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# Positive Side Effects in the Treatment of SIB Using the Self-Injurious Behavior Inhibiting System (SIBIS): Implications for Operant and Biochemical Explanations of SIB

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*The rate of self injurious head hitting was reduced using contingent electric shock delivered via the Self Injurious Behavior Inhibiting System (SIBIS) Positive side effects indicating an improved affective state and increased interaction with the environment were documented Treatment gains were maintained at a 1-year follow-up assessment The consistent reports of positive affective side effects from successful treatment studies using SIBIS and contingent electric shock are noted Implications for current operant based theories of SIB based on the communication function of SIB and endogenous opiate mechanisms are discussed*

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Head hitting is the most common form of self-injurious behavior (SIB) occurring in individuals with mental retardation/developmental disabilities (Johnson & Day, 1992) It has also proven to be one of the most difficult behaviors to treat (National Institutes of Health, 1989) Numerous behavioral and pharmacological methods have been utilized with, at best, mixed success In some individuals, the severity or nature of the SIB can result in serious medical complications, including death (Meinhold & Mulick, 1992) In these cases, a rapidly effective behavioral procedure and physical or pharmacological restraint are the only short-term treatment options Operant punishment procedures can rapidly suppress SIB in some cases (Favell et al , 1982, Linscheid, Iwata, Rickets, Williams, & Griffin, 1990)

Despite anecdotal reports to the contrary, the belief persists that punishment procedures in general, and electric shock in particular, produce numerous negative side effects (cf , Smith, 1990) Some have even suggested that the emotional side effects of punishment may decrease its effectiveness For example, Meyer and Evans (1989) write

> Punishment that is very distressing to the person and/or painful — such as isolation or slapping or shocking the person — may produce other emotional responses like anxiety stress crying attempts to escape or strike back A person who is in pain or feeling a great deal of anxiety may not be able to pay attention to the message of punishment and punishment sometimes creates side effects that might be even more serious than the original behavior (p 101)

However, research does not support these conclusions

Reports of treatment with contingent electric shock often include anecdotal descriptions of side effects and, despite the widely held assumptions, generally suggest more positive than negative side effects by a wide margin (Carr & Lovaas, 1983, Lichstein & Schreibman, 1976) Linscheid et al (1990) documented almost immediate decreases in distressed vocalizations and increases in positive affect in an individual who was treated with contingent electric shock using the Self-Injurious Behavior Inhibiting System (SIBIS) In addition, positive side effects were noted for all five individuals treated in that study Barrera, Teodoro, and Labadine (1989) also documented positive side effects, most notably, increases in self-initiated interactions in an individual treated with SIBIS Anderson (1992) reported increases in positive affect in the form of smiling, hand clapping and vocalizations and reductions in negative affect defined as crying and distressed vocalizations as early as the second day of treatment in a 10-year-old girl successfully treated with SIBIS Ricketts, Goza and Matese (1992) reported increased indicators of a positive affective state (smiling happy vocalizations) and less distressed vocalization in an individual during treatment with contingent electric shock compared to periods when shock was not used Most recently Williams Kirkpatrick-Sanchez, and Iwata (1993) documented positive side effects in an individual treated with the "Hot Shot" device which uses a shock intensity much higher than that employed by SIBIS. Of significance is the fact that these positive side effects begin almost with the onset of treatment.

Although there are exceptions (e.g., Romancyzk & Goren, 1975), it appears that widely held suppositions regarding the preponderance of negative side effects of contingent electric shock treatment may be inaccurate because there appears to be more scientifically sound evidence that the opposite is true. This report documents numerous positive side effects observed early in the successful treatment of SIB using contingent electric shock administered via SIBIS.

