Reduction of Self-Injurious Behavior Using Sensory Integrative Techniques

Theoretical rationale and case study information are presented for the use of a sensory integrative approach to self-injurious behavior. The program described uses sensory integrative techniques and soft restraint to reduce face hitting in a 28-year-old, nonambulatory, profoundly retarded resident. The noncontingent application of the procedures has reduced the occurrence of self-injurious behavior during treatment periods from an average of 13.1 responses per minute to an average of 1.02 responses per minute.

Self-injurious behavior (SIB) is one of the most common and perplexing problems facing therapists treating the mentally retarded. Literature on SIB indicates two major approaches to its etiology and treatment. The assumption that SIB is a learned behavior, appropriately treated with contingency management techniques, has been commonly used and has met with some well-documented, though incomplete success (1-3). A second approach is based on the conceptualization of SIB as a form of self-stimulatory behavior and thus supports the use of various forms of sensory and environmental enrichment as treatment (4-7). This self-stimulatory model, while less refined in its theory and technology, appears to offer a viable alternative to the behavioral approach for some SIB clients.

Review of the Literature

One major theoretical position found in the literature relates the etiology of SIB to reduced quality or quantity of environmental stimuli. Berkson and Mason (4) and Berkson and Davenport (5) studied stereotypic behavior, including SIB, of mentally retarded clients, and found stereotypic behavior positively correlated with self-manipulation and inversely related to frequency of manipulation of the environment. They found the more restrictive (i.e., less stimulating) the environment, the higher the level of stereotypic behavior. They concluded that, "the results of the correlational analysis are consistent with the view that stereotyped behaviors are self-stimulatory in character" (3, p. 852). This view that stereotypic behavior and SIB in mentally retarded clients is basically self-stimulatory is shared.
by Cleland and Clark (6), Hollis (7), Kulka, Fry, and Goldstein (8), and others.

Several studies have indicated that delayed acquisition of developmental skills, as well as development of stereotypic behavior and SIB, results from the lack of stimulation available to institutionalized clients (9-11). Yarrow also suggests that the negative effects of maternal deprivation are primarily attributable to decreased stimulation provided to the neonate.

Numerous investigators have explored the effects of sensory restriction on the developmental processes of infra-human subjects. Melzack (12), and Melzack and Burns (13) found that dogs raised in an environment that restricted visual stimuli had decreased ability to perform simple visual discriminations. They also found that sensory restriction resulted in “frequent failure to perceive noxious stimuli” (12, p 978) such as pin pricks and a lighted match touched to the nose. The dogs were often reported to engage in head banging and in a high frequency of rigid stereotyped behaviors. It was suggested that early deprivation in one sensory modality, in this case visual stimuli, may affect perception in other sensory modalities. In addition, it was proposed that these effects resulted from a disruption of central nervous system mechanisms relating to arousal functions which “underlie perceptual discrimination and adaptive responses” (15, p 164). Kubałsky and Leiderman (14) cited studies by Hebb and Reisen showing similar results, most of which indicated that experimental animals reared in isolation were found to be notably deficient in activity, social relatedness, and response to pain.

Davenport and Menzel (15) report development of stereotypic behaviors and SIB in chimpanzees raised in restricted environments. Head banging, eye poking, and posturing were observed as common in the restricted group and rare in animals raised in enriched environments or in the wild. The stereotypes were found in nearly all laboratory-reared chimps. The behavior persisted into adulthood even after the animals were returned to an enriched outdoor colony. The authors related development of stereotyped behavior, which included SIB, to the absence or insufficient quantity of stimulation. They also pointed out a resemblance of behaviors seen in these chimpanzees to behaviors frequently observed in the mentally retarded.

