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EXPERIMENTAL ANALYSIS OF SELF-INJURY WITH
AND WITHOUT PROTECTIVE EQUIPMENT

THESIS

Presented to the Graduate Council of the
University of North Texas in Partial
Fulfillment of the Requirements

For the Degree of

MASTER OF SCIENCE

By

Duy D. Le, B.S.

Denton, Texas

December, 1998

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Outcomes of experimental analyses during which protective equipment (PE) was placed on three participants were compared to those during which PE was not provided to them. Experimental analysis conditions were presented using a multielement format, and the effects of PE were evaluated using a withdrawal design. Results of experimental analysis without PE suggested that self-injurious behavior (SIB) was maintained by negative reinforcement for two participants and nonsocial mechanisms for the third participant. However, SIB was eliminated either immediately or eventually for all participants when PE was provided during experimental analysis. Thus, outcomes of assessments with PE did not match those without PE, and no conclusion about variables associated with SIB could be drawn from experimental analyses with PE alone. Therefore, the present findings do not support the use of PE as an alternative to standard methods for conducting experimental analysis (i.e., without PE).

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INTRODUCTION

One of the many contributions of applied behavior analysis is the emphasis on functional relationships between behavior and its environment, which has been termed the function-analytic approach to understanding behavior. As Skinner (1953) stated, “A functional analysis which specifies behavior as a dependent variable and proposes to account for it in terms of observable and manipulable physical conditions...has already shown itself to be a promising formulation...” (pp. 41-42). Discussing the application of function-analytic logic to self-injurious behavior (SIB), Iwata, Vollmer, and Zarcone (1990) suggested that a functional assessment may provide: (1) relevant information (e.g., conditions under which problematic behavior occurs, the source of reinforcement that maintains a behavior, and reinforcement-based procedures that are likely and unlikely to be effective, etc.) to increase the effectiveness of reinforcement-based treatments and, thus, decrease the likelihood of the use of punishment procedures; (2) “a system for classifying behavioral interventions based on the functions of behavior for which they are effective.” (p. 304); and (3) a systematic approach to prevent a person from acquiring SIB.

In addition to the use of functional analysis in clinical settings (i.e., to assess and treat aberrant behaviors), Vollmer and Smith (1996) suggested that it could also be used as a tool for research. For example, Smith, Iwata, Goh, and Shore (1995) investigated antecedent events that affected SIB controlled by social-negative reinforcement

contingencies. During the first phase of the experiment, these researchers used experimental analysis procedures developed by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994) to screen for participants to be included in subsequent phases of the study. Criterion for inclusion in the study was based on higher rates of SIB in the Demand condition, relative to other conditions of the experimental analysis.

There are three general methods for identifying functional properties of behavior (see Iwata, Vollmer et al., 1990; Iwata, Zarcone, Vollmer, & Smith, 1994; Mace, Lalli, & Lalli, 1991, for more detailed discussions of this topic). Indirect methods rely on the subjective verbal reports of the client or those who are familiar with the client through the use of a structured interview (O'Neil, Horner, Albin, Storey, & Sprague, 1990), checklist (Van Houten & Rolider, 1991), or questionnaires with rating scale (Durand & Crimmins, 1988). Indirect methods are easy to implement; thus, little training is required. The methods are also efficient in that they can be completed in relatively short period of time. Finally, and most relevant to the present study, the methods do not pose risk to the client because data obtained from indirect methods are verbal statements rather than actual records of aberrant behaviors and variables associated with them. Thus, aberrant behaviors are not directly observed. Despite these advantages, the use of indirect methods alone (i.e., not in conjunction with either descriptive or experimental analysis) is not recommended because of their questionable reliability and validity (Iwata, Vollmer et al.). For example, Zarcone, Rodgers, Iwata, Rourke, and Dorsey (1991) replicated Durand and Crimmins' Motivational Assessment Scale (MAS) procedures, which examined four possible classes of environmental events that might maintain aberrant

behavior, but found little agreement among raters as to the variables controlling the behavior.

A second functional assessment method is called descriptive analysis, or naturalistic observation, in which behavior is directly observed in its natural environment and hypotheses regarding environmental variable(s) associated with the behavior are formed based on these observations (Bijou, Peterson, & Ault, 1968; Touchette, MacDonald, & Langer, 1985). Thus, descriptive analyses involve observation, but not manipulation of environmental variables. One advantage descriptive analyses have over indirect methods is that the obtained data are more objective. That is, data represent actual records of observable events occurring in the environment rather than inferences about subjective events such as feelings and emotions. Further, more environmental variables may enter into the analysis of behavior when compared to limited retrospective accounts of a person as in the case of indirect methods (Iwata et al., 1990; Mace et al., 1991). Indirect methods rely on the verbal reports of other people about the conditions under which aberrant behaviors occur; therefore, these reports may be limited by what a person remembers. With direct observations, however, aberrant behavior and the variables associated with it are recorded immediately after its occurrence, which produces a permanent record of information about the behavior. Therefore, information is not lost due to inability to remember or poorly worded questions. The method, however, has some limitations (Lerman & Iwata, 1993). Descriptive analyses are difficult to implement, the analysis of the obtained data is tedious, and the maintaining contingency may be masked by other, irrelevant variables that are prevalent in the natural

environment. Moreover, the individual with SIB continues to be at risk because of the occurrence of the behavior.

A third functional assessment method is called experimental, or analog analysis. Unlike the other two methods, experimental analyses involve the systematic manipulation of environmental events that are thought to be associated with the behavior of interest. Specifically, environmental events such as task demands and attention are systematically introduced and withdrawn, and their effects on the target behavior (e.g., SIB) are observed. There are several ways in which experimental analyses can be conducted. Environmental variables can be manipulated singularly (Carr, Newsom, & Binkoff, 1976, 1980; Lovaas & Simmons, 1969), or several variables can be manipulated within a short period of time using either a withdrawal experimental design (Baer, Wolf, & Risley, 1968; Barlow & Hersen, 1984) or a multielement experimental design (Sidman, 1960). The present study examined a variation of the multielement-format experimental analysis procedures developed by Iwata, Dorsey et al. and, thus, will not present detailed information about the single-variable experimental analysis (Carr et al.; Lovaas & Simmons) and withdrawal-design experimental analysis (Carr & Durand, 1985).

