2009

Effects of sensory integration on motor development in K-3 students with autism

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EFFECTS OF SENSORY INTEGRATION ON MOTOR DEVELOPMENT IN K-3 STUDENTS WITH AUTISM

A Thesis

Presented to

The Faculty of the Department of Special Education

San José State University

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

by

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May 2009

SAN JOSE STATE UNIVERSITY

The Undersigned Thesis Committee Approves the Thesis Titled

EFFECTS OF SENSORY INTEGRATION ON MOTOR DEVELOPMENT IN K-3 STUDENTS WITH AUTISM

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ABSTRACT

EFFECTS OF SENSORY INTEGRATION ON MOTOR SKILLS IN K-3 STUDENTS WITH AUTISM

by Vrinda Murphy

This quasi-experimental study endeavored to determine whether or not Sensory Integration (SI) therapy has an effect on development of motor skills in children with autism. The intervention study included two participants who have a primary diagnosis of autism. For assessment, motor tasks were assessed in participants immediately following implementation of sensory stimuli. Results from the intervention study were compared to baseline assessments and identical exit assessments. It was hypothesized that outcomes of this study would support a relation between the implementation of Sensory Integration therapy and the development of motor skills. The intervention showed an increased ability of participants to complete motor tasks they were previously unable to perform. The survey showed an overwhelming agreement between professionals in the field regarding the effectiveness of SI in improving motor tasks. This study may be used to further enhance perceptions and use of SI to assist individuals in furthering their motor abilities.

ACKNOWLEDGEMENTS

This thesis would not have been possible without the support and encouragement of a select group of individuals. First and foremost, I would like to thank my fiancé, Bryan, for the constant love and support he provided me with throughout my graduate school process; without him, this thesis would not exist. Secondly, I would like to thank my mother, Janet, for encouragement, advice, and much needed laughs throughout this process. Third, thanks to my father Angus, who provided support, assistance, and a great motivator for completing this work in a timely manner. Last, but certainly not least, I'd like to express my gratitude to Dr. Peg Hughes, and the rest of my committee, for the countless hours they put into helping me create the study presented to you today.

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Chapter I

Introduction

Statement of the Problem

There are currently few options to treat the many symptoms of Autism Spectrum Disorders; the options there are do not have adequate research to support their effectiveness. Sensory Integration (SI) therapy is one of the leading therapy options for individuals diagnosed with autism. SI has been designed to assist individuals who have sensory deficits. These individuals may be hyposensitive, or they may be hypersensitive to a variety of sensory stimuli present in their own particular environments. Therapy allows said individuals a way to improve their areas of deficit by pinpointing the exact sensory trigger that sets them off and by slowly allowing exposure to those stimuli in order to increase the tolerance level the individual currently possesses.

Purpose of the Study

The purpose of the study is to determine how often sensory integration therapy is used with children with autism, and what benefits are attained from implementation. A more specific aim of the study is to determine what effects therapy has on the development of motor skills in children with autism, ranging in age from first through third grades. In addition, the study will analyze the degree in which motor function increases or decreases dependent on the specific type of sensory stimuli used in therapy. This specific type of therapy has been researched constantly throughout about the last ten years but is still not being considered a truly valid treatment option for children with autism. This is primarily due to the fact that the research which has been conducted has

been limited by a variety of factors, such as sample size, methodologies used, valid participants, length of study. Due to the many varying factors in research, this therapy is underused. This thesis will show the relation between sensory development and motor skill development. It will also present research from published scholarly articles supporting claims of a proposed relationship. From the current research available as well as research presented here, a proposed connection between the two areas of deficits and the importance of Sensory Integration therapy for individuals with autism will be examined.

Research Questions

1. How often is Sensory Integration therapy used in conjunction with motor skill tasks by professionals working with the autism population?
2. To what extent does Sensory Integration affect motor development in children with autism?
3. Will Sensory Integration improve fine and gross motor skills in individuals with autism?
4. Do professionals working with individuals with autism have positive attitudes about the effectiveness of Sensory Integration therapy?

Definition of Terms

1. Motor Imitation - attempting to copy a motor movement or skill.
2. Sensorimotor Therapies - using a combination of sensory and motor exercises to improve sensory and motor skills.

3. Sensory Integration (SI) - A therapy technique which involves doing exercises to improve the individual's understanding and capability to process sensory stimuli.
4. Occupational Therapy (OT) - A therapy technique which helps individuals regain or learn necessary daily living skills.
5. Auditory - The sense of sound and how it is processed.
6. Tactile - Information about the environment and the sense of touch.
7. Proprioception - How the body senses muscle and joint awareness.
8. Vestibular - The sense of balance, speed, and spatial awareness.
9. Gustatory/Olfactory - Having to do with the sense of smell.
10. Visual - Having to do with the sense of sight.

Chapter II

Review of the Literature

Introduction

Autism diagnosis rates have increased in the past few years. With this increase in diagnoses, more attention is being given to autism and how to treat and prevent it by professionals working in the medical, psychological, and neurological field. There is no cure for autism, and there is no clear answer as to what causes it (Centers for Disease Control and Prevention, 2009).

All autism spectrum disorders (ASD) are made up of three major areas of deficit; language, social, and behavioral (American Psychiatric Association, 2000). Children with autism also routinely show moderate to severe impairments in the areas of sensory skills and tolerance, and motor skills and control (Autism Continuum Connections, Education, and Support Site, 2009). These deficits can greatly affect development in social, behavioral, and language function, and significantly affect the individual's ability to gain skills in real-life situations, such as peer interactions, daily living skills, academic expectations, or communication. Sensory Integration (SI) is a therapy technique which can be used to improve sensory function for many people with disabilities, including those with autism (Reynolds & Dombeck, 2006). Because there is such a distinct relation between sensory and motor deficits, sensory integration therapy is a leading treatment of these deficits (Temple University, 2008). If individuals with autism begin processing sensory information better, they are often able to improve their motor skill development.

Because of this, sensory skill development and motor skill development are closely intertwined, and each affects the other's progress or lack of progress.

Autism spectrum disorders affect roughly one in one-hundred-fifty children (Centers for Disease Control and Prevention, 2009). It is a neurologically based disability which causes deficits in communication, behavior, and social skills. Autism is considered a spectrum disorder because of the vastly different forms it manifests in the individuals it affects. People with ASD's may present with a variety of manifestations; they may have Asperger's, where the individual has a difficult time in social situations but may have very competent language skills and minimal aggressive behaviors. They may have fairly severe autism with no speech, minimal communication skills, and therefore may be more apt to demonstrate tantrums and and/or aggressive behaviors. Every autism diagnosis is different, and the person affected by diagnosis varies widely from every other individual who has been diagnosed.

