IMMEDIATE AND SUBSEQUENT EFFECTS OF RESPONSE BLOCKING ON
SELF-INJURIOUS BEHAVIOR

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Thesis Prepared for the Degree of

MASTER OF SCIENCE

UNIVERSITY OF NORTH TEXAS

August 2006

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Atcheson, Katy. Immediate and subsequent effects of response blocking on self-injurious behavior. Master of Science (Behavior Analysis), August 2006, 54 pp., 4 tables, 9 illustrations, references, 29 titles.

In many institutional settings, blocking, response restriction (e.g., restraint, protective equipment), and re-direction procedures are used extensively as intervention for self-injurious behavior (SIB) and other forms of problem behavior. In the current study, a three component, multiple-schedule analysis was used to examine the immediate and subsequent effects of blocking on SIB that persisted in the absence of social reinforcement contingencies. During the first and third components the participant was in the room, alone, with no social consequences for SIB. During the second component (response restriction) the therapist sat in the room with the participant and blocked occurrences of SIB. Results indicated that, although blocking was effective in decreasing SIB while it was being implemented, subsequent effects were idiosyncratic across participants. Evidence of increased levels of SIB following blocking was observed for some participants.
ACKNOWLEDGEMENTS

I would like to extend my deepest gratitude to Dr. Richard Smith, who has been my boss, my friend, and most importantly, my mentor. Your knowledge, skills, and teachings have been instrumental in the acquisition of both my clinical and experimental skills. Your guidance and graciousness have pushed me to becoming an improved applied clinician, and I thank you for that. I will never forget the things you have taught and I will always be grateful to you for helping me become the person I am. I would also like to thank Cloyd Hyten and Janet Ellis for their dedication and feedback in this project, the two of you have always pushed me to succeed and I appreciate you both greatly. I extend my thanks to my sidekick, Roxy Wolf, who has helped get me through graduate school with her wonderful friendship, support, and advice. In addition, I would also like to thank Carla Smith (aka BARC “mom”) for always knowing what’s just around the corner, as well as Amanda Mann, Caroline Stevens, Curtis Harris, and Victoria White for their data collection and feedback in this project. Lastly, but not least, I would like to sincerely thank the rest of the professors and staff in the Department of Behavior Analysis at UNT for all of their support over the years.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>iii</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>v</td>
</tr>
<tr>
<td>LIST OF ILLUSTRATIONS</td>
<td>vi</td>
</tr>
<tr>
<td>1. INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>2. GENERAL METHOD</td>
<td>13</td>
</tr>
<tr>
<td>3. FUNCTIONAL ANALYSIS</td>
<td>15</td>
</tr>
<tr>
<td>4. RESTRICTION ANALYSIS</td>
<td>19</td>
</tr>
<tr>
<td>5. GENERAL DISCUSSION</td>
<td>29</td>
</tr>
<tr>
<td>REFERENCE LIST</td>
<td>50</td>
</tr>
</tbody>
</table>
## LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Operational Definitions (Tina)</td>
<td>37</td>
</tr>
<tr>
<td>2.</td>
<td>Operational Definitions (David)</td>
<td>38</td>
</tr>
<tr>
<td>3.</td>
<td>Interobserver Agreement Results (Tina)</td>
<td>39</td>
</tr>
<tr>
<td>4.</td>
<td>Interobserver Agreement Results (David)</td>
<td>40</td>
</tr>
</tbody>
</table>
# LIST OF ILLUSTRATIONS

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Results of the Functional Analysis (David)</td>
<td>41</td>
</tr>
<tr>
<td>2</td>
<td>Session-by-Session Mean Duration of SIB (David)</td>
<td>42</td>
</tr>
<tr>
<td>3</td>
<td>Session-by-Session Mean Duration of Hand-to-Hand Contact (David)</td>
<td>43</td>
</tr>
<tr>
<td>4</td>
<td>Session-by-Session Frequencies of SIB and Hand-to-Hand Contact (David)</td>
<td>44</td>
</tr>
<tr>
<td>5</td>
<td>Mean Duration per Minute of SIB and Hand-to-Hand Contact (David)</td>
<td>45</td>
</tr>
<tr>
<td>6</td>
<td>Mean Responses and Mean Frequencies per Component for SIB and Hand-to-Hand Contact (David)</td>
<td>46</td>
</tr>
<tr>
<td>7</td>
<td>Session-by-Session Frequencies (Tina)</td>
<td>47</td>
</tr>
<tr>
<td>8</td>
<td>Mean Responses per Minute (Tina)</td>
<td>48</td>
</tr>
<tr>
<td>9</td>
<td>Mean Responses per Component (Tina)</td>
<td>49</td>
</tr>
</tbody>
</table>
CHAPTER 1

INTRODUCTION

Interventions and treatment for self-injurious behavior (SIB) maintained by automatic reinforcement is an area of research that has been growing for many years. An experimental-epidemiological study of the types of consequences that can maintain SIB indicated that about 25.7% of SIB is maintained by automatic reinforcement (Iwata et al., 1994), and an array of interventions for automatically maintained SIB has been examined in the literature (Foxx & Azrin, 1973; Harris & Wolchik, 1979; Roscoe, Iwata, & Goh, 1998; Shore, Iwata, DeLeon, Kahng, & Smith, 1997; Vollmer, Iwata, Zarcone, Smith, & Mazaleski, 1993). This area of research is extremely important because of the unique challenges associated with developing effective and sustainable treatments for automatically maintained problem behavior. These challenges include the absence of a technology for identifying and manipulating the precise variables that are functionally related to this type of SIB (Vollmer, 1994). By contrast, consequences that maintain socially-mediated behavior problems can be systematically manipulated to analyze their effects on behavior. Thus, whereas “function-based” treatment (i.e., treatment that takes into account and manipulates elements of the operant contingency of reinforcement for the problem behavior) can be developed to correspond to specific maintaining factors when problem behavior is maintained
by social reinforcement, function-based treatment of nonsocially-maintained problems often involves a degree of “guesswork.” Due to these limitations, a focus of interventions for problem behavior that persists in the absence of obvious sources of social reinforcement is to find interventions that can be effective across a range of motivational situations.

