JOURNAL OF APPLIED BEHAVIOR ANALYSIS 1990, 23, 361–370 NUMBER 3 (FALL 1990)

ARTIFACTUAL EFFECTS OF SENSORY-INTEGRATIVE THERAPY ON SELF-INJURIOUS BEHAVIOR

SUSAN ANN MASON
UNIVERSITY OF MARYLAND

AND

BRIAN A. IWATA
UNIVERSITY OF FLORIDA

Three individuals who exhibited self-injurious behavior (SIB) were exposed to sensory-integrative therapy. Prior to treatment, a functional analysis baseline was conducted to identify the motivational features of their SIB. One subject's SIB appeared to be an attention-getting response (maintained by positive reinforcement), which varied subsequently as a function of attention being either withheld or provided noncontingently during sensory-integration sessions. The 2nd subject displayed a pattern of responding suggestive of stereotypic SIB (maintained by automatic reinforcement), which paradoxically increased during sensory-integration sessions. The 3rd subject's SIB appeared to function as an escape response (maintained by negative reinforcement), and his behavior during sensory-integration sessions was similar to that observed during baseline sessions in which demands were not present. The SIB of all 3 subjects later was reduced when behavioral interventions were applied. The data presented raise questions about the active components of sensory-integrative therapy and the functional types of SIB for which it might be appropriate.

DESCRIPTORS: functional analysis, self-injurious behavior, sensory-integrative therapy, stereotypic behavior

A considerable amount of research conducted over the past 20 years has focused on the treatment of self-injurious behavior (SIB), a serious and chronic disorder that poses significant physical, social, and educational risks. The most effective interventions developed to date have been based on operant conditioning principles (Baumeister & Rollings, 1976; Favell, Azrin et al., 1982; Johnson & Baumeister, 1978). This fact provides support for the general theory that much of SIB is learned behavior or, if not, responds nevertheless to environmental contingencies that are applied either directly (e.g., as in providing reinforcement or punishment for target behaviors) or indirectly (e.g., as in manipulating setting events to occasion the occurrence of an alternative behavior that is automatically reinforced, thereby competing with the SIB).

Other explanatory accounts for the development of SIB offer a theoretical foundation for the use of therapies in which a contingency is never manipulated. One such account is based on a neurodevelopmental orientation proposed by Ayres (1972, 1974) and Norton (1975). In its general form, the theory conceptualizes the failure to develop motor coordination as evidence of central nervous system (CNS) dysfunction, which may be alleviated through various types of physiological stimulation collectively described as sensory-integrative therapy. Lemke (1974) extended this position by suggesting that stereotypic and self-injurious behaviors seen in developmentally disabled individuals may be a further reflection of poor sensory-motor integration. In support of this position, Lemke presented an uncontrolled case study in which multiple forms of stimulation (finger massage and ice to the mouth, quiet talk, tooth brushing, towel massage to the

This research was supported by Grant HD16052 from the National Institute of Child Health and Human Development. We thank Merril Dorsey, Therese Goldfarb, Terri Helinski, Chris House, Michael Richardson, and Marcie Vinton for their assistance in conducting various aspects of the research.

Reprints may be obtained from Susan Mason, Department of Special Education, Benjamin Building, University of Maryland, College, Park, Maryland 20742, or from Brian Iwata, Department of Psychology, University of Florida, Gainesville, Florida 32611.

arms, patty cake, feet slapping, and body rolling) were applied to a self-injurious client. Although no quantitative data were presented, the author noted that the subject eventually was freed from restraint and was taught to hold a toy in each hand (one toy was mouthed; the other was banged).

In another case study, Bright, Bittick, and Fleeman (1981) administered tactile, vestibular, and social stimulation (rocking in a hammock, stroking the back, holding in a rocking chair while providing social interaction), and reported that their subject's frequency of SIB decreased during treatment sessions. Wells and Smith (1983) provided similar types of stimulation (rocking in a hammock and rocking chair, battery-operated vibratory stimulation, massage, rolling the body over a large ball, rolling bolsters over arms and legs). Results obtained with 4 subjects showed that the frequency of SIB decreased during therapy sessions when compared to baseline, although it was noted that SIB was prevented periodically through manual restraint.

