PROGRESSING FROM IDENTIFICATION AND FUNCTIONAL ANALYSIS OF PRECURSOR BEHAVIOR TO TREATMENT OF SELF-INJURY

Joseph Daniel Dracobly, B.A.

Thesis Prepared for the Degree of

MASTER OF SCIENCE

UNIVERSITY OF NORTH TEXAS

December 2009

APPROVED:

Richard G. Smith, Major Professor and Chair of the Department of Behavior Analysis
Sigrid Glenn, Committee Member
Manish Vaidya, Committee Member
Thomas L. Evenson, Dean of the College of Public Affairs and Community Service
Michael Monticino, Dean of the Robert B. Toulouse School of Graduate Studies

An evaluation of the utility of assessing and treating severe problem behavior through precursor functional analysis was completed. Ongoing measurement of problem behavior in two settings in the participant’s natural environment was conducted for the duration of the study. A precursor to self-injurious behavior was identified using descriptive assessment and conditional probability analyses. A precursor functional analysis was then conducted. Subsequently, a treatment, in which precursor behavior produced the maintaining variable identified in the precursor functional analysis, was implemented in the natural environment. Treatment resulted in increases in the precursor behavior and decreases in self-injury in both the treatment setting and the second setting in which observations occurred. Implications of the assessment and treatment procedures are discussed.
Copyright 2009

by

Joseph Daniel Dracobly
ACKNOWLEDGEMENTS

I would like to thank Dr. Richard Smith for both his mentorship throughout my time at the University of North Texas as well as his shaping, support, and fostering of my passion for research. I thank Nate Lyon, Claire Anderson, Christine Mosso, Bailey Devine, and Stephen Walker for their assistance with data collection. I would also like to express my gratitude to Dr. Sigrid Glenn and Dr. Manish Vaidya for their insightful and helpful feedback on my thesis, as well as their exceptional instruction during the course of my studies. Finally, I would like express my love and thanks to my wife Libba, without whose support this would not have been possible.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ACKNOWLEDGEMENTS</td>
<td>iii</td>
</tr>
<tr>
<td></td>
<td>LIST OF TABLES</td>
<td>v</td>
</tr>
<tr>
<td></td>
<td>LIST OF ILLUSTRATIONS</td>
<td>vi</td>
</tr>
<tr>
<td>I</td>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>II</td>
<td>METHOD</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>General Procedures</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>RESULTS</td>
<td>22</td>
</tr>
<tr>
<td>IV</td>
<td>GENERAL DISCUSSION</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>REFERENCE LIST</td>
<td>46</td>
</tr>
</tbody>
</table>
LIST OF TABLES

Page

1. Interobserver Agreement by Condition..........................................................37
# LIST OF ILLUSTRATIONS

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Running Percentage of Sessions with Self-Injury</td>
<td>38</td>
</tr>
<tr>
<td>2</td>
<td>Results of Pre-Treatment Observations</td>
<td>39</td>
</tr>
<tr>
<td>3</td>
<td>Data from Comparative Probability Analysis</td>
<td>40</td>
</tr>
<tr>
<td>4</td>
<td>Head-Up during Precursor Functional Analysis</td>
<td>41</td>
</tr>
<tr>
<td>5</td>
<td>Self-Injury during Precursor Functional Analysis</td>
<td>41</td>
</tr>
<tr>
<td>6</td>
<td>Data from Treatment Analysis</td>
<td>42</td>
</tr>
<tr>
<td>7</td>
<td>Rate of Head-Up and Self-Injury at Home during Treatment</td>
<td>43</td>
</tr>
<tr>
<td>8</td>
<td>Home Probability Analysis during Treatment</td>
<td>44</td>
</tr>
<tr>
<td>9</td>
<td>Rate of Attention at Home during Treatment</td>
<td>45</td>
</tr>
</tbody>
</table>
CHAPTER I
INTRODUCTION

Functional analysis (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994) has been shown to be an effective method for identifying the variables maintaining problem behavior, including self-injury. Analog functional analysis involves the systematic presentation of antecedent and consequent events thought to evoke and maintain problem behavior. During these manipulations, problem behavior may produce reinforcing consequences in one or more of the conditions, and differentiation in measures of problem behavior across conditions indicates the maintaining variables for problem behavior. Analog analysis allows for direct demonstration of the variables maintaining problem behavior, thus allowing for manipulation of those variables as effective, function-based treatment.

There are drawbacks to the use of functional analysis. Because functional analysis is designed to evoke and reinforce problem behavior, functional analysis may be contraindicated for severe topographies of problem behavior. For example, self-injury that could cause severe harm or death, and aggression that could cause significant harm to experimenters or others, cannot be allowed to occur, thus precluding the use of functional analysis to assess maintaining variables. Another drawback to the use of standard functional analysis methods is their difficulty in assessing low-rate problem behavior.
Typically, sessions in each condition last for 10 min, with a reported range between 1 min and 30 min (Hanley, Iwata, & McCord, 2003). For behavior that occurs relatively infrequently, this may be insufficient time to evoke the problem behavior. Several procedural variations have been developed to address these limitations.

To reduce risk during functional analysis, researchers have used brief, or time-limited functional analysis, which may involve abbreviated sessions (e.g., Wallace & Knights, 2003; Northup et al., 1991; Derby et al., 1992; Kahng & Iwata, 1999), single-session presentation of conditions (e.g., Northup et al.; Derby et al.), progression through a series of analyses designed to reduce the overall time necessary to observe differentiation (e.g., Vollmer, Marcus, Ringdahl, & Roane, 1995), or within-session analyses of response patterns (Vollmer, Iwata, Zarcone, Smith, & Mazaleski, 1993; Vollmer et al.). For example, in the brief functional analyses described by Derby and colleagues and Northup and colleagues, sessions in each condition lasted 5 min–10 min and were conducted only once during the initial analysis. The brief functional analysis procedure described by Vollmer et al. involved presenting 8–12 conditions (Phase 1), and conducting within session analyses to determine the sensitivity of problem behavior to various contingencies. If problem behavior was undifferentiated following the initial 8 – 12 sessions, participants were exposed to standard functional analysis conditions in a multielement format (Phase 2). If responding remained undifferentiated, only no-consequence conditions were presented (Phase 3), followed by conditions presented in a reversal design, if the participant’s behavior extinguished during the no-consequence only conditions (Phase 4). Results of the brief functional analysis have been mixed. In
three out of four of the above cited studies, significant numbers of the participants required additional assessment procedures beyond the brief functional analysis to identify the maintaining variables (Derby et al., 53.2%; Kahng & Iwata, 32 %-34%; Vollmer et al., 70% beyond Phase 1). Wallace and Knights, however, identified the maintaining variables during the brief functional analysis for all 3 participants. While the brief functional analysis was able to identify the maintaining variables for problem behavior for some participants in each of the studies, this procedural variation still requires problem behavior to be evoked and reinforced, which may be contraindicated if the problem behavior is severe. Further, these procedures have not been utilized with low-rate problem behavior, which may by insensitive to brief exposure to contingencies.