One function-based approach to treatment of SIB and other forms of inappropriate behavior is to provide the consequence identified as a reinforcer for the problem behavior noncontingently, or on a time-based schedule (noncontingent reinforcement, or NCR) (Foxx & Azrin, 1973; Iwata et al., 1994; Vollmer et al., 1993). This type of intervention involves time-based or free access to preferred sources of stimulation, independent of the behavior emitted by the participant. Although NCR can greatly reduce SIB, dense, or even continuous, schedules of stimulus presentation may be necessary; when reinforcers are delivered on intermittent or “lean” schedules, the effectiveness of NCR may be compromised (Hagopian, Fisher, & Legacy, 1994). Foxx and Azrin (1973) demonstrated that, of 5 different interventions for reducing self-stimulatory behavior, the NCR procedure they utilized (candy and verbal praise on a variable-time (VT) 1-min schedule) was the least effective for one participant and the second least effective procedure for reducing rates of self-stimulatory behavior. Much NCR research suggests that access to reinforcers during NCR must be delivered on very dense schedules to effectively reduce SIB and self-stimulatory behavior (Roscoe et al., 1998; Shore et al., 1997).
Differential reinforcement procedures such as differential reinforcement of the omission of behavior (DRO) and differential reinforcement of alternative behavior (DRA) have been shown to be effective in reducing rates of problem behavior maintained by social consequences (e.g., Mazaleski, Iwata, Vollmer, Zarcone, & Smith, 1993). DRO procedures involve the presentation of reinforcers contingent on the passage of a specified amount of time without occurrences of problem behavior, and DRA involves the presentation of reinforcers contingent on the emission of an alternative form of behavior. In both cases, the effectiveness of the intervention often is predicated on identification and manipulation of the maintaining consequence for the problem behavior. That is, the maintaining consequence for the problem behavior is withheld contingent on that response (extinction) and presented according to a differential reinforcement schedule. However, as with time-based stimulation, differential reinforcement may be compromised when used to treat non-socially maintained SIB. For example, even very short DRO intervals (e.g. 10 s) have been shown to be ineffective in treating non-socially maintained SIB (Shore et al., 1997). Similarly, Harris and Wolchik (1979) demonstrated that rates of SIB for one participant during a DRO intervention were actually higher than baseline rates, and rates of SIB for another participant were only slightly lower during DRO sessions than during baseline sessions.

The likelihood that stimuli used in noncontingent or differential reinforcement procedures will effectively compete with or substitute for SIB may
be increased by providing stimuli that have similar sensory reinforcing properties as the SIB (Kennedy & Souza, 1995; Shore et al., 1997; Thompson, Iwata, Conners, & Roscoe, 1999; Vollmer, Marcus, & LeBlanc, 1994). For example, Shore et al. (1997) demonstrated that when objects with similar sensory properties thought to maintain SIB were provided continuously throughout the session (e.g., using a vibrator for a participant who engaged in arm rubbing), SIB was almost completely eliminated. Kennedy and Souza (1995) demonstrated that their participant’s eye poking was less frequent when the participant had access to visually stimulating video games, but not when he had access to music. Although it is reported that “matched” stimuli compete with or more effectively substitute for automatically maintained problem behavior (Kennedy & Souza, 1995; Shore et al., 1997), some research has demonstrated that “unmatched” stimuli (stimuli that do not produce sensory consequences similar to those produced by SIB) also can be effective in reducing rates of SIB when presented on time- or behavior-based schedules (Favell, McGimsey, & Schell, 1981; Roscoe et al., 1998). When unmatched reinforcers are used during NCR sessions highly preferred items appear to be more effective in reducing rates of SIB than less preferred items (Vollmer et al., 1994).

Although noncontingent and differential reinforcement procedures to treat automatically maintained problem behavior continue to be researched and refined, several factors limit the general utility of this approach. For example, because identifying the specific form of stimulation responsible for automatic
maintenance of problem behavior is so difficult (Vollmer, 1994), the selection of matching stimuli is often compromised. For example, hand mouthing may be maintained by stimulation of the hand or the mouth (Goh et al., 1995). Because it is nearly impossible to directly evaluate which form of stimulation maintains mouthing for a given individual, selection of stimuli that will effectively compete with this behavior may involve some trial-and-error, using items that stimulate either toward the hand or the mouth and inferring the source of maintenance based on their effects on mouthing. Another limiting factor of noncontingent and differential reinforcement approaches is that it may be difficult to provide continuous, uninterrupted access to competing stimuli or to provide a sufficiently dense schedule of reinforcement for alternative behavior to sustain clinically significant treatment effects. Research outcomes indicate that, even if implemented with perfect or near-perfect fidelity, NCR treatments may not result in complete elimination of the problem behavior (Roscoe et al., 1998; Shore et al., 1997; Thompson et al., 1999; Vollmer et al., 1994); therefore, problems associated with caregivers’ ability to reliably apply this procedure may be magnified.

Another function-based approach to intervention is extinction (EXT). With socially-maintained problem behavior EXT is relatively straightforward: the maintaining consequence for problem behavior is identified and then withheld contingent on the problem behavior. However, when behavior is maintained independent of social contingencies EXT becomes more complicated. As with
reinforcement-based interventions, issues of identification of and access to the maintaining consequence often interfere with the development and effective implementation of EXT procedures. For automatically maintained SIB, procedures such as response blocking or the use of protective equipment (e.g., helmets for head-banging, goggles for eye-poking) to decrease the amount of sensory reinforcement produced by SIB have been characterized as "sensory extinction" (Rincover, 1979). For example, several studies have shown protective equipment to be very effective in decreasing SIB (Kennedy & Souza, 1995; Mazaleski, Iwata, Rodgers, Vollmer, & Zarcone, 1994; Moore et al., 2004). Similarly, a number of studies have investigated the effects of response restriction procedures such as blocking, either alone or in combination with other procedures. For example, Thompson et al. (1999) found that rates of SIB were lower during sessions in which blocking occurrences of SIB was combined with free access to leisure items, compared to sessions in which only blocking was implemented. Vollmer et al. (1994) demonstrated that when occurrences of hand mouthing were simply blocked (along with free access to reinforcers and verbal praise), rates of hand mouthing did not decrease as much as when blocking plus a 5-s hands-down time-out procedure was implemented.

