Effects of Reflex Integration in Autism: An Occupational Therapy Case Report

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Abstract

Introduction: Primitive reflexes play a role in motor development by preparing an infant to move against gravity and develop sensory organs and receptors. The Masgutova Neurosensorimotor Reflex Integration (MNRI) is a non-invasive, natural, and replicable neuromodulation technique that creates mature neurological pathways in the reflex circuit to aid in the development of mature motor patterns. Autism Spectrum Disorder (ASD) is a term used to describe a group of neurodevelopmental conditions characterized by social communication deficits and repetitive sensory-motor behaviors.

Objective: To describe the effects of the MNRI intervention on bilateral coordination, auditory-visual integration, and crossing midline motor patterns of a child diagnosed with ASD who presents with a persistent asymmetrical tonic neck reflex (ATNR) and to discuss the implications of MNRI as it relates to occupational therapy (OT) practice.

Methods: The child (10 years old) with a diagnosis of ASD with significant motor delays, persistent ATNR, and lack of independence for activities of daily living (ADL) was randomly selected from a purposive sample and participated in an 8-week MNRI intervention protocol to integrate the ATNR. The child was assessed pre and post intervention using the Schilder test, Bruininks-Oseretsky Test of Motor Proficiency, 2nd edition (BOT-2), Sensory Profile 2, and a crossing midline observation form.

Results: The case study results suggest that the MNRI intervention was successful at integrating the ATNR and improving bilateral coordination and crossing midline skills. The MNRI was not successful at improving upper-limb coordination. No effects were identified in regards to auditory-visual integration.

Conclusion: The use of the MNRI in OT needs to be further researched to validate these findings with a bigger sample and determine if the MNRI intervention can ultimately improve occupational performance.

Keywords: MNRI, ASD, occupational therapy, ATNR

Introduction

Motor development results from the interaction of multiple subsystems within a child, including the central nervous system (CNS), working together to achieve a functional goal influenced by task and environmental demands (Levac & DeMatteo, 2009). Primitive reflexes are defined as stereotypical movement patterns elicited by a specific sensory stimuli that are frequently used as indicators of CNS maturity or immaturity (Zafeiriou, 2004). Primitive reflexes also known as infant or primary reflexes, play a role in motor development by preparing an infant to move against gravity and gradually moving voluntarily to interact with the environment (Gieysztor, Choinska, & Paprocka-Borowicz, 2015). Early reflex movements help an infant engage with the environment and develop sensory organs and receptors (Melillo, 2011). Research shows that the persistence of primitive reflexes have been found to interfere with motor skills (McPhillips, Hepper, & Mulhem, 2000). Delayed motor responses and retained primitive reflexes can ultimately have an impact on how children participate in daily activities.

The asymmetrical tonic neck reflex (ATNR) has been found to persist for a longer time in children diagnosed with autism (Teitelbaum, Teitelbaum, Fryman, & Maurer, 2002). The ATNR is characterized by a movement response caused by head turning in which the upper and lower extremities on the side to which the head is turned extend and the contralateral extremities flex (Konicarova & Bob, 2013). The ATNR emerges at 18 weeks in utero and disappears between three to nine months after birth due to motor advancement (Gieysztor, Choinska, & Paprocka-Borowicz, 2015). The persistence of the ATNR reflex is a clinical indicator of abnormal development (McPhillips & Jordan-Black, 2007). The ATNR reflex plays a role in motor development as a precursor for early visual inspection of the hand and eye-hand coordination

(Sidaway et al., 2015). The ATNR is also theorized to play a role in auditory-visual integration (Renard-Fontaine, 2017).