At least two methods for adapting functional analysis procedures for use with low rate problem behavior have emerged in the literature. Kahng, Abt, and Schonbachler (2001) developed a procedure known as the “all-day functional analysis.” Under this procedure, each condition of the functional analysis is in effect for an extended period of time, such as during normal working hours (9:00 a.m. to 5:00 p.m.), during which experimenters follow the individual and implement procedures in his or her natural environment. Sessions can be conducted across days in a multielement or random format, allowing for significantly longer observation periods and increasing the likelihood that functional analysis contingences will successfully evoke and reinforce problem behavior. However, a drawback to this procedure is the amount of time and resources required to implement functional analysis procedures over such long periods of time.
An alternative method for assessing low rate problem behavior involves implementing standard functional analysis procedures (i.e., 10 min experimental sessions) following occurrences of problem behavior (Tarbox, Wallace, Tarbox, Landaburu, & Williams, 2004). Under this procedure, sessions from two experimental conditions and one control condition are presented following the first occurrence of problem behavior, with the cycle continuing if problem behavior occurs following the third condition. Tarbox et al. found this method to be effective in assessing the controlling variables of the participants’ problem behavior, requiring only slight modification of the standard functional analysis procedure. While this procedure requires significantly less time and resources than the Kahng et al. procedure, as experimental and control conditions are implemented only if problem behavior occurs, the procedure does assume that additional responses will occur following the first response (i.e., multiple responses occurring in close temporal proximity followed by longer periods of no responding), with low interresponse times during these episodes (i.e., the problem behavior has an overall low rate due to high inter-episode times). This may be problematic if the frequency of single responses is not well measured both within and across episodes, that is, if experimenters do not monitor how often responses occurred in close temporal proximity (i.e., how often episodes occurred compared to single responses), no responding during test conditions may have been the result of the standard “pattern” of behavior, rather than insensitivity to contingencies in effect.
Finally, although the procedures described by Kahng et al. and Tarbox et al. appear to represent effective methods for assessing low rate problem behaviors, both require problem behavior to be evoked and reinforced, which again can pose risks for individuals and caregivers in cases of severe problem behavior.

Another procedural variation of functional analysis involves examination of response class hierarchies of problem behavior (e.g., Lalli, Mace, Wohn, & Livezey, 1995). For example, Lalli et al. conducted a functional analysis of problem behaviors exhibited by a 15-year-old female with moderate mental retardation and autism. During the functional analysis, Lalli et al. found that her problem behaviors occurred in a relatively ordered, hierarchical pattern (i.e., response occurred in a temporal order, in which the first response topographies were less severe than the last response topographies). They then arranged the experimental contingencies for one response in the hierarchy, while all other members were under extinction. Results showed that when contingencies were on the first member of the hierarchy, no other responses in the hierarchy were observed. When contingencies were arranged for the last member of the hierarchy, the other topographies generally occurred in order, culminating in the final response, which produced reinforcement.

Several follow-up studies have replicated and extended the findings of Lalli et al. (1995). For example, Richman, Wacker, Asmus, Casey, and Andelman (1999) found that when all topographies of problem behavior produced reinforcement during functional analysis, only milder (earlier) topographies in the hierarchy occurred. Richman et al. conducted an extinction analysis similar to that described by Lalli et al. (1995), which
confirmed that 2 of 3 participants’ problem behaviors were part of a response class hierarchy. However, Richman et al. utilized a 6 s partial-interval recording system, which prevented precise measurement of latencies for each response. Harding et al. (2001) replicated the procedure using a second-by-second measurement system. This study provided further evidence that response hierarchies can be systematically evaluated by arranging contingencies for different members of the hierarchy.

Lalli et al. (1995), Richman et al. (1999), and Harding et al. (2001) demonstrated that placing contingencies on members of response hierarchies that occur early in the hierarchy resulted in decreased frequencies of response forms that were observed to occur later in the hierarchy. The authors of each study noted that this could be useful when assessing severe problem behavior, as the general procedure would allow determination of the environmental determinants of potentially functionally related problem behaviors without evoking and reinforcing severe topographies. Based on this logic, Smith and Churchill (2002) developed a precursor assessment, which involved identifying behaviors that reliably precede severe topographies of problem behavior and conducting a functional analysis of the precursor behavior. Whereas previous studies placed contingencies on all topographies of problem behavior during functional analysis, during precursor functional analysis, contingencies are placed on the precursor(s) only, while severe topographies are under extinction. To validate the results of the precursor functional analysis, Smith and Churchill also conducted functional analyses for the severe topographies. When contingencies were on the precursor behavior, severe topographies were suppressed, and when contingencies were on the severe topographies, the precursors
reliably occurred before the severe topographies, suggesting that the behaviors were functionally related in a hierarchical fashion. This assessment provided initial support for a method of identifying the controlling variables for problem behaviors without requiring that severe topographies be evoked and reinforced.

Several follow-up studies sought to replicate and extend the findings of Smith and Churchill (2002). Najdowski, Wallace, Ellsworth, MacAleese, and Cleveland (2008) conducted a precursor functional analysis, then utilized Functional Communication Training to teach the participants alternative responses. Najdowski et al. found a clear function as a result of the precursor functional analysis, and when this maintaining consequence was used to teach an alternative response, the rate of each participant’s precursor(s) decreased. However, Najdowski et al. discussed two significant drawbacks to this study. First, this study utilized staff reports to identify precursors, and problem behaviors were not observed to occur throughout the study. Therefore, it is possible that precursor and problem behavior were functionally unrelated, and that the contingencies presented during the functional analysis assessed antecedents and consequences that were relevant for the precursor and not the problem behavior. Furthermore, because contingencies were placed on precursor behavior during baseline conditions no problem behavior occurred; as a result, differential reinforcement of alternative behavior merely demonstrated an increase in manding and a decrease in the precursor behavior. Thus, the putative relationship between precursor and problem behavior was never demonstrated in this study.
Two additional studies provided more robust methods for identifying precursors to problem behavior. Langdon, Carr, and Owen-DeSchryver (2008) and Borrero and Borrero (2008) utilized comparative probability analyses to determine relations between potential precursors and problem behavior. Both studies utilized staff reports to identify potential precursors. Langdon et al. conducted observations in the participants’ natural environments, then calculated translation probabilities, including the probability of a problem behavior following a precursor, a precursor following a precursor, other behavior following a precursor, and problem behavior following problem behavior, as well as the probability of a problem behavior occurring without being preceded by a precursor or problem behavior. However, Langdon et al. did not calculate the unconditional probabilities of either precursor(s) or problem behaviors. Without these values, it is possible that the two events appeared related because one or the other was occurring at a very high rate. Borrero and Borrero’s method for determine probabilistic relations between two events, however, included both conditional and unconditional probabilities. A behavior was confirmed as a reliable precursor if both the probability of a precursor given a problem behavior and a problem behavior given a precursor were greater than the unconditional probability of both the precursor and problem behavior. Borrero and Borrero found that both the precursor(s) and problem behaviors shared the same reinforcer, indicating that comparative probability analyses based upon comparisons to unconditional probability values could be an effective method for identifying precursor behaviors.
The current study was designed to replicate and extend procedures utilized by Najdowski et al. (2008) and Borrero and Borrero (2008) by conducting comparative probability analyses to identify a reliable precursor, measuring the problem behavior and precursor in the participant’s natural environment throughout the study, conducting a precursor functional analysis, and using the results of the analysis to develop a treatment for problem behavior which was implemented and evaluated in the natural environment.
CHAPTER II