EXT is often invoked as the process underlying the effects of protective equipment, blocking, and related procedures, because these procedure presumably decrease the sensory reinforcement produced by the behavior. However, other explanations also have been suggested in the literature (Lerman
& Iwata, 1996; Mazaleski et al., 1994; Smith, Russo, & Le, 1999). For example, these procedures often restrict the occurrence of the behavior targeted for decrease (e.g., when goggles are used as treatment for eye poking it is not possible to complete the eye poking response); therefore, it is not clear whether the response decreases because it fails to produce reinforcement or because it is not possible to complete the response during restriction procedures. Alternatively, procedures such as blocking might function as aversive events, effectively punishing the response on which they are contingent. Lerman and Iwata (1996) described an experimental procedure for inferring the functional properties of blocking in which all or only a portion of self-injurious responses were blocked. These researchers found that when hand mouthing was intermittently blocked (as little as one in four occurrences), rates of hand mouthing were significantly lower, compared to baseline sessions. These results suggest that, for their participant, blocking functioned as punishment; when some but not all responses produce punishment the overall class of behavior will likely decrease, as was seen in this experiment. By contrast, a replication of this study (Smith et al., 1999) found that when their participant’s eye poking was blocked on an intermittent schedule, eye poking occurred as frequently or more frequently than during baseline sessions. These outcomes are consistent with an EXT account; blocking only a portion of responses produced outcomes consistent with an intermittent schedule of reinforcement in which some but not all responses produce a reinforcing outcomes (i.e., blocked responses were under EXT but
were not punished). The discrepancies between these two studies strongly suggest that blocking may have different functional properties for different individuals, serving as EXT in some cases and punishment in others.

Regardless of its functional properties, research outcomes indicate that continuous blocking can effectively reduce SIB and self-stimulatory behavior (Lerman & Iwata, 1996; Reid, Parsons, Phillips, & Green, 1993; Smith et al., 1999). However, continuous blocking may not be possible in the natural environment. For example, caregivers may not be able to continuously monitor and/or respond to each occurrence of SIB. Even when caregivers are able to closely monitor clients it may not be possible to effectively block each occurrence (e.g., when responding occurs at very high rates or when clients engage in behavior to evade blocking).

Procedures designed to decrease SIB and other problem behavior are typically evaluated in the context of perfect or near-perfect treatment fidelity. For example, the interventions described above have been tested under experimentally sound conditions, under which it is possible to implement all procedures as prescribed; however, implementation in natural settings is often not optimal, due to a number of constraints and limitations present in those settings. McCord, Grosser, Iwata, and Powers (2005) demonstrated that response blocking in the prevention of PICA was “effective only when implemented early in the chain and with near-perfect consistency” (p. 394). Treatment integrity may be compromised in a number of ways, such as a total
failure to implement the intervention, procedural variations, or schedule breakdowns.

Schedule breakdowns, or inconsistent implementation, can occur in at least two ways. For example, in some cases intervention periods are continuous but implementation is intermittent within periods (Lerman & Iwata, 1996; Smith et al., 1999). So, this type of schedule breakdown may consist of implementing differential reinforcement on a VR5 schedule when the prescribed schedule of reinforcement is FR1. A second type of schedule breakdown occurs when treatment periods are discontinuous, but treatment is implemented consistently and correctly within periods (Blevins, 2003; Simmons et al., 2004; Soderlund, 2003). This type of schedule breakdown occurs when an intervention is implemented with perfect fidelity during implementation periods, followed by a period of time in which the intervention is discontinued completely.

Reinforcement-based interventions such as NCR sometimes may be difficult or impossible to implement reliably outside of experimental sessions, especially when dense schedules are required. Furthermore, research outcomes of attempts to fade continuous or dense treatments to more manageable schedules have produced mixed findings (e.g., Foxx & Azrin, 1973; Shore et al., 1997), suggesting that schedule breakdowns may result in similar decrements in treatment effects.

Because it is often difficult or impossible to identify or manipulate the reinforcers maintaining automatically reinforced problem behavior, combined with
limitations in applying these procedures with integrity, blocking is often used to manage problem behavior of this type. Although blocking procedures may also be effective in immediately reducing rates of SIB, very little research has evaluated the effects of scheduling issues on the effects of blocking.

Two previous studies attempted to demonstrate the effects of blocking on subsequent SIB and self-stimulatory behavior (Blevins, 2003 [unpublished thesis]; Soderlund, 2003 [unpublished thesis]). Both of these studies utilized three-component multiple schedule analyses to determine the effects of blocking on automatically reinforced problem behavior. A multiple schedule analysis involves changing contingencies within sessions, in which two or more schedules are implemented sequentially and each component is associated with a distinctive discriminative stimulus (Iverson & Lattal, 1991). Each study implemented baseline, or “free operant,” procedures during the first and third components of the schedule, with blocking or other response restriction procedures during the second, or middle, component. This arrangement permitted the researchers to identify both the immediate effects of intervention (during the second component) and the immediately subsequent effects (during the third component). Results of the Blevins study indicated that, for both participants, measures of problem behavior (eye-gouging or hand mouthing) showed that blocking was effective while in place (during the second component) and increased (and were subsequently higher than component 1 levels) during the third component after blocking procedures had been discontinued.
Soderlund implemented similar procedures but extended this research by using a parametric analysis to evaluate the effects of different blocking durations (15 min, 30 min, or 60 min) on his participant’s hand mouthing. Results varied across parameters of blocking, showing that hand mouthing attempts increased during blocking components lasting 15 min and 30 min and maintained at baseline levels during the 60-min blocking component. Response patterns during the third components also varied, with no change from baseline following 15 min of blocking, an increase over baseline following 30 min of blocking, and patterns showing long latencies to the first response followed by significant increases in responding following 60 min of blocking. The results of these studies indicate that responses to blocking and response restriction procedures for automatically maintained SIB may be idiosyncratic both across and within individuals, indicating the need for further analysis of the variables that influence the effects of these procedures.