Levin and Alpert (16) studied the development of central nervous system (CNS) functions in rats. By measuring cholesterol levels, which are felt to be a reliable index of myelination, they indicated that increased stimulation accelerates myelination, while lack of stimulation delays the myelination process. Meisami (17) studied sensory influences on the development of anatomical structures and neurochemical substances of the brain. It was shown that changes in cortical thickness, size of neuronal nuclei, dendrite proliferation, and thickness of myelination of nerve fibers all depend on afferent input during early postnatal development. Lack of stimulation in early periods of development was also found to impair development of nucleic acids, adenosine triphosphatase, and other brain enzymes. Meisami (17) and Mendel (18) found that altered sensory environments resulted in biochemical changes in the cortex, medulla, limbic system, and hippocampus. Their study suggests that biochemical changes, as well as anatomical changes, are related to environmental experience and are important factors in brain development and behavior.

Studies of effects of sensory deprivation in adults have also demonstrated notable behavioral and physiological changes. Most studies identify some disturbance in perceptual processes following sensory deprivation (19-21). Heron stated that “nearly all subjects reported gross disturbances in visual perception” (22, p 20). His finding of changes in EEG activity “strongly suggests that . . . mechanisms that are responsible for regulating electrical activity of the brain are affected” (p 29). He felt that reduced sensory input into the reticular activating system disrupted the “normal relationship between this system and the rest of the brain” (p 30). This disruption is described as a “change in the integrated activity of the systems” (p 32).

Melzack (12), Melzack and Burns (13), and Zubeck (20-21) document similar findings of changes in electrical activity and suggest that the ascending reticular activating system is involved in these changes. Zubeck found the degree of restriction of motor activity to be the most important variable in producing behavioral and EEG changes. The importance of the reticular activating system as the location for neurophysiological changes resulting from sensory deprivation is also supported by Casler (9) and Lindsey (23). Some authors also implicate the hypothalamic structures as being involved in such changes (9, 14).

In summary, the above literature consistently suggests that: 1. decreased sensory stimulation results in neurophysiological change in the central nervous system; and 2. decreased sensory stimulation is an important factor in the development of SIB.
ment from the child, and lack of parental education regarding need for and methods of stimulation are factors that disturb normal patterns of parent-child interaction and stimulation. Finally, many clients have been institutionalized for long periods of time. Each of these factors has been cited in the literature on sensory deprivation and SIB as significantly restricting sensory stimulation (9-12, 15). It is therefore suggested that the client who has experienced a combination of several or all of these factors would be experiencing a sensory deprivation, or at least a sensory restriction, condition. This initial phase of the etiological hypothesis can be diagrammed as follows: CNS damage $\Rightarrow$ physical and cognitive dysfunction, and possible impairment of sensory function $\Rightarrow$ decrease in mobility and ability to interact with environment + altered parent-child interaction + institutionalization $\Rightarrow$ sensory deprivation.

This condition of sensory deprivation has often been cited as one of the primary factors in the development of SIB. On this basis treatment techniques have been aimed at providing an environment that contains a normal quantity and variety of stimuli (24). Such an atmosphere was hypothesized to remove the sensory deprivation, relieve the stimulus hunger and thereby reduce the SIB. While in general agreement with the basic philosophy of this approach, we believe that it fails to adequately take into account the neurophysiological effects of sensory deprivation. The literature indicates that in the condition of sensory deprivation there is a breakdown in the sensory integrative functions of the CNS that decreases the clients' ability to process normal environmental stimuli in a meaningful fashion (12-14, 16-18, 20-22).

**Treatment Hypothesis**

The clients for whom sensory integrative treatment of SIB is proposed are severely physically and cognitively handicapped, and thus limited in both their physical mobility and their ability to explore and interact with the environment. They have some original CNS dysfunction (e.g., cerebral palsy) that is basic to the physical and cognitive delays and that may also involve dysfunction in one or more of the specific sensory systems such as impaired vision, hearing, or tactile perception. In many instances opportunities for stimulation have been decreased since birth. Guilt, fear of handling the physically disabled child, lack of response or reinforce-
We believe that this breakdown in processing functions and the resulting distortion of perceptual input magnifies the sensory deprivation and creates a situation in which normal environmental stimuli, even if made available, are inadequately processed. Studies indicating that animals raised in restrictive environments persisted in their stereotypic and self-injurious behavior even after being returned to an enriched environment, appear to support this view (15). Thus it follows that normally noxious stimuli, the SIB, become the clients' method of providing some form of self-stimulation.