The studies by Bright et al. (1981), Lemke (1974), and Wells and Smith (1983) contained a number of methodological problems that prevent clear interpretation of the reported data. None of the studies provided evidence of adequate measurement or assessment of interobserver agreement, and only Wells and Smith (1983) presented data from a baseline condition. A third problem with each of the studies was confounding of the independent variable. Physiological stimulation was presented concurrent with other events, most notably noncontingent social stimulation, that by themselves may have been responsible for reported changes in behavior. Some of these problems were addressed in a recent investigation by Dura, Mulick, and Hammer (1988). The authors compared the effects of vestibular stimulation (movement back and forth on a swing while the client was seated on a therapist's lap) with those of a control condition in which a therapist provided attention without apparent vestibular stimulation (playing catch with assistance, rolling a toy, and taking turns at an activity while seated). Results showed that the subject exhibited no SIB during sessions containing vestibular stimulation and variable rates of SIB during the attention control.

The Dura et al. (1988) study is noteworthy in that it is the first controlled evaluation of sensory-integrative therapy showing positive results with SIB; additional research is needed to clarify the conditions under which similar or different results would be obtained. For example, it is now generally agreed that SIB is a complex disorder that may be developed and maintained through a variety of mechanisms; from a learning perspective, these include positive, negative, and automatic reinforcement. The theoretical basis for sensory-integrative therapy suggests that the most appropriate test condition would be with stereotypic (automatically reinforced) SIB that is not maintained by environmental contingencies. By contrast, SIB that is clearly related to environmental events may be affected by coincidental features of sensory-integrative therapy. Attention-motivated SIB would be suppressed through noncontingent attention, which is a component of sensory-integrative therapy; therein lies the importance of the attention control provided by Dura et al. Escape-motivated SIB also may show a decrease during sensory-integration sessions merely as a function of reduced aversive stimulation through withdrawal of demands.

The present study extends previous research on sensory-integrative therapy by examining its effects with 3 self-injurious individuals selected on the basis of data obtained during a functional analysis baseline. One subject exhibited SIB that seemed to function as an attention-getting response, the 2nd subject's SIB appeared to be stereotypic in nature, and the 3rd subject's SIB functioned as escape behavior.

METHOD

Subjects and Setting

Sally, a 6-year-old severely retarded female, could feed herself with assistance, but she had no other independent self-care skills. She responded to her name but otherwise exhibited no language skills. Kathy, a 3-year-old profoundly retarded female,

had cerebral palsy and scoliosis. She required full assistance with feeding, dressing, toileting, and other self-care skills, and she did not have any language skills. Mort, an 18-year-old profoundly retarded male, had microcephaly and scoliosis. He could feed himself and dress with minimal assistance, but he had no other independent self-care or language skills.

All subjects displayed SIB that produced tissue damage and was judged to pose moderate risk (i.e., lacerations and contusions required minor wound care by a physician or nurse, but they had never required inpatient care, nor were they likely to impair vision or hearing). Sessions for Kathy and Mort were conducted in therapy rooms equipped with one-way observation windows. Sally's sessions were conducted in a small empty classroom that did not contain observation windows. Observers for Sally's sessions were seated behind a fine-mesh screen placed at least 3 m from the subject.

Response Measurement and Reliability

Self-injurious responses were defined as follows: ***hand biting*** (Kathy)—closure of upper and lower teeth on hand or wrist; ***hand mouthing*** (Kathy)—insertion of fingers or hand into the mouth; ***head banging*** (Mort)—audible contact between the head and either a fist or an object; and ***slapping*** (Kathy, Sally, Mort)—audible contact between the hand and another part of the body. Data were collected on hand-held computer (Panasonic Model RL-H1800 or Hewlett Packard Model HP-71B) and were summarized as the percentage of 10-s intervals during which one or more SIBs occurred.

Interobserver agreement was assessed by having a second observer simultaneously but independently record data during 38%, 39%, and 35% of the sessions overall for Sally, Kathy, and Mort, respectively, and during at least 20% of the sessions in each phase of the study. Agreement percentages were calculated via computer based on interval-by-interval comparisons of observers' records by dividing agreements by agreements plus disagreements and multiplying 100. Mean overall, occurrence, and nonoccurrence agreement percentages, respectively, were as follows: Sally—93%, 95%, 91%; Kathy—96%, 96%, 97%; and Mort—97%, 97%, 93%.

Experimental Sequence

The study consisted of three phases. In Phase 1, subjects were observed in a series of baseline conditions to assess the functional properties of their SIB. In Phase 2, they were exposed to sensory-integrative therapy. Additional control procedures were implemented with Sally and Mort based on results obtained during sensory-integration sessions. Finally, subjects' SIB was treated via behavioral interventions in Phase 3.