The purpose of the current study was to evaluate the immediate and subsequent effects of blocking on rates of automatically maintained behavior by replicating and extending previous research by Blevins (2003) and Soderlund (2003). A three-component multiple schedule analysis was used to determine the effects of blocking on target behavior both during intervention and after blocking procedures had been discontinued. Free access to target behavior was allowed during the first and third components, and target behavior was blocked during the second component. Measures of target behavior during the first and
third components were compared in order to demonstrate the subsequent effects of blocking on measures of target behavior during the third component.
CHAPTER 2

GENERAL METHOD

Participants and Setting

One female and one male resident at a long-term residential facility for persons with developmental disabilities participated in this study. Tina was 45 years old and David was 58 years old at the time of the study. Both participants had a diagnosis of profound mental retardation, neither possessed verbal skills, but communicated their needs and wants by grunting or utilizing gestures. Both Tina and David received specialized on-site services from the Behavior Analysis Resource Center (BARC) based on referrals for assessment and treatment of self-injurious behavior (SIB). Tina was referred to BARC due to chronic object and hand mouthing, as well as face licking and rubbing. David was referred to BARC due to continued hand picking and scratching which had previously caused skin breakdown, abrasions, and calluses. Experimental sessions were conducted at the BARC facility in a 3.7-m by 2.4-m room, containing a table and two chairs. The session room contained a one-way mirror on one wall for unobtrusive observation and data collection.
Measurement Procedures

Response Measurement and Scoring Procedures

Data were collected on laptop personal computers with data collection software (Observe®: Psychsoft Inc., [http://www.psycho.com/]). For Tina, data were collected on the frequency of target behaviors (object licking, mouthing, and face rubbing and licking) (see Table 1). For David, data were collected on the frequency and duration of target behaviors (SIB, defined as picking or scratching the palms or back of his hands, rubbing his hands together and hand-to-hand contact) (see Table 2). David’s target behaviors were scored continuously from 1 s after their onset until the response had ceased for 1 s.

Interobserver agreement (IOA) data were collected simultaneously but independently during a portion of each of the participant’s sessions. IOA coefficients were calculated by dividing each session into 1-s bins, summing the number of bins in which observers agreed on the occurrence or nonoccurrence of target behaviors, dividing the results by the total number of seconds in the session, and multiplying the result by 100. Tina’s, IOA data were collected during 80% of baseline 1 sessions, 70% of response restriction sessions, and 80% of baseline 2 sessions (see Table 3). David’s, IOA data were collected during 34% of functional analysis sessions, 90% of baseline 1 sessions, 30% of both response restriction sessions, and 80% of baseline 2 and baseline 3 sessions (see Table 4).
CHAPTER 3

FUNCTIONAL ANALYSIS

David participated in a functional analysis prior to the extended baseline and response restriction conditions. The functional analysis was conducted to determine the effects of specific environmental antecedents and consequences on David’s self-injurious behavior (SIB), and consisted of 5 conditions presented in a multi-element experimental design, and each session was 10 min in length. Between 3 and 5 sessions were conducted 2-3 times per week. Sessions were conducted in the sequence described below.

Tina did not participate in an experimental functional assessment prior to the extended baseline sessions. However, caregivers reported that Tina’s target behaviors occurred in the absence of social contingencies, and these behaviors persisted throughout ten extended alone sessions. Therefore, it was concluded that her target behaviors were, at least in part, maintained by automatic reinforcement.

Procedures

Alone Condition

David was observed in a barren environment without access to tangible items or social interaction. There were no programmed consequences for engaging in SIB, and no social consequences were delivered. This condition was conducted to determine if SIB persisted in the absence social or environmental
changes. Behavior that persists under these conditions is typically thought to be maintained by its automatically produced consequences.

**Attention Condition**

During this condition, the therapist sat in the room with David and delivered programmed consequences contingent on SIB. Programmed consequences consisted of sympathy statements (e.g., “You might hurt yourself if you keep doing that”) or recognition statements (e.g., “You are scratching your hands”). David had access to leisure items and the therapist ignored him except when SIB occurred. Programmed consequences were delivered contingent on SIB; social consequences were not provided following David’s hand-to-hand contact. Behavior that persists in this condition is typically thought to be maintained by positive reinforcement in the form of attention and social interaction.

**Tangible Condition**

This condition was similar to the attention condition in that programmed consequences were delivered contingent on SIB; however, during this condition programmed consequences were access to a preferred item (leisure or food item). In addition, noncontingent access to leisure items was not available during this condition. If David engaged in SIB, he received one bite of pudding. No other type of social consequence (e.g., verbal comments) was presented and all other behavior was ignored. Behavior that persists in this condition is thought to
be maintained by positive reinforcement in the form of access to preferred items or activities.

Control Condition

During the control condition, David had free access to preferred leisure items and social attention was delivered every 30 s, independent of behavior. The purpose of this condition was to serve as a control condition against which to compare measures of problem behavior in test conditions. Typically, target behavior maintained by social consequences (e.g. attention or escape from tasks) is not observed during this condition because no demands are presented, while attention and preferred items are delivered independent of target behaviors. Automatically maintained problem behavior is unlikely to be observed in this condition because leisure and recreational stimulation, as well as social stimulation, are provided according to a rich, response-independent schedule.

Demand Condition

During this condition, the therapist delivered a specific, one-step task request (e.g., “Put a poker chip in the can”), that could be completed within 10 s. A task trial was presented every 30 s using a graduated prompting sequence (verbal prompt, model prompt, physical guidance) at 5-s intervals. Compliance was scored and verbal praise (e.g., “Good job putting the poker chip in the can”) was delivered if David completed the task prior to the presentation of the third prompt. If David did not comply with the task after the model prompt, physical guidance was used to complete the task and no verbal praise was provided. If
David engaged in SIB at any time during the prompting sequence, the therapist removed the task, delivered verbal feedback (e.g., “Ok, you don't have to do this”), and moved away from him until the next scheduled demand trial. If behavior persists in this condition it is thought to be maintained by negative reinforcement in the form of escape from tasks and demands.

Results and Discussion

Results of David's functional analysis are presented in Figure 1. The mean duration of SIB during the alone condition was 268 s (range = 0 s-576 s), 373 s (range = 0 s-557 s) during the attention condition, 44 s (range = 0 s-235 s) during the tangible condition, 254 s (range = 0 s-550 s) during the play condition, and 233 s (range = 47 s-529 s) during the demand condition. David's functional analysis outcomes demonstrated that SIB occurred at relatively high levels across assessment and control conditions. Thus, David's SIB appeared to be maintained, at least in part, by its automatically produced consequences.