METHOD

General Procedures

Participant

Peter was a 29 year-old male with mild mental retardation, who exhibited self-injury in the forms of face-slapping, face-punching, and head-banging. Although Peter’s self-injury occurred relatively infrequently (e.g., records indicated a rate of 72 episodes per month during the 12 months prior to this investigation, with self-injury occurring an average of 15 days per month) it resulted in tissue damage including bruising, lacerations, and bone fractures, as well as destruction of property (e.g., holes in the wall, broken glass, etc.) as a result of head banging. Peter lived at a large state institutional facility for adults with mental retardation. Peter’s personal support team referred him to the Behavior Analysis Resource Center (BARC) for assessment and treatment of his self-injury.

Settings

Baseline and treatment sessions took place in Peter’s apartment and worksite. Peter lived with 7 other individuals in an apartment located on the campus of the residential facility and shared a room with one other resident of the facility. The apartment contained a living area, a dining room, a kitchen, two bathrooms, laundry closet, and four shared bedrooms. There was also a shared patio area, directly behind
Peter’s apartment, which contained a basketball goal. Peter’s worksite (an employment training center, located on the grounds of the residential campus) was attended by all of Peter’s housemates, as well as other residents of the facility. Two staff members from Peter’s residence and a vocational monitor were assigned to the worksite during all observations. The worksite contained three tables with chairs and various work materials corresponding to the work contract the facility had at the time.

The preference assessment and precursor functional analysis took place in a clinic room in the BARC clinic. The room in which procedures were conducted was 3.7 m by 3.7 m, with a two-way mirror mounted on the front wall, allowing unobtrusive observation. The room contained a 1.2 m by 0.8 m table, a stationary chair, and a rolling chair. During all sessions, trained observers with handheld computers were outside the room.

Response Definitions, Measurement, and Interobserver Agreement (IOA)

Self-injury was operationally defined as open-handed slaps to the head or face, punches to the head or face, and head banging against stationary objects. Head-up was scored when no part of Peter’s chin or neck touched his chest or shoulders. An additional dependent variable, nose wiping, was added before the precursor functional analysis was started. Nose wiping was defined as Peter moving the palm of his hand across his nose and mouth area within 2 s of head-up. This behavior was included because Peter was often observed to lift his head while wiping his nose; however, he never engaged in self-injury while wiping his nose. Therefore, instances of head-up that were immediately followed by nose wiping were excluded for data analysis purposes. No nose wiping
occurred during treatment. Additional independent variables scored during baseline observations and worksite treatment were attention (from staff during baseline observations, from the therapist during treatment), tangible delivery (from staff), and activity engagement (work, eating a meal, playing a sport, or self-care tasks). During the precursor functional analysis, additional therapist behaviors, including attention delivery, tangible delivery, and delivery of demand, and participant behaviors, including tangible consumption and completion of demand, were scored.

Trained observers collected all data. During baseline and treatment sessions, attention and activity engagement were scored using duration measures while tangible delivery was scored using event recording. During the precursor functional analysis, tangible delivery, tangible consumption, delivery of demand, and completion of demand were scored using event recording, while attention was scored using a duration measure.

IOA was calculated by dividing each session 1s intervals, summing the number of intervals in which the primary and secondary observers agreed on the occurrence or non-occurrence of the target behavior (head-up or self-injury) within a moving 2 s window, dividing the result by the total number of intervals in the session, and multiplying the outcome by 100. For example, if the primary observer recorded an event at time x, agreement was scored if the secondary observer recorded the same event at time x-1 s, time x, or time x+1 s. For the baseline, IOA was calculated for 42.4% of sessions, and the mean agreement was 99.71% (range 98.6%-100%). IOA was calculated for 37.9% of precursor functional analysis sessions, and the mean agreement was 98.5%
IOA was calculated for 40.0% of treatment sessions, and the mean agreement was 98.9% (range of 95.6%-100%). See Table 1 for a detailed breakdown of head-up and self-injury IOA scores.

Timeline

The study took place over the course of 17 months, with baseline observations in effect for the duration of the study. The scatter plot analysis and pilot observations occurred before the formal study began. The precursor functional analysis began following Baseline Session 31 (observation at Peter’s apartment), and preceded Baseline Session 32 (observation at Peter’s worksite). Baseline sessions remained in effect during the precursor functional analysis. Following completion of the precursor functional analysis, baseline observations continued for an additional 30 sessions (15 at Peter’s apartment, 15 at Peter’s worksite) prior to treatment. Treatment began at Peter’s worksite following Baseline Session 81 (observation at Peter’s apartment). Baseline conditions remained in effect at Peter’s apartment for the duration of the study.

Scatter Plot Analysis

A scatter plot, using procedures similar to those described by Touchette, MacDonald, and Langer (1985), was completed to determine temporal patterns of self-injury. Direct-care staff at the residential facility scored occurrences of problematic behavior on data sheets that contained boxes below each hour, with room for staff to make a tick mark for each occurrence of problem behavior. One month of data sheets (one per shift, three per day) were collected, and the results were plotted on a scatter plot consisting of a grid on which days of the month were distributed horizontally and times
of day were distributed vertically. Cells on the grid that corresponded to times on the data sheet on which problem behavior had been recorded were filled. This yielded a graphical display of the temporal patterns of Peter’s self-injury across 24 hours for 30 days. The scatter plot indicated that Peter was most likely to engage in self-injury between the hours of 6:30 am and 9:00 am and 2:00 pm and 4:00 pm. Peter was in his apartment during the morning hours and at his worksite during the afternoon hours.

Peter’s psychologist had also previously created a graphical display of the reported times of Peter’s injuries as a result of self-injury, which indicated that the majority of Peter’s injuries from self-injury occurred during the times identified on the scatter plot. Baseline observations were subsequently scheduled during these times.

