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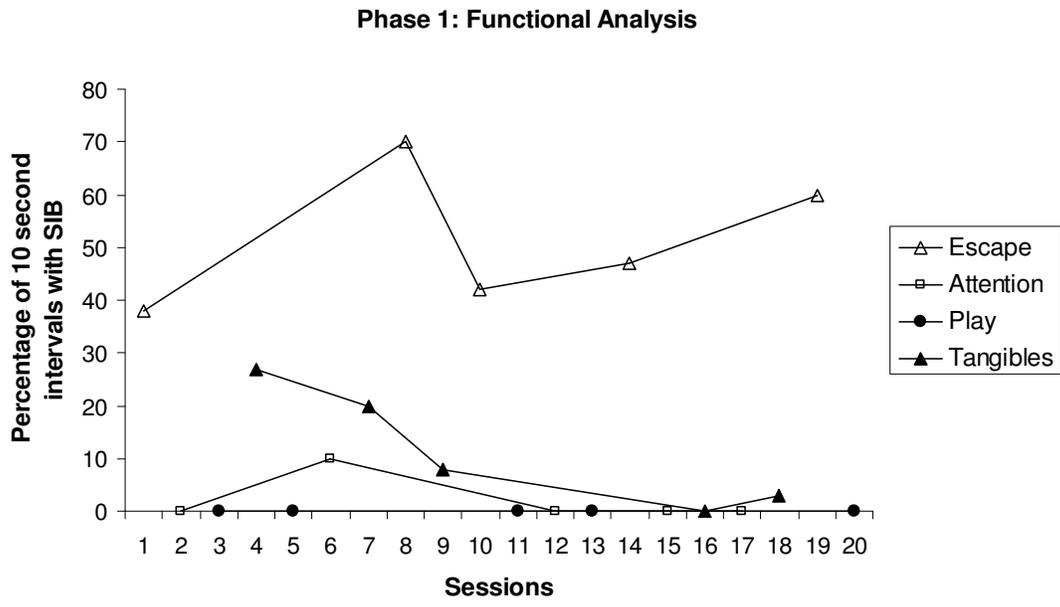
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Abstract: The current study investigates the comparative effects of sensory-integration therapy and behavioral interventions on rates of self-injurious behaviour (SIB) in a nine-year-old boy with a diagnosis of autism. A functional analysis was conducted to identify the variables maintaining the self-injurious behavior. This analysis demonstrated that SIB was maintained by negative reinforcement as a result of escaping or avoiding demand situations. A sensory integration therapy and a behavioral intervention were compared within an alternating treatments design. Results from this study clearly demonstrate that the behavioral intervention was more effective in reducing SIB than the sensory-integration therapy. Finally, in the best treatment phase, the behavioral intervention only was implemented and further reduction was observed in the frequency SIB.

\*Figure 1



\*Figure 2

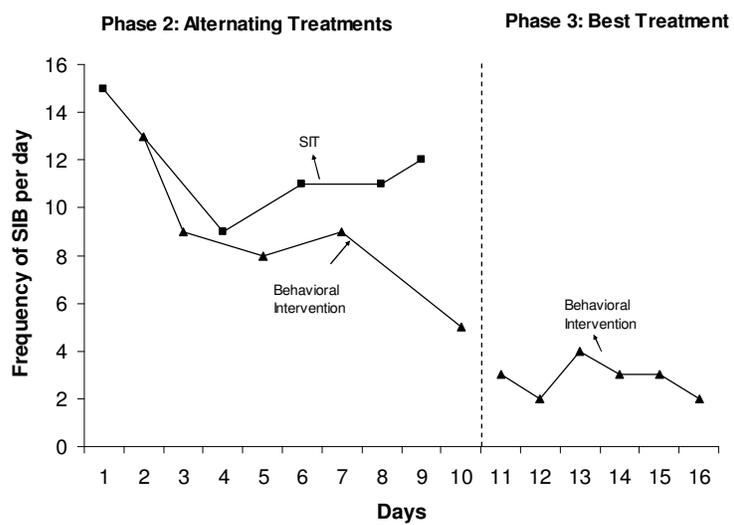


Table 1

Sequence of interventions during the alternating treatments phase of the experiment