Based on functional analysis results showing persistence of SIB in the absence of programmed social antecedents and consequences, David was selected to participate in the next phase of the study. Although it is possible that other sources of reinforcement contributed toward the maintenance of his SIB, only non-socially maintained target behavior was addressed during the response restriction analysis.
CHAPTER 4

RESPONSE RESTRICTION ANALYSIS

Procedures

The immediate and subsequent effect of blocking was evaluated using a three-component multiple schedule design. The first and third components were identical to the baseline condition, in which Tina and David were able to freely engage in target behaviors and no programmed or social consequences were delivered. During the second component, blocking, occurrences of target behavior were blocked or interrupted. Extended baseline conditions were conducted in which all three components were identical to components 1 and 3. Data on target behaviors were collected during all three components, and measures were compared to evaluate the effects of blocking on target behaviors during and immediately following intervention.

For Tina, an initial 10 baseline sessions were followed by the restriction analysis, in which 10 blocking sessions were interspersed among 5 baseline sessions using a multielement design. For David, an initial set of 10 baseline sessions was followed by two restriction analyses. During the first restriction analysis, 10 sessions were conducted during which only self-injurious behavior (SIB) was blocked; these sessions were interspersed with 5 baseline sessions using a multielement design. During the second restriction analysis, 10 sessions
were conducted during which both SIB and hand-to-hand contact were blocked; these sessions were interspersed with 5 baseline sessions using a multielement design.

*Extended Baseline*

Baseline sessions were conducted to identify typical patterns of target behavior across the observation period in the absence of response restriction. Both Tina and David were observed continuously (30 min for Tina; 45 min for David) in a barren environment without access to leisure materials or social interaction. There were no programmed consequences for any target behavior during this condition. For the purpose of data analysis, each session was divided into three equal components. These components were equal in length to those in the response restriction analysis (10 min for Tina; 15 min for David).

*Response Restriction*

During response restriction sessions, access to target behavior was systematically manipulated during the second of the three components of the multiple schedule. Discriminative stimuli were not programmed for the changing components; however, there were clear differences between the blocking component and the baseline components (i.e., the therapist entered the room at the beginning of the second component and sat next to the participant; then the therapist stood up and left the session room at the beginning of the third component). This arrangement represents a multiple schedule design, in which
schedule components are presented sequentially with specific discriminative stimuli associated with each component

Component 1: Baseline. Tina and David were observed in a barren room alone, without access to leisure materials; no social consequences were delivered for target or any other behavior. Component 1 lasted 10 min for Tina and 15 min for David.

Component 2: Response Restriction. Access to target behavior was restricted using blocking techniques during the second component of the session. At the beginning of the second component the therapist walked into the session room, sat next to the participant, and remained for the duration of the component. For Tina, the therapist placed her hand approximately 3 cm in front of Tina’s mouth (between Tina’s hands and mouth) to prevent contact when she attempted to engage in target behaviors (object mouthing, hand mouthing, or face rubbing/licking). David participated in two different response restriction conditions. During the first 10 response restriction sessions, the therapist only blocked instances of SIB by moving David’s left hand away from the other and placing the left hand down by his side for 1-2 s. During the second set of 10 response restriction sessions, the therapist blocked occurrences of both SIB and hand-to-hand contact, using the same procedures as during the first ten response restriction sessions. Component 2 lasted 10 min for Tina and 15 min for David.
Component 3: Baseline. Component 3 was identical to component 1, in which Tina and David were observed in a barren room alone, without access to leisure materials and no social consequences delivered for target behavior. Component 3 lasted 10 min for Tina and 15 min for David.

Results

David’s Results

Figures 2, 3, 4, 5, and 6 illustrate the results of extended baseline and response restriction analysis sessions for David. Figure 2 shows the duration per session of SIB across each session component and experimental condition. The duration of SIB was highly variable across components, sessions, and conditions, with the exception of low durations during component 2 of both response restriction analysis conditions.

Figure 3 shows the duration per session of hand-to-hand contact across each session component and experimental condition. No data are presented for the initial baseline because data were not collected on hand-to-hand contact at that point in the study. The duration of hand-to-hand contact was variable across components, sessions, and conditions, with the exception of some suppression in responding during component 2 of the second response restriction analysis.

Figure 4 shows the count per session of SIB (top panel) and hand-to-hand contact (lower panel) across each session component and experimental condition. The top panel shows generally low and variable frequencies of SIB across components, sessions, and conditions; however, substantial increases in
the frequency of SIB during component 2 of both blocking conditions. Similarly, the lower panel shows low frequencies of hand-to-hand contact except during component 2 of the second blocking condition, when both SIB and hand-to-hand contact were blocked. Thus, both responses were observed to occur more frequently during the specific period when they were blocked.

Figure 5 shows the mean duration (in seconds) of SIB (all panels) and hand-to-hand contact (second through fifth panels) per 1-min bin. Outcomes for the first baseline are displayed in the top panel; outcomes for the block SIB only condition are displayed in the second panel; outcomes for the second baseline are displayed in the third panel; outcomes of the block both condition are displayed in the fourth panel; and outcomes for the third baseline are displayed in the bottom panel. These graphs show decreases in durations of each response topography corresponding to components during which those topographies were blocked. In addition, when only SIB was blocked (panel 2), mean durations of SIB remained low and stable throughout all components while mean durations of hand-to-hand contact remained relatively high and stable. When both topographies were blocked (panel 4, component 2) each showed decreases in mean durations. Slight increases in durations of both topographies were observed immediately after blocking was discontinued (comp 3). However, an increasing trend in average duration of hand-to-hand contact occurred during the last third of that component, while the average duration of SIB showed a decreasing trend.
Figure 6 shows mean duration (in seconds) and mean frequency of SIB and hand-to-hand contact for each component and condition. During the 10 extended baseline sessions, David engaged in varying durations of SIB across session components. Average duration of SIB was 338 s (range = 0 s-895 s) during component 1; 375 s (range = 0 s-850 s) during component 2; and 303 s (range = 0 s-894 s) during component 3. David engaged in SIB an average of 3.7 times (range = 0-12) during component 1; 4.9 times (range = 0-23) during component 2; and 2.7 times (range = 0-15) during component 3.

