

*SYSTEMATIC APPLICATION AND REMOVAL OF  
PROTECTIVE EQUIPMENT IN THE ASSESSMENT OF  
MULTIPLE TOPOGRAPHIES OF SELF-INJURY*

JAMES W. MOORE, WAYNE W. FISHER, AND ANGELA PENNINGTON

MARCUS AND KENNEDY KRIEGER INSTITUTES

We evaluated the effects of systematic application and removal of protective equipment on three topographies of self-injurious behavior (SIB) exhibited by a girl who had been diagnosed with autism. Results showed that when protective equipment was applied, SIB decreased to near-zero levels. In addition, withdrawal of protective equipment for specific topographies of SIB (by removing only the corresponding padding) increased rates of SIB only for that topography of SIB. Next, a functional analysis of hand SIB showed that protective equipment suppressed this behavior in all conditions and that the behavior was maintained by automatic reinforcement when padding was removed. Results are discussed in terms of sensory extinction as a possible mechanism responsible for response suppression.

DESCRIPTORS: automatic reinforcement, functional analysis, protective equipment, self-injurious behavior

The use of protective equipment is often indicated for severe self-injurious behavior (SIB) that could potentially cause major tissue damage or even death (Dorsey, Iwata, Reid, & Davis, 1982). Such dangerous behavior makes the identification of behavioral function difficult and often results in the use of reinforcement- or punishment-based procedures irrespective of behavioral function (Fisher et al., 1994). Although protective equipment is often used in the treatment of severe SIB, few studies have investigated the use of such devices in the assessment of severe SIB.

Le and Smith (2002) and Borrero, Vollmer, Wright, Lerman, and Kelley (2002) conducted functional analyses of SIB with and without protective equipment. In both studies, protective equipment suppressed SIB and the function of SIB was identified

only when the equipment was removed. However, neither study examined whether the suppressive effects of protective equipment on SIB were due to sensory extinction (see Rincover, 1978) or some other mechanism.

In the current study, we evaluated the effects of protective equipment by systematically applying and removing padding that mitigated the sensory consequences of SIB during a series of alone conditions for one topography of SIB at a time. Finally, we replicated the findings of Le and Smith (2002) and Borrero et al. (2002) by comparing functional analysis outcomes with and without protective equipment. In addition, because of the severity of the participant's SIB, we removed padding from only one part of the body at a time in order to lessen the risk of tissue damage.

## METHOD

### *Participant, Setting, and Data Collection*

Jody was a 12-year-old girl who had been diagnosed with autism and who displayed over 18 topographies of SIB, which were

---

This investigation was supported in part by Grant 5 R01 HD37837-03 from the Department of Health and Human Services, the National Institute of Child Health and Human Development.

Requests for reprints should be addressed to James W. Moore, May South, Inc., 1770 The Exchange, Suite 140, Atlanta, Georgia 30339 (e-mail: jmoore@mayinstitute.org).

grouped into three categories: (a) shoulder SIB, defined as her shoulders making forceful contact with her head or with objects; (b) hand SIB, defined as her hand making forceful contact with her other hand, parts of her body, or objects in the room; and (c) leg SIB, defined as her heel forcefully striking her shin or her foot forcefully striking the floor. Jody received 5 mg of paroxetine HCl throughout the course of this study.

Data collectors were positioned behind a one-way mirror and used laptop computers to record the three categories of SIB. Inter-observer agreement was collected during 57.9% of the alone analysis sessions and 33.6% of the functional analysis sessions. Exact agreement averaged 96.9% (hand SIB), 94.6% (shoulder SIB), and 99.9% (leg SIB) during the alone analysis and 96.2% (hand SIB), 100% (shoulder SIB), and 99.9% (leg SIB) during the functional analysis. Two to five 10-min sessions were conducted per day in a padded room.

#### *Protective Equipment*

Several probes were conducted prior to the main analyses to determine the minimum level of equipment required to keep Jody safe and to mitigate the sensory consequences of SIB (i.e., produce sensory extinction), but to allow her to physically engage in each topography of SIB (data available upon request). Head SIB was omitted from the current analysis due to an increased risk of blindness with continued head-related SIB. Therefore, Jody wore a helmet with a plastic visor and rigid arm sleeves (to prevent face punching) throughout the study. Jody's shoulders and legs were padded using foam approximately 5 to 8 cm thick. These pads were placed on Jody's body so that they could not be removed but did not physically block SIB. Her hands were padded using martial arts equipment that included a 2.5-cm foam pad. Standard boxing gloves were placed over her hands and the foam pad-

ding. Additional padding included foam padding approximately 8 to 10 cm thick that was placed on Jody's hips.