| <u>Sequence of Treatments</u>      |                                    |
|------------------------------------|------------------------------------|
| Day 1: Sensory-Integration Therapy | Day 6: Sensory-Integration Therapy |
| Day 2: Behavioral Intervention     | Day 7: Behavioral Intervention     |
| Day 3: Behavioral Intervention     | Day 8: Sensory-Integration Therapy |
| Day 4: Sensory-Integration Therapy | Day 9: Sensory-Integration Therapy |
| Day 5: Behavioral Intervention     | Day 10: Behavioral Intervention    |

Table 2

Description of the 'sensory diet' during the SIT condition

|                        |  |
|------------------------|--|
| Motor Activities       |  |
| Swinging               | The participant was assisted into a sitting position on a net swing.<br>Linear and rotational swinging was facilitated by experimenter.  |
| Beanbag<br>compression | The participant was assisted into a lying position on a beanbag.<br>The experimenter placed a second beanbag on top of the participant's body and pressed firmly to exert necessary pressure needed to achieve a 'deep pressure' effect. |
| Rocking                | The participant was positioned on a 'peanut' shaped ball with experimenter sitting behind him to provide necessary support. The participant was encouraged to 'rock' backwards and forwards and from side-to-side.                       |
| Jumping                | The participant was assisted on to the trampoline and was encouraged to jump independently for 1 minute.   |
| Commando<br>Crawling   | The participant was instructed (and assisted if necessary) to lie face-down on the ground and encouraged to move forward primarily using his elbows and the inside of the knees.   |
| 'Hot-dog' wrap         | The participant was rolled up tightly in a blanket made from lycra and was rolled slowly across foam mats.   |
| Oral-motor control     |  |
| Chewy Tube             | The participant was provided with a chewy tube that he was encouraged to bite on at various intervals throughout the day.  |

## Wilbarger Brushing Protocol

- Brush with a firm slow pressure so that the bristles of the brush are flattened.  
Hold the brush horizontal in the direction of the brushing (long ways or sideways).
- Cover every area 3 times and try not to lift the brush off the skin.
- Use up and down strokes, maintaining the same pressure throughout the brushing.
- Start on the palm and upper surface of the right hand.
- Progress up the back of the arm only. Avoid the inside of the elbow and softer area inside the arm.
- Continue brushing onto the back, brushing up and down in rows.
- Progress down the left arm, moving up and down.
- Brush the left palm and upper surface of the left hand.
- Moving down to the legs, brush up and down the front of the leg, avoiding the groin area and the soft area behind the knee.
- Brush the top of each foot using heavy pressure.

## Joint Compression

Compression is a firm push/release action of the joint.

Hold one hand on either side of the joint. Use flat hands, with fingers pointing outwards.

Each of the following joints should be compressed ten times.

- Shoulders: Support one hand on the shoulder and the other hand on the upper arm. Lift the upper arm into a horizontal position and compress into the

shoulder joint ten times.

- Elbow: Ensure that the arm is straight. Hold on either side of the elbow joint and compress ten times.
- Wrist: Place one hand into the child's and the other hand on the lower forearm and compress ten times.
- Hips: Bend the legs at the hips and knees and compress both knees together into the surface ten times.
- Ankles: Place the foot positioned in a standing position. Hold the foot with one hand and hold above the ankle with the other and compress ten times.