Sensory Integration Therapy

Prater and Sylstra (2002) present a comprehensive article detailing the medical etiology and epidemiology, as well as basic information about autism and possible interventions and diagnosis protocols. This article provides a detailed medical background explaining why individuals with autism experience the sensory and motor delays commonly seen. Dunn, Saiter, and Rinner (2002) go into more detail to define the sensory system and how autism affects one's ability to process and regulate sensory stimulation and input efficiently and in a beneficial manner. The authors also presented models for sensory processing, and presented information from studies done regarding

the sensory system and how it processes various stimuli. This article discussed the relationship between how a person with autism's lack of sensory regulation hinders their development and poses potential problems at various stages of life (Dunn et al. 2002). Their study contributes to the idea that sensory processing is an area of deficit for individuals with autism, and that sensory integration could be a viable treatment option.

Motor Skills and Imitation

According to Stone, Ousley, and Littleford (1997), "the performance of imitation by normally developing infants is related to developmental characteristics as well as the nature of the act being imitated" (p. 475). Motor imitation is a critical and crucial part of a young child's development. Children with autism consistently have difficulties with motor imitation, and this deficit considerably affects symbolic play, language development, theory of mind skills, cognitive skills, and social skills. Typically developing children use motor imitation constantly, especially throughout the first few years of life. Imitating basic and complex motor skills is how children learn to do everything, from walking and standing, to holding a crayon and drinking from a cup (Meltzoff, 2007). Motor imitation is a basic skill which is necessary for typical motor development. Unfortunately, individuals with autism typically have severe deficits in the areas of motor development, as well as motor skill imitation. Ingersoll, Schreibman, and Tran (2003) studied the results of nonsocial motivation for sensory feedback when imitating an action. They also addressed the use of social behaviors with imitation in children with autism, and children who are neurotypical.

According to Ingersoll et al. (2003), children with autism exhibit deficits in the areas of body, object, gestural, vocal, and pantomime imitation tasks. These deficits are more pronounced in a limited, specific set of actions. Also, the authors addressed the belief that children with autism are more motivated by sensory feedback than social feedback. This means that children with autism will respond better to motivation and prompting when it is sensory-based, such as touches, squeezes, objects with bright lights, etc., than the social feedback generally used to motivate young children, such as verbal praise, etc. Typically developing children often respond more positively to stimuli and motivation when it is social; in other words, when they are verbally praised in front of an audience of some sort, or awarded points in a classroom, etc. The study also tested the hypothesis that children with autism are less motivated when it comes to engaging in interactive and personal, biased contact with other children through imitation. Children with autism do not possess the same need to belong and fit within a specific group of same-age peers. These individuals are more interested in their own opinions, feelings, and needs, than in figuring out how to mold themselves to others around them. Without the ability to imitate motor skills, children with autism are at a severe loss when dealing with social and academic requests and requirements.

Therapy Options for Sensory Skill Development

Sensory deficits are present in over half of children with autism (Baranek, 2002). Due to these deficits, many therapy procedures have been established as possible treatments for sensory processing. For example, if a child has difficulty with their proprioceptive system, you would provide tools to help them better understand their

proprioceptive system (i.e., muscles and body awareness). These tools would vary with each child, but some commonly used tactics include: jumping on a trampoline, swinging in a swing, and chewing on crunchy, gummy, or hard foods. For a child with tactile difficulties, you may try having them wear different clothing textures, give deep pressure, follow a therapeutic brushing program, or give the child a fidget, or toy, during seated activities. However, many of these strategies have had minimal research done to prove their effectiveness. According to Baranek, Dawson and Watling (2000), and Dunn et al. (2002), there was a statistically relevant outcome in favor of sensory integration therapy as a treatment option for sensory deficits. Baranek found that many treatment options were effective, with the exception of sensorimotor handling, auditory intervention training, physical exercise, prism lenses, and sensory stimulation, but that Sensory Integration Therapy was the most effective according to her research. Dawson and Watling (2000) concluded that although Sensory Integration Therapy and Occupational Therapy can help individuals with autism, there have not been enough studies conducted to be conclusively effective. In the few studies which have been done, Auditory Intervention Therapy has been shown to be an ineffective therapy option for children with autism (Dawson & Watling). Due to these findings, the authors conclude that sensory processing is clearly a strong deficit for individuals with autism. Furthermore, since individuals with autism experience many problems associated with sensory deficits, sensory integration therapy is a critical approach to implement in order for these students to gain daily life skills and sensorimotor abilities.

Through careful research and implementation of case studies, Dunn et al. (2002) found that not only is sensory processing a strong deficit area for individuals with autism, but that Sensory Integration Therapy is clearly the best treatment option for sensory implementation in daily life (Dunn et al 2002). All studies reviewed found Auditory Integration Therapy (AIT) to be statistically insignificant in treating sensory deficits (Baranek, 2002; Dawson & Watling, 2000; Dunn et al.; Iarocci & McDonald, 2006; O'Neill & Jones, 1997). Auditory Intervention Training is a technique popularized by Drs. Bernard Rimland and Stephen Edelson (The Berard AIT Website, 2004). It theorizes that in individuals who have an auditory processing problem, AIT can be an effective treatment to improve auditory function. The theory behind AIT is that by using listening devices to listen to very specific sounds and music, the ear's acoustical reflex muscle is able to be retrained in order to decrease hypersensitivity or increase hyposensitivity to sound (Auditory Integration Training Institute, 2009). Because AIT is designed to assist an individual in regulating their auditory system, it is closely related to Sensory Integration because of the involvement with the sensory system.

There were also types of Sensory Integration Therapy which were still under review in order to determine their effectiveness in improving sensory skills and processing abilities. For example, Qigong therapy is a Chinese technique which is a treatment sometimes used to decrease stereotypical autistic behaviors and deficits. Qigong is a relaxation technique which helps the individual regulate their energy level and their bodies using breathing techniques, postural changes, and imagery. This therapy is often done to assist the individual in calming their bodies when they are over-aroused.