In the United States, one in every 59 children are diagnosed with autism (Baio et al., 2018). Autism Spectrum Disorder (ASD) is defined as group of neurodevelopmental conditions characterized by limited social communication and interaction and restricted and repetitive behaviors (Lai, Lombardo, & Baron-Cohen, 2014). The deficiencies of children diagnosed with ASD can manifest as follows: abnormal social approach and reciprocity, limited emotions, lack of facial expressions, stereotyped repetitive movements, poor object manipulation, ritualized verbal and non-verbal behavior patterns, and decreased sensory processing skills (Juergensen, Mattingly, Pitts, & Smith, 2018). Occupational therapy (OT) interventions specific to ASD include independent living skills training, motor development, motor planning skill development, sensory integration, self-regulation, cognitive-behavioral approaches, social emotional development, compensatory supports, and work readiness skill development (Crabtree, 2018). The impact of bilateral motor delays and persistent ATNR in the participation of a child diagnosed with ASD can be explained using the International Classification of Functioning, Disability, and Health (ICF) model.

The International Classification of Functioning, Disability, and Health (ICF) has been accepted as a standard and acceptable language framework to describe health by OT practitioners (Haglund & Henrikson, 2003). The ICF is based on the biopsychosocial model that integrates the medical and social aspects of health. The World Health Organization (2002) defined the components of the ICF as follows: a *health condition* is defined as a specific diagnosis or condition, *activity* is the execution of a task, *participation* is the involvement of an individual in a specific life situation, *body functions and structures* include the anatomical parts and physiological functions of the body, *personal factors* include the individual's background information (gender, age, social skills, language, education, etc*),* and *environmental factors* include the physical, social, and attitudinal contexts in which the person lives. The ICF model suggests that health conditions such as ASD can impact participation in daily activities. Figure 1 provides the ICF model diagram and Figure 2 provides an ICF model diagram for ASD.

Figure 1

ICF Model Diagram

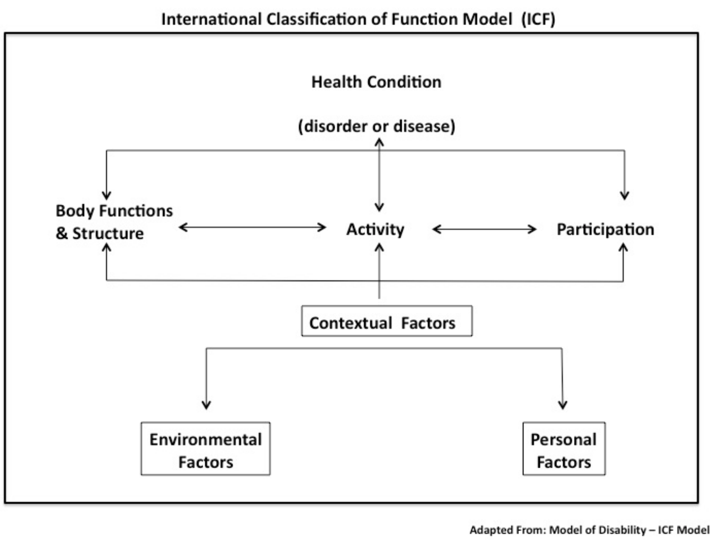
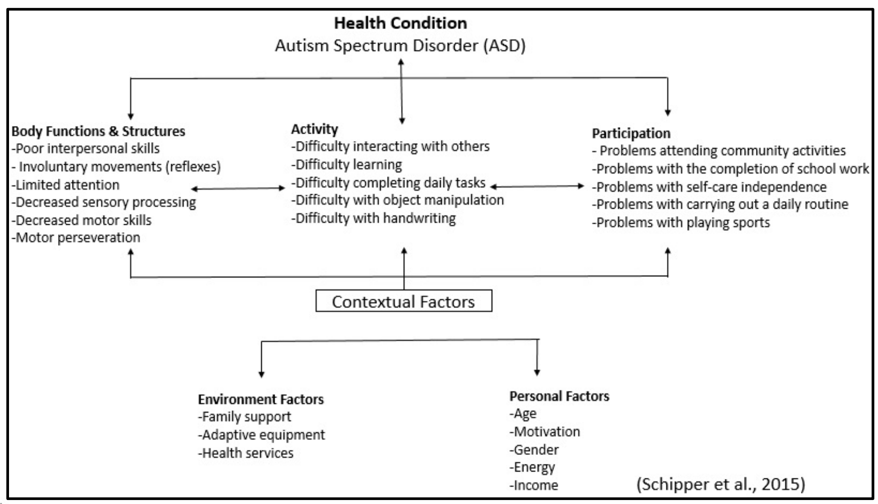