Phase 1: functional analysis baseline. Subjects were exposed to four conditions, each presented during 15-min sessions in a multielement format (Sidman, 1960; Ulman & Sulzer-Azaroff, 1975). A brief description of these conditions is provided here; more complete details can be found in Iwata, Dorsey, Slifer, Bauman, and Richman (1982) and Iwata, Pace, Kalsher, Cowdery, and Cataldo (1990). During the demand condition, a therapist presented academic tasks to the subject in a discrete-trial format, delivered praise contingent on correct responses, and implemented a 30-s time-out contingent on the occurrence of SIB. During the attention condition, a therapist initially instructed the subject to play with toys that were in the room and proceeded to do paperwork. Contingent on the occurrence of SIB, the therapist delivered a verbal reprimand, expressed concern, and briefly interrupted the SIB. During the alone condition, the subject was observed while alone in the room, which was empty except for a chair (Kathy and Mort) or observers positioned behind the screen (Sally). The final condition, play, served as a control for the other three conditions. The therapist provided access to toys, provided praise approximately every 30 s contingent on the absence of SIB, and ignored occurrences of SIB.

Phase 2: sensory-integrative therapy. Sensory-integrative therapy refers to a variety of techniques whose major components involve the delivery of multisensory stimulation, although operational descriptions are difficult to find even in primary sources. In addition, the techniques that have been applied

as treatment for SIB represent only a few of the many components that have been described by others (e.g., Ayres, 1972, 1974), and these techniques varied significantly across studies (Bright et al., 1981; Dura et al., 1988; Lemke, 1974; Wells & Smith, 1983). The modalities and specific stimuli selected for inclusion in this study were based on available literature and recommendations provided by occupational therapists who were trained in and who used sensory-integration techniques. The procedures were designed to be representative of those used by Bright et al., Dura et al., and Wells and Smith, with exceptions noted below.

Sensory-integration sessions were begun immediately upon completion of the baseline phase and were implemented in a multiple baseline across subjects design. During these sessions, subjects were provided noncontingent access to apparatus that delivered auditory, kinesthetic, tactile, vestibular, and visual stimulation. The apparatus for all subjects were similar and consisted of (a) a flashing amber or blue light suspended from the ceiling, (b) a rocking chair with a vibrating pillow attached at neck level, and (c) a cassette tape recorder that played rock or jazz music. During each 15-min session, all apparatus were activated. A therapist remained in the room to monitor the subject's safety but did not otherwise interact with the subject. The absence of interaction was designed to allow continuous access to several sources of physiological stimulation independent of the potentially confounding effects of social stimulation. Although this seems like a significant departure from the manner in which sensory-integrative therapy usually is delivered, the lack of social interaction should be unimportant if physiological stimulation is the critical component. Moreover, this variation not only was considered acceptable but was specifically suggested by Wells and Smith (1983), who recommended ". . . the automated provision of sensory stimulation through vibratory chairs and magic-finger beds, as well as audio-visual and other forms of sensory stimuli" (p. 666). With 1 subject (Sally) the effects of sensory-integrative therapy with and without attention were examined systematically in a reversal design.

Phase 3: behavior intervention. Based on data obtained during Phase 1, behavioral treatments were designed for each subject that seemed appropriate to the apparent function of their SIB. These procedures were implemented in a staggered sequence across baselines but, because the treatments necessarily differed across subjects, the design cannot be considered a true multiple baseline (i.e., the effects of the *same* variable were not replicated). Treatment for Sally and Mort involved extinction through removal of the reinforcement contingency found to be maintaining their SIB during baseline. An analogous extinction procedure for Kathy—sensory extinction (Rincover & Devaney, 1982)—was not possible because we could not identify the specific reinforcing stimuli produced by her behavior. As in previous conditions, sessions lasted for 15 min.

Sally's assessment data suggested that her SIB was maintained by attention, which was further confirmed through attention manipulations (absent vs. continuously present) during sensory-integration sessions in Phase 2. Therefore, we examined the effects of another attention manipulation—time-out from attention—in Phase 3. The therapist sat close to Sally and provided praise, pats on the back, etc., during each 10-s interval in which Sally did not exhibit SIB. Contingent on the occurrence of SIB, the therapist moved her chair away (approximately 1 m) and turned her back to Sally. Attention was resumed after SIB had ceased for 10 s. The effects of extinction were evaluated in a reversal design (ABA) in which the A condition consisted of extinction and the B condition consisted of the original baseline, in which the therapist attended to Sally only when she exhibited SIB.

