Effects of Sensory Integration Intervention on Self-Stimulating and Self-Injurious Behaviors

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This study compared the effects of occupational therapy, using a sensory integration (SI) approach and a control intervention of tabletop activities, on the frequency of self-stimulating behaviors in seven children 8–19 years of age with pervasive developmental delay and mental retardation. Daily 15-min videotape segments of the subjects were recorded before, immediately after, and 1 hour after either SI or control interventions performed during alternating weeks for 4 weeks. Each 15-min video segment was evaluated by investigators to determine the frequency of self-stimulating behaviors. The results indicate that self-stimulating behaviors were significantly reduced by 11% one hour after SI intervention in comparison with the tabletop activity intervention ($p = 0.02$). There was no change immediately following SI or tabletop interventions. Daily ratings of self-stimulating behavior frequency by classroom teachers using a 5-point scale correlated significantly with the frequency counts taken by the investigators ($r = 0.32$, $p < 0.001$). These results suggest that the sensory integration approach is effective in reducing self-stimulating behaviors, which interfere with the ability to participate in more functional activities.

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Introduction

Among the many challenges for therapists treating individuals with mental retardation or developmental disabilities is the tendency for people in this population to engage in self-stimulating, self-injurious, or stereotypic behaviors. Self-injurious behavior is one of two major categories of destructive behavior as identified by the National Institutes of Health (1989); the other is aggression toward others and property. In the United States it is estimated that 160,000 individuals with developmental disabilities demonstrate destructive behavior at a cost that exceeds $3 billion. Self-injurious behavior is more prevalent in persons with severe to profound retardation. Severe self-injurious behavior is found in 20,000 to 25,000 individuals. All forms of destructive behavior have serious social, personal, educational, and economic impact (National Institutes of Health, 1989) and limit an individual's ability to participate in normal life routines. The majority of individuals displaying self-injurious behavior also have stereotypical behavior. Between 5% and 17% of people with mental retardation self-inflict tissue damage on a regular basis (Merrill Advanced Studies Center, 2002).

Self-stimulating or stereotypic behavior is "repetitive bodily movement which serves no apparent purpose in the external environment" (Harris & Wolchick, 1979, p. 185). These behaviors frequently interfere with the ability to function independently and therefore must often be addressed before any significant improvement in function can be accomplished through intervention (Harris & Wolchick).

Although not as physically harmful as self-injurious behaviors, frequent self-stimulating and stereotypic behaviors can also interfere with participation and engagement in meaningful occupations. These behaviors interfere with an individual's ability to communicate, learn and interact adaptively with the environment (Storey, Bates, McGee, & Dycus, 1984) and are incompatible with the establishment of new skills (Iwasaki & Holm, 1989).

Although it is difficult to determine the specific etiology of these behaviors, several theories have been developed to explain why they may occur. Storey, Bates, McGhee, and Dycus (1984), offer two possible explanations for self-stimulating behaviors. The first explanation is that these behaviors are inherently reinforcing by providing tactile, proprioceptive, and sensory stimulation to an extent, which is not achieved through conventional adaptive behavior. An alternate explanation is that self-stimulating behaviors are used to help regulate sensory information for people who otherwise have difficulty receiving and interpreting this information.

Bright, Bittick, and Fleeman (1981) suggest that self-injurious behavior is a form of self-stimulation as well. They postulate that persons with multiple handicaps are limited in their ability to explore and interact with their environment which, when combined with initial central nervous system dysfunction, leaves them with some degree of sensory deprivation. This sensory deprivation then leads to breakdown in the central nervous system's ability to process sensory stimuli and consequently causes "further deprivation, perceptual distortion and stimulus hunger," which may eventually cause self-stimulation as a way of compensation for the lack of natural, environmental stimulation (Bright et al., p. 170).