During the initial response restriction sessions in which only SIB was blocked, David engaged in SIB for a mean duration of 206 s (range = 0 s-837 s) during component 1; 39 s (range = 0 s-126 s) during component 2; and 169 s (range = 0 s-795 s) during component 3. David engaged in SIB an average of 1.7 times (range = 0-7) during component 1; 17.6 times (range = 0-67) during component 2; and 6.6 times (range = 0-47). David engaged in hand-to-hand contact for a mean of 576 s (range = 0 s-865 s) during component 1; 739 s (range = 328 s-883 s) during component 2; and 700 s (range = 101 s-900 s) during component 3. David engaged in hand-to-hand contact an average of 9.1 times (range = 0-26) during component 1; 9.6 times (range = 1-28) during component 2; and 6.0 times (range = 0-26) during component 3.

During the 5 extended baseline sessions conducted within the multielement analysis, David engaged in SIB for a mean of 352 s (range = 0 s-689 s) during component 1; 351 s (range = 0 s-900 s) during component 2; and
400 s (range = 112 s-791 s) during component 3. David engaged in SIB an average of 2 times (range = 0-6) during component 1; 1.2 times (range = 0-4) during component 2; and 2 times (range = 0-6) during component 3. David engaged in hand-to-hand contact for a mean of 527 s (range = 210 s-865 s) during component 1; 566 s (range = 0 s-900 s) during component 2; and 530 s (range = 74 s-895 s) during component 3. David engaged in hand-to-hand contact an average of 5.4 times (range = 1-13) during component 1; 2.8 times (range = 0-11) during component 2; and 3.4 times (range = 1-7) during component 3.

During the second set of response restriction sessions in which both SIB and hand-to-hand contact were blocked, David engaged in SIB for a mean of 282 s (range = 0s – 880 s) during component 1; 67 s (range = 0 s – 424 s) during component 2; and 297 s (range = 0 s –847 s) during component 3. David engaged in SIB an average of 3.9 times (range = 0-14) during component 1; 26.4 times (range = 0-72) during component 2; and 3.7 times (range = 0-10) during component 3. Mean duration of hand-to-hand contact during component 1 was 543 s (range = 0 s-899 s); 265 s (range = 25 s-700 s) during component 2; and 507 s (range = 12 s-895 s) during component 3. David engaged in hand-to-hand contact an average of 2.5 times (range = 1-7) during component 1; 133.3 times (range = 14-391) during component 2; and 2.2 times (range = 0-5) during component 3.
During the 5 extended baseline sessions that were alternated between each two response restriction sessions, David engaged in SIB for a mean of 223 s (range = 0 s-599 s) during component 1; 91 s (range = 0 s-424 s) during component 2; and 152 s (range = 6 s-752 s) during component 3. David engaged in SIB an average of 1.8 times (range = 0-5) during component 1; 3 times (range = 0-12) during component 2; and .6 times (range = 0-2) during component 3. David engaged in hand-to-hand contact a mean duration of 642 s (range = 250 s-899 s) during component 1; 717 s (range = 427 s-890 s) during component 2; and 564 s (range = 0 s-900 s) during component 3. David engaged in hand-to-hand contact an average of 2.4 times (range = 1-5) during component 1; 4.6 times (range = 0-10) during component 2; and .8 times (range = 0-2) during component 3.

Overall, the data from Figure 6 indicate that although blocking resulted in shorter durations of SIB and hand-to-hand contact during component 2 the average frequency of each topography increased during blocking periods. The data do not indicate that blocking had significant or reliable effects on subsequent behavior (during component 3).

Tina’s Results

Figures 7, 8, and 9 illustrate the results of the response restriction analyses for Tina. Figure 7 shows the count per session of target behaviors across each session component and experimental condition. The data show moderate levels of responding during baselines 1 and 2, with substantial overlap
across components. However, during the blocking condition, responding
maintained during component 1, decreased during component 2, and showed
substantial increases during component 3, with no overlap between components
1 and 3.

Figure 8 shows the mean frequency of target behaviors per 1-min bin
across components and experimental conditions. During baseline 1 and 2
sessions, the average frequency of target behavior was relatively consistent at
low to moderate levels across session components. During the blocking
condition, the frequency of target behavior during component 1 was similar to
measures obtained during baseline conditions; however, during component 2
(when blocking procedures were implemented) a decrease in target behavior
was observed. When blocking was discontinued (component 3) immediate,
substantial, and sustained increases in average frequencies of target behaviors
were observed.

Figure 9 shows the mean frequency of target behaviors per component,
displayed across conditions. During the 10 initial baseline sessions, Tina
engaged in target behaviors an average of 26 times (range = 18-42) during
component 1; 25 times (range = 8-54) during component 2; and 23 times (range
= 15-37) during component 3. These results show little variability across
components.

During the response restriction sessions, Tina engaged in target behaviors
an average of 33 times (range = 10-70) during component 1; 12 times (range =
5-20) during component 2; and 62 times (range = 25-100) during component 3. Thus, during the blocking condition (middle graph) the frequency of target behavior decreased during component 2. When blocking was discontinued (component 3), average frequency of target behaviors increased almost two-fold over component 1 frequencies.

During the 5 extended alone sessions (baseline 2 sessions) conducted within the multielement analysis, Tina engaged in target behaviors an average of 26 times (range = 10-51) during component 1; 26 times (range = 12-26) during component 2; and 18 times (range = 8-33) during component 3. Baseline 2 showed little variability across components, although a decrease in target behavior was observed during component 3.
CHAPTER 5

GENERAL DISCUSSION

The outcomes for the two participants in this study indicate that the effects of blocking can be idiosyncratic across individuals and that blocking may result in complex relationships of covariance between blocked and non-blocked topographies. For example, measures of target behavior showed different patterns both within and across participants during blocking periods, with Tina showing decreases in the number of responses, while David showed increases in the number of responses, but decreases in the overall duration of responding. Subsequent measures of target behavior (during the third component) also showed idiosyncratic and complex patterns, with immediate and sustained increases in frequencies of Tina’s target behavior contrasted with David’s results that showed more complex patterns, including covariance between blocked and unblocked topographies.