Kathy's intervention consisted of providing her with access to materials whose manipulation might compete with hand biting, hand mouthing, and slapping (Favell, McGimsey, & Schell, 1982). Several hanging toys were suspended on a pole from here wheelchair in such a way that she could grasp them and either hold or guide them to her mouth. This procedure was supplemented with a differential reinforcement of other behavior (DRO) contingency in which the therapist provided praise for

the absence of SIB (a 1-min schedule initially that was extended to 2 min on Session 52) and a mild verbal reprimand ("No") plus brief response interruption contingent on the occurrence of SIB.

Because Mort's SIB decreased during sensory-integration sessions, a return to baseline in the demand condition was implemented before initiating his behavioral program. Treatment was then implemented, still within the context of the demand condition, and consisted of "escape extinction" (Iwata et al., 1990). The therapist issued instructions as before but did not terminate trials contingent on the occurrence of SIB. Instead, whenever Mort hit himself, he was immediately guided to comply with the therapist's request.

RESULTS

Figure 1 shows that the occurrence of SIB, expressed as percentage of 10-s intervals, for all subjects during all experimental conditions. Due to differences observed across subjects during the initial baseline that determined subsequent variations in procedure, each subject's experimental sequence and results are described separately.

Sally

During baseline, Sally's SIB occurred almost exclusively during the attention condition, suggesting that the behavior was maintained by positive reinforcement. Little or no SIB occurred during conditions in which attention was provided noncontingently (demand), contingent on the absence of SIB (play), or when stimuli associated with attention were completely absent (alone).

Sally's behavior during baseline indicated that contingent or discriminative arrangements based on attention would differentially affect her SIB; this possibility was explored in Phase 2. Sensory-integration sessions with no attention were alternated in a reversal design with sessions in which the therapist provided noncontingent attention (praise, reading a story aloud, pats on the head or back) during every 10-s interval. During sensory integration without attention, Sally's SIB remained unchanged from the baseline attention condition. Although these negative results were not consistent with those from previous studies on sensory-integrative therapy, they were very consistent with her baseline pattern of responding, which suggested that the presence of a therapist during sensory-integration sessions was discriminative for SIB. Because it was not possible to eliminate the therapist completely from the immediate situation due to the electrical apparatus in the room, the therapist next provided continuous attention concurrent with sensory-integrative therapy. This operation presumably would amount to noncontingent reinforcement, which would remove the motivational basis for responding. When the attention was implemented and later removed, Sally's SIB decreased rapidly and later returned to its previous level.

The final three conditions for Sally involved still another evaluation of attention-related effects. The positive reinforcer (attention) for her SIB was withheld contingent on SIB during extinction, delivered contingent on SIB during the return to baseline, and withheld again. During these three conditions, her behavior showed orderly changes similar to those observed when attention was manipulated during the baseline assessment and sensory-integrative therapy.

Kathy

During baseline, Kathy's SIB was somewhat lower in the play condition; in demand, attention, and alone conditions, her SIB was rather variable and undifferentiated. Responding of this type suggests several interpretations. One is that Kathy failed to discriminate among the different conditions. If such were the case, one would expect eventual separation of the data based on repeated contact with the contingencies, but that did not occur over 37 sessions. A second possibility is that SIB was maintained by more than one source of reinforcement (i.e., some combination of positive, negative, and/or automatic reinforcement). However, the continued occurrence of SIB during the alone condition, in which the absence of a therapist was highly discriminable for extinction (assuming that attention was a motivational factor) or the absence of aversive events (assuming that escape from de-

