



# **Sensory Integration Efficacy Packet**

## **Article Reviews**

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**Title:** Clumsiness in Adolescence: Educational, Motor, and Social Outcomes of Motor Delay Detected at 5 Years  
**Authors:** Cantell, Marja; Smyth, Mary; Ahonen, Timo  
**Reference:** (1994). *Adapted Physical Activity Quarterly*, (11), p. 115-129.

### Description

This is a 10-year follow-up study of a group of children in a town in Finland, who were found to have motor and perceptual delays at age 5 years. The children were selected from the general population of 5 year olds. They were tested at ages 7, 9, and 11. At age 11, half of the children still differed from the control group in performing motor tasks. These children also appeared to be having problems in academic performance, specifically, in reading, writing, and arithmetic. This current study focused on the status of the children's motor abilities, educational performance, and social-emotional development, especially self-image and leisure activities. The measures that were used were the Movement Assessment Battery for Children (ABC), Test of Motor Impairment (TOMI), four subtests of the Wechsler Intelligence Scale for Children (WISC), Self-Perception Scale for Adolescents, and school reports. A semi-structured interview to assess their hobbies and future career plans was also conducted. The original study had a total of 146 subjects: 106 experimental and 40 control. For this follow-up, 53 remained in the experimental category (clumsy), and 28 were placed in the intermediate group, which meant that these children were no longer different from the control group.

To measure movement and perceptual ability 19 items were studied, such as ball throwing, catching, and jumping. Consistently, the control group scored better than the subjects in the clumsy group on all tasks. The intermediate group performed better than these children as well, but performed worse than the control group on three tasks: the Purdue Pegboard, visual matching, and spatial relation. The IQ tests followed a similar pattern. The children in the clumsy group had lower scores on each test than did the children in either the intermediate group or the control group. School performance was also measured. In all school subjects the children who were clumsy performed the worst. When IQ at age seven was factored in, the differences in performance disappeared, except in three areas: drawing, music, and physical education. The clumsy children's scores were the lowest in comparison to the intermediate and control groups.

The interviews provided data on hobbies that were broken down into four categories: physical and social, physical and nonsocial, nonphysical and social, and nonphysical and nonsocial. Overall, the children in the clumsy group had fewer hobbies than the control group. No significant difference was found between the intermediate and the control groups. Significant differences existed for the specific categories. In the social/nonphysical category, the control group differed from the clumsy and intermediate groups combined. For the social/physical category a significant difference

also was found: the children in the clumsy group had significantly fewer hobbies than either of the two other groups. In the other two categories no significant differences were found. Therefore, the authors concluded that even though the children in the clumsy group had fewer physical hobbies, they overall had fewer hobbies of any kind.

In regard to the subjects' self-perceptions, the major areas of difference were on their views of their scholastic and athletic competence. The children in the clumsy group had a poorer opinion of their competence than either the intermediate or control groups. These two groups did not differ from each other. The authors concluded that the subjects in the clumsy group had a realistic perception of their abilities. This related directly to the subjects' future plans. Those children in the study who remained in the clumsy category at age 15 had lower aspirations to go on for further academics than the other two groups. In addition, although the intermediate group experienced some difficulties with motor tasks, they succeeded academically and engaged in social sports. Given these differences with the clumsy children, the authors concluded "social and educational outcomes are poorest for those with the most extreme motor difficulties...some children do 'grow out of it,' some do not."

**Title:** The Efficacy of Sensory Integration Procedures, Part I  
**Authors:** Cermak, Sharon; Henderson, Anne  
**Reference:** (1989). *Sensory Integration Quarterly*, (XVII) 3, p. 5.

### Description

In Part I of a two-part series, Cermak and Henderson explored the characteristics of sensory integration therapy, how it works, and how to measure the therapy's effectiveness. They used the criteria that Kimball described in 1988 to define sensory integration therapy. The treatment must be child-directed, individualized, and purposeful. Proprioceptive, vestibular, and tactile input must be utilized in order to evoke an adaptive response, with the goal being improvement in sensory processing. These criteria ruled out sensory stimulation procedures, which use controlled applied vestibular input, or perceptual motor programs, which are pre-planned and therapist directed.