According to the Qigong Sensory Training Institute, qigong therapy is essentially a research-based intervention technique. It has shown encouraging research in assisting children overcome their sensory deficits in controlled studies. As their sensory impairments improve, the children become less stressed, and are able to continue more natural learning (Silva, 2008). In a study by Silva and Cignolini (2005), they stated that medical Qigong is an effective treatment which should be used and depended on in more cases and with more clients. The research also made a very effective and convincing case for Qigong therapy implementation as a means to reduce autistic-like behaviors. Though their sample size was quite small, the elements of the study were thorough and well-defined. Every element of their presentation was explained well, and no information was missing. The authors also state that another case series was in the process of being planned with a larger sample size, which may show promising results for treating sensory deficits in individuals with autism.

The vast majority of scientific studies conducted show that there are definite sensory deficits present in individuals with autism, the extent of which is not yet known (Autism Speaks, 2009). Comprehensive studies of the available research have also shown clear evidence of sensory problems in those with autism (Autism Speaks).

Iarocci and McDonald (2006) believe in a multi-sensory approach to improve sensory deficits. For a treatment to be categorized as multi-sensory, it must engage all the senses—proprioceptive, auditory, vestibular, tactile, visual, gustatory, and olfactory. They believe that there is a clear connection between visual perception and auditory perception. Due to this belief, the authors state that research regarding multi-sensory

disciplines are required to further knowledge regarding sensory integration therapy. They also state that the perception of people with autism seems to be most significantly affected by their auditory systems and any multisensory approach which engages the auditory system.

Efficacy Studies

Baranek (2002) and Dawson and Watling (2000) reviewed empirical studies in order to make their conclusions, while Dunn et al. (2002) reviewed previous research and presented case studies depicting children who have had sensory treatments integrated into their therapy routine. All authors recognize that there is not enough research available to allow them to come to a conclusive answer regarding the effectiveness of sensory integration therapy, but what is available clearly shows sensory integration's relevance and importance.

In Silva and Cignolini's (2005) study, eight children under the age of six were chosen to receive medical qigong services. These children were then tested in a variety of areas, including behavior typically associated with autism, communication and language, and motor skills. These tests were given before and after treatments, and the results were compared and analyzed.

All of the children involved in the study showed decreased symptoms of autism than they had demonstrated beforehand. Three of the test subjects dropped from borderline to non-autistic in the Autism Behavior Checklist (Krug, Arick, & Almond, 1980) test. In the Childhood Autism Rating Scale (Schopler, Reichier, & Renner, 1993), four children went from moderately autistic to non-autistic, and one from severely to

moderately autistic. The variance between the tests taken before and after treatment was statistically relevant. As far as language improvements are concerned, seven out of eight individuals tested advanced in their level of language skills; only one made no change. With the Peabody Motor Skills (Folio & Fewell, 2000) evaluation, seven children made significant developments in the areas of stationary, locomotion, object manipulation, and visual-motor integration.

O'Neill and Jonas (1997) used published first-hand accounts, as well as psychological studies, in order to arrive at their conclusion regarding the correlation between sensory perceptual abnormalities and their relevance in individuals diagnosed with autism. In the first-hand accounts, more evidence is provided supporting the idea that individuals with autism experience many difficulties with sensory stimuli throughout their lives, and these deficits greatly affect their ability to functionally perform in daily life tasks.

Stone, Ousley, and Littleford (1997) conducted two studies. In the first, an equal number of children with autism, with developmental delay (DD), and with neurotypical development were examined. The Motor Imitation Scale and the MacArthur Communicative Development Inventory (CDI) were used to assess the children's imitation skills. The second study made an attempt to relate and compare the concurrent and predictive relations between motor imitation and other developmental skills. For the intervention study, 26 children with autism participated, 15 of whom were in study one, and 11 new subjects. The Motor Imitation Scale and the Communicative Development Inventory were used again, as well as Play Assessment Scale and Doll play. The authors

found a differential performance in imitation of non-meaningful versus meaningful actions. They also found that object and body imitation are not connected to each other. Imitation is not always the same; body, object, non-meaningful, and meaningful imitation all differ greatly from each other. Also, the imitation skills of typically developing children were rated higher than children with autism, but the total scores did not have a statistically significant difference.

Ingersoll, Schreibman, and Tran (2003) selected fifteen children with autism and fourteen typically developing children to use for their study. Three pairs of new testing toys were chosen for the sensory and manipulations capabilities they possess. The study took place in a quiet room, at a small table, with one facilitator present. The facilitator modeled the desired action three times, and encouraged the child verbally. The child was then given the toy immediately after each modeling period, with the expectation that they would then attempt to imitate the motor action needed by the facilitator. The study showed insubstantial differences between the two groups of children in the areas of imitation. Although the numbers were insubstantial, the group of children with autism showed a greater capacity for imitating actions and play with toys that had sensory feedback. This shows a clear preference for toys which hold a sensory element as opposed to toys with no sensory stimulation input. The sensory toys were ones with different textures, lights, and sounds. Toys which possessed these attributes were chosen to add interest to the toy for the child. These toys engage the sensory system due to the lights, sounds, and textures, which further engages the child.

In a study conducted by Hughes (1996), 36 children with autism, 24 children with no diagnosis of autism, and 28 typically developing children were tested and observed. The test began with a short play session to establish the baseline for each participant. The participants were then asked to follow one to two step directions to manipulate various toys and objects. The materials used were four simple wooden objects designed to further develop the child's motor function. All the participants showed a high level of consistency in how the trial was completed between each trial. The results showed that children with autism have problems executing direct goal motor actions, even in very basic, simplistic situations. There are also many factors which affect the ability to execute a task. Most of these factors have to do with motor planning and sensory ability deficits.

Recommendations for Further Research

Overall, most researchers felt that more research regarding the use of Sensory Integration Therapy for improving sensory capabilities for children with autism is greatly needed. Baranek (2002) recommends that further research be conducted to answer a variety of questions and concerns. These concerns were as follows: (a) effectiveness of sensory integration in improving educational goals, (b) other sensory intervention's effectiveness in improving educational goals, (c) effectiveness of task and environmental modifications to accommodate sensory sensitivities, (d) large-scale, cross-sectional, and longitudinal experimental studies to establish the effectiveness of sensory therapies and (e) to record the developmental process of sensory processing and motor function. In short, the author believes that a great deal more research is required within the area of

sensory processing and sensory deficits in order to have any baseline for measuring and prescribing sensory integration therapy for individuals with autism. Iarocci and MacDonald (2006) state that the next step in determining the theory of perception within autism is to study the outcomes of "enhanced feature detection or discrimination, weak central coherence or temporal binding, and atypical neural modulation or connectivity on perception in the context of the multisensory world (p. 86)." Although the authors feel more research is needed within this subject, they state their belief that research should not be done in a clinical manner, but rather, by using information gained from neuroscience. They believe that this will allow for more beneficial evidence and concepts for clinicians and researchers to use in order to better implement them in a realistic setting. Because there is such a lack of research regarding sensory integration therapy and motor skill development in those diagnosed with Autism, my research study will address how, and to what extent, sensory integration therapy affects the development of fine and gross motor skills in children with Autism by testing my hypothesis in an intervention study, as well as through a survey given to professionals in the autism fields.