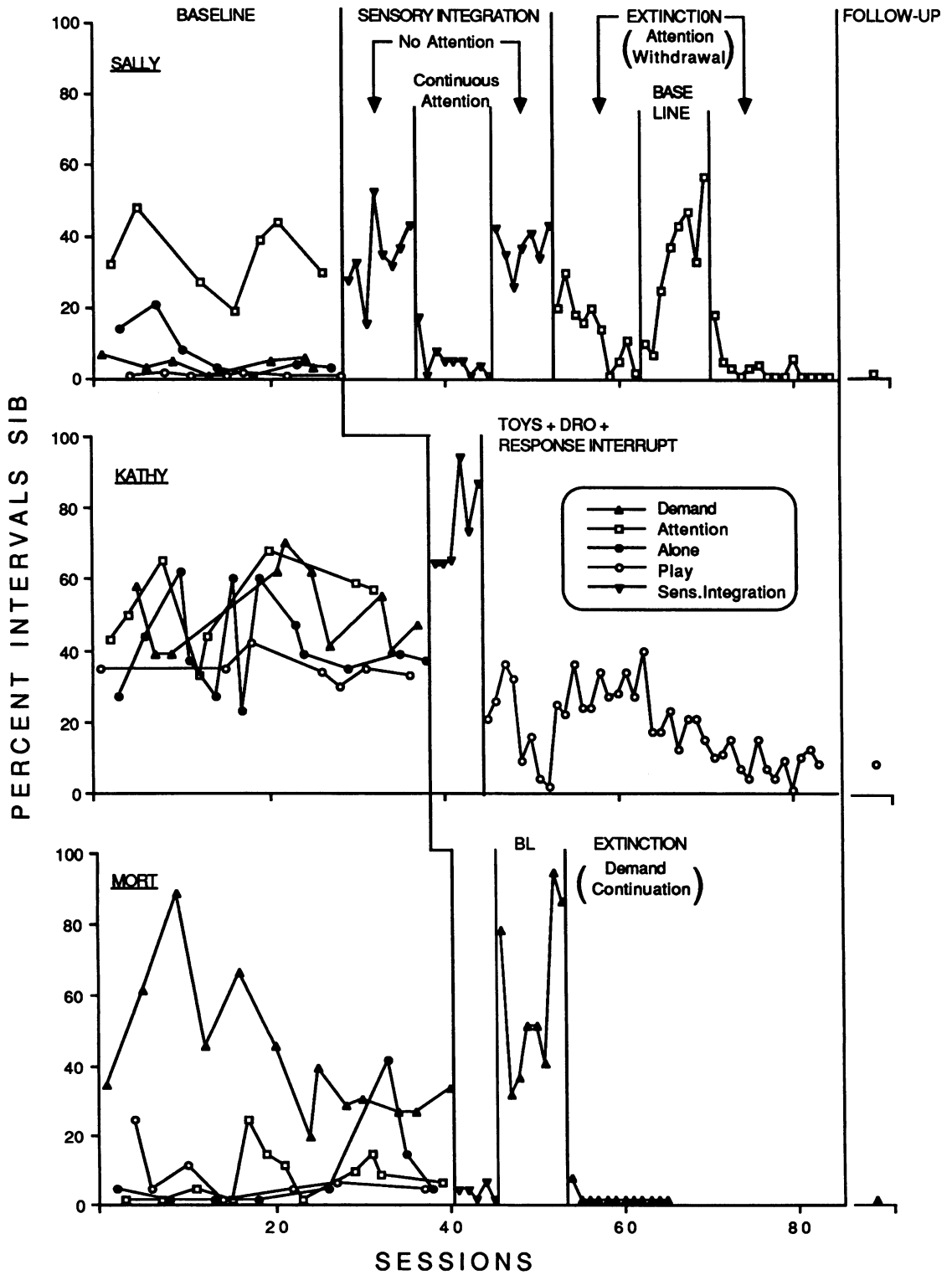

Figure 1. Percentage of 10-s intervals of SIB exhibited by Sally, Kathy, and Mort during baseline assessment, sensory-integration therapy, and behavioral treatment.

mands was a motivational factor), suggests that neither positive nor negative reinforcement were maintaining variables for Kathy's SIB. The most plausible explanation is that her SIB was stereotyped in nature (Baumeister, 1978) and unrelated to any of the events that were manipulated during baseline conditions.

Kathy's SIB actually got worse during sensory-integration sessions, increasing to a level higher than that observed during any of her baseline conditions. Although this conclusion is based on data obtained during only six sessions of treatment, the trend was rather clear. In addition, it is unlikely that extended application of sensory integration would have produced different results because, as Bright et al. (1981) predicted, the reductions in SIB demonstrated in later studies using sensory integration (Dura et al., 1988; Wells & Smith, 1983) were immediate. Thus, Kathy's results were not consistent with findings from previous studies on sensory-integrative therapy and were surprising in light of her baseline data, which indicated that she would be a "positive responder."