The experimental analysis procedures described by Iwata, Dorsey and colleagues (1982/1994), which were based on previous conceptual work by Carr (1977), was chosen because they have been repeatedly demonstrated in the literature to be effective at identifying the controlling variables for aberrant behavior (e.g., Hanley, Piazza, Fisher, Contrucci, & Maglieri, 1997; Iwata, Pace, Cowdery, & Miltenberger, 1994; Iwata, Pace, Dorsey et al., 1994; Kahng, Iwata, DeLeon, & Worsdell, 1997; Smith, Iwata, Vollmer, &

Zarccone, 1993; Vollmer, Iwata, Zarccone, Smith, & Mazaleski, 1993) (a more detailed description of the procedures is described under the method section). This protocol systematically manipulates (i.e., withholds or delivers) both antecedent and consequent events to determine if functional relationships exist between these events and the participant's behavior. Participants in the Iwata, Dorsey et al.'s study were exposed to three test conditions designed to simulate environmental situations that may evoke and/or maintain SIB (Alone, Social Disapproval, and Academic Demand) and a control condition (Unstructured Play). During the Alone condition, no leisure materials or social interactions were provided to the participant (antecedent manipulation [AM]), and SIB produced no programmed consequences (consequent manipulation [CM]). This condition tested whether SIB persisted in the absence of a programmed social contingency. If so, then it was inferred that nonsocial variables were (at least partially) responsible for the production and/or maintenance of SIB. During the Social Disapproval or Attention condition, leisure materials were available to the participant to compete with SIB maintained by non-social variable(s) (AM). A therapist, who was supposed to function as a discriminative stimulus, was nearby but did not interact with the participant, to deprive him/her of social interaction (AM). Self-injury resulted in attention from the therapist in the form of reprimands and/or concern statements (e.g., "No, don't do that. You will hurt yourself," or "Hey, stop banging your head") (CM). If SIB occurred at higher rates during this condition compared to the others, then this was taken as evidence that SIB was sensitive to social interaction from the therapist as a reinforcing consequence. During the Academic Demand condition, task demands were presented on

a fixed-time (FT) 30-s schedule (AM). Compliance resulted in social praise from the therapist (e.g., “Good job folding the towel”) and a break until the next scheduled trial, and SIB resulted in the termination of the task until the next interval (CM). This condition tested whether SIB was sensitive to escape from demands as a reinforcing consequence. If SIB occurred at higher rates during this condition compared to the others, then this was taken as evidence that SIB was sensitive to escape from demands as a reinforcing consequence. During the Unstructured Play condition, leisure materials were available to the participant to compete with SIB maintained by non-social variable(s) (AM). A therapist interacted with the participant on a FT 30-s schedule to prevent deprivation of social interaction (AM). No demands were presented to the participant to prevent the occurrence of escape-maintained SIB (AM), and self-injury produced no programmed consequences (CM). This condition served as the control against which the other conditions were compared. Results of this study indicated that higher levels of SIB were correlated with a specific condition for six of the nine participants, suggesting that this procedure could isolate controlling variables for SIB. Results for the remaining three participants showed that SIB either occurred at high levels across all experimental conditions or had undifferentiated patterns. A subsequent large-scale study, which included 152 participants and took place over the course of 11 years, provides further support for the utility of the Iwata, Dorsey et al.’s experimental analysis (Iwata, Pace, Dorsey et al.). Results of this study indicated that hypotheses about the variables associated with aberrant behaviors were possible in 145 cases (95.4%), of which 58, 40, and 39 cases were associated with social-negative

reinforcement contingency, social-positive reinforcement contingency, and non-social mechanisms, respectively. In only seven of the cases (4.6%) were results uninterpretable.

When compared to the other two functional assessment methods (i.e., indirect methods and descriptive analyses), experimental analysis allows more experimental control when attempts are made to discover behavior-environment relations. Further, information derived from an experimental analysis reveals a functional relationship rather than a correlational relationship as in the case of descriptive analysis. However, because behaviors are observed under analog situations, idiosyncratic behavior-environment relations might be not investigated and, therefore, might be overlooked (Carr, Yarbrough, & Langdon, 1997; Iwata et al., 1990). Moreover, experimental analyses are time consuming and difficult to conduct; therefore, therapists must be trained on experimental analysis procedures. Because aberrant behavior is evoked and potentially reinforcing consequences are provided contingent on its occurrence, the establishment of new behavior-environment relations is a potential risk of experimental analyses (Iwata et al.). Finally, another disadvantage of this method is that individuals with injurious behavior are exposed to risk because aberrant behavior is evoked during the assessment.

Many parents, guardians, and advocates have expressed concerns about the safety of their children during experimental analyses and suggest that precautions be taken to reduce risk of injury. There are several ways in which experimental analysis can be modified to reduce risk of injury. Session termination criteria (e.g., upper limits of rates of SIB, evidence of blood, etc.) can be established in conjunction with the medical staff prior to the assessment. The assessment itself can also be shortened to reduce risk due to

exposure to SIB by (1) utilizing single-data-point conditions (Derby et al., 1992; Northup et al., 1991), or (2) analyzing data at a molecular level (e.g., examining within-session patterns of responding) (Vollmer et al., 1993). The assessment of appropriate behavior (instead of problematic behavior) has also been attempted in cases which the problematic behavior is so severe that tissue damage was a possibility (Derby et al.). Finally, although specifically contraindicated by Iwata, Dorsey et al. (1982/1994), protective equipment can also be provided during an experimental analysis to reduce risk of injury.

Several studies have reported the use of protective equipment to treat self-injury (e.g., Dorsey, Iwata, Reid, & Davis, 1982; Iwata, Pace, Cowdery et al., 1994; Mace & Knight, 1986; Mazaleski, Iwata, Rodgers, Vollmer, & Zarcone, 1994; Silverman, Watanabe, Marshall, & Baer, 1984). For example, Dorsey et al. found that providing protective equipment (foam-padded gloves and football helmet) continuously throughout a session suppressed the SIB of the three participants in that study. However, the controlling variable(s) for the participants' SIB was not known because the researchers did not conduct a pretreatment assessment of the behaviors. Mazaleski et al. conducted a pretreatment experimental analysis of the SIB (hand mouthing and tongue pulling) of two participants and found that their behaviors were maintained in part by nonsocial variable(s). These researchers then placed oven mittens over the participants' hands either contingent on SIB or continuously throughout a session. These procedures greatly reduced the SIB of the two participants. Mace and Knight, on the other hand, found that lowest rates of pica were observed when the participant did not wear a helmet; highest rates of pica were observed when the participant wore a helmet with a face shield; and

moderate rates of pica were observed when the participant wore the helmet without a face shield. Iwata, Pace, Cowdery et al. found that providing helmets to two of three participants, whose SIB was either escape- or attention-maintained, did not affect rates of responding as long as their respective contingencies (i.e., negative reinforcement in the form of escape from task demands or positive reinforcement in the form of verbal reprimands) were intact.

Given the inconsistent results of previous studies on the effects of protective equipment on SIB, it is difficult to predict what effects protective equipment would have on outcomes of an experimental analysis. If outcomes of experimental analyses are not influenced by protective equipment, it would be preferable to provide participants with such protection. However, no available data have directly evaluated the effects of protective equipment on outcomes of experimental analyses. Thus, the present study examined a variation of the experimental analysis developed by Iwata, Dorsey et al. (1982/1994) in which protective equipment was placed on participants during an experimental analysis. Specifically, outcomes of experimental analyses during which protective equipment was placed on the participants were compared to those during which protective equipment was not provided to the participants to determine the extent to which the two outcomes matched. For the purposes of this study, matched results are defined as those that support the same interpretation about the variable(s) related to SIB.