#### *Component Analysis in an Alone Condition*

Alone sessions were conducted to test the hypothesis that Jody's SIB was maintained by automatic reinforcement. During these sessions, Jody was left alone in a padded room with no other items available. A reversal design was used to assess the presence or absence of padding on Jody's SIB. During the use of protective equipment, Jody wore a helmet, shoulder pads, padded arm sleeves, boxing gloves, padded leg sleeves, and padded slippers, thus mitigating the sensory consequences of all topographies of SIB. During other phases, padding was removed from a specific area of the body (either the shoulder, hands, or legs) while it remained in place for the other topographies of SIB. For example, to discontinue the use of protective equipment only for shoulder SIB, the shoulder pads were removed in the second phase while all of the other pads remained in place.

#### *Functional Analysis*

During the component analysis, Jody showed high rates of hand SIB and produced the least amount of tissue damage when the hand pads were removed. Based on these results, we conducted a functional analysis to examine whether hand SIB was sensitive to social positive and negative reinforcement when protective equipment was and was not in place for hand SIB. Using a combination multielement and reversal design, four functional analysis conditions (attention, demand, alone, and play) were conducted using procedures described by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994), with modifications described by Fisher, Piazza, and Chiang (1996). Jody wore padding for all topographies of SIB in the first and third phases, and only the hand

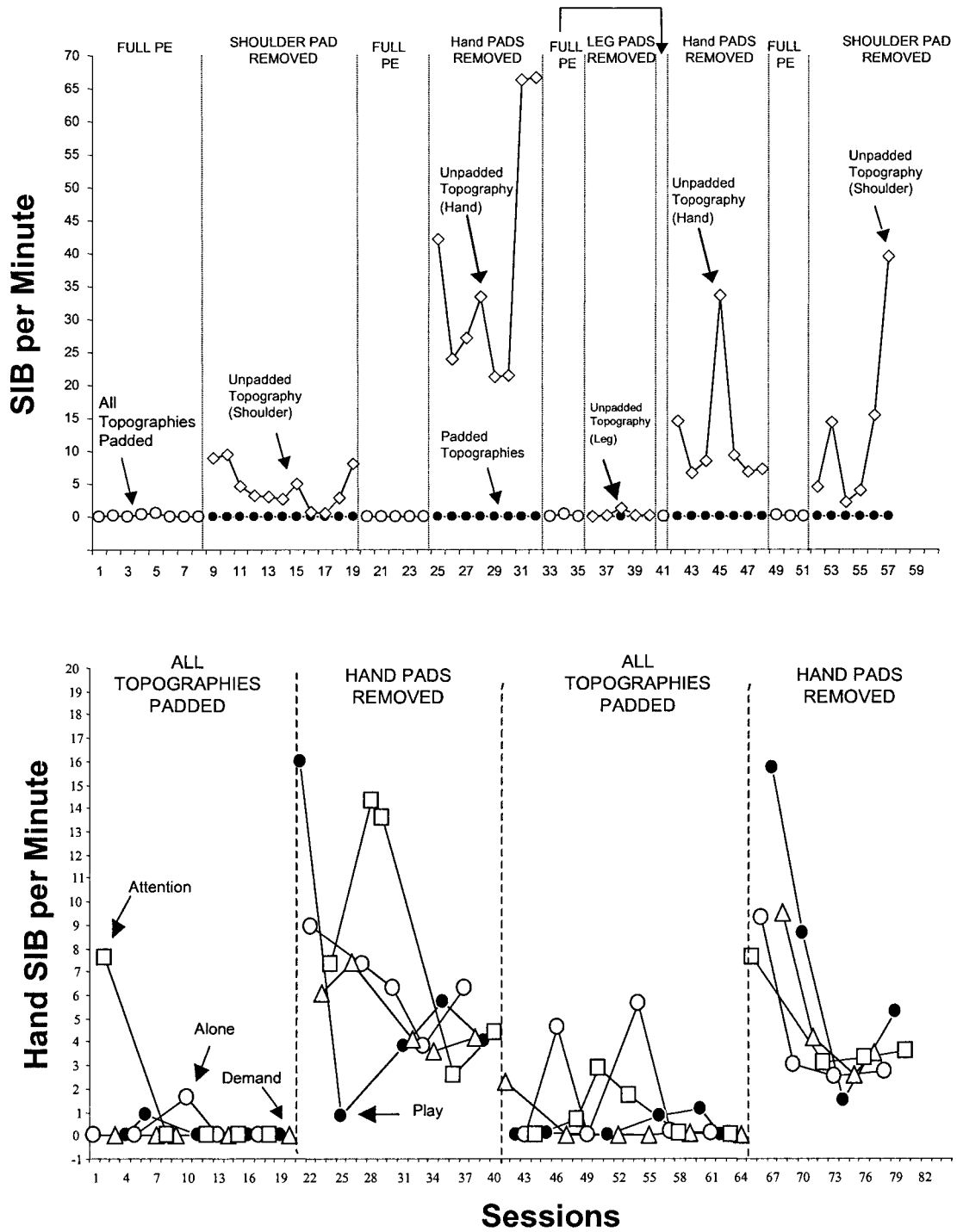


Figure 1. The top panel shows the rates of various topographies of SIB during the component analysis in an alone condition, and the bottom panel shows the rates of hand SIB during a functional analysis with and without protective equipment.