## SUBJECT

Stan was an 8-year-old nonambulatory, nonverbal boy with a diagnosis of microcephaly, cerebral palsy (CP), and severe/profound mental retardation. He had a ventricular peritoneal (VP) shunt placed soon after birth to prevent brain damage secondary to hydrocephalus. Stan was referred for treatment with SIBIS by his neurosurgeon because of concern that his increasing head hitting would result in damage to his shunt. If the shunt was rendered inoperable by a blow to the head, further brain damage could occur and, if undetected, could cause death. Because Stan and his parents lived several hours from the acute care hospital where Stan was treated, an extended analog functional analysis was not conducted. Observation of Stan and questioning of his parents suggested that the SIB was multiply determined. It occurred at roughly similar rates when Stan was left alone and when he was with parents or others and did not seem to escalate in escape or demand situations. Rates were not affected by constant attention. Parents were informed of the numerous treatment options available to them but chose, on the basis of advice from Stan's neurosurgeon, treatment with SIBIS because of its potential for rapid decrease of the SIB and its automated features. Previous programs of blocking and redirecting and ignoring the SIB at school and at home had proven ineffective by parent report. No other punishment program had been attempted. At the time of treatment, Stan frequently needed arm splints to prevent him from hitting his head. These were worn in school and when his mother could no longer physically prevent the blows. However, they interfered with the use of his hands and arms.

## PROCEDURE

SIBIS is a device designed to provide a brief electrical stimulation contingent upon an automatically detected blow to the head. There are two components, a sensor module that the client wears on the head and a stimulus module usually worn on the leg When the sensor module detects a blow to the head, a radio signal is sent to the stimulus module, and a 200-ms, 3 5 mA electrical charge at 85 volts is administered to the leg (for a more detailed description of the device see Linscheid et al , 1990)

### *Design*

The effectiveness of SIBIS was assessed using a single subject reversal design with the following conditions Prior to admission for treatment, Stan was on medications for seizures, agitation, and gastroesophageal reflux No changes in these medications were made during baseline or treatment conditions

*Baseline* Stan was observed continuously with instructions to his mother to react to his SIB in her usual manner This involved blocking his blows, holding him on her lap, and occasionally placing him on his stomach in bed No physical or pharmacological restraints were used

*SIBIS — No Shock* This control condition was used to determine the effect of wearing SIBIS without the delivery of the electric shock

*SIBIS — Shock* During this condition, SIBIS was activated and automatically delivered a 200-ms shock (3 5 mA) when a head hit was detected by the sensor module

Stan was observed and treated in his hospital room for periods ranging from approximately 2 h to 6 h each day for 5 consecutive days (total = 22 8 h) During all conditions, Stan was seated in his wheelchair/stroller on his mother's lap, or in his hospital bed Videotapes supplied by his mother and judged to be his favorites were played almost constantly during the observation periods, and interactive toys (e g , electronic voice teaching toys) were on his bed or within his reach at all times His mother periodically encouraged him to interact with the toys or watch his videotapes

### *Assessment*

The target behavior, head hitting, and other behaviors representing Stan s affective state and interaction with the environment, defined here, were recorded by trained observers

- Head hit Any forceful contact by the hand directed at the head
- Laugh Any audible, nonverbal sound recognizable as laughter
- Smile A noticeable upturning of the corners of the mouth suggesting a positive affective state

- "Doggie" A word spoken by Stan and suggestive of a happy, contented mood, as reported by his mother
- Self-initiated toy play Any self-initiated physical contact with a toy or play object
- Cry Any audible sound indicating distress accompanied with tears or a sad or pained expression
- Self-stimulation A characteristic, repetitive behavior consisting of lightly rubbing an object (e g , comb) across his face or head By mother's report, this occurred when Stan was relaxed and happy

Head hits were recorded live by simple frequency counts recorded in consecutive 10-min periods Two observers independently counted head hits on six different occasions representing approximately 15% of the entire observation time across the 5 days Reliability as defined by percent agreement (smaller count/larger count × 100) was above 90% overall and in all samples Other behaviors were scored by two trained observers using a 10-s partial interval scoring system from videotapes covering the entire time of treatment Interobserver reliability was above 90% for all behaviors Due to a malfunction of the audio portion of the videotapes or due to Stan s position in relation to the camera, not all behaviors could be scored for all intervals This occurred exclusively during initial baseline sessions

## RESULTS

Data on rate of head hitting are presented in consecutive 10-min intervals covering the entire 5 days of the study (see Fig 1) It can be seen that head hits ranged between 0 and 120 per 10-min period during the initial baseline The SIBIS — No Shock condition produced no major change in the rate of head hits, but a rapid suppression of head hitting occurred during the SIBIS — Shock condition Returning to both the Baseline and SIBIS — No Shock conditions resulted in rapid escalation of the head hitting behavior