Cermak and Henderson then discussed evidence of how the therapy works. They reviewed the works of Kavar and Ottenbacher, whose studies demonstrated changes in hemispheric specialization, and Postrotary Nystagmus (PRN), respectively. The authors also quoted the work of Linda Tickle-Degnen who has suggested that neurophysiological processes should be monitored through PET scans or EEGs to provide evidence of the effect of the treatment. Cermak and Henderson then described three variables: treatment, patient, and therapist, which could influence a child's response to treatment. The treatment variables were the sequence of sensory inputs and therapist-induced vs. child-induced stimulation. Patient variables were age, sex, diagnosis, and severity. Therapist variables were sex, personality, and expectations. The authors then described three methods used to examine these variables: treatment observation, theory, and controlled testing. Although observation and theory are important, Cermak and Henderson primarily addressed how sensory integration has been studied, and they made recommendations for future research. In their review of the research on sensory integration therapy, they found that six types of outcome measures were used: academic, language, motor, Postrotary Nystagmus, self-stimulation, and behavior. To measure treatment outcomes, standardized instruments were used 50% of the time. It was the authors' impression that using such a wide range of outcome measures with the inconsistent use of standardized instruments made it very difficult to compare studies on sensory integration.

Therefore, the authors suggested that the measures that are currently used are insufficient. They may not be sensitive enough to pick up subtle changes. Cermak's and Henderson's recommendations for addressing this problem were to develop additional clinical evaluation measures and expand the outcomes measured to be more specific. They suggested several new areas to study: organization, learning rate, attention, affect, exploratory behavior, biologic rhythm (sleep-wake cycle), sensory responsivity, play

skills, self-esteem, peer interaction, and family adjustment. These are areas which family, teachers, and therapists may observe and which could lend important evidence to support the use of sensory integration therapy.

**Title:** The Efficacy of Sensory Integration Procedures, Part II  
**Authors:** Cermak, Sharon; Henderson, Anne  
**Reference:** (1990). *Sensory Integration Quarterly*, XVIII (1), p.1-5.

### **Description**

Cermak and Henderson continued their discussion of sensory integration research in this article. They described two major reasons why sensory integration therapy has been criticized. First, two conflicting philosophical orientations exist in occupational therapy for children. Sensory integration and neurodevelopmental therapy both focus on influencing the nervous system, while the other approach is to develop skills, through teaching and the use of equipment. This emphasis on skills has found support in other fields, such as education and medicine, where studies have concluded that normal growth and development would cause improvement in the nervous system without the need for any intervention. The second reason for the criticism of sensory integration therapy has been problems in the research. The authors discussed the findings of several studies, which identified problems in the selection of subjects, the design, the instruments used, and the analysis of data. They found that in these studies positive results had been dismissed because of disagreement about an aspect of the research.

The authors drew several conclusions from their review. In the face of this criticism they acknowledged that it was necessary to recognize problems in the research and attempt to make improvements, while still believing in the work. Therefore, they recommended the development of the meta-analysis approach that Ottenbacher first used in 1982. This approach provides a much larger sample size overall, which could include important data from an accumulation of small studies that might have been minimized if considered in isolation. In addition they suggested studying the effect of sensory integration therapy with children who have different diagnoses, disabilities, and ages. This would allow a better definition of who can benefit from this type of therapy and who cannot. They also recommended looking at the immediate effect of the therapy, as well as studying the changes over time. Although informally noted by parents, teachers, and therapists, the immediate change in the child has not been formally studied. Finally, Cermak and Henderson stressed that it was necessary to maintain the focus on functional changes when addressing the effectiveness of treatment. This is the hallmark of the occupational therapy profession.

**Title:** A View from the "Outside": Sensory Integration and Developmental Neurobiology  
**Author:** Cool, Steven  
**Reference:** (1987). Sensory Integration Special Interest Section Newsletter, 2-3.

### Description

In this article Steven Cool explored the role of motor output in sensory integration and the overall role of the vestibular system. He compared research in developmental neurobiology with research and practice in sensory integration occupational therapy in order to understand the sensory integration process. Occupational therapy defines sensory integration as the coordination of sensory input, motor output, and sensory feedback. Cool chose to focus his initial research review on motor output and found that "it is the motor patterns which give meaning to sensory input." To further elucidate this point, he explored how external spatial information is organized. When a person takes in information from the visual, auditory, and somatosensory systems, the input goes to a specific area: the Occipital, Temporal, and Parietal lobes. This occurs in the posterior parietal area of the cerebral cortex, which Cool described as "an integrated map of the real-world space." After the input is registered, the person acts upon this information, which is called motor output. If this does not occur then the individual cannot validate the sensory information, and as Cool described it, the person is "lost in space." Without the motor output, no feedback occurs to the sensory system.