Figure 2

ICF Model and ASD



The Masgutova Neurosensorimotor Reflex Integration (MNRI) approach developed by Dr. Svetlana Masgutova in 1989, utilizes reflex integration techniques guided by the concept of sensory activation of a reflex, followed by a motor response associated with the reflex and all its motor variants to create a more mature neurological pathway between the reflex circuit memory and the reflex circuit to elicit conscious processes to aid in the development of more mature motor patterns (Renard-Fontaine, 2017). The literature available examining the effectiveness of reflex integration intervention programs to aid in treating motor deficits is limited. Currently, there is a gap in knowledge about the effects of reflex integration interventions in OT practice making this an issue that requires attention and consideration in OT practice.

The aim of this research article is to examine the effects of the MNRI dynamic and postural reflex pattern integration program on bilateral coordination, auditory-visual integration, and crossing midline motor patterns in a child diagnosed with ASD who has a persistent ATNR. The research to be discussed in this article will aim to provide preliminary data to the OT literature on the effects of one reflex integration program (MNRI) to address motor deficits.

Background Information

The participant in the study was a 10 year and 3 months of age male with a sole diagnosis of Autistic Disorder (ICD-10 code: F84.0) at the time of the study. He had a Hispanic heritage background. Birth and medical history of the participant indicated that the mother received adequate prenatal care and the participant was delivered full-term via cesarean section with no complications. At approximately 12 months of age, the participant developed infant spasms and a brain tumor was detected. The brain tumor was removed when he was 2-years-old and spasms resolved when tumor was resected. The participant was formally diagnosed with ASD when he was 3-years-old. The participant had a history of receiving therapy services since he was 2-years-old to treat motor delays, speech delays (receptive and expressive), cognitive delays, lack of independence with activities of daily living (ADL) and instrumental activities of daily living (IADL), behavioral difficulties, and sensory deficits.

At the time of the study, the participant presented with bilateral motor skills below 4 years of age as per the Bruininks-Oseretsky Test of Motor Proficiency, 2nd edition (BOT-2) assessment tool, flight risk precautions, limited selective attention, poor nutrition (picky eater), behavioral defiance, and requiring assistance to complete daily activities. The participant required the following levels of assistance: total assistance to complete most IADLs and manipulation of fasteners and shoe laces; maximal assistance to complete grooming and meal preparation; moderate assistance to complete bathing, meal clean-up and cutting with scissors; minimal assistance to complete upper body dressing, lower body dressing and handwriting of first name; and supervision for toileting.

The participant had a history of receiving OT, speech therapy (ST), and behavioral therapy services. He had no prior history of receiving MNRI intervention. He benefited from using visual schedules. He tested positive for ATNR reflex using Schilder Test with a total score of 6 (Right=3, Left=3). He presented with inability to cross midline with left upper extremity to manipulate blocks and doff socks and shoes. He completed table top activities sitting parallel to the table. He demonstrated inability to perform bilateral coordination activities such as jumping jacks, synchronized jumps, alternating synchronized jumps, tapping feet and fingers following synchronized patterns, and touching his nose with index finger. He presented with poor ability to follow two-step directions. The participant was receiving ST and OT two times per week at the time of the study at an outpatient pediatric clinic in Texas.