The results of David’s analysis were particularly interesting. For example, blocked responses showed little change between components 1 and 3 but an unblocked topography increased during component 2 and persisted at high levels throughout component 3. Specifically, when David’s self-injurious behavior (SIB) was blocked the average duration of SIB decreased during component 3 relative to component 1 (means = 206s and 169s, respectively), whereas duration of
hand-to-hand contact increased during components 2 and 3 as compared to component 1 (means = 576s, 739, and 700, respectively). When both SIB and hand-to-hand contact were blocked, the duration of SIB in component 3 was only slightly higher than in component 1 (means = 297s and 282s, respectively), whereas, duration of hand-to-hand contact was lower (means = 507s and 543s, respectively).

Another interesting pattern was seen in the immediate effects of blocking on the frequency of David’s target behavior. Although the overall duration of David’s SIB and hand-to-hand contact decreased when these responses were blocked (component 2), the frequency of these behaviors increased significantly during these periods. These results were specific to the response blocked; as shown by increases in the frequency of SIB when it was blocked and increases in frequencies of both topographies when both were blocked (unfortunately, no condition was conducted to evaluate the effects of blocking on hand-to-hand contact alone). Frequency measures were higher during blocking periods than during any other condition of the study.

The significant increase in the frequency of problem behavior during component 2 suggests that blocking functioned as extinction for David. Previous research has shown that intermittent schedules of blocking can produce patterns of responding that permit inferences about the functional properties of blocking (e.g., Lerman & Iwata, 1996; Smith et al., 1999). Whereas the participant in the Smith et al. study showed persistence and even higher levels of SIB during
intermittent blocking sessions (relative to baseline sessions), Lerman and Iwata's participant showed nearly complete elimination of SIB regardless of parametric manipulations of the blocking schedule. The researchers interpreted their data to indicate that, for the participant in the Smith et al. study, blocking functioned as extinction, as intermittent blocking produced patterns similar to those produced by intermittent reinforcement. However, blocking appeared to function as punishment for the participant in the Lerman and Iwata study, as intermittent blocking produced general decreases in SIB, a pattern often seen with intermittent punishment procedures. In David’s case, the finding that he was able to occasionally complete responses during blocking (as evidenced by duration measures) suggests that the schedule of blocking was functionally, if not formally, intermittent and, therefore, he may have occasionally contacted reinforcement for blocked behavior. Similar patterns were evident in the study by Soderlund (2003), whose participants’ problem behavior persisted at high levels during periods of blocking.

The results for Tina provide less evidence about the functional properties of blocking. Because it was possible to block virtually all of her attempts to engage in target behaviors, the schedule of blocking was continuous and would have been expected to result in substantial decreases in target behaviors whether blocking functioned as extinction or punishment. Outcomes showing that blocking did not result in complete elimination of her target behavior and that target behavior increased to very high levels immediately following
discontinuation of blocking are consistent with an extinction account of her behavior; however, her data must be interpreted cautiously and a punishment account of her outcomes remains tenable.

The outcomes of this study extend previous research suggesting that blocking may have different functional properties for different individuals. Roscoe et al. (1998) demonstrated that even when protective equipment (latex gloves, foam sleeves, and boxing gloves) was used, participants continued to attempt to engage in problem behavior during most sessions and responding rarely decreased to zero levels. Although the authors remained appropriately cautious in their interpretation of the functional properties of protective equipment, these results appear most consistent with an extinction account. In addition to persistence of responding, protective equipment was present throughout sessions and, therefore, was not applied contingent on each response (as with blocking); thus, while blocks may punish the responses that produce them, effects of noncontingent presentation of protective equipment are more difficult to interpret in terms of consequences.

Mazaleski et al. (1994) applied protective equipment (mittens) both contingent on their participants’ SIB and noncontingently, and outcomes showed differences in treatment effects. For one participant, noncontingent use of mittens did not produce as substantial decreases in SIB as when mittens were applied contingently. The authors suggested that “suppression resulting from wearing equipment noncontingently may be due to extinction, whereas the same results
obtained when equipment is applied contingently may reflect the outcome of punishment or time-out” (p.353).

It is unclear whether the immediately subsequent effects of blocking procedures differentiate according to the functional properties of treatment. Although little research has been conducted in this area, it is reasonable to suggest that subsequent effects may be, in part, affected by the functional properties of treatment. For example, Simmons, Smith and Kliethermes (2003) showed that when popcorn was provided on dense, response-independent schedules, responding decreased immediately and remained at low levels for at least 10 min following discontinuation of the treatment. These outcomes, compared with those from the current study and those obtained by Blevins (2003) and Soderlund (2003) suggest that the effects of reinforcement-based procedures may endure longer than blocking procedures. In the current study (and in Blevins’ and Soderlund’s studies), variability in subsequent effects was observed. One potential explanation for these differences is that the functional properties of blocking varied across participants (i.e., blocking may have functioned as extinction in some cases and punishment in others); however, the current procedures and results do not permit a definitive account of the properties of blocking and, therefore, further investigations will be needed to address this issue.

Another potential source of variability in subsequent effects of interventions is response patterns generated while the treatment is in place.
Relationships—if any—between patterns of responding during and immediately following periods of blocking remain unclear at this time. In the current study, both participants’ target behaviors showed relatively immediate recovery to levels at or above baseline. However, patterns of responding during blocking periods were different, with Tina showing decreases in response frequencies and David showing substantial increases in frequencies when blocking procedures were in effect (during component 2). Blevins’ (2003) participants showed nearly complete suppression of problem behavior during blocking with subsequent increases in responding to or above baseline levels, whereas Soderlund’s participant’s data suggested a greater influence by the duration of blocking periods than by extent to which target responses were suppressed.

The current data, combined with the results of previous studies on blocking and protective equipment, highlight the importance of implementing function-based, rather than default interventions for problem behavior maintained by automatic reinforcement. Results showing incomplete suppression and rapid recovery suggest that additional treatment components are necessary to achieve acceptable treatment effects. For example, combining blocking with non-contingent access to preferred toys and contingent time-out period from those toys has been demonstrated to be effective in reducing problem behavior (Goh et al., 1995).

Some limitations are evident in the current study. First, inconsistent outcomes across participants preclude general conclusions about the effects of
blocking. However, these outcomes, combined with those from the Blevins (2003) and Soderlund (2003) studies suggest that the effects of blocking may be idiosyncratic; therefore, a general account of the effects of blocking may not be tenable. Rather, it may be that the immediate and subsequent effects of blocking are mediated variables that have yet to be determined (and that, apparently, varied across the current and previous studies). Future research should attempt to identify the conditions associated with variability in the effects of blocking.