Iwasaki and Holm (1989) agree that the common factor among many studies into the etiology of stereotypic behaviors is a dysfunction of the sensory processing system, which manifests itself as a sensory deficiency or a sensory overload. The individual with sensory processing dysfunction uses self-stimulation in order to either compensate for restricted sensory input or to avoid over-stimulation. The same behavior may be used for either compensation or avoidance, making it difficult to identify its specific function (Iwasaki & Holm).

The neurological mechanisms, which precipitate stereotypical behaviors in people with mental retardation, may involve one or more of the sensory systems (Berkson & Davenport, 1962). Berkson and Mason (1963) believe that it is likely that tactile, vestibular, and kinesthetic systems are mainly involved. Berkson and Mason found that stereotypic behaviors decreased significantly when locomotion and manipulation of environment were increased. This indicates that changes in sensory input may reduce the incidence of self-stimulating behaviors. Effectively reducing self-injury and self-stimulation raises the potential for increased participation and independence, as well as the creation of more productive educational and therapeutic environments. The common theme in the literature that the cause of these behaviors is sensory in nature provides a natural bridge for the application of occupational therapy using sensory integration techniques.

The use of sensory techniques for the purpose of decreasing self-stimulating or self-injurious behaviors in people with mental retardation was first explored by Lemke in 1974. Lemke found that systematic application of sensory stimulation was effective in decreasing the self-injurious behaviors of a 19-year-old woman diagnosed with mental retardation. Since this study, a number of others have assessed the effects of sensory stimulation on self-stimulating and self-injurious behaviors.

Reisman (1993) reviewed articles that claimed to research the effects of sensory integration intervention on reducing self-stimulating behaviors of adults with developmental disabilities (Bright et al., 1981; Dura, Mulick, & Hammer, 1988; Favell, McGimsey, & Jones, 1978; Favell, McGimsey, & Schell, 1982; Hirama, 1989; Lemke, 1974; Mason & Iwata, 1990; Mulick, Hoyt, Rojahn, & Schroeder, 1978; Wells & Smith, 1983). Reisman reported that design flaws made it impossible to draw any conclusions. According to Reisman this included (1) lack of a control group, (2) activities were provided without initial assessment of the clients' sensory needs, and (3) the use of visual and auditory medium may have provided over stimulation rather than a balanced sensory diet. Reisman concluded that use of a sensory integration approach has been misrepresented as a treatment approach in the efficacy literature. In a more recent review, Miller (2003) outlines gains made in the understanding of behavioral and neurophysiologic differences in individuals with and without sensory processing dysfunction and efficacy work that is currently in process to address limitations identified by Reisman (1993) a decade earlier. Miller identifies the question "does sensory integration therapy work?" as naïve and recommends that current research focus on "what effects are evident for a specific group of individuals receiving a specifically defined intervention compared to another intervention?" (p. 34). Further examination of the efficacy and application of sensory integration intervention for the treatment of self-stimulating behaviors in individuals with developmental disabilities is warranted. It is also necessary to clarify what comprises sensory integration intervention.

Sensory Integration Intervention

Although originally designed to treat children with learning disabilities and sensory integrative dysfunction, the sensory integration frame of reference has been applied by occupational therapists to other populations (Smith Roley, Blanche, & Schaaf, 2001) including children and adults with autism (Zissermann, 1992) and mental retardation (Arendt, MacLean, & Baumeister, 1988) and adults with profound handicaps (Reisman, 1993).

The difference between using the sensory integration frame of reference and techniques for intervention versus sensory stimulation requires clarification. Sensory integration uses planned, controlled sensory input (somatosensory, vestibular, proprioception, etc.) in accordance with the child's neurological needs, which usually elicit a spontaneous adaptive response that integrates the senses. The purpose is to create a state of arousal, attention, and sensitivity to environmental stimuli that is optimal for learning (Ayres, 1972).