Chapter III

Method

The purpose of the survey was to determine how often Sensory Integration therapy is used with children with autism, and what, if any, benefits are attained from implementation. This survey was given to professionals in the special education field who may have experience implementing sensory integration therapy for children with autism. The questions asked addressed background information, experience with sensory integration, and a variety of questions surrounding the complex topic of sensory integration. The purpose of the intervention was to determine what effects Sensory Integration Therapy had on the development of motor skills in children with autism, ranging in age from first through third grades. Specifically, the study analyzed what exact type and degree of sensory stimuli would increase or decrease motor function in participants. This study was implemented by the researcher, in the participants' homes. It was an intervention study with the goal of using sensory integration to improve motor skill development.

Research Design

The survey employed a quantitative descriptive study. This was done over a period of approximately one month. The intervention study utilized a quasi-experimental, single-subject design.

Participants

Thirty-seven professional occupational and behavioral therapists working in the autism field were asked to complete the survey. Selection of participants was based on

availability and convenience. Participants in the survey ranged in age from 18 to 60 years old. The majority of survey respondents (n=60%) are college graduates, with an additional 19% listed as post-graduates. Survey respondents were mostly Caucasian (n=68%), followed by Asian (n=19%) and Hispanic (n=16%). The majority of respondents were female (89%). Most respondents were behavior therapists (n=8%), and n=11% were occupational therapists. Of the respondents, n=32% have worked in special education for six to eight years, and n=29% have worked in the field for three to five years. The majority of clients serviced by the survey respondents live in a suburban community (n=69%) and attend a public school (n=80 percent). One hundred percent of survey respondents currently work with children with autism, the majority of whom are three to five years old (n=87%) and six to 10 years old (n=68%).

Using convenience sampling, the intervention study included two participants with a primary diagnosis of autism. Participants were found through recommendations from parents of children diagnosed with autism and known professionals in the autism field. The identified participants are male. One participant is nine-years-old and in third grade (A) and the other is seven-years-old and in second grade (B). Participant A is mainstreamed in a California public school with a 1:1 aide for the full school day. Participant B is in a Special Day class at a California public school and does not have an aide. Both receive comprehensive speech, occupational, and behavior therapy. Both participants function at grade level for reading and math, but are two to three years behind grade level in social goals, comprehension skills, and motor skills. The intervention consisted of play-based activities. For this intervention study, the

participants followed two to three step directions, with moderate prompting, to complete the tasks presented to them.

Setting

The survey was completed in the home or workplace of the individual who took the survey. The setting for the intervention was in the living room or the participant's room of the participant's home. All sessions were conducted in a 1:1 basis.

Independent Variable

The independent variable for the single subject design was sensory integration therapy, and was a discrete variable. Sensory Integration therapy is a technique which involves performing exercises to improve the individual's understanding and capability to process a variety of sensory stimuli. The therapy technique was administered weekly by the researcher in a play-based, 1:1 setting in the participant's home. Each intervention session lasted approximately two hours.

Dependent Variable

The dependent variable for the intervention was the development of motor skills. These were measured throughout the intervention using a motor skills checklist and data collection forms to determine any changes in skill maturity.

Hypothesis

When used as a therapy intervention technique for children with autism, Sensory Integration therapy will positively benefit the development of motor skills. More specifically, the therapy may increase the child's ability to complete fine and gross motor tasks.

Materials/Instruments

A survey was used, which was given to Applied Behavior Analysts and Occupational therapists. The survey covered demographic information, knowledge of sensory integration therapy, and current practice of sensory and motor development with clients. There were 26 questions in the survey. The survey was developed to address deficit areas that are related to sensory and motor skill development.

For the intervention, a sensory checklist (See Appendix B) was used, as well as a motor checklist (See Appendix C). Both checklists consisted of sensory or motor skills which are typically present in children within this age group. The checklists were then used to measure what skills the child already had at the start of the study (the baseline) and what they were able to achieve by the end of the intervention. There were over 50 questions on each checklist to accurately measure skill level. Both checklists were developed by the researcher based on a variety of resources concerning typical child development milestones, as well as the researcher's own knowledge of child development. The checklists were also field-tested by the researcher on four children to evaluate practicality and validity. Questions are close-ended and unambiguous to ensure reliability. The checklists were maintained by the researcher; each skill that the child possessed was recorded, and totals calculated at the end of the checklist. The sensory/motor play kit is used on conjunction with the survey. The sensory/motor play kit consists of balls, shaving cream, a bin for beans and rice, crayons, 1 or 2 small toys, paint, and water balloons.

Data Collection Procedure

The survey was distributed to 37 professionals in the Applied Behavior Analyst and Occupational therapist field. The survey was given to professionals via mail and in-person, names of whom will be obtained via referral by the researcher's professional contacts. Instructions for the survey were provided. The survey was delivered by the researcher who is a behavior therapist with seven years of experience working in the autism field. The consent form had an informed consent clause, so it did not need to be returned. The survey acted as consent. There was no compensation for survey participants. The compensation was a gift of a sensory/motor play kit, one per participant. The results from the intervention study were evaluated by comparing the results of the baseline to a) the results of the weekly therapy session, and b) the results of the intervention as a whole.

Anticipated Findings

The researcher anticipated that the intervention would show that the participants would display an increase in motor skills development.

Confidentiality

All materials related to this study were kept in a locked cabinet at the researcher's residence. It was maintained solely by the researcher. Only the researcher had access to the materials, and all materials used in this study will be destroyed three years after the conclusion of the study. No key regarding participant information was used for the survey study. Participants' names were not included in the study

Benefits/Risks to Participants

For the survey, there were no risks or direct benefits to participants. For the intervention, some children experienced minor discomfort with sensory stimulation or specific stimuli. Examples of this include covering their ears when certain noises are made, mild gagging with oral or olfactory stimuli, or resisting physical stimuli. Stimuli producing discomfort was stopped immediately. Benefits from participating in this study were the participants' improvement in motor and sensory skills.