Once he addressed the role of motor output, the author explored the role of the vestibular system. He acknowledged that occupational therapy has addressed this extensively, but neurobiology has not. Cool compared the five commonly known senses to the vestibular system and found that, unlike the other senses, the vestibular system not only has ascending nerve pathways to the cortex, but also descending. This suggested to him that the vestibular system might be both sensory and motor. The vestibular input that does ascend to the cortex does not go to a single primary area like other sensory input, but goes mainly to the posterior parietal area where visual, auditory, and somatosensory information is integrated. Cool therefore surmised that the vestibular system might be the "integrator" for all sensory and motor systems. Therefore, it is the vestibular system that provides information to the person about where they are in space. Cool described this information as a "reference base against which all sensory input and motor output information must be evaluated."

His conclusion is that for sensory integration to occur, the following criteria must be met: normal input of sensory information; referencing of sensory inputs against a stable, spatial coordinate system provided by the vestibular system; planning of motor outflow patterns referenced against the same coordinate system; the actual execution of motor output; and the resulting sensory mapping of space, validated by actual

movement of the individual through space. In his view if any of these components is missing, then normal sensory integration will not be possible. He credits the clinical experience of occupational therapists practicing sensory integration therapy with leading the way to understanding this connection.

**Title:** The Efficacy of Sensory Integration Therapy for Children with Learning Disability  
**Authors:** Humphries, Tom; Wright, Maureen; McDougall, Beth; Verites, Joan  
**Reference:** (1990). *Physical and Occupational Therapy in Pediatrics*, Vol. 10 (3), p. 1-17.

### Description

In this study the authors attempted to measure the effect of sensory integration therapy on children in regard to their sensorimotor, cognitive, language, and academic skills, as well as sensory integration dysfunction. Thirty children, ages 72-99 months, who had learning disabilities and sensory integration dysfunction, were placed randomly into three groups: sensory integration treatment (SI), perceptual-motor treatment (PM), and no treatment (NT). These children were pre-tested using the Wechsler Intelligence Scale for Children, the Wide Range Achievement Test, the Southern California Sensory Integration Test (SCSIT), the Bruininks-Oseretsky Test of Motor Proficiency (B-O), the Developmental Test of Visual Motor Integration (VMI), and clinical observations. Criteria for inclusion in the study also included the lack of a primary physical, emotional, or sensory impairment as well as cultural or language differences. Each group had 10 subjects who were tested prior to treatment and after the six-month period of treatment was concluded. Both the SI and PM groups received 24 hours of therapy on a one-to-one basis for one hour a week. The children did not receive any other therapy or special education assistance during this time period. Therapists were certified in sensory integration testing and experienced in both SI and PM therapy. The same therapists provided both types of therapy and were randomly assigned the subjects. All the pre- and post-testing was done by therapists certified in SI, but they did not provide the therapy.

The results were that the most significant differences were found in motor functioning. SI therapy was superior to PM therapy and to NT on Motor Accuracy (from the SCSIT) and Strength (from the B-O). The Motor Accuracy test measured precise eye-hand coordination and planning of visually directed hand movements around a maze. The Strength test required the ability to assume and maintain supine and prone postures in sit-ups and push-ups. It also involved co-contraction of shoulder, elbow, and wrist joints. Gains were also made in motor planning by the SI group, which was seen by significant group differences in the Bilateral Coordination test (from the SCSIT) and Motor Accuracy. Bilateral Coordination measured sequencing of motor tasks.

The authors did not find any significant improvement in cognitive, language, or academic skills in this study. They stated that this could be related to several factors: duration and intensity of therapy, the type and severity of the child's

problem, or limitations in studying the therapy's effectiveness. In addition, the Wide Range Achievement Test may not have been the best measure for academic skills. The authors referred to other studies, which have reported some academic gains related to SI therapy, but indicated the need to have further research so that any reported improvement can be verified.

**Title:** Clinical Evaluation of the Effectiveness of Sensory Integrative and Perceptual Motor Therapy in Improving Sensory Integrative Function in Children with Learning Disabilities  
**Authors:** Humphries, Thomas; Snider, Laurie; McDougall, Beth  
**Reference:** (1993). *The Occupational Therapy Journal of Research*, Vol. 13 (3), p. 163-182.