When access to toys, reinforcement, and response interruption were implemented with Kathy, an immediate reduction was seen in her SIB compared to the preceding condition (sensory-integrative therapy). During subsequent sessions, as she began to manipulate the toys more frequently, her SIB gradually decreased further. These results are consistent with those presented by Favell, McGimsey, and Schell (1982), who found with some subjects that it was necessary to supplement a toy-available condition with explicit reinforcement and interruption procedures. In Kathy's case, the effects of these supplementary interventions were unclear. Because her SIB continued in a downward trend throughout the final condition (which ended when she was no longer available for participation in the study), we were unable to evaluate the relative effects of the different components of her treatment.

Mort

SIB occurred reliably in the demand condition during baseline and much less frequently in the attention, alone, and play conditions, suggesting that the temporary removal of academic tasks (escape) served as negative reinforcement for Mort's SIB. During sensory-integration sessions, SIB occurred at low levels comparable to those observed during baseline conditions in which demands were not presented (e.g., play). Mort's SIB increased when baseline demand contingencies were reinstated and decreased to zero during the final condition, when the therapist continued to present demands independent of Mort's behavior and did not allow him to escape by engaging in SIB.

Follow-Up

At the end of Phase 3, a maintenance/generalization program was designed and implemented for each subject. The general approach involved training other therapist and caretakers (parents, teachers, etc.) in the use of interventions in effect during Phase 3 through written instructions, demonstration, and supervised practice, and thinning the reinforcement schedules for Sally and Kathy. Periodic follow-up and observation were then conducted either at the clinic (Kathy and Mort) or at the subject's regular school (Sally). Data collected at the end of the 6-month follow-up period indicated that Sally's and Mort's SIB remained at 0% and that Kathy's SIB occurred at a level equivalent to that obtained at the end of Phase 3 (8%).

DISCUSSION

The results of several studies (Bright et al., 1981; Dura et al., 1988; Lemke, 1974; Wells & Smith, 1983) have indicated that sensory-integrative therapy might be a promising treatment for SIB. This conclusion, however, is not based on data collected using adequate experimental techniques. Only Dura et al. used appropriate measurement procedures and attempted to control for coincidental effects of intervention. A closer examination of the existing research, in light of the theoretical basis for sensory-integrative therapy and variables known to maintain SIB, suggested the need for additional subject-selection and control procedures. When these procedures were incorporated into the present study, the data obtained during sensory-integrative ther-

apy were paradoxical for 1 subject and artifactual for the other 2. These results extend previous research on SIB in several ways and raise important questions about the effectiveness of sensory-integrative therapy as a specific treatment for this disorder.

First, this study further demonstrates the utility of assessment procedures that identify the functional properties of behavior disorders. Data obtained during baseline provided a means of selecting individuals whose SIB might be affected by sensory-integrative therapy in different ways. More specifically, the baseline allowed us to identify 1 subject whose SIB was not maintained by environmental events. Kathy's behavior most clearly met the definition for stereotypic or self-stimulatory responding, and it is this function of SIB for which sensory-integrative therapy reportedly was designed. Additionally, we were able to identify two individuals (Sally and Mort) whose SIB was maintained by environmental events; their inclusion in the study allowed us to examine the effects of additional control procedures.

Second, the results obtained during sensory-integrative therapy were not consistent with previous findings and/or reflected the influence of confounding variables. Based on previous research and data obtained during baseline, we expected to see a marked reduction in Kathy's SIB; instead, her behavior got worse. A number of hypotheses are suggested by her negative results; one is based on the relationship between her SIB and type of stimulation provided during sensory-integration sessions. Previous research has shown that noncontingent stimulation related to that produced by stereotypic SIB can suppress responding. For example, Bailey and Meyerson (1970) used vibratory stimulation with an individual who banged his head, and Favell, McGimsey, and Schell (1982) provided visual toys to an individual who engaged in eye poking and popcorn to an individual who exhibited pica. These types of stimulation apparently were similar to that produced by the subjects' SIB and alleviated a condition of deprivation. In the present study, the stimulation provided to Kathy during sensory-integration sessions was not closely related to her target behaviors (primarily hand mouthing and biting), whereas the toys provided during her final treatment condition were such that toy manipulation may have competed with SIB. Thus, the effects of sensory-integration therapy might be solely a function of competing stimulation; the more varied the stimulation, the more likely it is to accommodate the specific topography of the SIB. This interpretation of the differences in Kathy's SIB during these two conditions is a tentative one because other treatment components—DRO and response interruption—were included. In the absence of further manipulations to determine why Kathy's SIB responded in a countertherapeutic direction during sensory-integration therapy, no conclusive explanation for her results can be offered at this time. At best, we can describe the effects seen with Kathy as paradoxical in that they were unexpected, given previous data.