Ottenbacher (1991) described sensory integration as a multifaceted intervention approach that is difficult to reduce to its component parts or to define operationally. A summary of characteristics of sensory integration treatment was developed by Kimball (1988) and elaborated over time (Bundy, 2002; Kimball, 1999; Miller & Kinnealey, 1993) included the following characteristics: active participation by the individual being treated, client directed activity, treatment that is individualized, activities that are purposeful and require an adaptive response, an emphasis on sensory stimulation, treatment based on improving underlying neurological processing, and organization and treatment provided by a therapist trained in sensory integration.

Reisman (1993) elaborated on Kimball's characteristics when using sensory integration for reducing self-stimulatory and self-abusive behaviors in people who were severely and profoundly disabled. She clarified that the characteristic of self-direction of treatment by people with severe or profound handicaps must be broadened to include responding to activities offered with communication of preference, lack of withdrawal, eye contact, vocalizations of pleasure, or being relaxed, alert, or smiling (Reisman).

The purpose of this study was to compare the effects of sensory integration intervention and a control intervention on self-stimulating and self-injurious behaviors in children and adolescents with severe and profound pervasive developmental disorder and mental retardation. It is assumed that a reduction of these behaviors will contribute to a calm alert state, which will allow for learning functional skills and social participation. We hypothesized that sensory integration intervention will reduce the frequency of engagement in self-stimulating and self-injurious behaviors compared to a control intervention, in children and adolescents with pervasive developmental disorder and mental retardation.

Methods

Subjects

The location of the study was a private, nonprofit, residential facility for children and adults with mental, emotional, physical, and/or developmental disabilities. The facility houses approximately 600 clients and provides day programming and residential accommodations. Subjects were recruited from individuals at this facility diagnosed with pervasive developmental disorder and/or severe or profound mental retardation who regularly engaged in self-stimulating, stereotypical, or self-injurious behaviors. The study consisted of seven subjects, four boys and three girls, 8–19 years of age. All of the subjects attended school at the facility and all but one resided there as well. Informed consent was obtained from the legal guardians of all potential subjects prior to participation. In addition, each guardian and subject was informed that they could withdraw from the study at any time without penalty.

Intervention

Each subject was assessed using The Sensory Integration Inventory Revised—For Individuals With Developmental Disabilities (Hanschu & Reisman, 1992), which was completed by the teacher. The Inventory has four sections: tactile, vestibular, proprioception, and general reactions. In each section behaviors suggestive of sensory needs are listed as well as the self-stimulatory or self-injurious behavior associated with that system. The evaluator indicates whether or not these behaviors have been observed. A profile of sensory strengths and needs and associated self-injurious and self-stimulating behaviors is elicited through this process that provides a guideline for treatment. The Sensory Integration Inventory Revised—For Individuals With Developmental Disabilities was designed to assess individuals with developmental disabilities to decide if they would benefit from a sensory integration treatment approach. Since these behaviors are not addressed in standardized assessments and the behaviors themselves interfere with formal test taking skills, this is an effective and appropriate tool for this population and for use in this study. This tool, along with the occupational therapy evaluation, provided information on the subject's sensory processing abilities and specific self-stimulating or self-injurious behaviors.

Consistent with sensory integration theory, interventions were designed to incorporate enhanced sensation,

with controlled sensory input to elicit adaptive responses in an environment that offered experiences that met each subject's individual needs in order to enhance their processing (Ayres, 1972, Bundy & Murray, 2002, Smith Roley, Blanche, & Schaaf, 2001) During the sensory integration intervention condition, the subject engaged in sensory based treatment that included a variety of tactile, proprioceptive and vestibular input, based on their unique sensory needs. This is distinguished from sensory stimulation programs in that treatment was individualized based on assessment results, and the type or types of sensation and specific activities used varied depending upon the subjects' responses and desired outcome. Vestibular, tactile, and proprioceptive based activities were primarily used, which is consistent with accepted characteristics of intervention (Bundy, 2002; Case-Smith, 2001; Smith Roley et al., 2001). Responses to intervention were interpreted by the therapist and the sensory input was altered or continued based on the subject's response. Adaptive responses were behavioral and affective such as calming, indication of contentment or pleasure, indications for continuing input such as reaching, smiles, eye contact, and reduction of purposeless activity. The purpose was to provide the appropriate amount and type of sensory input to allow the subject to be free to organize a more adaptive response. This is consistent with Ayres' central principle of the utilization of a sensory integration approach. Specifically, the therapists' ability to "provide planned and controlled sensory input with usually—but not invariably—eliciting a related adaptive response" (Ayres, 1972, p. 114).