The complete form of the etiological process can be stated as follows:

Conditions causing inadequate stimulation (cited previously) — sensory deprivation — breakdown in CNS ability to process sensory stimuli — further deprivation, perceptual distortion and stimulus hunger — SIB.

If the breakdown in processing or integrative functions is an important factor in the etiology of SIB, then treatment procedures should be aimed at providing stimuli of an appropriate quality and type to have an organizational effect on the subcortical processing mechanism of the central nervous system. Sensory integration techniques, by definition, provide this controlled sensory input, facilitate organization and interpretation of these stimuli, and elicit adaptive responses.

Sensory integrative treatment techniques, as described by Ayres (25), have been developed and primarily used with learning-disabled clients. Ayres feels that "sensory integration, or the ability to organize sensory information for use, can be improved through controlling [sensory] input to activate brain mechanisms" (p 1). In the learning-disabled child, Ayres suggests that enhancement of the sensory integrative process through treatment facilitates academic learning. "The objective is modification of the neurological dysfunction ..." (p 2)

In the SIB client there appears to be a similar breakdown in the ability to organize and use sensory information. The literature indicating breakdown in neurological function suggests that the sensory integrative approach with its focus on neurological processes may be applicable to SIB populations. As improvement in integrative functions is hypothesized to give the learning-disabled child the capacity for academic learning, similar activation of processing mechanisms should also develop in the SIB client the ability to appropriately integrate and use environmental stimuli and thereby decrease SIB.

In the use of sensory integrative techniques in the treatment of SIB, the following sequence of results is predicted:

1. The stimuli provided will have sufficient impact on the client to temporarily satisfy the stimulus hunger, resulting in reduction of the rate of SIB during treatment sessions. These results should be expected to begin in early treatment sessions but with little immediate generalization to nontreatment periods.

2. The stimuli provided will have an organizing effect on the CNS processing functions, that is, sensory integrative processes, enabling the client to more adequately interpret stimuli from the environment (assuming the environment is no longer deficient in assessable stimuli). There is, therefore, a decrease in unmet stimulus needs during nontreatment periods, providing gradual reduction of SIB and generalization of treatment throughout the day.

**Method**

**Subject.** The subject, who is both nonambulatory and nonverbal, is a 28-year-old, profoundly retarded male with a diagnosis of cretinism and a seizure disorder. According to the Vineland Social Maturity Scale, he functions at a five-month level. Reference to self-injurious behavior was made as early as 10 years of age. Since his admission to this facility at 14 years of age, numerous behavioral programs (differential reinforcement of other behaviors, differential reinforcement of incompatible behaviors, positive practice overcorrection) had been attempted without success. Further evaluation indicated the possibility of SIB being emitted as a form of self-stimulation rather than as a means of seeking attention. The rate of SIB remained essentially the same, with or without the presence of staff, and the behavior appeared to decrease when tactile and vestibular stimulation were applied. Because of the nature of the behavior, unless one-to-one contact from staff was provided, the subject was physically restrained through Velcro straps attached to the table top of the wheelchair. The behavior consisted of chin hits with the fists, forehead hits with the fists, and ear pokes with the finger tips.

**Procedure.** A sensory integration treatment regime was designed to decrease the self-injurious behavior. The program, run once a day for approximately one hour, concentrated heavily on slow, rhythmic vestibular and firm but light tactile stimulation in attempts to provide an organizational effect on the subcortical processing mechanisms of the CNS. Auditory and visual stimuli, soft music and dimmed lighting, were used to provide a consistent organized environment. The treatment techniques were applied noncontingently, during daily 50-
minute sessions, which included 30 minutes of treatment and 20 minutes of rest breaks. During the sessions, foam sleeves that extended from the upper arm to the finger tips were applied to cushion the SIB, but not to prevent the behavior from occurring. Each treatment regime began with a 5-minute pre-test and ended with a 5-minute post-test. During these tests, the subject was placed on his or her back on a bean bag and left without staff attention. A 5-minute break between each of the three treatment techniques was also provided in this manner. The first technique used reached the coccyx, the other hand began at the neck, therefore providing continual stimulation to the subject. Stroking was done in a firm but light manner for 3 minutes. The final treatment procedure consisted of the trainer holding the subject in a rocking chair for 15 minutes and slowly rocking. This technique provided excellent opportunities for social interaction between the staff member and the subject. Although the subject was initially placed with his head on the trainer’s left arm and his legs under the trainer’s right arm, he was allowed to choose a comfortable position.