Chapter IV

Results

This study examined the effectiveness of the implementation of Sensory Integration therapy to improve motor skill development in children with autism. In order to test SI's effectiveness regarding motor skills, two procedures were conducted; a single subject, quasi-experimental intervention, and a quantitative descriptive survey. The survey's priority was to establish validity for the intervention, as well as to gather background information regarding current use of SI for motor skill development in the professional world. The intervention tested the theory by having children with autism engage in SI treatment and then complete motor tasks. These designs were used to present a cohesive study regarding the effectiveness of SI on motor skill development.

Data Analysis

The results of the survey were analyzed using descriptive statistics, i.e. percentages, based on the number of responses given by participants. Results were generated, and the findings assisted the researcher in determining current trends in the use and implementation of Sensory Integration therapy's effect on motor skills. The participants motor skills were observed and scored as either yes or no in terms of their occurrences.

Baseline. For the intervention study, baseline data was collected through assessment checklists. The baseline was determined over three sessions with each participant and yes/no scores were summed for a total count and converted to percentages.

Intervention. The intervention consisted of weekly therapy sessions to improve skills. Yes/No scores were collected during each session using the motor checklist to record changes from baseline to intervention. During post-intervention, each child was re-assessed using the same initial assessment tools to determine if any progress was made, and if so, in what areas. The yes/no scores were totaled and percentages were calculated using frequencies.

Hypothesis Part 1: Sensory Integration Therapy improves fine and gross motor skills in individuals with autism.

The hypothesis stated that SI would positively benefit the development of motor skills in children with autism. This hypothesis was tested using a single subject intervention, as well as through information gathered from the descriptive survey.

Intervention findings. The intervention consisted of two participants: Participant A and Participant B.

Baseline data. During baseline data collection, the participants were tested in a variety of areas, including sensory capabilities, fine motor tasks, and gross motor tasks. The intervention was administered over a period of six-weeks, with the baseline tested twice in the first week. Results were drawn from weekly observational data that was totaled and converted to percentages.

Assessments indicated that Participant A has sensory needs in the areas of: vestibular (hypersensitive), tactile (hypersensitive), proprioception (hyposensitive), auditory (hypersensitive), visual (hyposensitive), and gustatory/olfactory (hypersensitive). From these scores, it appears that for Participant A, the vestibular and

auditory areas are the most difficult sensory deficits for him. For example, while testing his various sensory capabilities during the intervention, Participant A had a seizure when his head was tipped back slightly. Also, when testing auditory capabilities, Participant A refused to take part and ran away from the room when presented with a variety of auditory toys, headphones, etc. to stimulate his auditory system. Because of these barriers presented during the baseline period, vestibular and auditory interventions were used very minimally for the study in order to cause no harm or discomfort to the participant.

Assessments indicated that Participant B has sensory needs in the areas of: vestibular (hyposensitive), tactile (hyposensitive), proprioception (hypersensitive), auditory (hypersensitive), visual (hypersensitive), gustatory/olfactory (hypersensitive). Participant B had a lower degree of difficulty when testing his various sensory systems. He was uncomfortable during the visual tests, as well as the gustatory/olfactory section, but not to the point of pain or severe discomfort. He requested that the activity be stopped and a break be given; this was immediately done. The researcher limited Participant B's exposure to visual stimulus and gustatory/olfactory therapies to ensure the comfort and complete participation of Participant B. See Tables 1, 2 and 3 below for baseline data for participants.

Table 1

Fine Motor baseline data by participant

Fine Motor Task	Participant A	Participant B
Cut straight line	Yes	Yes
Cut curvy line	Yes	No
Cut simple shapes	Yes	No
Draw vertical lines	Yes	Yes
Draw horizontal lines	Yes	Yes
Draw "U's"	Yes	Yes
Draw circles	No	Yes
Write first name	No	Yes
Use tongs grab 1/2" items	Yes	No
Holds pencil correctly	Yes	Yes
Holds scissors correctly	No	No
Traces letters and shapes	Yes	Yes
Draws simple drawing's	No	Yes
Can button buttons	No	No
Can zip zippers	No	Yes

Table 2

Gross Motor baseline data by participant

Gross Motor Task	Participant A	Participant B
Touch thumb to each fingertip	No	No
Balance on one foot	No	No
Balance with eyes closed	No	Yes
Gallop ten to twelve feet	Yes	Yes
March for 30 seconds	No	Yes
Throw ball underhand	Yes	Yes
Throw ball overhand	No	No
Kick still ball	Yes	Yes
Catch ball with extended arms	No	No
Jump on two feet ten times	No	Yes
Hop on one foot ten times	No	No
Crawl on hands and knees	Yes	Yes
Jump and clap simultaneously	No	Yes
Do five wall push-ups	Yes	Yes
Lay in prone for 30 seconds	No	No

Table 3

Sensory baseline data by participant

Sensory behavior	Participant A	Participant B
Vestibular avoidance	Yes	No
Vestibular seeking	No	Yes
Tactile avoidance	Yes	No
Tactile seeking	No	Yes
Proprioceptive avoidance	No	Yes
Proprioceptive seeking	Yes	No
Auditory avoidance	Yes	Yes
Auditory seeking	No	No
Visual avoidance	No	Yes
Visual seeking	Yes	No
Gustatory/Olfactory avoidance	Yes	Yes
Gustatory/Olfactory seeking	No	No

Findings. For Participant A, the post data showed improvements in certain areas, such as fine motor tasks (e.g., writing his first name, holding scissors correctly, drawing simple drawings, and zipping zippers). He also made gains in his ability to complete gross motor tasks, such as marching in place, catching and throwing a ball, and lying in the prone position for at least thirty seconds. He also hit plateaus in other areas. Despite the researcher's best efforts, he was unable to improve in his ability to balance on one foot, or to stand on both feet with his eyes closed. He also did not improve in his ability to button buttons or to draw circles. The intervention also showed that this child did not respond as well to tactile sensory input for improvement of motor skills as he did to other types of sensory stimuli. This was shown throughout the duration of the study using the weekly data on participant A. Each week, at least 60% of unsuccessful tasks (n=18) were ones which had tactile input used prior to task completion. Overall, Participant A was able to complete 53% of gross and fine motor targets (n=16) at the beginning of the study; at the end of the study, he was able to complete 73% of targets (n=22) presented to him.