### Description

In this study the authors were addressing the efficacy of sensory integration therapy for children with learning disabilities who also had sensory integration dysfunction. This study investigated the impact on sensory integration functioning only. It differed from a previous study conducted in 1990 by Humphries, Wright, McDougall, and Vertes, which looked at improvement in motor functioning and in academic skills. In this study there were 103 children, ages 58-107 months. The subjects were included in this study based on their performances in several tests: the Weschler Intelligence Scale for Children, the Wide Range Achievement Test, the Southern California Post Rotary Nystagmus Test (SCRNT), as well as clinical observations. Sensory integration dysfunction was measured by the SCRNT and the Southern California Sensory Integration Test (SCSIT). None of the subjects could have a primary sensory impairment or physical handicap, emotional disturbance, cultural difference, or have English as a second language. The children were also given cognitive, language, attention, and academic testing, even though the focus of the study was their sensory integration functioning. They were randomly assigned to the sensory integration (SI), perceptual motor (PM), and no treatment (NT) groups. Both the SI and PM groups received 72 hours of therapy on a one-to-one basis for three 1-hour sessions a week. The SI therapy included activities that provided tactile, vestibular, and proprioceptive experiences, using overhead equipment, balls, and mats. The PM therapy focused on remediating specific weakness of motor control, using gross motor activities, such as jumping jacks and skipping, and fine motor activities, such as cutting, mazes, and dot-to-dot puzzles. Children were randomly assigned to one of eight therapists, who were all qualified to provide either type of therapy. The pre- and post-testing was done by occupational therapists who were certified in SI testing but had not provided treatment in the study.

The results were that more children receiving sensory integration therapy and perceptual motor treatment improved compared to the children who did not receive treatment. Sixty-one percent of all the children improved their sensory integration functioning. This confirms the clinical observations of occupational therapists about the effect of their treatment. Seventy percent of both the SI and PM groups showed improvements, whereas only 44% of the NT group improved. In addition, the SI group significantly reduced the severity and number of their

dysfunctional systems. Improvement in the NT group raised the issue of the accuracy of evaluations and the possibility of improvement over time. The authors also found that the subjects who received PM therapy raised their scores into the normal range and those receiving SI reduced the severity and number of their dysfunctional systems. When the two groups were further compared it was found that in the PM group there was a greater number of subjects with vestibular dysfunction. Those in the SI group had a greater number with severe generalized dysfunction. The authors thought that these distinctions could have influenced the results. Overall, they found that both mildly and severely involved children improved, but to different degrees.

**Title:** Changes in Special Needs Children Following Intensive Short-Term Intervention  
**Authors:** Kinnealey, Moya; Koenig, Kristie; Huecker, Gail Eichelberger  
**Reference:** (1999). *Journal of Developmental and Learning Disorders*, Vol. 3, (1) p. 85-103.

### Description

The purpose of this study was to measure the effectiveness of an intensive occupational therapy intervention with children who had been identified as having special needs. The experimental group comprised 48 children, ages 6-13, who attended the OT/Sensory Integration camp for 6 days. In this group the children had sensory experiences in the morning, daily 45-minute gross motor movement, sensory fine motor sessions, and rhythm and movement. The activities were all individually adapted to the needs of each child. This group was compared to a group of 27 children who attended a special needs camp, (Special Ed group). They went to a six-week camp and received occupational therapy once or twice a week. The intervention they received supported educational activities, such as remedial handwriting and academics, as well as gross motor, fine motor, auditory processing, and perceptual motor skills. The authors hypothesized that the OT/SI group would show a reduction in soft neurological signs, improved behavior, reduction of defensive responses, and reduction of ADD type behaviors, and that these changes would be maintained. All of the subjects were given the following tests at different points during the study (before, during, or one week after their camp ended): Quick Neurological Screening (QNST), Conner's' Parent Rating Scales, Sensory Profile, and the Behavioral Style Questionnaire (BSQ).

The results were that the children in the intensive OT/SI camp demonstrated a reduction in soft neurological signs compared to the Special Ed group. In regard to improvement in behavior, the Special Ed group showed changes in mood only. The SI group showed significant changes in activity, predictability, and adaptability. No significant change was found between the two groups in defensive responses. There was a significant difference between the two groups in reduction of ADD behaviors. The children in the SI group demonstrated a decrease in these behaviors. The final hypothesis regarded maintenance of the improvements. The SI group maintained its improvement in adaptability, as well as in ADD behaviors.