**Changes made to manuscript based on reviewers recommendations**

P. 5 Ayres (1974) erased

p.16 Reference section: Ayres (1972) changed to (1979)

p. 4 changed Stock & Kranowitz to Stock Kranowitz (erased &)

p.9 Iwata, Pace, Dorsey, Zarcone, Vollmer, Smith et al. (1994) replaced with Iwata, Dorsey, Slifer, Bauman, & Richman (1994)

p.12 Horner, Day, Sprague, O' Brien & Heartfield -- Heartfield changed to Heathfield

p.16 Added a reference for Horner et al. (1991) to the reference section

p.15 Lemke (1974) (not Demke as reviewers write) is cited in the text and reference section

p.15 Arendt (1998) changed to (1988)

p.17 Vollmer et al. moved to appear alphabetical order

Bellamy, Horner, Inman (1979) removed from the reference section

Running Head: COMPARISON OF BEHAVIORAL INTERVENTION AND  
SENSORY-INTEGRATION THERAPY

Comparison of behavioral intervention and sensory-integration therapy in the  
treatment of self-injurious behaviour

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### Abstract

The current study investigates the comparative effects of sensory-integration therapy and behavioral interventions on rates of self-injurious behaviour (SIB) in a nine-year-old boy with a diagnosis of autism. A functional analysis was conducted to identify the variables maintaining the self-injurious behavior. This analysis demonstrated that SIB was maintained by negative reinforcement as a result of escaping or avoiding demand situations. A sensory integration therapy and a behavioral intervention were compared within an alternating treatments design. Results from this study clearly demonstrate that the behavioral intervention was more effective in reducing SIB than the sensory-integration therapy. Finally, in the best treatment phase, the behavioral intervention only was implemented and further reduction was observed in the frequency SIB.

**Keywords:** autism, negative reinforcement, sensory-integration therapy, behavioral intervention

## Comparison of Behavioral Intervention and Sensory-Integration Therapy in the Treatment of Self-Injurious Behaviour

A considerable amount of research conducted over the past number of years has focused on the treatment of self-injurious behaviour (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 (e.g. Bachman, 1972; Johnson & Baumeister, 1978; Mason & Iwata, 1990; Vollmer, Iwata, Zarcone, Smith, & Mazaleski, 1993). Various other therapies within the literature have claimed to be effective in the treatment of SIB, particularly interventions based on developmental and physiological hypotheses. However, these therapies have much less empirical support (Linscheid & Valvano, 1987; Mason & Iwata, 1990).

The most prevalent of these ‘interventions’ reported and the most commonly applied is Sensory-integration Therapy (SIT). Despite the fact that there is a paucity of controlled research to support the effectiveness of SIT in the treatment of self-injurious behaviour, some qualitative studies have demonstrated wide-spread applications of SIT in the treatment of SIB. A survey of Occupational Therapists revealed that 82% of respondents reported that they “always” use a sensory integrative approach when working with children with autism (Watling, Dietz, Kanny, & McLaughlin, 1999). Parents of children with autism in applied behavior analysis programmes were surveyed on their use and perceptions of supplemental treatments. Results from this study indicated that 56% of respondents had their children exposed to sensory-integration techniques (Smith & Antolovich, 2000). Because of the potentially dangerous effects of SIB, it is hugely important to review the efficacy of sensory integration procedures in the treatment of self-injurious behaviour.

Sensory Integration Therapy (SIT) was first introduced by Ayres (1972) as the “neurological process that organizes sensation from one’s own body and from the environment and makes it possible to use the body effectively within the environment” (p.11). Subsequent authors have referred to problems with sensory integration as “the inefficient neurological processing of information received through the senses, causing problems with learning, development and behaviour” (Stock Kranowitz, 1998, p. 292) which may be alleviated through various types of physiological stimulation.

Sensory integration dysfunction is thought to impair the vestibular, proprioceptive and tactile systems. The vestibular system provides sensory input to the brain about the body’s movement through space. Signs of vestibular impairment include poor posture and difficulties in planning and sequencing motor activities. The proprioceptive system provides sensory input for muscles and joints. Impairment to this system is said to be manifested by stereotyped body movements such as repeatedly hand-flapping. Impairments in the tactile system are shown by lack of sensitivity or over-sensitivity to sensory stimuli. SIT is designed to restore effective neurological processing by enhancing each of these systems. The application of a “sensory diet” is a common clinical practice by sensory-integration therapists and can involve individualized activity plans to ameliorate the sensory needs of the individual. Such a plan may involve activities such as jumping on a trampoline, swinging, rolling and riding on scooter boards. Other activities involve the delivery of “deep pressure”, “joint compression”, and body brushing. In addition, the use of weighted vests, oral motor exercises and body massage are all said to alter and improve arousal states (Wilbarger, 1995).