Research Questions

1. What are the effects of the MNRI at improving bilateral coordination in a child diagnosed with ASD who presents with a persistent ATNR?
2. What are the effects of the MNRI at improving auditory-visual integration in a child diagnosed with ASD who presents with a persistent ATNR?
3. What are the effects of the MNRI at improving crossing midline skills needed for play in a child diagnosed with ASD who presents with a persistent ATNR?

Literature Review

The literature available examining the effectiveness of reflex-based interventions at improving motor skills and self-care skills is limited. Currently, there is no available evidence of reflex integration neuromodulation techniques being used in OT practice. Several studies have revealed that a persistent ATNR, can lead to poor performance of fine motor and gross motor skills (McPhillips et al., 2000; McPhillips & Sheehy, 2004; Alibakhshi et al., 2018). The assessment of the ATNR has been suggested as a screening tool for ASD (Teitelbaum et al., 2002). Various studies have found a correlation between persistent primitive reflexes and motor delays (McPhillips et al., 2000; McPhillips & Sheehy, 2004; Geysztor, Choinska, & Paprocka-Borowicz, 2015; Sankar & Mundkur, 2005).

The research work by Masgutova et al., (2016a; 2016b) on reflex integration techniques following the Masgutova Neursosensorimotor Reflex Integration (MNRI) protocol, revealed positive outcomes at improving sensorimotor, physical, cognitive, and behavioral development in children with ASD. The MNRI protocol to re-pattern 30 reflexes proved to be effective at improving reflex patterns/expressions in children with ASD (Masgutova, Akhmatova, Sadowska, Shackleford, & Akhmatov, 2016a). The MNRI has also been found to be beneficial in the areas of sensory-motor integration (tactile sensitivity), physical development (posture and balance), behavioral control, emotional regulation, cognitive functioning (self-awareness), and communication in children with ASD (Masgutova et al., 2016b).

The MNRI protocol has also been found to be effective at improving reflex pattern expressions, motor function, postural control, stability, and sense of equilibrium in children with cerebral palsy (Masgutova, 2008). A study completed by Pilecki et al. (2012), found that the MNRI caused changes in the brain stem and neuro-motor rehabilitation of children with cerebral palsy. Children diagnosed with Down syndrome have also benefited from the MNRI protocol in their sensory-motor function (Masgutova et al., 2015). The research by the physical therapist, Renard-Fontaine (2017) found that the use of the MNRI neuromodulation techniques provided a unique and faster motor milestone development by restoring voluntary motor and cognitive control of an immobile limb. Renard-Fontaine also suggested the use of MNRI as an intervention tool for physical therapy (PT) and OT practices. Refer to Appendix A for a critically appraised topic (CAT) paper on reflex-based interventions, Appendix B for a detailed literature review, and Appendix C for the case study needs assessment.