Figure 3 Percent of time per month free from restraint

![Graph showing percent of time per month free from restraint]

was gentle rocking of the subject in a hammock for 10 minutes. Slow stroking of the dorsal primary rami was the next treatment administered. For this technique the subject was placed in prone position on a bean bag. Using the first and second finger of each hand, the trainer began at the base of the neck and stroked slowly to the coccyx. As one hand

Results
Since this intervention was the last effort of the interdisciplinary team before the application of more severe means of reducing the behavior, no formal baseline level was established. Data collection was done in two ways. First, event recording by a single observer was done during treatment sessions and converted to average responses per minute for the session. On a monthly basis, the number of hits was divided by the total time in sessions to give the average response per minute for all of the treatment sessions for the month. A second means of evaluation was the amount of time free from physical restraint within the living environment. This was accomplished by ward personnel recording the time placed in restraint and the time removed from restraint.

As can be seen in Figure 1, the response level during the treatment sessions varied widely. However, a general downward trend is noted. As treatment progressed, the rate of responses became much more stable. The average for the first month was 13.1 responses per minute with a range of 26.1 to 0.84 responses per minute (SD = 6.4). By the fifth month of treatment, the average rate for the month was 1.02 responses per minute with a range of 2.0 to 0.74 responses per minute (SD = .47). The general slope of decline as well as the stabilization of the responses is very clearly indicated in Figure 2.

Attempts were made during the treatment sessions to differentiate between hard hits (those which lead to tissue damage) and soft blows (those which were nondamaging). Although no reliability could be established, subjective judgments of the observer indicated a reduction from about 75 percent to 10 to 15 percent hard blows. The hash marks seen in Figure 1 between treatment session 69 and treatment session 70 indicate a period of 13 days in which no treatment occurred. As shown in Figure 3, the percent of time spent free from any restraint remained stable until the beginning of the fifth month. At this point, the time the subject was free from restraint began to increase from an
average of 36 percent to 61 percent of each day.

Discussion

The results of this case study did follow the pattern predicted. Decrease in the rate of SIB was evident during early treatment sessions with monthly averages declining steadily. Both subjective observation and the objective records of percentage of time out of restraint indicate that generalization of results to non-treatment time, as predicted, did not begin immediately but did occur in a significant manner after the fourth month of treatment. We consider this initial latency period for generalization an important factor that is consistent with the hypotheses presented.

The intervention program described in the case study was used as the last effort of the interdisciplinary team before application of more severe means of reducing the behavior (aversive stimulation). The authors were constrained in design of the program by the need to produce positive treatment results within a severely limited time period. There are, therefore, numerous recognized weaknesses in design, including lack of controlled baseline data, or reversal procedure. There are numerous uncontrolled variables of which staff attention is perhaps the most critical. Since previous contingency management programs had provided similar quantities of attention without appreciable results, it appears that the type or quality of attention and interaction inherent in these treatment procedures is most worthy of analysis.

The results indicate potential value in the treatment procedure and suggest that further study is warranted. Such study is needed to provide confirmation of results on other SIB clients with similar histories as the subject of this case study, to explore and analyze the effects of the variables mentioned above, and to determine whether these procedures will be effective with less severe, similar behavior (i.e., non-self-injurious stereotypes). The establishment of such parameters identifying effectively treated populations and the development of reliable means of selecting candidates for this type of treatment are seen as important steps in the potential development of a promising idea into an effective clinical tool.

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