Practitioners using the SIT approach have reported three types of benefits: (a) enhanced ability to focus on relevant materials in educational, therapeutic, and social environments (Wilbarger & Wilbarger, 1991); (b) reduction in the rate of aberrant behaviours such as self-injury (Bright, Bittick, & Fleeman, 1981) and (c) generalized improvements in nervous system functioning, reflected in gains in higher cognitive activity such as language and reading (Ayres, 1979; Magrun, McCue, Ottenbacher, & Keefe, 1981). However, inspection of the literature reveals there is no scientific basis for these assertions (Arendt et. al., 1988).

Many studies have attempted to demonstrate beneficial effects of sensory integration as a therapy for children with developmental disabilities, presenting with self-injurious behaviours. Lemke (1974) proposed that SIB seen in developmentally delayed populations may be a reflection of poor sensory-motor integration. In support of this position, Lemke (1974) presented an uncontrolled case study in which a self-injurious client was exposed to multiple forms of stimulation (e.g. finger massage and ice to the mouth, tooth-brushing, towel massage to the arms, feet slapping and body rolling). Quantitative measures were not a feature of this study and the author simply noted that the subject was freed from restraint.

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. No objective, quantitative measures were reported in this study. Wells & Smith (1983) provided similar types of sensory stimulation as Bright et al. as a treatment for SIB. Results from this study indicated that, compared to baseline, the frequency of SIB decreased during therapy sessions.

The studies described present with a number of methodological difficulties that prevent clear interpretation of the reported data. None of the studies provided adequate measurement or assessment of interobserver agreement, and only one of the three studies described, presented data from a baseline condition (Wells & Smith, 1983). In addition, in each of the studies described there was a confound of the independent variable. Clients were not exposed to physiological stimulation alone. Instead, physiological stimulation was presented concurrent with other variables, most notably social stimulation. Therefore, there is no clear understanding of exactly which variable was responsible for the improvement in behaviour.

A study by Dura, Mulick, and Hammer (1988) addressed some of these issues. The authors used a multielement design to evaluate the effects of SIT on SIB in an individual with mental retardation. Dura et al. (1988) compared the effects of vestibular stimulation (movement back and fourth on a swing while the client sat on the therapist's lap) with those of a control condition in which the client accessed attention but did not receive any vestibular stimulation. Results from this study showed no incidents of SIB during the sessions containing vestibular stimulation and variable rates of SIB during the control sessions with attention only.

This is the first controlled evaluation of sensory-integration therapy that has generated positive results with self-injurious clients. From a behavioral perspective SIB may be developed and maintained through positive, negative and automatic reinforcement. Therefore, SIB that is related to environmental contingencies, such as attention, may be affected by coincidental features of SIT such as non-contingent attention. SIB maintained by escape from demands may also show a decrease during sensory-integration sessions merely as a function of reduced aversive stimulation

through withdrawal of demands. Therefore additional research is needed to clarify these issues.

Mason and Iwata (1990) compared the effects of SIT and a behavioral intervention within a multiple-baseline across subjects design. Functional analysis data indicated that SIB for the three participants was maintained by positive reinforcement (Participant 1), automatic reinforcement (Participant 2) and negative reinforcement (Participant 3). SIB for all subjects was only reduced when the behavioral interventions were applied. The data generated from this investigation raises questions about the active components of sensory-integration therapy and the functional types of SIB for which it might be appropriate.

The current investigation extends previous research by examining and comparing the effects of sensory-integration techniques and behavioral interventions on rates of self-injurious behaviour in a child with autism. Both interventions were compared within an alternating treatments design with the best treatment implemented in the final phase.