Baseline Observations

Anecdotal reports from Peter’s staff indicated that Peter usually maintained a position in which his head was facing down toward the floor or table but would typically lift his head and stare at staff just before and during episodes of self-injury. Prior to the structured observations, two 60 min pilot observations were conducted. Observers recorded, in a narrative format, what Peter was doing during the observation. Self-injury was observed during both observations, with all occurrences preceded by Peter lifting his head. Following these pilot observations, behavioral definitions were developed and structured baseline observations were started.

Observations occurred in Peter’s apartment between the hours of 6:30 am and 9:00 am, and in Peter’s worksite between the hours of 2:00 pm and 4:00 pm. Observations were always conducted in pairs (i.e., one observation at Peter’s apartment
and worksite per day) and, once initiated, occurred 2-5 times per week throughout the duration of the study. Thus, self-injury occurring at home and in the worksite was monitored before, during, and after the precursor functional analysis, as well as before and during treatment. Observations lasted for a duration of 10 min to 30 min at each site. Observations were shorter than 30 min only when Peter left his home prior to 30 min elapsing (e.g., for a medical appointment). If a morning observation was less than 30 min, the duration of the afternoon observation or treatment was yoked to the duration of the morning session. 58 of 154 sessions (37.7% of sessions) were terminated before 30 min elapsed.

When observers arrived, they greeted Peter by saying hello and shaking his hand. Staff were informed that Peter was being observed and asked to go about their work as usual. The observers then went to a corner of the room and began observation. If Peter moved from one area to another, observers followed Peter. If Peter entered the bathroom and shut the door, the observation was suspended until Peter left the bathroom. This only occurred twice during the study and it did not appear that Peter engaged in self-injury while in the bathroom alone.

If Peter attempted to interact with the observers (e.g., approaching the observers and talking to them), the interaction was ignored. Observations were terminated at the end of 30 min or when Peter left the site. If 30 min of observation elapsed, the observers said goodbye to Peter, shook his hand, and left the site.
Precursor Identification

A comparative probability analysis, using procedures described by Borrero and Borrero (2008), was conducted using data from baseline observations. To determine potential relations between head-up and self-injury, the conditional probability of head-up preceding self-injury within 10 s was calculated. To calculate this conditional probability, the time (in s) of each occurrence of self-injury was recorded. From this anchor point, occurrences of head-up in the previous 10 s were scored and the proportion of self-injury that was preceded by head-up was calculated. In addition, the conditional probability of self-injury following head-up within 10 s was calculated. To calculate this conditional probability, the time (in s) of each occurrence of head-up was recorded. From this anchor point, occurrences of self-injury in the following 10 s were scored, and the proportion of head-up responses followed by self-injury was calculated. Finally, the unconditional probabilities of head-up and self injury were calculated, to determine the ambient level of each. All probabilities were summarized both within and across sessions.

Multiple Stimulus Without Replacement Preference Assessment

A multiple stimulus without replacement preference assessment (DeLeon & Iwata, 1996) was conducted using food items. Peter was seated at a table and ten food items were placed approximately 0.25 m in front of Peter. Peter was then told to pick one item. After Peter picked an item, all remaining items were re-arranged until all items had been chosen. The preference assessment was conducted five times.
The results of the preference assessment indicated that Peter’s most preferred item was a pizza flavored chip. Chewy chocolate chip cookies and pudding tied for the second most preferred item.

Multiple Stimulus Engagement Preference Assessment

In order to identify potentially reinforcing leisure items, a multiple stimulus engagement preference assessment (Hagopian, Rush, Lewin, & Long, 2001) was conducted using leisure items. With Peter seated at a table, items were placed approximately 0.25 m in front of him, and the duration of his engagement with the item, up to 120s, was recorded. Each time an item was placed in front of Peter, he immediately shook his head and said no. He then began making the manual sign and gesture for cookie. Thus, no results were obtained for the leisure item preference assessment. However, anecdotal reports from observers at Peter’s apartment indicated that he occasionally looked at magazines. Therefore, magazines were used, when appropriate, during the precursor functional analysis.

Paired Choice Preference Assessment

A paired choice preference assessment (Fisher et al., 1992) was conducted using the same food items used in the multiple stimulus without replacement preference assessment. Each item was assigned a number using a form that pre-assigned pairings, to control for location or pairing bias. With Peter seated at a table, two food items were simultaneously presented approximately 0.25 m in front of him. He was told to pick one item. When he chose a food item, he was permitted to consume it, the remaining item was removed, and the next trial started.
45 trials were conducted. The results indicated that chewy chocolate chip cookies were the most preferred item. Further analysis indicated that when paired with the pizza flavored chip and chocolate pudding (food items that were previously identified as highly preferred), the chewy chocolate cookie was chosen each time. The chewy chocolate chip cookie was used for the remainder of the study.

Precursor Functional Analysis

A precursor functional analysis (Smith & Churchill, 2002), using procedures similar to those described by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994), was conducted. Sessions were 10 min in length and were presented in a multielement format. One session was truncated when Peter repeatedly tapped the therapist on the shoulder, made the manual sign for bathroom, and attempted to leave the room. Sessions were conducted 3-4 times per day, 2-5 times per week. Peter attended sessions at the BARC clinic, which was located in the same building as his worksite, approximately one hour after arriving at the worksite in the morning.

*No interaction.* In the no interaction condition, Peter and the therapist were in the room alone. The therapist did not say anything to Peter and no leisure items were present. All occurrences of head-up and self-injury were ignored.

*Attention.* In the attention condition, the therapist entered the room with magazines and placed them on the table in front of Peter. The therapist told Peter he had some work to do, sat down in a chair at the end of the table, and began reading a magazine. All occurrences of head-up were followed by 5 s-10 s of attention in the form of a statement of concern. All occurrences of self-injury were ignored. If Peter’s head
remained up, the therapist continued to provide attention until Peter’s head was back down.

_Tangible._ In the tangible condition, the therapist entered the room with reading material. Peter was given a quarter of a soft chocolate chip cookie at the beginning of the session. The cookies remained in a clear plastic container on the therapist’s lap, within view of Peter. If Peter engaged in head-up, he was given a quarter of a cookie. Self-injury was ignored. No attention was provided during the session.

_Play._ In the play condition, the therapist, Peter, and magazines were present in the room. For the first three play sessions, the therapist talked to Peter at the beginning of the session for 5 s-10 s and then started a 30 s timer. At the end of 30 s, the therapist again talked with Peter and interacted with the magazines for 5 s-10 s. If head-up occurred at the end of the interval, the interaction was delayed for 10 s. However, during intervals between scheduled interactions, Peter frequently lifted his head and attempted to communicate with the therapist about material in the magazine. Therefore, for subsequent play sessions, the therapist delivered attention and interacted with the magazine throughout the sessions. Head-up and self-injury were ignored.