Methods

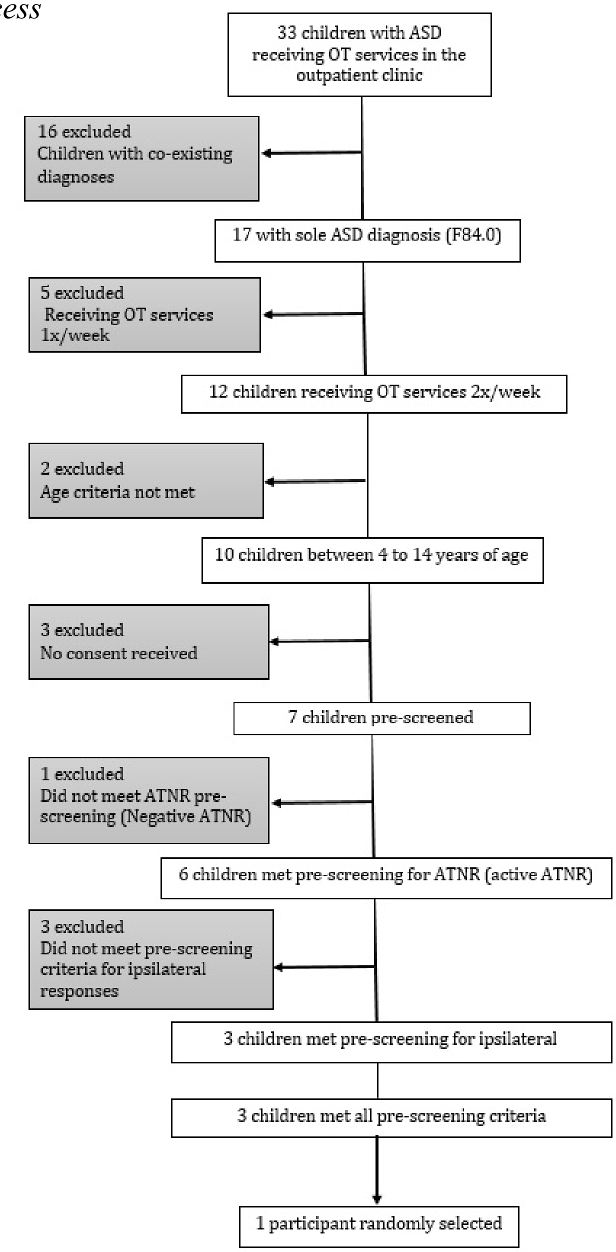
A case study was completed using a participant diagnosed with ASD with a persistent ATNR. The participant was randomly selected from a purposive sample of children diagnosed with ASD who receive OT services at a pediatric outpatient clinic in Texas. The participant had to meet the following inclusion criteria: sole diagnosis of Autistic Disorder (ICD-10 code: F84.0), age between 4-14 years old, positive ATNR with a score of at least 1 using Schilder Test, ipsilateral motor responses in at least one side of the body, and current use of OT services. Children who had diagnoses other than ASD or ASD with co-existing conditions were excluded from the study. Children with a history of receiving the MNRI protocol to integrate ATNR were also excluded from the study.

A preliminary screening was performed in May 2019 to identify a positive ATNR and ipsilateral responses from the purposive sample of children with a sole diagnosis of ASD. Refer to Figure 3 for more details on the participant selection process. One participant was randomly selected from the sample of participants who met the inclusion and preliminary criteria. Written consent forms were obtained from the parents/caregivers prior to formal assessment. Refer to

Appendix C for consent forms used in the study. Approval for this study was given by the University of Texas Medical Branch.

Figure 3

Participant Selection Process



Schilder Test

A positive ATNR score was determined using the Schilder Test (McPhillips, Hepper, & Mulhmem, 2000). During this test, the participant stands upright with feet together, arms extended in front at shoulder level, and wrists and hands relaxed. The tester stands behind the participant and the tester provides specific instructions to passively turn the head to each side of the body. The tester turns the participant's head slowly to one side, 70-80 degrees of neck rotation until chin is over the shoulder and pauses for 5 seconds, then slowly turns the participant's head to the other side and pauses for 5 seconds. This rotation sequence is repeated two times. Positive indicators of the ATNR include movement of the arms in the same direction the head is turned, dropping the arms, or swaying and loss of balance. The scores are defined as follows: 0= no response; 1 =slight movement of the arms (up to 20 degrees) to the same side as the head is turned, or slight dropping of the arms; 2=movement of the arms (up to 45 degrees) as the head is turned, or marked dropping of the arms; 3= movement greater than 45 degrees either to the side or down, swaying and loss of balance. Each side of the body is scored separately and then a total is obtained for both sides.