## Method

### *Participant and Setting*

The participant was 10:1 year old boy, and was diagnosed with Autistic Spectrum Disorder at the age of 3:4 by an independent clinical psychologist prior to the study. He was diagnosed with epilepsy and received 700mg of tegretol daily to help control seizures. He attended a school using applied behaviour analysis as treatment for children with autism five days per week, for six hours per day.

The participant presented with very limited cognitive and communication skills. He emitted signs to mand for four preferred reinforcers. The participant

required full assistance with feeding, toileting, dressing and other self-care skills. He was receiving a gluten and casein free diet.

It was reported by parents and school staff that the participant emitted SIB (hand-mouthing and hand-biting) that resulted in visible tissue damage. Occurrences of the behaviour were observed both at school and at home. Sessions were applied daily in the participant's regular classroom.

### *Apparatus*

Sensory integration therapy equipment. A net swing was used measuring 78" x 39" and was hung from a bar structure on the ceiling with a safety snap and a heavy duty rotational device. A therapy ball measuring 21" in diameter made from durable, heavy-duty molded vinyl was also used. Other equipment included a beanbag made from polystyrene beans and foam pieces, a blanket made from lycra and a 'T' shaped 'chewy tube' oral motor device which provided a chewable surface for biting and chewing skills. A trampoline measuring 14' diameter x 36" high with a safety enclosure surrounding surface area was also used.

### *Experimental Design*

The study was conducted in the format of an alternating treatments design with initial baseline and final best treatment phase. Treatments were alternated across daily sessions.

### *Response Measurement and Interobserver Agreement*

Disruption consisted of two inappropriate behaviors. Hand biting included inserting the hand past the plane of the lips and closing his teeth on the hand. Hand mouthing included inserting the hand past the plane of the lips and not closing his teeth on the hand

A 10-s partial-interval recording system was used to record the occurrence or non-occurrence of SIB during all functional analyses sessions. Interval changeovers were signalled by a digital timer. Event recording was used to measure the frequency of the target behaviour across each of the daily sessions.

Interobserver agreement was recorded on an interval-by interval basis for the two responses during 34% of sessions distributed throughout the functional analysis. Agreement was also calculated for 38% of treatment sessions over 10 consecutive days. Agreement was calculated by dividing the number of intervals in which observers agreed on the presence or absence of target behaviour (agreements) by the number of agreements plus disagreements and multiplying the result by 100%. Mean agreement on target behaviours was 97% and ranged from 91% to 100%.

*Phase 1: Functional Analysis.*

The participant was exposed to four conditions (demand, attention, access to tangible items and play) each presented during 10 minute sessions within a multi-element design. The format used in this investigation was based on that described by Iwata, Pace, Dorsey, Zarcone, Vollmer, Smith, et al. (1994).

Escape condition. During this condition the experimenter presented academic tasks to the participant. Praise was delivered contingent on correct responses. Contingent on the occurrence of the target behaviours (hand-mouthing/hand-biting) at any time during the session, the experimenter immediately terminated the trial and removed the demand for 30 second. This condition was included to assess whether self-injury was maintained through negative reinforcement as a result of escaping or avoiding demand situations.

Attention Condition. During this condition the experimenter directed the participant to a variety of toys in the room and subsequently sat in another corner of

the room and assumed the appearance of reading a book. Attention, in the form of a reprimand or expression of concern, was given contingent on the occurrence of SIB. This condition was included to approximate one type of reinforcement contingency that may be maintaining the self-injury.

**Access to tangible items.** During this condition, many desired objects were present in the room but initially these were not accessible. If the participant at any time attempted to approach or grab the item, he was prevented from doing so. The participant accessed the item only contingent upon occurrences of SIB.

**Play condition.** The final condition served as a control for the other three conditions. The tutor delivered social praise contingent on appropriate behaviour at least once every 30seconds. Also, in this condition the participant had free access to toys and no demands were placed.