Much like Participant A, Participant B made some gains, but did not master every task presented to him. The fine motor targets he struggled with at the beginning of the intervention were cutting curvy lines and simple shapes, holding scissors correctly, buttoning buttons, and using tongs to pick up ½" objects. In terms of gross motor tasks, he had difficulty completing the following: touching his thumb to each fingertip, balancing on one foot for 20 seconds, throwing a ball overhand, catching with extended arms, hopping on one foot ten times, and laying in the prone position for at least thirty

seconds. After taking baseline data, participant B was able to complete 67% of fine motor tasks (n=10), and 60% of gross motor tasks (n=9). At the end of the intervention, Participant B was able to complete 87% of both fine and gross motor tasks (n=26). See Tables 4 and 5 below for post intervention scores.

Table 4

Post intervention fine motor data by participant

Fine Motor Task	Participant A	Participant B
Cut straight line	Yes	Yes
Cut curvy line	Yes	Yes
Cut simple shapes	Yes	No
Draw vertical lines	No	Yes
Draw horizontal lines	No	Yes
Draw "U's"	Yes	Yes
Draw circles	No	Yes
Write first name	Yes	Yes
Use tongs to pick up 1/2" Objects	Yes	No
Holds pencil correctly	Yes	Yes
Holds scissors correctly	Yes	Yes
Traces letters and shapes	No	Yes
Draws simple drawing's	Yes	Yes
Can button buttons	No	Yes
Can zip zippers	Yes	Yes

Table 5

Post Intervention gross motor data by participant

Gross Motor Task	Participant A	Participant B
Touch thumb to each fingertip	Yes	No
Balance on one foot	No	Yes
Balance with eyes closed	No	Yes
Gallop ten to twelve feet	Yes	Yes
March for 30 seconds	Yes	Yes
Throw ball underhand	Yes	Yes
Throw ball overhand	Yes	Yes
Kick still ball	Yes	Yes
Catch ball with extended arms	Yes	Yes
Jump on two feet ten times	Yes	Yes
Hop on one foot ten times	No	Yes
Crawl on hands and knees	Yes	Yes
Jump and clap simultaneously	Yes	Yes
Do five wall push-ups	Yes	Yes
Lay in prone for 30 seconds	Yes	No

Hypothesis Part 2: Professionals who work with individuals with autism have positive attitudes about the effectiveness of Sensory Integration therapy.

Survey findings. The survey found that 43% of behavior and occupational therapists (n=16) target fine motor goals with their clients five times per week. Almost the majority of survey respondents (46%; n=17) also stated that 76 to 100% of their clients currently have a fine motor deficit. Seventy percent of the survey respondents (n=26) also found that when a client was given a fine motor task immediately following sensory input, the fine motor task was performed at a higher skill level. Overall, 100% of survey participants (N=37) found that their client's fine motor skills increased since the implementation of a regular sensory diet.

Forty-one percent of survey respondents (n=15) reported that they target gross motor skills with their clients five times per week. The majority of survey respondents (67%; n=25) found that when given a gross motor task immediately following sensory input, the task was performed at a higher skill level. The most commonly reported percentage of clients with a gross motor deficit was 26-50%. Also, 100% of survey respondents (N=37) indicated that their client's gross motor capabilities increased after implementing a regular sensory diet.

Experience with sensory integration. Seventy-three percent of survey respondents (n=27) felt that they are familiar with sensory integration therapy techniques, although only 43% of them (n=16) have attended or received any training on the topic. Thirty-nine percent of respondents (n=14) stated that 81 to 100% of their clients have a sensory deficit, while 36% of them (n=13) stated that 61 to 80% of their clients have a sensory

deficit. When asked if they had ever used sensory integration techniques with a client, 87% of respondents (n=32) stated that they had.

When asked what types of techniques they use or have used, the breakdown from most used to least used was as follows: 91% of them (n=34) used tactile techniques; 66% of them (n=24) used auditory techniques; 63% of them (n=23) used visual techniques, 63% of them (n=23) used vestibular techniques, 49% of them (n=18) used proprioceptive techniques, and 29% of them (n=11) used gustatory/olfactory techniques.

When examining the frequency of sensory implementation and overall effects, the respondents answered in a positive manner for the effectiveness of sensory integration and motor skill development. That is, 44% of respondents (n=16) administered sensory stimuli five times per week. Ninety-four percent of them stated that they saw differences in their client's overall ability to complete tasks they previously were unable to after the implementation of sensory therapy (n=35). Furthermore, 93% of them (n=34) noted that the difference was positive. Overall, 100% of respondents (N=37) felt that sensory integration positively affected motor skill development in children with autism.

Summary

Overall, this study showed a positive relationship between the use of Sensory Integration therapy and further development of motor skills. Participants' ability to complete motor tasks increased, and their tolerance of sensory stimuli also improved. Regarding the perceptions of the professionals, the findings indicated a very positive indication for the use of Sensory Integration therapy for improving motor skills in children with autism.

Chapter V

Discussion

Introduction

The purpose of this study was twofold: to determine how often sensory integration therapy is used with children with autism; and what, if any, benefits are attained from the implementation of Sensory Integration therapy. Specifically, the study analyzed what exact type and degree of sensory stimuli would increase or decrease motor function in participants. The study also strove to determine how professionals in the autism field regarded Sensory Integration therapy as an option to improve motor skill development. The major findings of the study indicated that Sensory Integration therapy does, in fact, improve motor skills to a certain degree, and that SI is used on an almost daily basis by a variety of professionals in the autism field. Furthermore, this study showed the value of using a variety of sensory stimuli to elicit a desired response from the participants by utilizing many different types of sensory stimuli throughout the intervention study. In this way, connections between more dominant and less dominant sensory areas and traits were clearly presented.

The findings discussed in this chapter are the most relevant and noteworthy of the study. The implications regarding the use and efficacy of Sensory Integration therapy and motor skill development are also discussed. And lastly, the limitations of the intervention and the survey study, as well as recommendations for further research, are addressed in this chapter.