_Demand._ In the demand condition, the therapist, Peter, and work materials were present in the room. The work material, a spool of welding wire with stickers on the top and bottom of the spool, was similar to materials used in Peter’s worksite. The spool was placed in front of Peter. Every 30s, Peter was prompted to remove the stickers from the spool. If Peter began or continued removing the stickers within 5 s of the first prompt, the therapist provided verbal praise (e.g., “good job”) and started a 30 s break interval. If
5 s elapsed without Peter removing the stickers, the therapist modeled the task. If Peter then began removing the stickers, a 30 s break interval was started. If Peter did not begin removing the stickers within 5 s of the modeling prompt, the therapist used hand-over-hand assistance to guide him to remove the stickers and then started a 30 s break interval. Occurrences of head-up immediately prior to the first prompt resulted in a re-start of the 30 s break interval. If Peter engaged in head-up at anytime during the prompt sequence, the therapist said, “Ok, you don’t have to,” and started a 30 s break interval. Self-injury was ignored.

Treatment

**General procedures.** Based on the results of baseline observations indicating that self-injury was most likely to occur at Peter’s worksite, treatment was initiated in that setting. Sessions were conducted during the same time period as baseline observations (between 2:00 pm-4:00 pm). Baseline observations continued in Peter’s apartment for the duration of treatment. All sessions were 10 min-30 min in duration. Sessions were less than 30 min only if the morning baseline session had been terminated before 30 min elapsed. Sessions occurred once per day 2-5 times per week. A therapist sat directly next to Peter and implemented treatment procedures during all treatment sessions. One or two data collectors were present during all sessions. No other systematic changes to the worksite context were made compared to the baseline observations. Treatment effects were evaluated within the worksite context using a reversal design.

**Treatment procedures.** Before the session began, the therapist instructed Peter’s staff to not interact with Peter during the session, and that any occurrences of self-injury
would be handled by the therapist. The therapist then sat next to Peter at his work table, and gave Peter instructions. Peter was instructed to lift his head if he wanted to talk to the therapist or needed anything. The therapist then signaled the observer(s) to begin collecting data and the session began. Each time Peter lifted his head, the therapist delivered 5 s-10 s of attention. If Peter’s head remained up, attention continued until he lowered his head (identical to the attention condition of the precursor functional analysis). Self-injury was ignored. If Peter moved from his work table, the therapist and data collectors followed, and treatment continued. Sessions were paused (i.e., contingencies were suspended and observers stopped collecting data) when Peter entered the restroom. After 30 min, data collectors signaled the end of the session to the therapist. The therapist then waited for the next occurrence of head-up, shook Peter’s hand, told him goodbye, and the therapist and data collectors left the room.

Reversal criteria. The criterion for moving from treatment to baseline and for ending the analysis was twice the number of consecutive sessions without self-injury relative to the immediately preceding baseline phase. Reversal criterion for moving from baseline back to treatment was a minimum of 10 sessions in the condition, with the percentage of sessions with self-injury following the final baseline observation equal to or greater than the percentage of sessions with self-injury during the pre-treatment worksite baseline observations. See Figure 1 for a graphical display of the running percentage of sessions with self-injury during each phase of the study.
CHAPTER III

RESULTS

Pre-Treatment

Observations

Results of the observations are presented in Figure 2. The majority of Peter’s self-injury occurred at his worksite, on average, every 3 observations, with a mean rate, measured in responses per minute (rpm), of 0.108. Self-injury occurred at his apartment, on average, every 5 observations, with a mean of 0.050 rpm. Peter’s mean rate, measured in responses per min (rpm), of head-up followed a similar pattern, with a mean at his worksite of 0.291 rpm and a mean at his apartment of 0.231 rpm. However, on the fourth observation at Peter’s apartment (Session 7), he was playing basketball for the majority of the session, which resulted in an unusually high 2.43 rpm of head-up. This artificially raised the mean rate of head-up at his apartment. Without this session, the mean rate of Peter’s head-up at his apartment was 0.175 rpm.

Comparative Probability Analysis

The results of the comparative probability analysis are presented in Figure 3. Across all sessions, 74.19% of the occurrences of Peter’s self-injury were preceded by head-up within 10 s and 52.00% of the occurrences of head-up were followed by self-injury within 10 s. Peter’s self-injury frequently occurred in episodes, with individual responses occurring in close temporal proximity and long periods of time separating episodes. Thus, head-up could precede an episode of self-injury, but not precede, within
10 s, some of the individual occurrences of self-injury during an episode. When the lag interval for calculating the probability of head-up prior to self-injury was 20 s, 82.58% of the occurrences of Peter’s self-injury were preceded by head-up. For the purpose of the precursor identification, only the more stringent 10 s requirement was used. The overall unconditional probability of head-up was 0.0051 and the overall unconditional probability of self-injury was 0.0008. The results of the comparative probability analysis strongly indicated that head-up was a reliable precursor to Peter’s self-injury.

Precursor Functional Analysis

Results of the precursor functional analysis are presented in Figures 4 and 5. Self-injury occurred in the first attention session only, at a rate of 0.60 rpm. Head-up occurred in all conditions. For the first three and a half cycles, head-up occurred most often in the play condition, with a mean of 2.45 rpm, and a range of 1.40 rpm-3.15 rpm. However, following the change to continuous attention during the play condition, the mean rpm of head-up was 0.588 rpm, with a range of 0.10 rpm-1.00 rpm. In the no interaction condition, the mean rpm was 0.125 rpm, with a range of 0 rpm-0.40 rpm. In the attention condition, the mean rpm was 1.70, with a range of 0.70 rpm-2.70 rpm. In the tangible condition, the mean rpm was 0.692 rpm, with a range of 0.10 rpm-1.20 rpm. In the demand condition, the mean rpm was 0.064 rpm, with a range of 0 rpm-0.20 rpm. The attention condition produced the highest mean rpm of head-up, strongly indicating that head-up was maintained by social positive reinforcement, in the form of attention.
Treatment

The results of the treatment analysis are presented in Figure 6. Initially, treatment was to be carried out in a multiple-baseline across settings format, with ongoing measurement of self-injury at Peter’s apartment while treatment was first implemented at Peter’s worksite. However, when treatment was implemented at Peter’s worksite, measures of head-up increased and self-injury decreased in the home setting. During the initial baseline, Peter’s mean rpm of head-up at home was 0.175 rpm (Session 7 excluded). Following the implementation of treatment at Peter’s worksite, the mean rpm of head-up at home was 0.364 rpm. Similarly, self-injury occurred at 0.049 rpm (19.51% of sessions) at home during the initial baseline but decreased to 0.023 rpm (10.53% of sessions) following implementation of treatment at the worksite. In fact, self-injury was observed during only one session (Session 85) in the home setting during the initial treatment phase at the worksite. A reversal design was then chosen, to directly evaluate the effects of treatment at Peter’s worksite. An ongoing baseline remained in place at Peter’s home, to monitor for systematic changes in measures of head-up and self-injury corresponding with phase changes at his worksite. When a reversal to baseline was implemented at Peter’s worksite, self-injury re-emerged within 4 sessions in both contexts.