The control intervention consisted of tabletop activities related to each client's specific individualized education program goals. Tabletop tasks included one or more of the following: Sorting tasks such as sorting by color or shape, writing activities, puzzles and/or placing pegs in a peg board.

The study took place over a 4-week period. During the 2nd and 4th weeks, a sensory integration approach was employed during 30-minute treatment sessions, daily, five times per week. During the 1st and 3rd weeks a 30-minute control session was implemented using the same schedule and at the same time. Both sensory integration and tabletop interventions were individual sessions and took place in the occupational therapy treatment room at the facility.

Procedure and Instrumentation

Each subject was videotaped performing their routine school activities for 15 min before the start of each intervention session. The therapist then took the subject from the classroom to the treatment room. Once in the treatment room, the therapist provided 30 min of SI intervention or tabletop (control). Following intervention, the client returned to his or her classroom. He or she was videotaped for 15 min immediately after returning to the classroom and again for 15 min 1 hour after he or she returned to the classroom.

The target behaviors were self-stimulating or self-injurious behaviors. They were defined as repetitive, frequent, nonfunctional actions, which sometimes caused bodily harm. Behaviors were specific to each client and had been identified through the assessment using the Sensory Integration Inventory Revised—For Individuals With Developmental Disabilities. Behaviors included biting self, hitting self, poking self, hand flapping, flicking objects, compulsively chewing objects or tapping them on teeth, head banging, and repetitious vocal sounds.

The 15-min videotape segments were analyzed to determine the frequency of self-stimulating and self-injurious behaviors using a model described by Alberto and Troutman (1999). The researcher recorded whether or not the client engaged in any sort of self-stimulating or self-injurious behaviors during continuous 15-sec intervals. For each 15-sec interval, a plus (+) sign was recorded if self-stimulating or self-injurious behaviors were observed and a minus (–) sign was recorded if there were none. The total number of plus signs were divided by the total number of 15-sec intervals for each of the three time periods (before, immediately after, and 1 hour after intervention) to provide a percentage of self-stimulating or self-injurious behaviors for that time period (Alberto & Troutman, 1999). A timing device was used that beeped every 15 sec to facilitate accuracy of scoring. During the videotaping 1 hour after returning to the classroom, the subjects followed their regular class schedules and were involved in one or more of the following activities: tabletop tasks, gross motor play, eating lunch, eating snack, unstructured play, watching a video, hearing a story, art, music, gym, swimming, or resting. Classroom activities remained on a consistent schedule from week to week.

To corroborate the results of the analysis and to determine if there was carryover of results into the classroom environment, the teacher for each subject rated the frequency of self-stimulating and self-injurious behaviors and the frequency of repetitious vocal sounds at the end of each day for the 4 weeks of the study. For each subject, the teachers answered the question "Did the client engage in self-stimulating or self-injurious behavior?" and "Did the client exhibit repetitious vocal sounds?" using a Likert scale with 1 = never, 2 = rarely, 3 = sometimes, 4 = often, and 5 = constant.