METHOD

Participants and Settings

Three adult males, who were diagnosed with mental retardation, participated in the study. At the time of the study, Tom, Mike, and Fred lived in state residential facilities for people with developmental disabilities. Tom was non-ambulatory and could not propel his wheelchair during transportation. He had no expressive and very little receptive language. Tom was referred to a day program for assessment and treatment of self-injury because of his chronic and severe face slapping. Mike was non-ambulatory and could not propel his wheelchair during transportation. His expressive language consisted of several short sentences (e.g., "I want to eat," "I'm cold," etc.) and shaking and nodding his head. He could respond to a few simple instructions. Mike was referred to a day program for assessment and treatment of self-injury because his fingernail biting resulted in tissue damage (i.e., parts of the fingers were chronically raw and red). Fred was 35 years old and was diagnosed with profound mental retardation. He walked with an extremely unsteady gait and often used a wheelchair for transportation. Fred could propel his wheelchair with his feet but rarely did so. Speech evaluations indicated that he had severe expressive and receptive language delays. Fred's head banging resulted in lacerations which required sutures on several separate occasions. Fred did not receive psychotropic medications at the time of the study.

Tom and Mike's sessions were conducted at a day program for assessment and treatment of self-injury located on the premises of the facility where they reside. Chairs, a table, a couch, and appropriate materials for each condition were present in the

experimental room. Fred's sessions were conducted in a bedroom at his residence, where two beds, a table, two dressers, and appropriate materials for each condition were present.

Apparatus

Mittens, non-latex gloves, and a helmet were used for Tom, Mike, and Fred, respectively, to protect them from possible harm resulting from engaging in SIB. These types of protective equipment were chosen because they did not restrict or prevent the participants from engaging in SIB. The mittens used with Tom were similar to oven mittens, and are commonly used as protective equipment for SIB or other destructive behaviors. The mittens had two compartments; a smaller one was for the thumb and a larger one was for the other four fingers. The non-latex gloves used with Mike were (Medline Synthetic Examination Gloves @, MDS19-1076) identical to those often worn by physicians, nurses, and medical staff. Fred's helmet weighed approximately 2 lb, did not cover his ears, and had a clear face shield, which was positioned approximately two inches away from his face. The shield had two open areas, one for the mouth and another for the eyes. A strap, which was secured with a snap button, extended under the chin from one side of the helmet to the other. Two additional straps, which were attached to the face shield, were secured to the back of the helmet while crossing one another. The three straps were designed so Fred could not take the helmet off. Fred routinely wore his helmet, which was originally recommended by his physical therapist because of his unsteady gait.

Target Behaviors, Observation Procedures, and Interobserver Agreement

Tom engaged in face slapping, which was defined as audible contact of the palm (or that part of the mittens covering the palm during Assessment with Protection) with any part of the face. Mike engaged in fingernail biting, which was defined as contact of the teeth with fingernail(s) (or that part of the gloves covering the fingernails during Assessment with Protection). Fred engaged in head banging, which was defined as audible contact of the back of the head (or helmet during Assessment with Protection) with the top edge of the back of his wheelchair or stationary chair.

Each occurrence of the target behaviors was scored by trained observers using hand-held computers (Apple Newton MessagePad ® 100 and 130) onto which data-collection software had been installed (Behavior Observer System ® software). Data were calculated as rate (responses per min [rpm]) of SIB by dividing the recorded number of self-injurious acts by the number of min in a session. A second observer simultaneously but independently scored data during 20.5%, 33.3%, and 33.3% of sessions with Tom, Mike, and Fred, respectively. Interobserver agreement scores were calculated by dividing the session length into 10-s intervals. Within each interval, the smaller number of recorded responses was divided by the larger number, and the results were summed across the entire session, divided by the total number of intervals, and multiplied by 100. Mean interobserver agreement scores for SIB were 99.0% (range, 93.8% to 100%) for Tom, 96.2% (range, 85.7% to 100%) for Mike, and 99.8% (range, 95.19% to 100%) for Fred.

General Procedure, Experimental Design and Conditions

Experimental analysis conditions (Alone, Attention, Play, and Demand for all three participants and a fifth condition, Escape from Wheelchair, for Fred) were presented using a multielement format. For Mike, an Extended Alone condition followed the multielement assessment. The effects of protective equipment were evaluated using a withdrawal design. All sessions were 15 min in length except for Extended Alone phases with Mike, in which sessions were 45 min in length. Typically, one to five sessions were conducted five days per week. Tom, Mike, and Fred's experiments were conducted over a period of 2, 3, and 3 months, respectively.

Figure 1 shows the general strategy for conducting the experiment. All three participants were initially exposed to the multielement assessment without protective equipment (hereafter referred to as No Protection Assessment) until a hypothesis about variable(s) associated with SIB could be formed. For Mike, SIB occurred in the Alone condition and the data were undifferentiated (i.e., SIB occurred across several other conditions) during the initial multielement assessment; therefore, an Extended Alone condition was conducted to rule out the possibility that SIB occurring in the Alone condition was a function of lack of discrimination among conditions (a potential problem of the multielement design) (Vollmer, Marcus, Ringdahl, & Roane, 1995). After the No Protection Assessment was completed, protective equipment was placed on the participants and procedures identical to the No Protection Assessment (i.e., same contingencies, therapists, number of sessions per condition, and sequence of conditions) were conducted (hereafter referred to as Assessment with Protection). Protective

equipment was then removed and a second No Protection Assessment was conducted. Thus, the study employed a multielement design within an A-B-A withdrawal design with Tom and Fred, and an A1-B1-A2-B2-B1 withdrawal design with Mike.

Experimental Analysis. Procedures similar to those described by Iwata, Dorsey et al. (1982/1994) were used to test whether SIB was sensitive to certain consequences as maintaining variables. Below is a brief description of the procedures (a more detailed description of the procedures can be found in Iwata, Dorsey et al.).

Alone. The participant was seated in a chair with no leisure materials and SIB produced no programmed consequences. This condition tested whether SIB persisted in the absence of a programmed social contingency. If so, then it was inferred that nonsocial variables were (at least partially) responsible for the production and/or maintenance of SIB.

Attention. The participant was seated in a chair with leisure materials available. Self-injury resulted in attention from the therapist in the form of reprimands and/or concern statements (e.g., “Tom, don’t do that. You will hurt yourself,” or “Hey, stop banging your head Fred”). This condition tested whether SIB was sensitive to attention from the therapist as a reinforcing consequence.

Play. The participant was seated in a chair with leisure materials available. A therapist approached the participant and delivered neutral or positive statements (e.g., “Hi, Mike! You’re the man!” or “Let me change the station for you Fred”) on a FT 30-s schedule. No demands were presented to the participant and SIB produced no

programmed consequences. This condition served as the control against which the other conditions were compared.