Intervention did not produce immediate decreases in self-injury in the worksite. Although instances of head-up increased from a baseline mean of 0.291 rpm to 0.966 rpm on the first day of treatment, self-injury also occurred during that session. Worksite staff responded to Peter’s self-injury with attention (instructions to stop the behavior) and
continued to do so whenever self-injury was observed for the first nine sessions of treatment. By the ninth treatment session (Session 98), all of Peter’s staff, as well as the vocational monitors at the worksite, had been trained on the treatment protocol and were reminded each session to not interact with Peter. Within 2 sessions of the completion of this training, the rpm of head-up increased to just below the level at which the rpm of head-up stabilized during Treatment Phase 1 (mean of 4.68 rpm during the last 5 sessions of Treatment Phase 1) and self-injury ceased to occur. Following 10 consecutive sessions without self-injury (twice the number of consecutive sessions without self-injury observed during the immediately preceding baseline), a return to baseline was implemented.

During the return to baseline, self-injury began to reoccur on the fourth session and was observed during 41.67% of sessions. The mean rate of self-injury during this condition was 0.089 rpm. Head-up decreased to a mean of 0.688 rpm, with the last five sessions all below 1 head-up per minute. The return to treatment yielded an immediate cessation of self-injury as well as a return of the rpm of head-up to levels observed during the first treatment phase. The second treatment phase continued until self-injury did not occur for six consecutive sessions (twice the number of consecutive sessions without self-injury observed in the immediately preceding baseline). Head-up increased to a mean of 4.77 rpm during this final treatment.
CHAPTER IV
DISCUSSION

The current study utilized a multiple-component approach to the assessment and treatment of the infrequent but severe self-injury exhibited by Peter, a man with a mild developmental disability. The results of ongoing observation in the natural environment indicated that Peter was frequently observed to lift his head just prior to episodes of self-injury but not at other times. A functional analysis of head-up indicated that it was maintained by positive reinforcement in the form of attention. While the precursor functional analysis was occurring, Peter’s self-injury continued to occur and be preceded by head-up responses in the natural environment at levels seen prior to the precursor functional analysis. Finally, Peter’s self-injury was successfully treated through differential reinforcement of alternative behavior (head-up), whereby head-up produced attention from a therapist and no attention was provided following instances of self-injury.

Najdowski, Wallace, Ellsworth, MacAleese, and Cleveland (2008) also directly assessed precursor behavior as an indirect method for developing a course of treatment for severe problem behavior. However, Najdowski et al. did not include ongoing measurement of the participants’ problem behavior during the precursor functional analysis and treatment; therefore, it is unclear what accounted for the non-occurrence of self-injury. By including observation before, during, and after the precursor functional
analysis, the current study provides several converging lines of evidence that head-up and self-injury were members of a response-class hierarchy and that both topographies were maintained by attention from caregivers. First, head-up was almost always observed to occur just prior to episodes of self-injury throughout the study. Second, when functional analysis contingencies were placed on head-up, it was observed to occur more frequently in the attention condition than in other conditions and at levels much higher than were observed in the natural environment (strongly suggesting that attention effectively reinforced head-up). Third, whereas head-up was almost always followed by self-injury during baseline observations in the natural environment, head-up was almost never followed by self-injury during the functional analysis. That is, in a context where head-up did not reliably result in attention but some instances of self-injury were followed by attention (as was observed during baseline conditions in the natural environment), escalation to self-injury was observed. However, in a context where all occurrences of head-up resulted in attention and no instances of self-injury were followed by attention (as during the functional analysis), progression to self-injury rarely occurred. Fourth, when head-up reliably produced attention from a therapist in the natural environment (during treatment), head-up significantly increased in frequency and self-injury was nearly eliminated. These outcomes, taken together, provide strong evidence that the functional analysis of precursor behavior effectively identified a common reinforcement contingency for Peter’s head-up and self-injury, and that treatment based on this outcome was effective in eliminating self-injury in a natural context. This adds to existing evidence that identifying, assessing, and treating a precursor to a severe problem behavior
is an effective method for assessing and treating problem behaviors that put individuals at risk of injury or other serious effects (e.g., Najdowski et al.). Furthermore, this study extends previous research on precursor functional analysis by demonstrating a relationship between precursor and problem behavior without necessitating a programmed contingency of reinforcement for problem behavior at any point in the experiment.

An interesting and unexpected outcome of the current study was the observation of changes in the measures of self-injury and head-up at Peter’s apartment when treatment was in effect at his worksite. Although observations in the apartment were intended to provide baseline measures for a multiple baseline across settings experimental design, changes in self-injury and head-up in this context corresponded with the implementation and withdrawal of treatment at Peter’s worksite. During the initial baseline observations in Peter’s apartment, the mean rpm of head-up was 0.231, and the mean rpm of self-injury was 0.051. Following implementation of treatment at Peter’s worksite, the mean rpm of head-up at his apartment increased to 0.364, and the mean rpm of self-injury at his apartment decreased to 0.016. This pattern continued during the reversal to baseline conditions at work, with the mean rpm of head-up at home decreasing to 0.344 and the mean rpm of self-injury increasing to 0.019. Following the second implementation of treatment at Peter’s worksite, the mean rpm of head-up at Peter’s apartment again increased, to 0.417, and there were no additional occurrences of self-injury. These outcomes, showing covariation of self-injury and head-up between treatment and non-treatment contexts, did not permit a direct replication of treatment.
effects in the apartment but did provide evidence of generalization of the effects of treatment across settings.