The authors also explored the role of medication in these results. Sixty-four percent of the SI group and 67% of the Special Ed group were on medication, mostly on Ritalin. They originally thought that children on medication would benefit less from the SI intervention. However, they found

that those on medication and those not on medication both benefited and made changes as seen in their scores on the QNST, the BSQ, and the Sensory Profile. Children on multiple medications made improvements on the QNST and the Conner's' Parent Rating Scales, but not on the Sensory Profile. The authors thought this might have been due to the need for a longer time for these children to respond to a Sensory Integration approach. In their conclusion, the authors recommended that other models of treatment, such as weekly or biweekly sessions over longer periods of time, should be studied.

**Title:** Clumsiness in Children--Do They Grow Out of It? A 10-Year Follow-Up Study  
**Authors:** Losse, Anna; Henderson, Sheila; Elliman, David; Hall, David; Knight, Elizabeth; Jongmans, Marian.  
**Reference:** (1991). *Developmental Medicine and Child Neurology*, (33), p. 55-68.

### Description

In this article the authors described a follow-up to a study done in 1982 with 32 children, 16 of whom were found to be "clumsy" at the age of six years. Those in the control group were individually matched for age and gender, and each pair of children were in the same class in school. For this follow-up study, seventeen of the original subjects, ages 15 years, 1 month to 17 years, 4 months, participated. Five measurements were administered individually: Neurodevelopmental Test Battery (NDT), The Test of Motor Impairment (TOMI), Wechsler Intelligence Scale for Children, Perceived Competence Scale for Children, school records, and an interest questionnaire developed by Nias. An informal interview was also conducted but was not included in the analysis.

The authors compared both groups. Their first question was Were the "clumsy" children still different from their peers? The findings were that these children differed "substantially" on the neurodevelopmental testing and the TOMI. In addition, their teachers reported that they had difficulty in handwriting, art design, technology, home economics, and practical science lessons. The second question considered was Do the "clumsy" teenagers differ in other ways? The authors did not find any differences between the groups in the Verbal and Performance IQ. However, there were differences in their competence. Teachers reported that these students tried as hard but did not achieve. An example of this is that 14 members of the control group were taking "public examinations," whereas only six in the "clumsy" category were. The "clumsy" group also experienced more behavior problems, including social difficulties, poor concentration, problems with organization, and antisocial activity. Differences also existed in their interest and participation in activities that included sports, leisure, and school.

The children in the "clumsy" group were also studied for specific characteristics. Persistence of their motor difficulties was measured. The authors found that the majority of children continued to have these problems. Nine of the children rated poor on three out of four assessments and no child scored as high as average on any of the four assessments. Common difficulties were handwriting and organization and presentation of materials. The authors also studied academic and social competence in this group. Twelve were found to be doing poorly academically, while five were doing well. However, only one of the five did not have any other problems. It was not possible to define if other factors, besides clumsiness, were influencing these results.

They did find, though, that even if a child was bright and competent at age six years, this did not necessarily continue into later school years. They included cases to describe how two of the children have coped.

The author's overall findings were that the children did not outgrow clumsiness. They found that almost all the children previously defined this way continued to have motor difficulties. They also had poor self-concept and other difficulties. The authors recommended that minor motor problems in early childhood should not be ignored and that intervention should be considered because these problems continue into adolescence.

**Title:** Researching the Effectiveness of Sensory Integration  
**Authors:** Miller, Lucy Jane; Kinnealey, Moya  
**Reference:** (1993). *Sensory Integration Quarterly*, XXI (2), 2-7.

### **Description**

In their article Miller and Kinnealey reviewed the important issues to consider when evaluating research done on sensory integration therapy. The authors found that consistent criteria were not utilized when studying the therapy and the inclusion of subjects. In order to address this, they first described specific characteristics of the therapy that must be present in order to call it sensory integration. They used the criteria that Kimball (1988) has described: the treatment has to be client-directed, individualized, and purposeful. It requires that the person is actively engaged in the process and that the goal of the treatment be to improve underlying neurological processing. They contrasted this with sensory stimulation, which is therapist-directed, even though the activities may be similar. Miller and Kinnealey also discussed perceptual-motor treatment, which they described as preplanned and directed by the therapist. Clarifying these distinctions among treatment approaches ensures that a study is measuring sensory integration and not another type of therapy.

Another concern expressed by the authors related to the description of the sample. In their review of the research the authors found that a wide diagnostic range was studied. However, prior to inclusion in the study, if the sensory integrative functioning of the children was not evaluated or if the criteria varied from one study to the next, then the results of the studies could be different. Without adherence to consistent criteria then the effectiveness of the treatment may not be accurately measured, and results would not be valid or reliable.