Implications

Effects on fine motor skills. The participants' ability to complete fine motor skills increased with the implementation of the intervention study. Both of the participants that were involved developed the ability to complete a variety of fine motor tasks with minimal prompting. Participant A made a 7% increase in ability level, and participant B achieved a 20% increase in task completion ability. Overall, both participants were more willing to complete the tasks, and were more attentive to the requests being made of them as the study progressed over the six-week duration. Following the research ideals presented by Ingersoll et al. (2003) regarding motivation, and reward, all the participants received constant verbal praise and sensory feedback throughout the duration of the study. This type of reinforcement was very encouraging and motivating for both participants, and kept them interested and engaged in each activity presented to them. Data collected during the course of the intervention showed clearly the connection between the implementation of Sensory Integration therapy and increased motor skill development.

Effects on gross motor skills. As with fine motor skills, participants' ability to successfully complete gross motor tasks also increased. In fact, the difference in ability to complete gross motor tasks was much greater than that with fine motor tasks. Over the course of the study, Participant A gained 54% more gross motor skills. Participant B gained 27% more skills in this area. These skills were worked on over the course of the intervention. Progress was slow, but steady, and very measureable. In order to teach the new gross motor skills which were targeted, the research model employed a multisensory

model, much like Iarocci and McDonald's (2006). Many tasks presented were ones which would involve and engage all the senses. For example, teaching a participant to crawl would be done on carpet and a wood floor to stimulate the tactile system (with the feel of each surface), as well as the auditory system (with the difference in sound on each surface), etc. Iarocci and McDonald (2006) felt strongly that individuals with autism learn more fully and completely when taught using a multisensory model, and the research done throughout this intervention further supported the efficiency of this model.

Attitudes about Sensory Integration Therapy

The survey showed an overwhelming consensus for the support of Sensory Integration therapy and its effectiveness in improving fine and gross motor skills. Occupational and behavior therapists felt that Sensory Integration was an effective treatment option for children with autism, and also felt that the use of SI therapy with children with autism was effective in improving skill acquisition in the motor areas. The findings of this survey further supported many scholarly views on Sensory Integration therapy as an effective treatment option. Baranek (2002) and Dawson and Watling (2000) all felt that Sensory Integration was a valuable therapy option, although more research would need to be completed before justifying its full efficacy. Dunn et al. (2002) also stated that they felt Sensory Integration therapy is the best treatment option for improving sensory processing issues in everyday life for individuals with autism.

Limitations

During the course of this study, some limitations presented themselves. First, with the survey, there were some related questions and answers which were

contradictory. For example, when asked the question, "Have you ever used Sensory Integration therapy techniques with a client?" some participants would answer "no." A few questions later, when asked what types of Sensory Integration therapy techniques they used with their clients and how often, the same participant would answer that they used "Vestibular and tactile, five times per week." Because of these contradicting answers, some of the findings related to the survey data may be suspect. The survey was done first in order to ensure full validity of the research content.

With the intervention, the only limitation suspected was with Participant A. This participant has a primary diagnosis of autism, but also has Cerebral Palsy and a seizure disorder. Three weeks into the study, the researcher learned that the participant was not on medication at the time of the study. This meant that he had fairly constant seizures during the intervention sessions. When this participant has seizures, he becomes quite disoriented and loses some motor control, poorly affecting his ability to complete the tasks presented to him. Therefore, the data regarding Participant A might not be truly reliable or representative of his potential.

Future Research

Future research is needed within the field of Sensory Integration therapy as a whole. More specifically, more research is needed to further support the relationship between SI therapy and motor skills; especially the effects it may have on children with autism. Based on the intervention and survey completed, there is clear data to support continuing research regarding the relationship between Sensory Integration therapy and motor skill development. Most of the research which has been conducted in past years

surrounding the topic of Sensory Integration has not specifically targeted the effect it may or may not have on motor skill development. The research which did target this specific relationship was mostly done with older participants. The research that has already been done is a first step towards supporting Sensory Integration as an effective therapy technique, but there has not been enough specific and conclusive research to fully support it.

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APPENDIX A

SURVEY

Sensory Integration and Motor Skills

The purpose of this survey is to gather information about the use of Sensory Integration therapy to improve motor function in young children with autism. Your responses to the following questions will assist the investigator in determining how sensory integration does or does not improve motor function in children with autism.

Background Information

What is your highest education level completed?

○	○	○	○
High school	Some college	Bachelor's degree	Post-graduate

What is your race/ethnicity?

○	○	○	○	○	○
Caucasian	African-American	Asian	Hispanic	American-Indian	Other (please specify)_____

What is your gender?

○	○
Male	Female

What job field are you currently involved in?

○	○	○
Behavior Therapist/ABA	Occupational Therapist	Other (please specify) _____

Are you familiar with Sensory Integration Therapy?

○	○
Yes	No

Have you ever attended a training on Sensory Integration Therapy?

O	O
Yes	No

If so, what type of training was provided?

How many years have you worked in Special Education?

O	O	O	O	O	O
0-2	3-5	6-8	9-11	12-14	15+

Client Information

What type of community do the majority of your client's live in?

O	O	O
Urban/City	Suburban/Suburb	Rural/Country

About what percent of your client's have a sensory deficit?

O	O	O	O	O
0-20%	21-40%	41-60%	61-80%	81-100%

What type of school do the majority of your client's attend?

O	O	O	O
Public	Private	Homeschool	Does not attend

What age ranges do you work with?

O	O	O	O	O
Birth-2	3-5	6-10	11-14	15 and up

What primary diagnosis do the majority of your client's have?

O	O	O	O
Down Syndrome	Autism	Orthopedic Impairment	Other (please specify) _____

Experience with Sensory Integration Therapy

Have you ever used Sensory Integration techniques with a client?

O	O
Yes	No

What type of sensory systems do you target? (Check all that apply)

O	O	O	O	O	O
Vestibular	Tactile	Auditory	Visual	Gustatory/Olfactory	Proprioceptive

How often do you administer sensory stimuli?

O	O	O	O	O
1x/week	2x/week	3x/week	4x/week	5x/week

In general, did you notice any differences in your client's overall ability to complete tasks they previously were unable to after receiving Sensory Integration?

O	O
Yes	No

Was this difference *positive*, *negative*, or *neutral*? (Circle one)

On average, how often do you target fine motor skills with each client?

O	O	O	O	O	O
Not	1x/week	2x/week	3x/week	4x/week	5x/week

On average, how often do you target gross motor skills with each client?

O	O	O	O	O	O
Not targeted	1x/week	2x/week	3x/week	4x/week	5x/week

What percentage of your client's have a fine motor deficit?