Second, an experimental functional analysis was not conducted with Tina prior to the multiple schedule analysis in order to evaluate the effects of social contingencies on her problem behavior. Therefore, although it is impossible to draw definitive conclusions about the consequences that maintained her target behavior, the persistent responding during several extended baseline sessions strongly suggests that her behavior was maintained by an automatic contingency of reinforcement. Third, the blocking sessions required that another individual be present in the session room to block occurrences; thus, manually blocking problem behavior may have provided some attention to the participants that would not have existed had protective equipment been used.

Future studies might extend the current research in a number of ways. The multiple schedule design appears to be an effective and useful method for analyzing immediate and immediately subsequent effects of interventions. Previous research has investigated the effects of blocking (Blevins, 2003; Soderlund, 2003), protective equipment (Blevins, 2003), and NCR (Simmons et
Subsequent studies might use this general method to investigate immediate and subsequent effects of other interventions, (e.g., differential reinforcement). Another potential direction for future research is to identify any potential relationships between the functional properties of interventions and their enduring effects. Subsequent studies could investigate these and other potential sources of variability on the effects of blocking and other procedures. Other potential influences might include participant histories and types of contingencies that maintain problem behavior, among others.

The current study demonstrated the effects of schedule breakdowns (inconsistent implementation) on measures of target behavior by observing and measuring levels of target behavior before and after the application of blocking. The results, combined with those from previous research (Blevins, 2003; Soderlund, 2003), indicate that these procedures may have unpredictable effects on immediate and subsequent measures of target behavior. The current procedures may permit researchers and clinicians to identify idiosyncratic responses to these interventions and assist in the development of individualized treatment programs for optimal treatment effectiveness.
Table 1

Operational Definitions for Extended Baseline and Response Restrictions

Analysis Sessions (Tina)

<table>
<thead>
<tr>
<th>Mouthing</th>
<th>Fingers/hand/object passing the plane of her lips for 1s or longer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rubbing/Licking</td>
<td>Rubbing any part of the face with any part of the body. When she touches and then removes her hand or any contact between the tongue and any part of the body. Does not include inside the mouth</td>
</tr>
<tr>
<td>Object Licking</td>
<td>Any contact between the tongue and any object. Does not include the inside of the mouth</td>
</tr>
</tbody>
</table>
Table 2

Operational Definitions for the Functional Analysis, Extended Baseline, and Response Restriction Analysis Sessions (David)

| Self-Injurious Behavior (SIB) | Picking, scratching, or rubbing hands together for 1s or longer. Using fingernails to scratch the palms of the hands, wrists, or back of the hands. Also includes scratching any part of the fingers/fingertips with the nails |
| Hand-to-hand Contact | Any contact between both hands, that does not meet the definition of SIB or clapping hands, with no more than a 2s absence between each occurrence |
### Table 3

Average Interobserver Agreement Results of Target Behaviors during the Ten Extended Baseline Sessions and the Response Restriction Analysis Sessions (Tina)

<table>
<thead>
<tr>
<th></th>
<th>Rub/Lick</th>
<th>Range</th>
<th>Object Lick</th>
<th>Range</th>
<th>Mouthing</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline 1</td>
<td>95.4%</td>
<td>92.0-97.0%</td>
<td>99.3%</td>
<td>97.3-99.9%</td>
<td>98.9%</td>
<td>95.8-99.9%</td>
</tr>
<tr>
<td>Restriction</td>
<td>94.2%</td>
<td>91.8-95.6%</td>
<td>99.8%</td>
<td>99.6-99.9%</td>
<td>98.3%</td>
<td>96.1-99.8%</td>
</tr>
<tr>
<td>Baseline 2</td>
<td>94.8%</td>
<td>91.0-98.3%</td>
<td>99.1%</td>
<td>97.8-100%</td>
<td>99.1%</td>
<td>98.3-99.7%</td>
</tr>
</tbody>
</table>
Table 4

Average Interobserver Agreement Results of Target Behaviors during the Functional Analysis, the Ten Extended Baseline Sessions, and the Response Restriction Analysis Sessions (David)

<table>
<thead>
<tr>
<th></th>
<th>SIB</th>
<th>Range</th>
<th>Hand-to-hand</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>FA</td>
<td>94.2%</td>
<td>81.3-99.7%</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Baseline 1</td>
<td>98.3%</td>
<td>92.2-99.8%</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Restriction (SIB)</td>
<td>98.3%</td>
<td>96.5-100%</td>
<td>95.2%</td>
<td>89.0-99.1%</td>
</tr>
<tr>
<td>Baseline 2</td>
<td>99.3%</td>
<td>98.0-99.9%</td>
<td>98.7%</td>
<td>95.9-99.9%</td>
</tr>
<tr>
<td>Restriction (Both)</td>
<td>96.7%</td>
<td>92.4-99.2%</td>
<td>94.2%</td>
<td>91.1-96.3%</td>
</tr>
<tr>
<td>Baseline 3</td>
<td>99.1%</td>
<td>98.1-100%</td>
<td>99.2%</td>
<td>98.3-100%</td>
</tr>
</tbody>
</table>
Figure 1. Results of the functional analysis for David. Data are presented as total duration of SIB during each session for all conditions.
Figure 2. Results of the extended baseline and response restriction analysis sessions for David. Data are presented as total duration of SIB per component across conditions.
Figure 3. Results of the extended baseline and response restriction analysis sessions for David. Data are presented as total duration of hand-to-hand per component across conditions.
Figure 4. Results of SIB and hand-to-hand contact from the extended baseline and response restriction analysis sessions for David. Data are presented as count per session for each component.
Figure 5. Results of extended baseline and response restriction analysis sessions for David. Data are presented as mean duration (in seconds) per minute.
Figure 6. Results of SIB and hand-to-hand contact from the extended baseline and response restriction analysis sessions for David. Data are presented as mean duration (in seconds) per component and mean frequency per component.
Figure 7. Results from the extended baseline and response restriction analysis sessions for Tina. Data are represented as total number of responses per session across components.
Figure 8. Results from the extended baseline and response restriction analysis sessions for Tina. Data are shown as mean number of responses per 1-min bin.
Figure 9. Results from the extended baseline and response restriction analysis sessions for Tina. Component data are displayed in mean responses per component.
REFERENCES