Miller and Kinnealey made some recommendations regarding research design. They stated that consistent criteria for the therapy are necessary so that the results can be reliable. It was also important to the authors that well-standardized tools be developed in addition to the few that are currently used. They raised the concern that reliance on a few measurements could cause reliability and validity of results to be questionable. They also discussed the need to choose a measure based on the research question. To exemplify this, Miller and Kinnealey discussed the measurement of the impact of sensory integration therapy on academic performance. If the hypothesis of a study were that sensory integration therapy would improve academic performance, then change in academic performance or behavior, not just test scores would need to be measured. Overall their recommendation for the best research approach was to use a large variety of well-defined samples and multiple researchers who represent large numbers of programs. It was the authors' opinion that the subject of sensory integration therapy was too complex to be able to answer questions on its effectiveness with isolated studies.

**Title:** Sensory Integration Therapy: Affect or Effect  
**Author:** Ottenbacher, Kenneth  
**Reference:** (1982). American Journal of Occupational Therapy, 36 (9), 571-8.

### Description

In this article Kenneth Ottenbacher described his meta-analysis of eight studies on the effectiveness of sensory integration therapy. The criteria for inclusion of these studies were the effect of sensory integration therapy was investigated, dependent measures of academic achievement, motor or reflex performance and/or language function were included, and the studies quantitative results of the therapy's effect. Of the 49 studies that Ottenbacher reviewed, only eight were included in the analysis. Studies that used sensorimotor approaches were eliminated even though the techniques were similar to sensory integration therapy. There were 317 subjects, ranging from ages 4-62 years. The diagnostic breakdown was as follows: 89 mentally retarded, 19 learning disabled, 18 aphasic, and 19 "at risk" for learning disorder. In the eight studies, 47 hypotheses were tested using the required dependent measures. Random assignment to experimental and control groups was used in four of the studies. Three used random assignment and matching and one used pre-existing groups.

When Ottenbacher performed analyses, he compared the experimental and control groups. He found that the average performance of subjects in the experimental groups receiving the therapy was better than 78.8% of the subjects in the control groups. He analyzed the tests according to the type of dependent variables measured. Of the 19 hypothesis tests that measured motor or reflex performance, 12 found a significant effect, which meant that the average subject receiving sensory integration therapy performed better than 84.8% of the control subjects. Academic performance was measured in 17 of the 47 hypothesis tests. Of these 17.9 had a significant effect in the experimental groups, which meant that the experimental groups performed better than 77.3% of the control groups in academic achievement. Language function was measured in 11 of the 47 hypothesis tests. Four of the tests found significant effects. Therefore 66.6% of the experimental subjects performed better than the control groups in their language function. The overall results were that sensory integration therapy was most effective with motor or reflex performance and least effective with language function.

Ottenbacher further analyzed the studies according to diagnoses. He found that 17 of the hypothesis tests involved the subjects with a mental retardation diagnosis. The average subject performed 69.8% better than those in the control group. In the learning-disabled category, those in the experimental group performed 75.2% better than those in the control group. The remaining 15 hypothesis tests were on those in the "at risk" or aphasic category. Those receiving treatment performed better than 88.5% than those that did not. Sensory integration therapy was found to have its greatest effect on those

who were diagnosed as aphasic or at risk. It was the least effective with subjects who had mental retardation.

**Title:** Is Sensory Integration Related to Achievement? A Longitudinal Study of Elementary School Children  
**Author:** Parham, Diane  
**Reference:** (1990). *Sensory Integration Quarterly*, p. 9-17.

### Description

Diane Parham conducted a four-year study of the relationship between sensory integration factors and arithmetic and reading achievement. Unlike previous studies, she used statistical controls for intelligence so that intelligence would not influence the results. The subjects were 32 children who were in the learning handicapped group (LH) and 35 who were in the non-learning handicapped (NLH) group. The LH group had been previously identified and were receiving special education services. The NLH children were randomly selected from the same schools as the LH children. The subjects' ages ranged from six to eight years, and they were ten to twelve years old at the follow-up. Sensory integration functioning was measured by three factor scores on the Sensory Integration and Praxis Tests (SIPT): somatopraxis, visuopraxis, and tactile-kinesthesia. The Kaufman Assessment Battery for Children was used for measurement of arithmetic and reading. Intelligence was controlled for by using the K-ABC Mental Processing Composite (MPC). Ethnicity, gender, and socioeconomic factors were also included in the analysis.