Data on behaviors indicative of affective state are summarized as percent intervals scored for each behavior for each of the separate conditions (See Fig 2) The behaviors, Laugh, Smile "Doggie," Self-Initiated Toy Play, and Self-Stimulation were felt to be indicative of positive side effects because they suggested either a positive affective state or increased interaction with the environment All of these behaviors increased from baseline levels during treatment with SIBIS Cry as a behavior showed little change across the various conditions and suggests that Stan was not specifically distressed by treatment with SIBIS

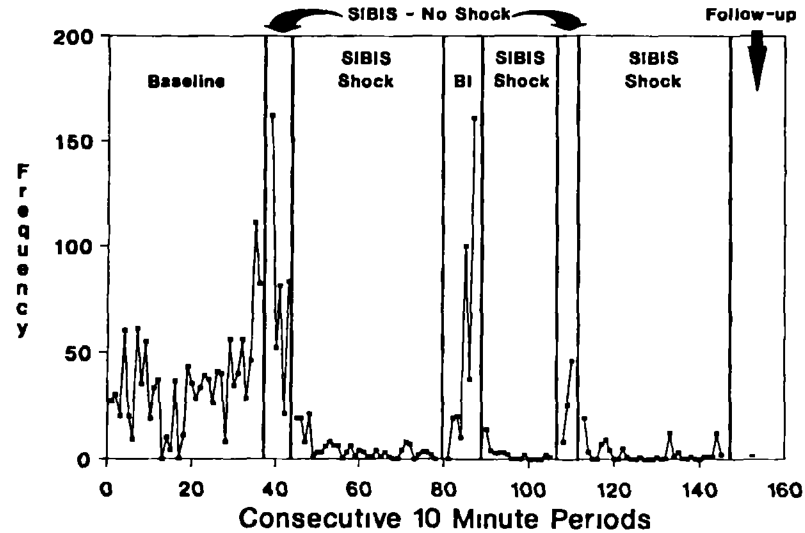


FIGURE 1 Frequency of head hits per consecutive 10-min periods across all conditions

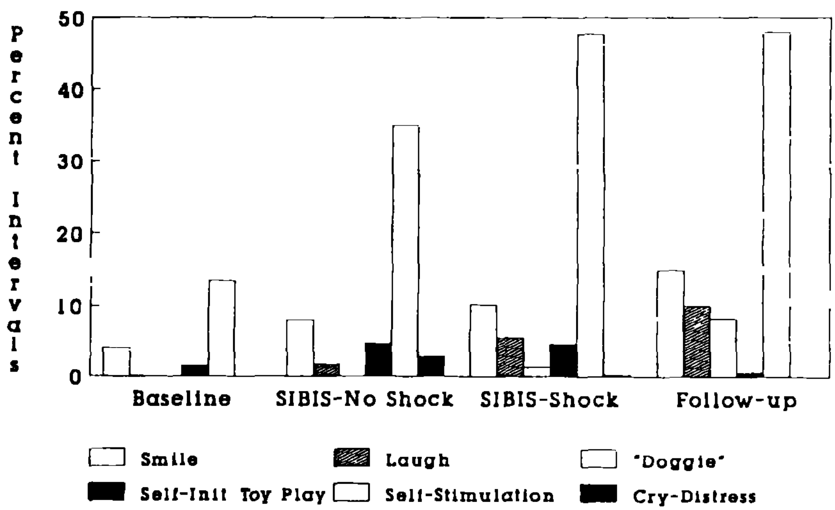


FIGURE 2 Percent of 10-s intervals scored for behavior reflecting affective state by condition

### *Follow-Up*

Data, collected during a 2-h observation period at the hospital where the original treatment was conducted 1 year following the initial treatment, documented that treatment gains continued There was near complete suppression of head hits Other behaviors, suggesting positive side effects, occurred at rates similar to those observed during initial treatment During the year, SIBIS was used at home and at school Mother reported that Stan had been doing so well at home that he needed to wear SIBIS only about 50% of the time Although he still wore SIBIS at all times during school, his progress improved, and reductions in head hitting made more educational programming possible