The results obtained for Sally and Mort raise a different question: What features of sensory-integration therapy affect SIB that is related to attention (positive reinforcement) and escape (negative reinforcement)? In Sally's case, the effects of sensory integration with and without attention identified an artifactual component in previous research on sensory-integrative therapy. All of the studies conducted to date included noncontingent social stimulation, ranging from continuous physical contact to multiple forms of physical and social interaction, as part of the treatment process. The Dura et al. (1988) study, the only one to include an attention control, compared the effects of *continuous* attention plus sensory integration versus *intermittent* attention without sensory integration. Thus, it is possible that schedule effects alone might account for the differences they obtained. The extent to which observed behavior change in previous studies was a function of attention per se is unknown, because the functional properties of subjects' SIB were not identified. Nevertheless, for individuals whose SIB is attention motivated, results obtained for Sally indicate that the confounding effects of attention may be misinterpreted as therapeutic benefit derived from sensory-integrative therapy.

Another feature of sensory-integrative therapy—

reduced demands—may eliminate aversive events that occasion escape behavior. Demand reduction was a certainty for Mort in the present study because sensory integration was automated, and no interaction occurred between him and the therapist. A more convincing demonstration of this effect would have been possible had we included a condition in which demands were issued during Mort's sensory-integration sessions, but his time-limited availability precluded the addition of extra conditions. A comparison of his data during sensory-integration and baseline sessions, however, supports the conclusion that Mort's SIB was likely to be low in any condition in which demands were absent.

A third contribution of the present study can be found in Phase 3, in which behavioral interventions were selected on the basis of subjects' assessment results. The data for Sally and Mort are particularly interesting in that they exemplify a critical difference between extinction procedures applied to behavior maintained by positive versus negative reinforcement. Repp, Felce, and Barton (1988) recently used both types of extinction with 1 subject whose SIB was escape motivated and found that only the escape extinction was effective. In the present study, we also used both types of extinction. Sally received attention extinction, whereas Mort received escape extinction; each was effective when applied to the appropriate function of SIB, which was identified during baseline.

The present study also contained several problems that limit the generality of our conclusions. Because Sally, Kathy, and Mort exhibited such different patterns of SIB during the assessment baseline, the study was, in a sense, comprised of three separate experiments, each containing 1 subject. The results obtained during sensory-integrative therapy, however, cannot be considered any less valid than those reported previously. Three of the four previous studies (Bright et al., 1981; Lemke, 1974; Dura et al., 1988) were single-case reports, and only one of the four (Dura et al.) demonstrated experimental control. Viewed solely as an investigation of the effects of sensory-integrative therapy (i.e., independent of subjects' assessment data and other manipulations), the present study involved systematic implementation of treatment in a multiple baseline design and showed positive results with only 1 subject (Mort). The additional manipulations undertaken to clarify the effects observed during the sensory-integration condition would have been strengthened by including additional subjects.

Another limitation is the degree of experimental control shown over implementation of the behavioral interventions. Because no two procedures were the same, there was no direct replication across subjects, although Sally's treatment did include a reversal condition. Limitations in subject availability did not allow us to conduct reversals for Kathy and Mort, which would have improved the final phase of the study. Nevertheless, the different experimental sequences to which subjects were exposed, as well as the introduction of treatment at different times, make it unlikely that the results obtained for Sally, Kathy, and Mort were simply due to maturation, sequence, time, or some other confounding variable.

In spite of these limitations, the present study and that of Dura et al. (1988) are the first experiments to provide controlled data in response to the following questions about sensory-integrative therapy: (a) What are its effects as a treatment for SIB? (b) Assuming that there is some therapeutic impact, is it limited to the stereotypic function of SIB for which sensory-integrative therapy was designed? (c) What are the active components of therapy? (d) How would these components affect SIB that is maintained by environmental events? The answers that we have provided are tentative but suggest that sensory-integrative therapy is not generally effective as treatment for SIB (Question a) and that its selective effects with stereotypic SIB may depend upon the relationship between response topography and the type of stimulation provided during treatment (Question b). Moreover, several of its components (i.e., increased attention and reduced demands), when applied to environmentally maintained SIB, may affect the behavior in a manner that is misleading unless the components of intervention, as well as the operant features of the SIB, are identified (Questions c and d). More definitive answers to these questions must await fur-

ther research that extends and improves methodology in the areas of subject selection, assessment of behavioral function, and component analysis.