The strongest relationship occurred between sensory integration functioning and achievement in arithmetic for children in the six to eight-year-old group. This association decreased as the children aged. Reading was most closely associated with intelligence and socioeconomic factors in the six to eight year age group. However, at ages ten to twelve, one of the SIPT areas, somatopraxis, along with intelligence and socioeconomic factors, was found to be significant. Prediction of reading ability across the four years was also measured. Those results were that somatopraxis and visuopraxis, as well as intelligence and socioeconomic status, were significant. Parham also measured the changes in performance between the two groups by comparing their SIPT factors over the four years. She found that the LH subjects performed significantly lower than the NLH children in the somatopraxis area in both age groups. A significant difference was found for visuopraxis at ages ten to twelve. No significant difference between the groups was found for the tactile-kinesthesia factor. Parham suggested that these results on the tactile tests supported Jean Ayres' (1976) statement that the tactile tests were "poor discriminators" of problems in older children.

Parham's findings do demonstrate that the LH children performed poorly on the somatopraxis and visuopraxis factors and "did not catch up" with the NLH children as they grew up.

**Title:** What is Sensory Integration?  
**Author:** Roley, Susanne Smith; Wilbarger, Julia  
**Reference:** (1994). Sensory Integration Special Interest Newsletter, 17 (2), p. 1-8

### Description

The purpose of this article was to interview occupational therapists regarding their reflections on sensory integration. In the interviews the therapists were asked to consider the scope of sensory integration theory and practice. The contributors to the article are all well-respected leaders in the field of occupational therapy: Florence Clarke, Josephine Moore, Sharon Cermak, Virginia Scardina, Anne Fisher, Winnie Dunn, Zoe Mailloux, Patricia Wilbarger, and Lawrence Kovalenko.

Sensory integration and its parameters is a challenging topic. Two of the authors, Sharon Cermak and Winnie Dunn, presented information suggesting that it might be necessary to add to the clinical populations identified as possibly having sensory integration difficulties. According to Cermak, children with autism or pervasive developmental disorder and those with complications from lead paint poisoning or fetal alcohol syndrome have been found to also have sensory integration difficulties. Dunn suggested that the theory of sensory integration could be applied to "anyone who has behavior that is indicative of a nervous system operating differently than that of typical persons." She proposed that this could include those with a brain injury or mental illness and that, therefore, this possibility should be studied. Florence Clark is involved in research to understand the relationship between sensory integration difficulties and adult occupational choices. This potential connection takes a broader view of how to use the theory.

Documenting the effectiveness of this theory and the therapy was a topic that many of the authors addressed. As suggested by Virginia Scardina the sensory integration process is an unconscious one and is therefore harder to document. In this regard, Josephine Moore suggested using positron emission tomography (PET) scans and magnetic resonance imaging (MRI) scans to help support the theory by looking for changes within the brain. Zoe Mailloux and Lawrence Kovalenko addressed the issue of working with members of other disciplines. Mailloux saw this as a possibility because of the growing support for sensory integration theory in the fields of medicine and education. In her view their input could contribute to and expand the theory. Kovalenko suggested collaborating with other disciplines so that the perspective from occupational therapy would be preserved in research. All the interviewees consistently raised the need for research to accurately document the effectiveness of sensory integration therapy. However, there was no agreement among the therapists on

what would be the best approach. While Scardina called for a “global” approach, using case studies to preserve the essence of the therapy, others such as Anne Fisher, expressed the importance of consistent terminology and the maintenance of the occupational therapy focus. Even though opinions differed regarding a research approach, the interviews reflected a consistent desire to communicate the benefits of sensory integration to a wide audience, including members of other fields as well as family members.

**Title:** Perspectives on the Status of Sensory Integration Theory  
**Author:** Tickle-Degnen, Linda  
**Reference:** (1988). American Journal of Occupational Therapy, 42 (7), 427-33.

### Description

The purpose of this article was to clarify how the research on sensory integration therapy relates to the theory. Tickle-Degnen described two methods of analysis of the research: synchronic, which describes the immediate response during therapy, and diachronic, which looks at the effect of therapy over time. In her review of the research the author has identified two types: one that studies the effectiveness of the therapy and another that determines how and why it is effective.

