provided brief vocal and physical attention following target or precursor behavior. During the play condition, preferred leisure items were continuously available, and the therapist provided brief attention to Jay on a fixed-time 15-s schedule. During the demand condition, the therapist presented instructions (e.g., wiping the table, tying a shoelace, folding a towel), using a three-step prompting hierarchy, and removed the demands for 30 s following target or precursor behavior.

RESULTS AND DISCUSSION

Results from the functional analyses are depicted on the middle (head hitting) and bottom (finger biting) panels of Figure 1. During the functional analysis of head hitting (left), head hitting and finger biting (precursor response) occurred at differentially higher rates in the demand condition, suggesting maintenance by escape from tasks. During the functional analysis of precursor behavior (right), finger biting occurred at differentially higher rates in the demand condition, suggesting maintenance by escape from tasks. Thus, the functional analysis of both the target and precursor behaviors identified the same maintaining consequence. It is also important to note that a reduction in the target response (head hitting) was observed during the functional analysis of finger biting ($M = 2.2$ responses per minute during demand sessions) relative to the functional analysis of head hitting ($M = 5.3$ during demand sessions). In addition, the temporal sequence of finger biting and head hitting during the functional analysis of head hitting was such that 95% of finger biting began prior to an occurrence of head hitting. Thus, finger biting primarily preceded the occurrence of head hitting during the functional analysis.

The present findings extend previous research on functional analysis of precursor behavior by including both indirect and descriptive methods for identifying precursor responses. Further, the current study extends Borrero and Borrero (2008) by conducting comparative probability analyses with multiple potential precursor responses to determine to what extent findings obtained from the indirect assessment matched those from the descriptive assessment. The present findings also replicate previous research showing that outcomes of the functional analysis of both the target behavior and precursor behavior showed the same outcome, and the functional analysis of precursor behavior resulted in fewer occurrences of the target response. These findings support the predictive validity of a functional analysis of precursor behavior and suggest the clinical utility of this approach for decreasing risk associated with a functional analysis of severe problem behavior.

Although results of the current study provide support for both indirect and descriptive assessment methods for identifying precursor behavior, additional research is needed to assess the generality of both approaches across participants and response topographies. In the current study, most respondents interviewed identified the correct precursor as being the most likely during the survey, but approximately a third of the respondents did not. In future research, functional analyses of multiple responses identified by both descriptive and indirect assessments might be compared to determine whether secondary or tertiary precursors are also members of the same response class as more severe problem behavior. In addition, it is important to note that, although levels of head hitting decreased during the functional analysis of precursor behavior, it continued to occur. Therefore, conducting a functional analysis of precursor behavior may not ensure complete suppression of the problem behavior during the analysis.

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