## DISCUSSION

This study documents increases in behaviors reflecting a positive affective state and interaction with the environment in a child with severe self-injurious behavior treated with contingent electric shock via SIBIS Reduction of the self-injurious head hitting was rapid and nearly complete during the SIBIS — Shock conditions, and reduction persisted at the 1-year follow-up assessment Stan's parents report that he is more content and that they are very pleased with the outcome of treatment Their anxiety about his inflicting damage upon himself and the worry over a VP shunt malfunction caused by his SIB have been reduced dramatically

The documented increases in positive affect seen in Stan and other individuals treated with contingent electric shock may be inconsistent with two current explanations of SIB, the communication hypothesis (Carr & Durand, 1985), and the endogenous opiate-based biochemical explanation (Harris, 1992) If head hitting serves a communication function (e g , I want attention, I need a break, I want more stimulation) then why does its reduction (i e , less ability to communicate) result in a happier person who interacts more with the environment? One might conclude that reductions in SIB allow for more appropriate and functionally equivalent forms of communication, however, increases in positive affect occur with the onset of treatment and have been observed prior to the training of functionally equivalent responses If SIB is a form of communication used by individuals to obtain positive or negative reinforcement then why should they be "happier" and more interactive when it is taken away? We have observed individuals treated with SIBIS either ask for SIBIS or who actually put it on themselves suggesting that the suppression of SIB can function as a reinforcer independent of communication abilities Given the findings of this study and other reports of successful treatment of SIB with contingent electric shock prior to enhanced communication abilities, it appears that the SIB may not serve a purely communicative function in all cases

If the reinforcement for SIB is the euphoria resulting from stress-induced endogenous opiate release, then suppression of SIB should lead to a reduction in that euphoria It seems logical that a reduction in euphoria (reinforcement) would not produce a more positive affective state What implications the observed increases in positive affect may have for the analgesia-based conceptualization of opiate system operation in SIB is unclear

If the communication hypothesis and the opiate release explanations of SIB do not account for the phenomenon of improved affect during treatment with contingent electrical stimulation, then we may need to consider other explanations Self-injurious biting and chewing of fingers, lips and the mouth area occurring in patients with Lesch-Nyhan syndrome appears related to a specific biochemical abnormality and can occur in individuals who may have normal intelligence and normal communication skills Patients with Lesch-Nyhan often request restraint or self-restrain and definitely show negative emotional affect when released from restraints (Schroeder & Luiselli, 1992) In addition, the existence of involuntary verbal and motor tics observed in Tourette's syndrome and involuntary motor movements observed in documented seizures attest to the fact that there are behaviors that are organically determined and are not under the full control of the individual or the environment It is surely possible that there are behaviors that are "caused" by organic conditions but may have their frequency modified by environmental contingencies It would be a mistake to assume that the ability to modify the rate of a behavior is proof that the behavior is learned or exclusively under the control of environmental contingencies (the reverse is true as well) Had the biochemical abnormality not been discovered for Lesch-Nyhan syndrome our ability to modify the rate of finger and lip chewing via operant techniques may have lead to the conclusion that these individuals simply learned this behavior

Until we understand the interaction of all factors (cf Romanczyk Lockshin, & O'Conner, 1992), assuming all SIB is primarily explainable in operant terms may be premature if not inaccurate It seems clear that the phenomenon of positive affective responses to punishment procedures needs to be considered in evaluating our explanations of SIB As Skinner (1990) discusses, there are two established sciences that have a bearing on understanding behavior These are physiology (body-cum-brain) and the combined fields of ethology, operant conditioning, and the study of social environments that can prime and expand operantly controlled behavior Although behavior analysts have developed operant explanations of SIB (Carr, 1977) and methods for functionally analyzing SIB (Iwata, Dorsey, Slifer Bauman

& Richman, 1982) it seems that prematurely excluding interactive and more complex explanations of SIB is unwarranted The ultimate value of functional analysis will be realized when all potential determinants of SIB (operant and other) can be evaluated separately and interactively

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