## Results

Figure 1 represents the results of the functional analysis during Phase 1. Occurrence of SIB is expressed as percentage of 10-s intervals for the participant during all experimental conditions – demand, attention, play and access to tangible items. Figure 1 shows a maximum occurrence of 10 instances of SIB during the attention condition. There were no occurrences of SIB during all five sessions of the play condition. During the demand condition the participant consistently engaged in relatively high levels of SIB (range from 38% to 70% of 10-s intervals with SIB). Moderate to low levels (range from 3% to 27% of 10-s intervals with SIB) were observed in the condition where access to tangible items was limited.

---Insert Figure 1 about here---

*Phase 2: Alternating Treatments Phase*

To compare the differential effects of the sensory-integration therapy and the behavioral intervention on rates of SIB an alternating treatments design was implemented across 10 daily sessions (see Table 1)

-- Insert Table 1 about here --

#### *Sensory-Integration Therapy Intervention*

The modalities and specific stimuli selected for inclusion in this part of the study were based on available literature and recommendations provided by the school's occupational therapist. Strategies for vestibular and proprioceptive activities were recommended along with Wilbarger's (1995) joint compression and brushing. Oral motor control was also developed. The Experimenter was trained in the application of sensory-integration procedures. During this condition, the participant was provided with access to the sensory-integration equipment and activities that delivered proprioceptive and vestibular stimulation, in the form of a 'sensory diet'. The 'sensory diet' consisted of a variety of motor activities, oral-motor control, a brushing protocol and joint compression (see Table 2). These sensory-integration techniques were applied every two hours of the school day for a 30 minute period, (i.e. at least four 30 minute sessions per day) or contingent on the emission of the target behaviour.

--Insert Table 2 here --

#### *Behavioral Intervention*

Data from the functional analysis conducted during Phase 1 of the experiment demonstrated that the target behaviors were maintained through negative reinforcement as a result of escaping or avoiding demand situations. The outcome of this analysis was used to design a treatment package which included interspersal of requests, a dense schedule of reinforcement (FR2) and an extinction procedure.

Interspersed Requests. During intensive teaching sessions (i.e., multiple tasks presented in massed trial table-top instruction), mastered and fluent operants were interspersed among trials of more difficult demands containing acquisition tasks. This component of the intervention was implemented to increase the probability that the participant would attempt to perform new or difficult tasks without engaging in self-injurious responses; (Horner, Day, Sprague, O'Brien, & Heathfield, 1991).

Schedule of Reinforcement. During intensive teaching sessions, academic materials (e.g., puzzles, matching tasks) were presented with a verbal instruction to complete the task. If the participant responded correctly within 2 seconds, verbal praise was delivered. Tangible items were delivered on an FR2 schedule (i.e. every second consecutive correct response). The tangible items consisted of small edibles (e.g. crisps and cereal). If an error was made or no response occurred after a period of 3-5 seconds, the experimenter restarted the trial and provided increased physical, gestural, or verbal assistance to obtain correct responding.

Extinction. Contingent on the occurrence of the target behavior during an instructional trial, the experimenter physically interrupted self-injurious responses, and immediately redirected the participant to the task. If necessary, the participant was physically prompted to respond to the instruction or complete the specified task.

### *Phase 3: Best Treatment Phase*

Data from the alternating treatments phase of the experiment (Phase 2) demonstrated that the greatest reduction of the target behaviors was observed when the behavioral intervention treatment package was implemented. As a result of the effectiveness of the behavioral intervention during Phase 2, it was implemented alone for seven subsequent and consecutive days.

## Results

-- Insert Figure 2 about here --

Figure 2 shows the rate of occurrence of SIB when the behavioral intervention and the sensory-integration therapy were alternated randomly on a daily basis. Generally, the data pattern for the behavioral intervention indicates a gradually decreasing variable trend. In contrast, data from the SIT shows zero trend with high variability.

On Day 1 of SIT, a rate of 15 incidents of SIB was observed. On the final day of SIT, the rate of SIB was 12 incidents per day. On Day 1 of the behavioral intervention, the rate of SIB observed was 13 incidents. On the final day, SIB had reduced to 4 incidents. Data from the alternating treatments phase clearly suggest that the behavioral intervention was more effective than SIT for the treatment of self-injurious behavior. Therefore, the final phase of the study consisted only of the behavioral intervention. During this phase, the rate of SIB decreased further to 2 incidents per day on conclusion of the study.