Data Analysis

A repeated measures analysis of variance (ANOVA) and Bonferroni post hoc test were used to analyze the mean differences in the percentage of self-stimulating or self-injurious

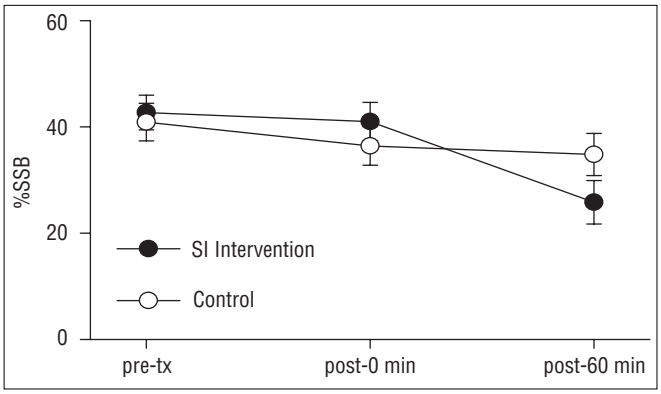

Figure 1. Percentage of self-stimulating behaviors (%SSB) for the 15-min periods before (pre-tx), immediately after (post-0 min), and 1 hour after (post-60 min) either sensory integration (SI-solid circles) intervention or tabletop activities (control-open circles). Values are means and standard errors.

behaviors for the sensory integration versus control (tabletop activities) intervention weeks and for each daily 15-min videotape assessment before, immediately after, and 1 hour after intervention (Figure 1). Mean differences in the percent change in self-stimulating or self-injurious behavior frequency occurring 1 hour after intervention was assessed using a repeated measures ANOVA comparing sensory integration and control weeks 1–4 (Figure 2).

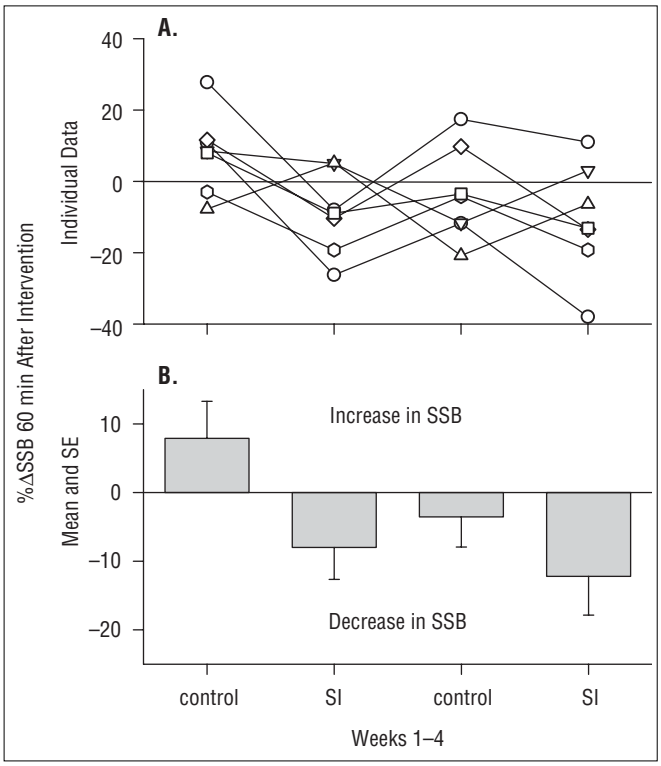

Figure 2. The percent change (%Δ) in self-stimulating behaviors (SSB) 60 min after either tabletop (control weeks 1 and 3) or sensory integration (SI weeks 2 and 4) interventions. A—Each symbol represents individual subject data. B—Represents mean data with values > 0 indicating an increase in SSB and values < 0 indicating a decrease in SSB. Values are means and standard errors.

Similarly, mean differences in teacher ratings of self-stimulating behavior and repetitious vocal sounds were analyzed using a repeated measure ANOVA on ranks. An ANOVA on ranks method was chosen given the nonparametric nature of the survey questions used to assess teacher perception of self-stimulating behavior frequency. Likewise, a nonparametric Spearman rank order correlation was used to determine the relationship between teacher ratings of self-stimulating behavior frequency and investigator observations of self-stimulating behavior frequency (Figure 3).