Demand. The participant was seated in a chair without leisure materials. Approximately every 30 s, a therapist approached the participant and presented a task demand (e.g., folding a towel, wiping the table, raising his arm, and clapping his hands, etc.) using a three-prompt (verbal, modeling, and physical guidance) sequence. The three prompts were approximately 5 s apart. Compliance prior to physical guidance resulted in social praise from the therapist (e.g., “Good job folding the towel, Fred”) and a break until the next scheduled trial. If physical guidance was necessary to complete the task, no praise was provided and the participant received a break until the next scheduled trial. Any SIB occurring during the three-prompt sequence resulted in the termination of the task until the next interval. Further, any SIB occurring at the end of a 30-s interval delayed the presentation of a demand for 5 s. This condition tested whether SIB was sensitive to escape from demands as a reinforcing consequence.

Escape from Wheelchair (for Fred). Casual observation and anecdotal reports indicated that Fred often engaged in head banging while sitting in the wheelchair and rarely did so when he was not in the wheelchair. Therefore, a fifth condition was added to the experimental analysis of Fred’s head banging. Fred was seated in the wheelchair without leisure materials. A therapist approached him and delivered neutral statements on a FT 30-s schedule. No demands were presented to Fred. Head banging resulted in removal from the wheelchair into a stationary chair for 1 min. Session time was suspended while Fred was out of the wheelchair. Sessions were terminated if either of

the following criteria was met: (1) Fred sat in the wheelchair for a total of 15 min, or (2) Fred escaped from the wheelchair 30 times. Sessions during which head banging was observed lasted up to 50 min in actual time. This condition tested whether head banging was sensitive to escape from the wheelchair as a reinforcing consequence.

In addition to the general procedures described above, each participant was exposed to individualized experimental procedures because of their idiosyncratic behavior patterns during various phases of the experiment. The individualized sequence of phases and procedures for each participant are described below.

Tom. All of Tom's sessions were conducted in his wheelchair. An A-B-A withdrawal design was used to evaluate the effects of mittens on Tom's face slapping during the experimental analysis. Tom was exposed to the following conditions and sequence: No Protection Assessment (A phase), Assessment with Protection (B phase), and No Protection Assessment (A phase). During the No Protection Assessment phases, Tom did not wear mittens and was exposed to four analog conditions (Alone, Attention, Play, and Demand) of the multielement assessment (Iwata et al., 1982/1994). During the Assessment with Protection phase, procedures used during the No Protection Assessment condition were replicated with one modification - the mittens were placed on Tom's hands throughout all sessions across the four conditions. There was a 35-day gap between the last Demand session of the first No Protection Assessment condition (the 16th session) and the first Alone session of the Assessment with Protection condition (the 17th session) because Tom participated in a study unrelated to the current experiment.

Mike. All of Mike's sessions were conducted in his wheelchair. An A1-A2-B1-B2-A2 withdrawal design was used to evaluate the effects of rubber gloves on Mike's fingernail biting during the experimental analysis. Mike was exposed to the following conditions and sequence: No Protection Assessment (A1 phase), No Protection Extended Alone (45-min sessions) (A2 phase), Assessment with Protection (B1 phase), Extended Alone with Protection (B2 phase), and No Protection Extended Alone (A2 phase). During the No Protection Assessment phase, Mike did not wear gloves and was exposed to four analog conditions (Alone, Attention, Play, and Demand) of the multielement assessment (Iwata, Dorsey et al., 1982/1994). Because Mike's fingernail biting was undifferentiated during the No Protection Assessment (i.e., it occurred in all four conditions), a No Protection Extended Alone condition was conducted to rule out the possibility that fingernail biting occurring during the Alone condition of the No Protection Assessment was a function of lack of discrimination between conditions (Vollmer et al., 1995). This condition was similar to the Alone condition of the No Protection Assessment (i.e., leisure materials were not available and SIB produced no programmed consequences) with one modification - sessions were 45 min in length, instead of 15 min. For the Assessment with Protection phase, procedures used during the No Protection Assessment condition were replicated with one modification - gloves were placed on Mike's hands throughout all sessions across the four conditions. Procedures used during the Extended Alone with Protection condition were identical to those from the No Protection Extended Alone with one modification - gloves were placed on Mike's hands throughout all sessions.

Fred. Fred's stationary chair was modified so that the response effort (i.e., the distance Fred's head had to travel to bang his head on the top edge of the back of either chair) involved in head banging while sitting in either chair (i.e., wheelchair vs. stationary chair) was equalized. Fred sat in the stationary chair during the Alone, Attention, Play, and Demand conditions, and was placed in the wheelchair at the start of the Escape from Wheelchair condition. If the Demand and Escape from Wheelchair conditions were conducted on the same day, then the Escape from Wheelchair condition started without pre-session preparations. Otherwise, Fred sat in the stationary chair for 5 min before the Escape from Wheelchair condition began, at which time Fred was removed from the stationary chair and placed into the wheelchair. The pre-session preparations were conducted to make the start of the Escape from Wheelchair condition more salient and enhance discrimination that escape from the wheelchair into the stationary chair was available. An A-B-A withdrawal design was used to evaluate the effects of the helmet on Fred's head banging during the experimental analysis. Fred was exposed to the following conditions and sequence: No Protection Assessment (A phase), Assessment with Protection (B phase), and No Protection Assessment (A phase). During the No Protection Assessment phases, Fred did not wear his helmet and was exposed to five analog conditions (Alone, Attention, Play, Demand, and Escape from Wheelchair) of the multielement assessment (Iwata, Dorsey et al., 1982/1994). During the Assessment with Protection phase, procedures used during the No Protection Assessment condition were replicated with one modification - the helmet was placed on Fred's head throughout all session across the five conditions.

RESULTS AND DISCUSSION

Figure 2 shows the results of the experimental analysis of Tom's face slapping. Face slapping occurred almost exclusively during the Demand condition of the No Protection Assessment, strongly suggesting that it was maintained by negative reinforcement contingency (i.e., face slapping was evoked by the presentation of task demands and maintained by their termination). Face slapping did not occur in any condition when mittens were placed on Tom's hands. When the mittens were removed, face slapping again occurred almost exclusively in the Demand condition. Further, rates of face slapping were higher than those during the Demand condition of the first No Protection Assessment.

Results of the No Protection Assessment strongly suggested that Tom's face slapping was escape-maintained; however, no conclusion could be drawn from those obtained during the Assessment with Protection condition. Thus, outcomes of assessment with mittens did not match those of the No Protection Assessment and did not provide independent evidence about the functional properties of Tom's SIB. That is, a hypothesis about variable(s) associated with SIB could not be formed based on results of the Assessment with Protection condition alone. Tom's results indicate that the use of protective equipment can alter outcomes of experimental analysis procedures, which may lead to erroneous conclusions about the functional properties of face slapping.