According to the author, synchronic research, measuring the effect of the sensory input on the child's nervous system within the treatment session, has not been done. Tickle-Degnen described the potential impact of this type of research. She suggested that this would make it possible for the therapist to receive feedback about the effect of the input from the child's responses. If the child has an "adaptive response" to the input then this would provide more feedback to the therapist, setting up the possibility of more adaptive responses from the child.

In contrast, diachronic research has been extensively conducted, especially using the case study method. After a period of therapy the child is tested in motor, academic, and social domains. When considering how and why the therapy is effective, the author identified two types of factors that could influence the results: moderating factors and mediating factors. She defined moderating factors as, "those qualities of the child, the therapist, and the environment that determine whether the therapy tends to be effective or ineffective." Tickle-Degnen found that much research has occurred that has studied these factors. The patient's age, diagnosis, and type of sensory integration dysfunction have all been studied, and the author has found that these appear to have great impact on the effectiveness of the treatment. The author also found research concluding that the degree of responsiveness to particular stimulation has been a moderating factor. Relatively unstudied factors, according to Tickle-Degnen, are the length and frequency of treatment, therapist's qualities, and other environmental factors. The author suggested that research into these variables might reveal which approach would be the most effective, with which type of problem.

Tickle-Degnen also discussed mediating factors, whose role was to, "help to explain why and how the therapy works." There are two types of mediating factors, those that can be observed and those that cannot. To measure the synchronic, or immediate effect of the therapy intervention, it would be necessary to monitor the neurophysiological responses during or right after the input. By using positron emission tomography (PET) scans and electroencephalogram (EEG), the mediating

factors would become observable. Both of these have begun to be used in research, which could provide immediate information about the response to sensory input. To determine mediating factors over time (diachronic) is more complex. The traditional method has been to observe changes in a child's performance. The author also described research that has found observable changes in the central nervous system as seen in changes in the postrotary nystagmus response after rotary vestibular input. Tickle-Degnen also pointed out that there is some controversy with the concept that a long-term effect of SI therapy is improvement in academic skills. As she described it, more research is needed to substantiate this connection.

The author made several recommendations about SI research. In order for the research to have more impact, it is necessary to use large enough sample sizes. Another option she suggested was to use a meta-analysis approach of combining the results of several small studies. Tickle-Degnen stated, as have other authors, that the careful choice of treatment and control subjects and the use of well planned control conditions would allow for replication of results, which would greatly enhance the effectiveness studies.

**Title:** Follow-up Assessment of Children Receiving Sensory Integration Treatment  
**Authors:** Wilson, Brenda; Kaplan, Bonnie  
**Reference:** (1994). *The Occupational Therapy Journal of Research*, Vol. 14 (4), p. 244-266.

### Description

This is a follow-up study to assess long-term effects of sensory integration therapy compared with tutoring. Out of the original 29 subjects, twenty-two 8-11 year olds participated in the follow-up. Each child was assessed by an occupational therapist, a physiotherapist, and a psychologist, none of whom was aware of which therapy the child had received. The assessments used were the Broad Cognitive Index & the Reading Cluster from the Woodcock-Johnson Psycho-educational Test Battery; fine motor, gross motor, and upper limb coordination subtests from the Bruininks-Oseretsky Test of Motor Proficiency; Developmental Test of Visual-Motor Integration; Design Copying Test of the Southern California Sensory Integration Tests and the Southern California Motor Accuracy Test-Revised; and the Abbreviated Symptom Questionnaire, completed by parents. The Hyperactivity Index of the Abbreviated Questionnaire was also used and was scored separately.

Test results were analyzed for academic, fine motor, visual motor, handwriting, and gross motor skills. Behavior, including hyperactivity, was also measured. A significant difference was found between the SI and tutoring groups on gross motor and upper limb coordination. The children receiving SI therapy maintained their gains, while the children in the tutoring group did not. All of the children, in both groups, continued to have difficulties in many areas, so maintenance of gains cannot be attributed to their growth and maturity. This disputed the notion that these children can "outgrow" their problems. It was interesting, however, that no other significant differences were found between the two groups. There was also no correlation between the amount of improvement a child had made in therapy and whether they maintained their improvement over time. This caused the authors to question what other factors may have influenced the results. They discussed the possible impact on the results of the individual differences of each child and also of the therapists. The authors concluded that several challenges face occupational therapists: to identify the desired change that is the goal for therapy, to identify the factors that can affect reaching the goal, and to develop accurate tools to measure the efficacy of treatment.