The factors underlying the apparent generalization effect are unclear, but may have included the presence of the therapist and data collectors in both contexts, changes in caregivers’ delivery of attention in Peter’s apartment, or both. The presence of the therapist and data collectors in both treatment and generalization contexts, combined with the absence of those individuals in other contexts, may have resulted in the establishment of stimulus control over precursor and problem behavior. Although treatment contingencies were not consistently applied in the presence of these individuals, treatment contingencies were applied only in their presence. Thus, although discriminative control may have been weakened by the inconsistent application of contingencies, it may have developed nonetheless. Furthermore, if the presence of the therapist and data collectors functioned to evoke head-up in the apartment and the increased frequency of head-up set the occasion for increases in caregiver attention, then “natural” contingencies may have further contributed to a generalized treatment effect. In fact, there was some evidence of differential patterning of caregiver attention in the apartment corresponding to implementation and withdrawal of treatment at the worksite. During the initial baseline in Peter’s apartment, the conditional probability of direct care staff attention following occurrences of head-up was 0.248 (unconditional probability of head-up = 0.004, unconditional probability of attention = 0.040), and the mean seconds per minute (spm) of attention was 2.57 (range = 0.067 spm-8.87 spm). However, excluding Session 7 (see discussion above), the conditional probability of direct care staff
attention following head-up was 0.139 (unconditional probability of head-up = 0.003; unconditional probability of attention = 0.037), and the mean spm of attention was 2.41 (range = 0.067 spm-7.70 spm). See Figure 7 for a graphical display of the changes in Peter’s rate of head-up during treatment phases at his worksite. During the first phase of treatment at Peter’s worksite, the conditional probability of direct care staff’s attention following head-up in Peter’s apartment increased to 0.261 (unconditional probability of head-up = 0.006; unconditional probability of attention = 0.112), and the mean spm of attention increased to 6.29 (range = 0 spm-18.5 spm). Following the reversal to baseline at Peter’s worksite, the conditional probability of direct-care staff’s attention following head-up in Peter’s apartment decreased to 0.125 (unconditional probability of head-up = 0.006; unconditional probability of attention = 0.060), and the mean spm of attention decreased to 3.25 (range = 0.833 spm-10.3 spm). Finally, following the second implementation of treatment at Peter’s worksite, the conditional probability of direct-care staff’s attention following head-up in Peter’s apartment unexpectedly decreased, to 0.057 (unconditional probability of head-up = 0.001; unconditional probability of attention = 0.057). The mean spm of attention increased to 3.81 (range = 0 spm-14.1 spm). See Figures 8 and 9 for a graphical display of the changes in caregiver attention at home during treatment phases at Peter’s worksite. These changes in the patterns of caregiver attention suggest that Peter’s caregivers may have responded differentially to high levels of head-up and low-levels of self-injury occurring as a function of stimulus generalization, they may have imitated the treatment procedures they observed at Peter’s worksite, or both variables may have influenced their behavior. The increased level of
both contingent attention (for head-up) and freely available attention in Peter’s apartment may have been at least partially responsible for the significant reduction in self-injury at Peter’s apartment.

In any case, the carry-over of treatment effects into a second environment represented a welcome and promising finding for application, albeit a challenge for demonstrating experimental control (fortunately, it was possible to demonstrate control via a brief reversal phase in the current study). Future research efforts in which apparent generalization is observed across multiple baseline settings may manipulate variables across treatment and generalization environments in order to further investigate the factors underlying generalization. For example, one might schedule covert observations in the generalization setting to assess the effects of the presence of observers on generalization of treatment effects. In addition to implications for research on generalization, this finding suggests that it may be worthwhile for practitioners to monitor for changes in problem behavior in contexts other than those in which treatment is directly applied. Carry-over effects of treatment, if present, could provide opportunities to extend treatment effects rapidly into non-treatment environments by “capturing” treatment effects through reinforcement.

Previous research (e.g., Lalli, Mace, Wohn, & Livezey, 1995; Smith & Churchill, 2002; Najdowski, et al., 2008) has identified precursor behaviors through staff interviews and informal observations. While staff interviews and informal observations are not time-intensive and do not require extended amounts observation or training, there are two significant drawbacks to utilizing only these methods for identifying potential precursors.
First, if a given response occurs at a very high rate (a high unconditional probability), it may precede many behaviors the individual emits, including the problem behavior. Informal observations may be especially sensitive to this potential false positive, as there is often no extended measurement of both the immediate and “ambient” levels of behaviors and/or environmental events of interest. Thus, high-frequency responses that occur in temporal proximity to severe problem behavior may be inaccurately identified as precursors. A second drawback, specifically to staff reports, is the subjective nature of this information. Caregiver report is not generally considered a highly reliable or valid method of assessing behavior, and it may be especially vulnerable to recency effects, dramatic or unusual incidents, and other sources of confounding influence. Furthermore, given that caregivers are tasked with recording and intervening on problem behavior, they may be more likely to identify problematic, rather than appropriate, behavior as precursors (see below for a discussion of this issue). Because of these limitations, staff reports may be best used to collect preliminary, or screening information, and to provide focus for more systematic efforts to obtain information about behavioral relations.

The study addressed these issues in identifying precursor behaviors by using methods similar to those employed by Borrero and Borrero (2008). Borrero and Borrero utilized comparative probability and lag-sequential analyses to identify reliable precursors to participants’ problem behaviors. While this method requires repeated observation of the individual’s problem behavior, it provides a quantitative method for identifying relations between environmental events or behaviors and problem behavior. This method also allows one to determine distinct temporal relations between a precursor
behavior and a target response that can have treatment implications. For example, if a precursor reliably occurs 5 s–10 s before a target response, it may be easier to prevent the occurrence of the target response through reinforcement of the precursor, than if the precursor reliably occurs only 1 s–2 s before the target response. In the cases of precursors that are themselves inappropriate behaviors, greater amount of time between the emission of a precursor and the emission of the target response may allow for training of an alternative response following the emission of a precursor.

Peter’s precursor to self-injury, head-up, was an appropriate response – a relatively uncommon finding in the current literature. Studies on precursor behaviors have frequently identified vocalizations (e.g., Smith & Simmons, 2002; Borrero & Borrero, 2008; Najdowski, et al., 2008) as precursors. While these vocalizations have generally been reported to be of low severity, they have also typically been characterized as problematic, requiring experimenters and practitioners to establish new, more appropriate responses as treatment. The identification of an appropriate response as a precursor to Peter’s self-injury facilitated rapid suppression of Peter’s self-injury in his natural environment, an important goal in assessing and treating severe problem behavior. Future research should focus specifically on ways to identify and manipulate appropriate precursors to problem behavior.

The relatively higher rate of Peter’s head-up, compared to self-injury, provided a unique opportunity to assess and treat his low-rate, high severity problem behavior. Previous research has focused on adapting standard functional analysis procedures by extending the conditions to an all-day format (e.g., Kahng, Abt, & Schonbachler, 2001).
or implementing standard functional analysis procedures following the first occurrence of problem behavior (e.g., Tarbox, Wallace, Tarbox, Landaburu & Williams, 2004). Although these methods have been shown to be effective means of identifying environmental influences on low-rate problem behavior, they require the participant to emit the severe problem behavior during assessment, which may be inappropriate for severe behavior. In the current case, head-up occurred somewhat more frequently than self-injury, providing an increased likelihood of producing precursor behavior during the functional analysis. Several previous studies have also found that earlier, less severe members of response-class hierarchies may occur at relatively greater frequencies (e.g., Lalli, Mace, Wohn & Livezey, 1995; Richman, Wacker, Asmus, Casey & Andelman, 1999; Harding et al., 2001). Lalli et al. suggested that earlier members of the hierarchy may occur more frequently due to a lower response effort and/or probability of punishment. Identifying precursors to low-rate problem behaviors that occur at a higher rate than the problem behavior may allow for more rapid assessment and treatment of low-rate problem behavior. Future research should examine the relation between response rates of members of response class hierarchies, as well as the utility of the precursor functional analysis in assessing low-rate problem behaviors, regardless of their severity.