Figure 3 shows the results of the experimental analysis of Mike's fingernail biting. Fingernail biting occurred across all four conditions of the No Protection Assessment, although it was generally higher during the Alone condition, suggesting that

it was maintained by nonsocial mechanism(s) (i.e., “automatically” maintained) and/or controlled by multiple sources. Fingernail biting persisted for seven 45-min sessions in the No Protection Extended Alone condition (rates of fingernail biting were at least 1.90 rpm during six sessions and the condition mean rate was 3.05 rpm), suggesting that it was maintained, at least in part, by nonsocial variable(s). Mike’s Assessment with Protection was also undifferentiated, although fingernail biting occurred at lower rates compared to those from the No Protection Assessment. Interestingly, fingernail biting generally occurred at higher rates during the Play condition, which was designed as a control. Fingernail biting never exceeded 1.0 rpm during the Extended Alone with Protection condition (the condition mean rate was 0.24 rpm), and decreased to zero or near-zero rates during the last four sessions of this condition. Finally, rates of fingernail biting comparable to those from the first No Protection Extended Alone were recaptured during the second No Protection Extended Alone condition (the condition mean rate was 2.71 rpm). The difference in condition mean rates between the Extended Alone with Protection and each of the two No Protection Extended Alone conditions represents a decrease of more than 90%.

Although the results of the multielement No Protection Assessment and Assessment with Protection were similar, neither of these assessments provided definitive information about the functional properties of fingernail biting. Results of the Extended Alone with Protection condition did not match those from the No Protection Extended Alone and did not provide independent evidence about variable(s) associated with Mike’s fingernail biting. Results from the No Protection Extended Alone showed that Mike’s

fingernail biting persisted in the absence of social contingencies, suggesting that it was maintained, at least in part, by sources that are not socially mediated; however, fingernail biting was eventually eliminated during the Extended Alone with Protection condition. Thus, considered independently, no conclusions about the functional properties of fingernail biting could be drawn from the Extended Alone with Protection condition. In summary, Mike's results indicate that providing protective equipment during experimental analysis altered assessment outcomes, making interpretation of data difficult.

Figure 4 shows the results of the experimental analysis of Fred's head banging. Head banging occurred almost exclusively during the Escape from Wheelchair condition of the No Protection Assessment, strongly suggesting that it was maintained by a negative reinforcement contingency (i.e., head banging was evoked when Fred was placed in the wheelchair and was maintained by escaping from the chair). Anecdotally, Fred generally did not cooperate during transfers from the stationary chair back into the wheelchair. However, Fred required little assistance during transfers from the wheelchair into the stationary chair. Further, on many occasions Fred pushed the wheelchair away while sitting in the stationary chair. Head banging ceased to occur in all conditions when the helmet was placed on Fred's head. When the helmet was removed, head banging again occurred exclusively in the Escape from Wheelchair condition, although rates were generally lower than those during the first Escape from Wheelchair condition without protective equipment.

Outcomes obtained from No Protection Assessment were not replicated during the Assessment with Protection condition, which did not provide independent evidence about the functional properties of Fred's head banging. Results of the No Protection Assessment strongly suggested that Fred's head banging was escape-maintained; however, no conclusion could be drawn from those obtained during the Assessment with Protection condition. Similar to the other two participants, Fred's results indicate that providing protective equipment during an experimental analysis can alter its outcomes and interferes with the interpretation of data.

GENERAL DISCUSSION

The present findings suggest that providing protective equipment (non-latex gloves, mittens, and helmet) during an experimental analysis of SIB may affect its outcomes. For all three participants in this study, results obtained from assessments with protective equipment did not match those without protective equipment, and did not provide independent evidence about the variables associated with SIB. These results may be significant for determining how best to conduct functional analysis procedures, suggesting that clinicians should be cautious when providing protective equipment during an experimental analysis. Many guardians, parents, and advocates suggest that protective equipment be used during experimental analyses of SIB to reduce risk of injury. Results of the present study suggest that such precautions may confound the outcomes of an assessment, which may lead to erroneous conclusions about variables associated with SIB. Thus, the present findings do not support the use of protective equipment as an

alternative to standard methods for conducting pretreatment experimental analysis (i.e., without protective equipment).

The present findings also indicated that providing protective equipment during an experimental analysis does not affect outcomes of subsequent assessments without protective equipment. For all three participants of the present study, SIB was eliminated during the B phase of the withdrawal design, but was recaptured during the second A phase. Based on these results, it is possible to initially conduct an experimental analysis with protective equipment. If unambiguous conclusions about variables associated with SIB could not be drawn, then an experimental analysis without protective equipment could be conducted without confounding the obtained results due to order effects. However, inconclusive results from the assessment with protective equipment could postpone the development and implementation of effective treatments for several weeks, which may be problematic if the aberrant behavior is severe.

The present findings provide an empirical basis for Iwata, Dorsey et al.'s (1994) recommendation "...that subjects be allowed to engage in self-injurious behavior while free from mechanical, physical or chemical restraint." (p. 199). The suppressive effects of protective equipment on the SIB of all three participants of the present study provide additional support for previous findings (Dorsey et al., 1982; Mazaleski et al., 1994; Silverman et al., 1984) that protective equipment can be used as part of a treatment package. However, long term treatments should involve the modification of the contingency responsible for behavioral maintenance. Otherwise, as indicated by the present findings, SIB is likely to re-emerge when protective equipment is removed. The

present findings, however, contradict previous studies which demonstrated that protective equipment either did not have an effect on SIB maintained by social contingencies (Iwata, Pace, Cowdery et al., 1994) or increased pica of which controlling variables were not known (Mace & Knight, 1986).

The reasons for inconsistent results between this and previous studies (Iwata, Pace, Cowdery et al., 1994; Mace & Knight, 1986) are not clear. One effect of protective equipment is that it attenuates the punishment component (i.e., pain) automatically produced by SIB. Thus, for SIB maintained by social contingencies, one would expect protective equipment to have no suppressive effects, or even increases rates of SIB (because the punishing effects are no longer present) as long the contingencies responsible for behavioral maintenance remain intact. Future studies investigating the effects of protective equipment on SIB maintained by social contingencies while keeping the respective contingencies intact might provide information on how best to conduct social (Attention and Demand) conditions of an experimental analysis. If additional data support Iwata, Pace, Cowdery et al.'s findings, then protective equipment could be provided during social conditions of an experimental analysis without altering the results. If, on the other hand, additional data support findings of the present study, then providing protective equipment during an experimental analysis may yield invalid outcomes.

It is possible that the suppressive effects of different types of protective equipment involve different mechanisms (i.e., response cost, S-delta, punishment, and time-out, etc.) or that the mechanisms vary among individuals. For example, it is possible that Fred did not engage in head banging when the helmet was placed on his

head because more effort was required (i.e., response cost). If so, then padding the top edge of the wheelchair would not be expected to affect Fred's SIB because no additional effort would be involved. A history with a particular type of protective equipment may also contribute to its effect on current behavior. Mace and Knight (1986) found that lowest levels of pica were observed when the participant was not wearing a helmet. These researchers found in a subsequent analysis that the absence of protective equipment was correlated with higher percentage of reprimands contingent on pica, leading them to conclude that the helmet had a discriminative function (i.e., the presence of which correlated with thinner schedule of punishment). Similar to Mace and Knight's findings, it is possible that mittens had a discriminative function with respect to Tom's face slapping. That is, mittens might have been used with Tom during escape extinction in the past. As a result, mittens may have an acquired S-delta function (i.e., mittens were highly correlated with the absence of reinforcement for Tom's slapping in the past). If mittens were the only type of protective equipment used during escape extinction, then it would be unlikely that other types of protective equipment (e.g., face masks, etc.) are in the same stimulus class (i.e., have same behavioral functions) as the mittens. As a result, Tom might continue to slap when face masks, but not mittens, are placed on him. Future studies investigating the conditions under which protective equipment affects assessment outcomes (e.g., functional properties of SIB, topographies of SIB, types of protective equipment, etc.) would be helpful.