pads were removed in the second and fourth phases.

## RESULTS AND DISCUSSION

Figure 1 shows the results of the analysis of protective equipment in the alone condition and the functional analysis of hand SIB. SIB occurred at near-zero levels when protective equipment was applied to relevant body parts (top panel). When padding was removed from the shoulder in the second phase, only shoulder SIB increased, an effect that was replicated in the final phase. Similarly, for both phases in which padding was removed from the hand, only hand SIB increased. One exception to this pattern was that leg SIB did not increase substantially when padding was removed from the leg, which may have been because this was usually a low-rate topography or because the padded walls and flooring in the treatment room mitigated the automatic consequences of leg SIB.

Hand SIB occurred at relatively low rates (zero in most sessions) when protective equipment was applied to all relevant body parts, regardless of the functional analysis condition in effect (Figure 1, bottom panel). Hand SIB increased dramatically in all functional analysis conditions when the hand pads were removed. Taken together, the results of the component analysis and the functional analysis suggest that shoulder and hand SIB were maintained by automatic reinforcement and that hand SIB was not sensitive to social reinforcement.

Results of the current investigation suggest that sensory extinction was most likely the underlying mechanism responsible for response suppression. Changes in responding occurred when protective equipment was systematically applied and removed from specific areas of Jody's body associated with SIB. These data replicate previous research by showing that protective equipment may

interfere with the identification of behavioral function during functional analyses. These results also extend previous findings by demonstrating the suppressive effects of protective equipment when applied to specific topographies of SIB.

One limitation of the current investigation was that not all topographies of SIB were subjected to removal of sensory extinction in the alone condition or to potential social reinforcers during the functional analysis. The reason for not removing the helmet or the arm splints was that head banging or punching could have produced permanent blindness, so the risks clearly outweighed the potential benefits. Nevertheless, it would have been both safe and useful to test whether leg SIB was sensitive to social reinforcement, given that this topography did not increase when its padding was removed in the alone condition. An alternative explanation of the current findings suggests that the suppressive effects of sensory extinction were due to the increased response effort associated with protective equipment. That is, the equipment itself may have increased the amount of effort Jody had to exert, thus suppressing SIB.

## REFERENCES

- Borrero, J. C., Vollmer, T. R., Wright, C. S., Lerman, D. C., & Kelley, M. E. (2002). Further evaluation of the role of protective equipment in the functional analysis of self-injurious behavior. *Journal of Applied Behavior Analysis, 35*, 69-72.
- Dorsey, M. F., Iwata, B. A., Reid, D. H., & Davis, P. A. (1982). Protective equipment: Continuous and contingent application in the treatment of self-injurious behavior. *Journal of Applied Behavior Analysis, 15*, 217-230.
- Fisher, W. W., Piazza, C. C., Bowman, L. G., Kurtz, P. F., Sherer, M. R., & Lachman, S. R. (1994). A preliminary evaluation of empirically derived consequences for the treatment of pica. *Journal of Applied Behavior Analysis, 27*, 447-457.
- Fisher, W. W., Piazza, C. C., & Chiang, C. L. (1996). Effects of equal and unequal reinforcer duration

- during functional analysis. *Journal of Applied Behavior Analysis*, 29, 117–120.
- Iwata, B. A., Dorsey, M. F., Slifer, K. J., Bauman, K. E., & Richman, G. S. (1994). Toward a functional analysis of self-injury. *Journal of Applied Behavior Analysis*, 27, 197–209. (Reprinted from *Analysis and Intervention in Developmental Disabilities*, 2, 3–20, 1982)
- Le, D. D., & Smith, R. G. (2002). Functional analysis of self-injury with and without protective equipment. *Journal of Developmental and Physical Disabilities*, 14, 277–290.
- Rincover, A. (1978). Sensory extinction: A procedure for eliminating self-stimulatory behavior in psychotic children. *Journal of Abnormal Child Psychology*, 6, 299–310.

*Received July 2, 2003*

*Final acceptance November 12, 2003*

*Action Editor, David Wacker*