Although this study extended previous findings supporting the use of the precursor functional analysis to assess severe problem behavior, there are some limitations. This study required a significant amount of time and resources to complete. The study, from the establishment of the initial baseline through treatment, took 17
months to complete. Although the low rate of Peter’s self-injury was a factor in the extended time frame of the current study, it is possible that other approaches (e.g., anecdotal assessment) may have led to more rapid treatment. Practitioners rarely have months to devote to observations prior to conducting assessment, especially if the problem behavior is severe in nature. However, the establishment of naturalistic baselines permitted identification of precursor behaviors while simultaneously establishing a baseline against which to measure treatment effects; thus, although the study required a significant amount of time to complete, the experimental arrangement made it possible to assess problem behavior while simultaneously collecting baseline data, to develop, implement, and evaluate a function-based treatment, and to interpret the outcomes of assessment and intervention with a high degree of confidence. Ultimately, however, additional research is needed to discover if more efficient, but reliable and quantitative, methods exist to assess and treat low rate problem behaviors,

An additional potential limitation is the specific probability method used to identify Peter’s precursor behavior. Borrero and Borrero (2008) noted that unconditional probability values may be artificially low when compared to conditional probability values, as unconditional probability was calculated using a 1 s interval, while conditional probability was calculated using a 10 s interval. If this method produces artificially low unconditional probability values, calculating the unconditional probability using a 10 s interval could raise the value to a point in which there is significantly less difference between the unconditional probability value and conditional probability value, calling into question the actual relation between two events. However, it is unclear whether
using a 10 s interval is appropriate for calculating the chance of an event during a specified time period, whether or not other events are occurring (i.e., unconditional probabilities). Thus, the questions answered by calculating each type of probability (unconditional or conditional) may be different.

Calculating the unconditional probability using the same interval unit as conditional probability calculations may also artificially raise the unconditional probability value. For example, during a 100 s observation, using 10 s intervals, the unconditional probability of Event A could be 100% and the conditional probability of Event A preceding Event B within 10 s could also be 100%. This would suggest no relation between Events A and B. However, data analysis using shorter intervals might show that Event A frequently occurred within 5 s prior to Event B but was never observed to occur 5 s after Event B. Further research may focus on determining what temporal parameters are appropriate and whether certain idiosyncratic characteristics, such as ambient levels of the reinforcing consequence, are correlated with specific temporal relations among members of a response class hierarchy.

Recent findings suggest that precursor functional analysis may represent a promising approach to the assessment and treatment of severe problem behavior. This approach reduces the risk, during assessment, of harmful problem behavior while still utilizing a robust procedure. The current investigation replicated and extended this body of research by collecting data on precursor and problem behavior in the participant’s natural environment, across two contexts, throughout the study, identifying a precursor through comparative probability analysis, conducting a precursor functional analysis for
low-rate, high-severity problem behavior, manipulating a precursor behavior as
treatment, and documenting apparent generalization of treatment effects across natural
settings. This study also presented an additional procedure for assessing low-rate
problem behavior, through the analysis of a higher-rate, functionally related behavior.
Although data from the current investigation should appropriately be viewed as
preliminary, they provide additional support for a growing body of evidence of the
general utility of the precursor functional analysis.

Table 1

*Mean Interobserver Agreement Results during the Home Baseline, Work Baseline,
Precursor Functional Analysis, Treatment Phase 1, Reversal, and Treatment Phase 2
Sessions*

<table>
<thead>
<tr>
<th></th>
<th>Head-Up Mean</th>
<th>Range</th>
<th>Self-Injury Mean</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home Baseline</td>
<td>99.4%</td>
<td>98.6%-99.9%</td>
<td>99.9%</td>
<td>99.7%-100%</td>
</tr>
<tr>
<td>Work Baseline</td>
<td>99.6%</td>
<td>98.8%-99.9%</td>
<td>99.9%</td>
<td>99.5%-100%</td>
</tr>
<tr>
<td>Precursor FA</td>
<td>96.5%</td>
<td>84.5%-100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Treatment Phase 1</td>
<td>98.1%</td>
<td>95.7%-99.1%</td>
<td>99.9%</td>
<td>99.4%-100%</td>
</tr>
<tr>
<td>Reversal</td>
<td>99.4%</td>
<td>98.9%-99.8%</td>
<td>99.9%</td>
<td>99.3%-100%</td>
</tr>
<tr>
<td>Treatment Phase 2</td>
<td>95.3%</td>
<td>95.3%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>
Figure 1. Running percentage of sessions with self-injury. Initial baseline data are only for pre-treatment worksite observations.
Figure 2. Results of observations conducted in Peter’s home and worksite prior to the precursor functional analysis. All data are displayed as responses per minute for all sessions. Data for head-up are presented on the primary $y$-axis and data for self-injury are presented on the secondary $y$-axis.
Figure 3. Comparative probability analyses for Peter. The types of probability include the conditional probability of head-up in preceding 10 s given an instance of self-injury, the conditional probability of self-injury within 10 s given an instance of head-up, the unconditional probability of head-up, and the unconditional probability of self-injury.
Figure 4. Results of the precursor functional analysis for Peter. Data are displayed as responses per minute for all sessions.

Figure 5. Occurrences of self-injury during the head-up precursor functional analysis for Peter. Data are displayed as responses per minute for all sessions.
Figure 6. Treatment analysis at Peter’s worksite and ongoing baseline at his apartment. Data are displayed as responses per minute for all sessions. Data for head-up are presented on the primary y-axis and data for self-injury are presented on the secondary y-axis.
Figure 7. Changes in Peter’s rate of head-up at home during treatment phases at his worksite. Data are displayed as mean responses per minute, and include error ranges. Home observations are divided based on the specific treatment phase in effect at the worksite.
Figure 8. Changes in the probability of attention at Peter’s apartment during treatment phases at his worksite. The types of probability include the conditional probability of staff attention following head-up within 10 s, the unconditional probability of head-up, and the unconditional probability of attention. Home observations are divided based on the specific treatment phase in effect at the worksite.
Figure 9. Changes in the rate of attention following head-up at Peter’s apartment during treatment phases at his worksite. Data are displayed as mean seconds per minute, and include error ranges. Home observations are divided based on the specific treatment phase in effect at the worksite.
REFERENCES