Time-out or punishment may also be responsible for the suppressive effects of protective equipment on SIB. Mazaleski et al. (1994) found that contingent application

of oven mittens decreased SIB by more than 80% compared to that during baseline for both participants of that study. These researchers suggested that their findings are more consistent with either a time-out or punishment interpretation as opposed to a sensory extinction interpretation. It could be the case that inherent punishing properties of protective equipment are responsible for the elimination of SIB for all three participants in the present study. Alternatively, protective equipment might have been used during time-out procedures with all three participants in the past. That is, protective equipment were placed on participants to attenuate injury while reinforcement for all behaviors, not just SIB (as in the case of the S-delta interpretation), was withheld.

Future studies investigating the effects of protective equipment during treatment procedures such as escape extinction and planned ignoring might yield significant clinical implications. It has been documented that escape extinction procedures can produce an initial increase in rate of responding and persist for over 20, 15-min sessions (Goh & Iwata, 1994). Thus, undesirable side effects of extinction-based treatment procedures (i.e., initial increase in rate of responding and the persistence of the behavior) can cause significant tissue damage for individuals with severe SIB. With protective equipment, however, one can engage in SIB for longer periods (even at high intensity) without significant harm, which may increase the likelihood of treatment fidelity.

Both Tom and Fred tolerated aversive events (e.g., task demands or being in the wheelchair) when protective equipment was placed on them. For these two participants, protective equipment had generalized suppressive effects on their SIB, even though contingencies identical to the No Protection Assessment condition remained intact.

Subjects in Iwata, Pace, Cowdery et al.'s study (1994), on the other hand, continued to engaged in SIB while wearing protective equipment as long as the contingencies were kept identical to baseline condition (i.e., no extinction took place). Given inconsistent results when contingencies were kept intact for both studies, it is difficult to predict what would have happened if reinforcement had been withheld in the current study. Future studies investigating the conditions under which protective attenuates, but does not suppress SIB would allow investigations of the effects of protective equipment during extinction procedures to be possible. Finally, future studies examining the effects of protective equipment during descriptive analysis would also have significant implications for those conducting direct observations.

For all three participants in the present study, the No Protection Assessment condition always preceded the Assessment with Protection condition; thus, order effects may be a problem. That is, results obtained during the Assessment with Protection condition might have been confounded because it always followed the No Protection Assessment condition. However, the purpose of the present study was to compare results of an experimental analysis with protective equipment to those without protective equipment. Therefore, the No Protection Assessment condition was always conducted first to establish the conditions (e.g., number of sessions, additional analyses if applicable, etc.) necessary to draw confident conclusions about variables associated with SIB. Further, previous exposure to the No Protection Assessment condition should enhance differentiation (i.e., results about variables associated with SIB are available quicker) during the Assessment with Protection condition because the participants' SIB

have already been exposed to and contacted assessment contingencies. The elimination of SIB with all three participants suggests that no such order effect was operating.

A second limitation of the study is the lack of representation of SIB maintained by social positive reinforcement contingency (e.g., attention or tangible items, etc.). The SIB of the participants of the present study was maintained either by social-negative reinforcement (Tom and Fred) or nonsocial mechanisms (Mike). Therefore, the effects of providing protective equipment during an experimental analysis of SIB maintained by social-positive reinforcement were not evaluated. Results of the Iwata, Pace, Cowdery et al.'s study (1994) suggest that protective equipment may not have an effect on SIB maintained by social-positive reinforcement during an experimental analysis. However, Tom and Fred's results, showing that socially-maintained SIB was eliminated during experimental analysis, were not consistent with those of Iwata, Pace, Cowdery et al. Therefore, additional empirical investigation is necessary to answer this question.

A third limitation is Tom's involvement in another study between the first No Protection Assessment and the Assessment with Protection condition. The effects of having been exposed to contingencies of a different study on outcomes of subsequent assessments are not known. It could be argued that mittens were not a determinant for the results obtained during the Assessment with Protection condition with Tom, but that the results were a function of having a history with contingencies of the other study. However, the fact that results of the first No Protection Assessment were replicated during the second No Protection Assessment condition suggests that no such effects were operating. In short, although it is not a desirable experimental practice to disrupt an

ongoing study with participation in other activities, results of Tom's second No Protection Assessment condition strongly suggest that results of the Assessment with Protection can not be attributed to having been participated in a different study.

Finally, although not a limitation because the internal validity of the current study was not jeopardized, Tom and Fred's experimental question could have been answered in a more expeditious fashion. During the second No Protection Assessment for both participants, irrelevant conditions (Alone, Attention, and Play for Tom, and Alone, Attention, Play, and Demand for Fred) could have been omitted because there was sufficient evidence to suggest that SIB was not occurring during these (irrelevant) conditions. However, a decision was made to keep these conditions because of the relatively short period of time required to conduct these conditions. For both participants, each session during an irrelevant condition lasted 15 min. Nine irrelevant 15-min sessions (an equivalent of 2 hr 15 min) were conducted with Tom, and 24 irrelevant 15-min sessions (an equivalent of 6 hr) were conducted with Fred. Further, the irrelevant conditions were kept so that the phases of the experiment could be symmetrical. Finally, irrelevant conditions were not omitted because the extent to which having been exposed to the Assessment with Protection altered outcomes of subsequent No Protection Assessment, including the irrelevant conditions, was not known at the time of this study. Thus, future studies may not need to include irrelevant conditions. Future studies can also employ a multielement design exclusively rather than a combination of multielement within a withdrawal design of the current study. That is, it may be possible to determine the effects of protective equipment on experimental analysis results by

conducting all assessment conditions, with and without protective equipment, within a multielement design. One advantage that an exclusive multielement design has over the design of the current study is that irrelevant conditions can be omitted as soon as there are sufficient data to suggest that SIB is not occurring in these (irrelevant) conditions. A disadvantage of an exclusive multielement design is that discriminative control over participants' SIB may be difficult because of the rapid alternation among so many experimental conditions.

In summary, the present study investigated a method for evaluating the effects of protective equipment during an experimental analysis and produced empirical data indicating that such a precaution alters outcomes of the analysis. In addition, data showed that protective equipment can eliminate SIB maintained by both social and non-social mechanisms, even when social reinforcement contingencies remain intact. Additional research on the effects of protective equipment during experimental analysis may clarify the conditions under which assessment outcomes are altered, as well as conditions under which protective equipment attenuates, but not eliminates, SIB. Such information will allow SIB to occur to contact contingencies during treatment as in the case of extinction of behaviors maintained by either positive or negative reinforcement.