To assure the interrater reliability of the videotape self-stimulating and self-injurious behavior scoring, three occupational therapists not involved with the study were trained in the observation of behaviors and scoring of the videotaped sessions. The three reviewers rated videotape sessions independently and were blinded to the time and condition of taping. Approximately 10% of the 440 videotaped segments were scored by the three reviewers and compared with the original scoring data. Pearson correlation coefficients between the three reviewers and the original scoring data were greater than 0.92. Significance for all analyses was set at $p < 0.05$.

Results

It was hypothesized that sensory integration intervention will reduce the frequency of engagement in self-stimulating and self-injurious behaviors compared to a control intervention in children and adolescents with severe pervasive developmental delay and mental retardation. Figure 1 shows the percentage of self-stimulating behaviors during

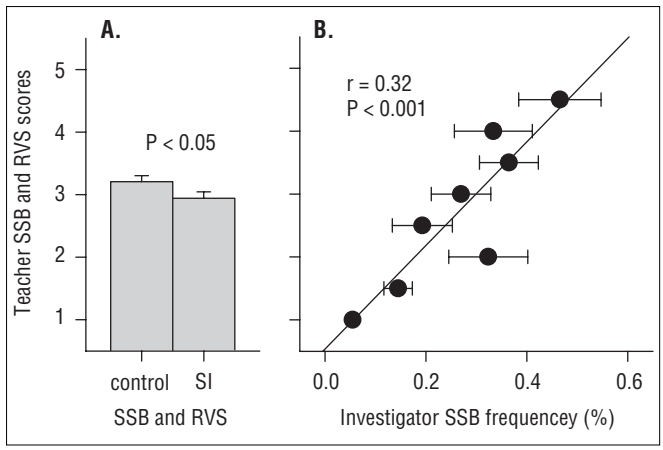

Figure 3. A—Combined teacher ratings for self-stimulating behavior frequency (SSB) and repetitious vocal sound (RVS) frequency during tabletop activity (control) and sensory integration (SI) intervention weeks. The teacher SSB frequency scores equate to 1 = never, 2 = rarely, 3 = some, 4 = often, and 5 = constant. B—The relationship between teacher ratings of SSB frequency and investigator observations of SSB frequency 60 min after control or SI intervention. Values are means and standard errors.

the 15-min periods before (pretreatment), immediately after (post-0 min), and 1 hour after (post-60 min) either sensory integration (SI) intervention or tabletop activities (control). The solid circles represent mean and standard error data from weeks 2 and 4 when the subjects received sensory integration intervention and the open circles represent data from weeks 1 and 3 when the subjects received tabletop activities as a control. The percentage of self-stimulating behavior was reduced 1 hour after sensory integration intervention when compared to the pretreatment and post 0 min percentages ($p = 0.01$).

Given the decline in self-stimulating and self-injurious behavior 1 hour after sensory integration intervention, we compared the change in self-stimulating behavior frequency occurring 1 hour after intervention across the 4 weeks. Figure 2A shows the individual results for the change in these behaviors 1 hour after integration activities for weeks 1 through 4. Figure 2B shows the mean data for the percent change in self-stimulating behaviors with values greater than zero indicating an increase in behavior frequency and values less than zero indicating a decrease in behavior frequency. Self-stimulating behaviors decrease by an average of 11 ± 5% one hour after sensory integration intervention (weeks 2 and 4) when compared to a 2 ± 4 % increase 1 hour after tabletop intervention (weeks 1 and 3) ($p = 0.02$). In addition, the frequency of self-stimulating behaviors declined from weeks 1 to 4 ($p = 0.04$).