### Discussion

Results of the functional analysis led to identification of the variables maintaining the self-injurious behavior. This analysis suggested that SIB was maintained through negative reinforcement as a result of escaping or avoiding demand situations. A sensory-integration therapy and a behavioral intervention were compared within an alternating treatments design. Results from this phase of the study demonstrated that the behavioral intervention was more effective in reducing levels of SIB than the sensory based intervention. When the behavioral intervention was implemented alone in the final phase of the study, the frequency of SIB per day was observed to decrease even further. The results of the current study are important,

both practically and scientifically for the field of behavior analysis and for those with developmental disability.

This study further demonstrates the utility of assessment procedures that identify the functional properties of behavior disorders. The data generated from the assessment successfully identified maintaining variables and were also imperative in designing an effective intervention that would effectively reduce the self-injurious behavior. Although the reinforcement based behavioral intervention did not reduce the SIB to zero levels across daily sessions, SIB was observed to decrease from approximately 13 incidents per day to 2 incidents per day on conclusion of the investigation.

The findings of this study demonstrate the effectiveness of a behavioral intervention over a sensory based intervention in treating SIB. These results are consistent with previous findings on sensory-integration therapy in reducing rates of SIB (Mason & Iwata, 1990). In this study rates of SIB did not result in a reduction during sensory-integration therapy while rates of SIB reduced to zero levels during the behavioral intervention phase. Together these studies demonstrate the importance of providing function-based treatment for challenging behavior. In both of these studies the behavioral intervention was designed based on a functional analysis of the problem behavior presented. The behavioral intervention was successful in reducing and eliminating the target behavior. However, during the sensory-integration therapy, techniques were applied without an analysis of the function of the behavior under investigation. As a result the behavior may have been reinforced through positive social reinforcement.

Some have indicated that SIT may be a promising treatment for SIB. This conclusion, however, is not based on adequately controlled research (Bright et al.

1981; Dura et al. 1988; Lemke, 1974; Wells & Smith, 1983). Examination of the available literature on SIT indicates that at present, there is no consistent agreement regarding the effectiveness of sensory integration. Studies have indicated that SIT is ineffective and that its theoretical underpinnings and assessment are not validated (Arendt et al. 1988). This can obviously have detrimental effects for the self-injurious client.

SIT it remains a popular treatment among various consumers despite lack of evidence for its efficacy (Arendt et al. 1988; Watling et al. 1999). SIT is a resource intensive intervention that is often incorporated with other treatments for autism resulting in an 'eclectic' approach. Because SIT views problem behavior as a lack of organization of the senses that results in the inability to process complex sensory information in an effective manner, it often involves contingent application of sensory input following disruptive behavior. In the current study, on the days of sensory-integration therapy, techniques were administered non-contingently for two 30 minute sessions. Future research should examine the effects of contingent application of sensory integration techniques on each occurrence of challenging behavior. This would examine the artifactual effects of sensory-integration therapy on challenging behavior.

Given the implications discussed above, it is crucial that more comparative studies are conducted within this area. Additional participants are required to strengthen the findings of the current study. In addition, the intrinsic effects that SIT may have on environmental variables by nature of its mode of application (e.g., increased attention and reduced demands), warrant investigation within the treatment of developmental disabilities.

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Figure Caption

Figure 1

Percentage of 10-s intervals of SIB emitted during each of the functional analysis conditions.

Figure 2

The rate of occurrence of SIB during alternating treatments phase (SIT and behavioral intervention) and final best treatment phase (behavioral intervention alone).





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13.6.08

Dear Dr. Matson,

Thank you for your reply. I am submitting a revised manuscript and I have addressed each of the changes recommended by the reviewers. I am also attaching a separate list of changes made to each page of the manuscript.

Thank you very much.

Yours sincerely,

Olive Healy, Ph.D., BCBA