APPENDIX

FIGURES

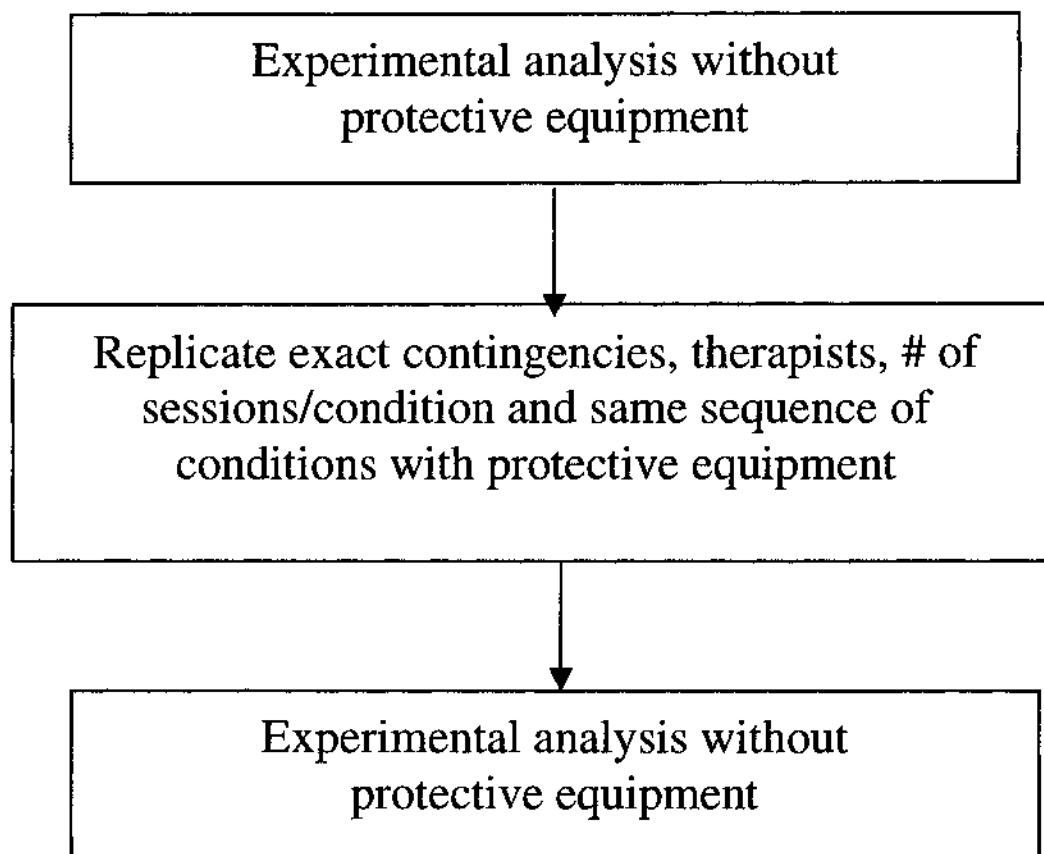


Figure 1. General strategies for conducting the experiment with Tom, Mike, and Fred.

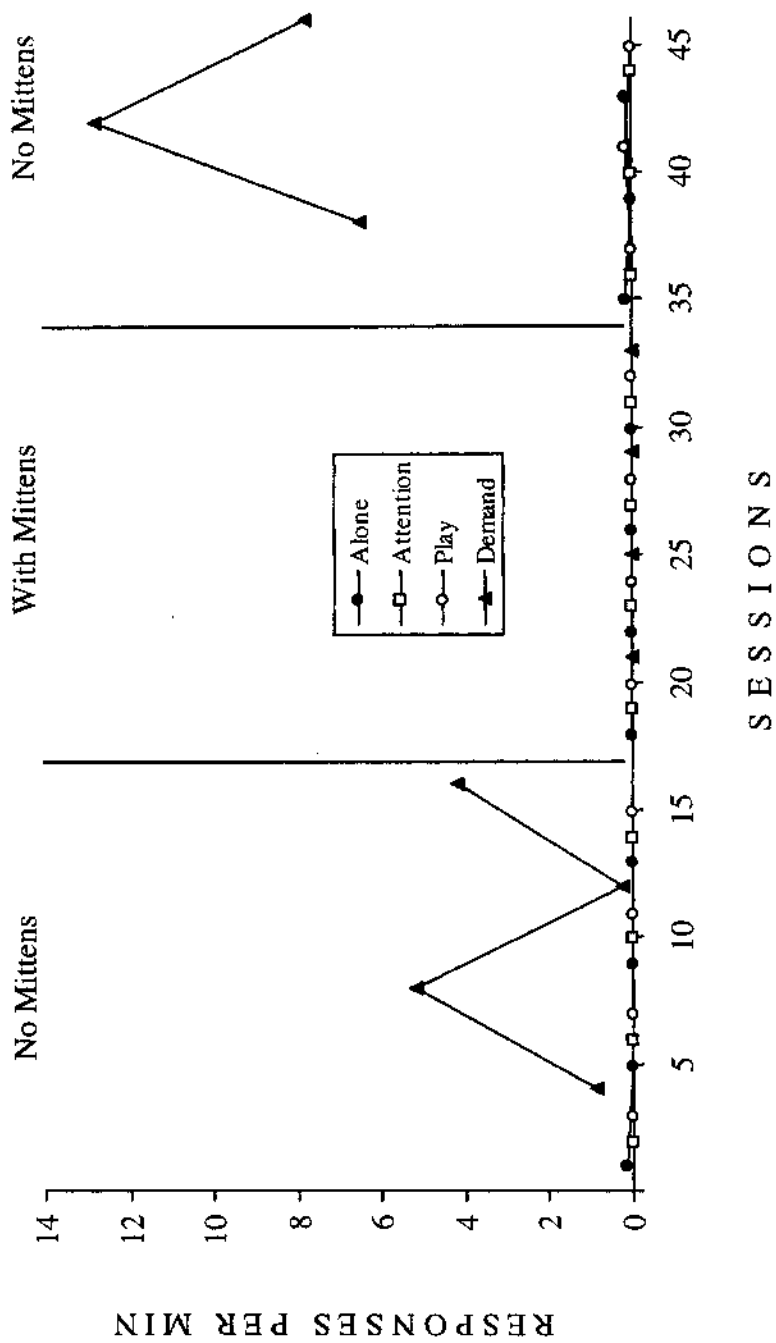


Figure 2. Responses per min of face slapping across Tom's experimental analysis conditions (Alone, Attention, Play, and Demand) with and without protective equipment.