REFERENCES

Ayres, A. J. (1972). *Sensory integration and learning disorders.* Los Angeles: Western Psychological Services.

Ayres, A. J. (1974). *The development of sensory integrative theory and practice.* Dubuque, IA: Kendall/Hunt.

Bailey, J., & Meyerson, L. (1970). Effect of vibratory stimulation on a retardate's self-injurious behavior. *Psychological Aspects of Disability,* **17,** 133–137.

Baumeister, A. A. (1978). The origins and control of stereotpyed behavior. In C. E. Meyers (Ed.), *Quality of life in severely and profoundly mentally retarded people* (pp. 353–384). Washington, DC: American Association on Mental Deficiency.

Baumeister, A. A., & Rollings, J. P. (1976). Self-injurious behavior. In N. R. Ellis (Ed.), *International review of research in mental retardation* (Vol. 8, pp. 1–34). New York: Academic Press.

Bright, T., Bittick, K., & Fleeman, B. (1981). Reduction of self-injurious behavior using sensory integrative techniques. *American Journal of Occupational Therapy,* **35,** 167–172.

Dura, J. R., Mulick, J. A., & Hammer, D. (1988). Rapid clinical evaluation of sensory integrative therapy for self-injurious behavior. *Mental Retardation,* **26,** 83–87.

Favell, J. E., Azrin, N. H., Baumeister, A. A., Carr, E. G., Dorsey, M. F., Forehand, R., Foxx, R. M., Lovaas, O. I., Rincover, A., Risley, T. R., Romanczyk, R. G., Russo, D. C., Schroeder, S. R., & Solnick, J. V. (1982). The treatment of self-injurious behavior. *Behavior Therapy,* **13,** 529–554.

Favell, J. E., McGimsey, J. F., & Schell, R. M. (1982). Treatment of self-injury by providing alternative sensory activities. *Analysis and Intervention in Developmental Disabilities,* **2,** 83–104.

Iwata, B. A., Dorsey, M. F., Slifer, K. J., Bauman, K. E., & Richman, G. S. (1982). Toward a functional analysis of self-injury. *Analysis and Intervention in Developmental Disabilities,* **2,** 3–20.

Iwata, B. A., Pace, G. M., Kalsher, M. J., Cowdery, G. E., & Cataldo, M. F. (1990). Experimental analysis and extinction of self-injurious escape behavior. *Journal of Applied Behavior Analysis,* **23,** 11–27.

Johnson, W. L., & Baumeister, A. A. (1978). Self-injurious behavior: A review and analysis of methodological details of published studies. *Behavior Modification,* **2,** 465–487.

Lemke, H. (1974). Self-abusive behavior in the mentally retarded. *American Journal of Occupational Therapy,* **28,** 94–97.

Norton, V. (1975). Neurodevelopmental and sensory integration for the profoundly retarded multiply handicapped child. *American Journal of Occupational Therapy,* **29,** 93–100.

Repp, A. C., Felce, D., & Barton, L. E. (1988). Basing the treatment of stereotypic and self-injurious behaviors on hypotheses of their causes. *Journal of Applied Behavior Analysis,* **21,** 281–289.

Rincover, A., & Devaney, J. (1982). The application of sensory extinction procedures to self-injury. *Analysis and Intervention in Developmental Disabilities,* **2,** 67–81.

Sidman, M. (1960). *Tactics of scientific research.* New York: Basic Books.

Ulman, J. D., & Sulzer-Azaroff, B. (1975). Multielement baseline design in educational research. In E. Ramp & G. Semb (Eds.), *Behavior analysis: Areas of research* and application (pp. 359–376). Englewood Cliffs, NJ: Prentice-Hall.

Wells, M., & Smith, D. W. (1983). Reduction of self-injurious behavior of mentally retarded persons using sensory integrative techniques. *American Journal of Mental Deficiency,* **87,** 664–666.

Received August 7, 1989
Initial editorial decision October 6, 1989
Revision received January 11, 1990
Final acceptance March 6, 1990
Action Editor, David P. Wacker