O	O	O	O
0-25%	26-50%	51-75%	76-100%

What percentage of your client's have a gross motor deficit?

O	O	O	O
0-25%	26-50%	51-75%	76-100%

In general, when a client is given a fine motor task immediately following sensory input, is the fine motor task performed at a…

O	O	O
Higher skill level	Lower skill level	Same skill level

In general, when a client is given a gross motor task immediately following sensory input, is the gross motor task performed at a…

O	O	O
Higher skill level	Lower skill level	Same skill level

With a regular sensory diet, do you feel your client's fine motor skills have generally *increased or decreased*? (Circle One)

With a regular sensory diet, do you feel your client's gross motor skills have generally *increased or decreased*? (Circle One)

In your experience, do you feel that Sensory Integration *positively or negatively* affects motor skill development for children with Autism? (Circle One)

Additional Comments

Please list any areas in which you'd like to share an opinion.

APPENDIX B

SENSORY CHECKLIST

Directions for Sensory Checklist:

Under each subject heading, check any items that apply to the child. Leave items blank that do not apply to the child.

Directions for Scoring:

Tally total number of checked items for each section included in graph. Write number of total responses out of possible responses in score column. If total responses out of possible responses is more than 50%, it is an area of concern.

Vestibular

Avoidance behaviors-

- ☐ Objects to head being tipped back
- ☐ Avoids positions in which feet are off the ground
- ☐ Enjoys and prefers quiet play
- ☐ Fearful of challenges to balance
- ☐ Fearful of moving equipment

Seeking behaviors-

- ☐ Often rocks when sitting or standing
- ☐ Often jumps
- ☐ Likes to spin
- ☐ Has no fear of movement or falling
- ☐ Craves being rocked
- ☐ Craves tumbling activities

Tactile

Avoidance behaviors-

- ☐ Dislikes brushing teeth and hair
- ☐ Dislikes washing face
- ☐ Strongly likes or dislikes certain food textures
- ☐ Avoids being touched
- ☐ Overreacts to unexpected touches
- ☐ Avoids messy things
- ☐ Protests nail cutting
- ☐ Dislikes certain clothing textures
- ☐ Excessively ticklish
- ☐ Walks on toes
- ☐ Unusually large personal space

Seeking behaviors-

- ☐ Requests touch
- ☐ Constantly puts items in mouth
- ☐ Touches everything
- ☐ Bangs head
- ☐ Pinches, bites, or hurts self
- ☐ Rubs, holds, or manipulates objects of similar texture
- ☐ Rubs fingers or body parts
- ☐ Chews or sucks non edibles

Hyposensitivity behaviors-

- ☐ Feels less pain than others
- ☐ Unaware of substances spilled on body

Proprioceptive

Avoidance behaviors-

- ☐ Refuses to hold vibratory appliances
- ☐ Fearful of hair clippers
- ☐ Gives up on resistance tasks
- ☐ Avoids crunchy or chewy foods
- ☐ Seems weak performing age appropriate tasks
- ☐ Walks on toes
- ☐ Prefers only crunchy or chewy food
- ☐ Bites or chews non edibles

Seeking behaviors-

- ☐ Places vibrating appliance in or near mouth
- ☐ Tolerates vibratory stimuli
- ☐ Gives lots of hugs
- ☐ Likes to be wrapped tightly
- ☐ Frequently bumps people

Auditory

Avoidance behaviors-

- ☐ Protests loud noises
- ☐ Unable to pay attention when other noises are nearby
- ☐ Runs away in response to loud noise
- ☐ Irrational fear of noisy appliances
- ☐ Seeks quiet areas
- ☐ Comments on background noises
- ☐ Covers ears frequently

Hyposensitivity behaviors-

- ☐ Misses hearing some sounds
- ☐ Doesn't respond to commands or requests without visuals
- ☐ Needs loud verbal input to respond or comply

Seeking behaviors-

- ☐ Seeks toys that make sounds
- ☐ Craves music

Visual

Avoidance behaviors-

- ☐ Poor eye contact
- ☐ Enjoys dark lighting
- ☐ Over-stimulated when presented with many visual objects
- ☐ Covers eyes often

Seeking behaviors-

- ☐ Examines objects and pictures very intimately
- ☐ Resists covering eyes
- ☐ Likes to flick lights on and off rapidly
- ☐ Manipulates objects or hands close to the face often

Gustatory/Olfactory

Avoidance behaviors-

- ☐ Often comments on odors, normal or not
- ☐ Reacts to faint odors as if they were very strong
- ☐ Prefers to eat bland foods

Seeking behaviors-

- ☐ Explores everything by licking and smelling
- ☐ Enjoys to eat very seasoned foods

Sensory behavior	**Score-** *total responses/ possible responses*	**Area of concern?**
Vestibular Avoidance		
Vestibular Seeking		
Tactile Avoidance		
Tactile Seeking		
Tactile Hyposensitivity		
Proprioceptive Avoidance		
Proprioceptive Seeking		
Auditory Avoidance		
Auditory Seeking		
Auditory Hyposensitivity		
Visual Avoidance		
Visual Seeking		
Gustatory/Olfactory Avoidance		
Gustatory/Olfactory Seeking		

APPENDIX C

MOTOR EVALUATION FORM

Directions for completing Motor checklist:

Complete checklist by marking correct column associated with task. If the child can complete said task with 80% accuracy, they have mastered it. If not, the skill is un-mastered and needs work.

Motor Skill	Able to complete with 80% accuracy?	Unable to complete with 80% accuracy?
Cut straight line		
Cut curvy line		
Cut simple shapes		
Draw vertical lines		
Draw horizontal lines		
Draw "U's"		
Draw circles		
Write first name		
Use tongs to pick up ½" objects		
Holds pencil correctly		
Holds scissors correctly		
Traces letters and shapes		
Draws simple drawings (person, sun, house)		
Can button buttons		
Can zip zippers		

Motor Skill	Able to complete with 80% accuracy?	Unable to complete with 80% accuracy?
Touch thumb to each fingertip		
Balance standing on one foot for 20 seconds		
Balance standing on both feet with eyes closed		
Gallop ten to twelve feet		
March for 30 seconds		
Throw ball underhand to target		
Throw ball overhand to target		
Kick still ball		
Catch ball with extended arms		
Jump on two feet ten times		
Hop on one foot ten times		
Crawl on hands and knees		
Jump and clap simultaneously ten times		
Do five wall push-ups		
Lay in prone position for 30 seconds		