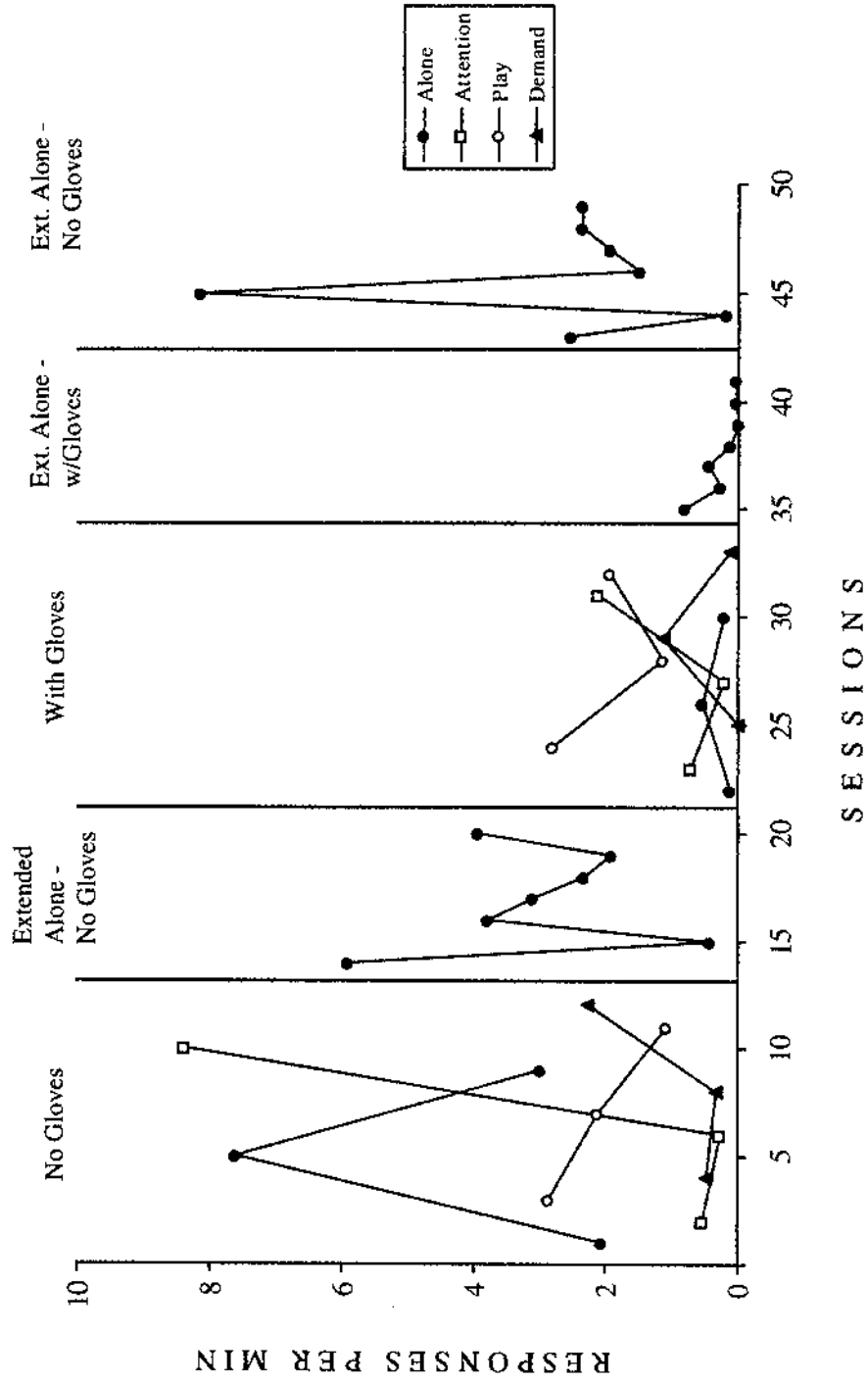


Figure 3. Responses per min of fingernail biting across Mike's experimental analysis conditions (Alone, Attention, Play, Demand, and Extended Alone) with and without protective equipment.

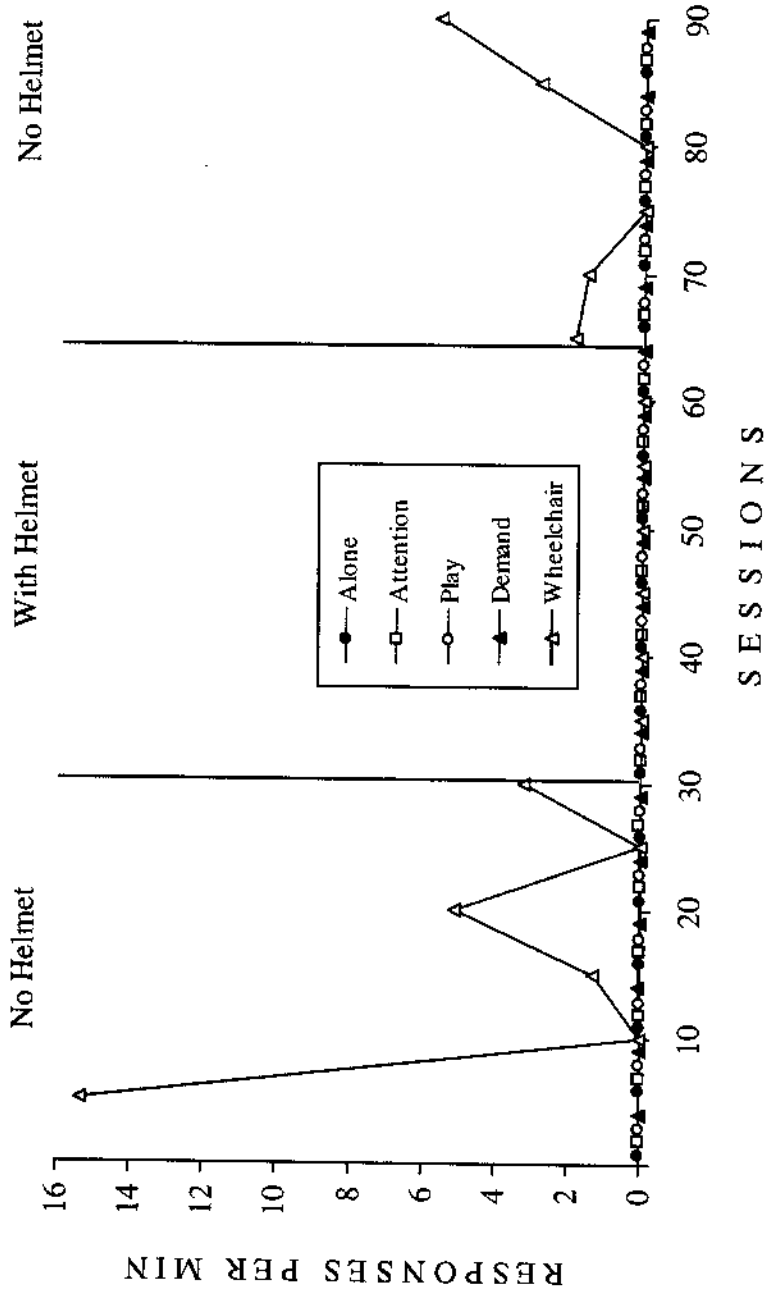


Figure 4. Responses per min of head banging across Fred's experimental analysis conditions (Alone, Attention, Play, Demand, and Escape from Wheelchair) with and without protective equipment.

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