The teacher ratings of self-stimulating and self-injurious behavior frequency and repetitious vocal sound frequency for the control and sensory integration conditions are shown in Figure 3A. Teachers reported fewer self-stimulating and repetitious vocal sound behaviors during the sensory integration weeks compared to the control weeks ($p < 0.05$). Given the similarity in the self-stimulating and repetitious vocal sound results, the data were combined in Figure 3A. The primary objective for collecting the teachers' ratings of self-stimulating behavior was to determine whether the teachers' perceptions of self-stimulating behavior frequency related to the investigator observations of self-stimulating behavior frequency. A Spearman rank order correlation was used to determine the relationship between teacher ratings and the investigator observations of self-stimulatory behaviors. Figure 3B shows a moderate but significant correlation ($r = 0.32$, $p < 0.001$) between the frequency of behaviors scored by the investigators 1 hour following the sensory integration or control intervention, and the teacher ratings of self-stimulating and repetitious vocal sound frequency combined. These results further support the reliability of the method used by the investigators to determine self-stimulatory behavior frequency.

Discussion

Clinical research has shown that self-injurious and self-stimulating behaviors have a tendency to interfere with a person's ability to function independently and therefore must often be addressed before any significant increase in function is accomplished through intervention (Harris & Wolchick, 1979). This study found the frequency of self-stimulating and self-injurious behaviors remained relatively the same before and after both the sensory integration and control interventions. However, 1 hour after sensory integration intervention the frequency of self-stimulating behaviors declined ($p = 0.01$, Figure 1). Figure 2 illustrates that during weeks 2 and 4, when participants received sensory integration intervention, self-stimulating behaviors decreased by an average of 11% ($p = 0.02$). In contrast, during weeks 1 and 3, when participants were engaged in tabletop activities, self-stimulating behaviors increased by an average of 2% one hour following intervention. Figure 2 also shows a decline in self-stimulating behaviors over the 4-week period in spite of the intervening control week ($p = 0.04$).

The results of this study support the findings of several other researchers (Bonadonna, 1981; Bright et al., 1981; Dura et al., 1988) who found no change immediately following sensory integration intervention however, after a latency period, they report a reduction in self-stimulating and self-injurious behaviors. In addition, some researchers (Bonadonna; Case-Smith & Bryan, 1999) found an overall downward trend of behaviors over time. Case-Smith and Bryan reported positive results when intervention occurred over a 10-week period. The results of this study conducted over four weeks with only 2 weeks of sensory integration intervention support these findings. The findings of these studies suggest that future research examine the long-term effects of more extensive intervention.

The independent rating of behavior by the classroom teachers working with the subjects corroborated the observations of the therapist (Figure 3). This suggests that reduction of self-stimulatory and self-injurious behavior is carried over into the classroom. The purpose of occupational therapy as a related service in schools is to enable students to benefit from their educational placement. The results provide evidence that sensory integration intervention was effective overall in reducing self-stimulating and self-injurious behaviors in the classroom, which interfere with function and participation. Activities that were rich in vestibular, tactile, and proprioceptive input that specifically addressed the individual's sensory processing needs were most beneficial in reducing the maladaptive behaviors when compared to the control conditions. By incorporating intervention that used sensory integration, better organization of

adaptive responses to input appeared to enhance the subject's general behavior organization.

Limitations of this study include the small sample size, use of a single clinical site and lack of psychometrics for the Sensory Integration Inventory Revised—For Individuals With Developmental Disabilities. Continued research is indicated in this area to further examine the effectiveness of sensory integration intervention on reducing self-stimulating and self-injurious behaviors and increasing positive participation in educational and work settings of people with severe and profound mental retardation. Future studies are needed in the following areas: (1) employing a larger sample size in order to increase the probability of significant results, (2) examining the results of sensory integration intervention over a longer period and its influence on promoting positive behaviors as well as reducing self-stimulating and self-injurious behaviors, and (3) researching the effectiveness of nontraditional models of intervention such as having an appropriate sensory diet implemented within daily routines by caretakers to counteract the tendency for self-stimulatory and self-injurious behaviors thereby facilitating continuous attending, functional development and participation in society.▲

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