BOT-2

The ATNR reflex plays a role in motor development as a precursor for early visual inspection of the hand and eye-hand coordination (Sidaway et al., 2015). Bilateral coordination and upper-limb coordination of the participant were assessed using the BOT-2. The BOT-2 is a motor assessment that measures fine motor and gross motor skills in children between 4 years and 21 years of age (Brown, 2019). The BOT-2 has been used to assess motor skills of children diagnosed with ASD (Liu, Breslin, & ElGarhy, 2017). The bilateral coordination subtest of the BOT-2 measures motor skills needed for playing sports and recreational activities (Bruininks & Bruininks, 2005). This subtest assesses the following skills: touching nose with index finger (eyes-closed), jumping jacks, jumping in place with same side synchronized, jumping in place with opposite side synchronized, pivoting thumbs and index fingers, tapping feet and fingers with same side synchronized, and tapping feet and fingers with opposite side synchronized. The upper limb coordination subtest of the BOT-2 measures visual tracking skills coordinated with arm and hand movements (Bruininks & Bruininks, 2005). This subtest assess the following skills: dropping and catching a ball with both hands, catching a tossed ball with both hands, dropping and catching a ball with one hand, catching a tossed ball with one hand, dribbling a ball with one hand, dribbling a ball alternating hands and throwing a ball at a target.

Sensory Profile 2

The ATNR is theorized to play a role in auditory processing (Renard-Fontaine, 2017). Auditory and attentional skills were assessed in the participant using the Sensory Profile 2. The Sensory Profile 2 is an assessment tool that measures sensory processing patterns in children between birth and 14 years of age (Jorquera-Cabrera et al., 2017). The Sensory Profile 2 has been used to discriminate sensory profiles in children with ASD (Simpson, Adams, Alston-Knox, Heussler, & Keen, 2019). For this assessment, the parent and/or caregivers of the participant completed the standardized forms. Auditory skills were measured with eight caregiver questions about reactions to sounds, physical behaviors to avoid sounds, ability to complete tasks while noise if present, noise distractions, unproductivity with background noise, tuning sounds out, hearing difficulties, and noise enjoyment. Attentional skills were measured with 10 caregiver questions about eye contact, ability to pay attention, noticing actions in a room, oblivious behaviors, staring at objects, staring at people, watching other move in a room, jumping from one thing to another, getting lost, ability to find objects in competing backgrounds.

Crossing Midline Event Frequency Data Sheet

A persistent ATNR has been found to affect eye tracking skills and the motor ability to cross the visual midline of the body (Gieysztor, Choinska, & Paprocka-Borowicz, 2015). When motor skills are impaired, a child's participation in activities of daily living can be compromised (Summers, Larkin, & Dewey, 2008). The participant's ability to complete a play skill to stack six blocks while crossing midline was measured using an event frequency observation form. The form measured the total of crossing midline motor patterns while retrieving blocks from a designated area that required the movement of the hand, forearm, or elbow across the midline of the body to the opposite side of the body of upper extremity being used, up to 10 inches, and stacking them on a designated area closer to the upper extremity being used. The observation form also measured a time component to determine how long it took the participant to stack six blocks with each individual upper extremity while crossing midline. Refer to Figure 4 for the crossing midline event frequency form used in the study.

Figure 4

Crossing Midline Event Frequency Observation Form

Event Frequency Recording Data Sheet

Directions: This recording data sheet is to be used as an observation checklist to determine crossing midline motor patterns. The participant will stack *six* blocks while retrieving blocks from a designated green square placed at a distance of 10 inches from the participant's midline on the opposite side of the body of the hand being used and stack them by positioning them on a designated red square placed at a distance of 10 inches from the participant's midline on the side of the hand being used. Use tally marks or X's to record the number of target behavior occurrences. Record how long it took the participant to stack 6 blocks while crossing midline from a designated green square to a red square. Both upper extremities to be measured individually.

Participant:	Date:
Observer:	Credentials:

Directions to the participant: Say "let's get the blocks from the green square and stack them on the red square with the right hand only to make a tall tower". Repeat for left hand saying "let's get the blocks from the green square and stack them on the red square with the left hand only to make a tall tower".

Play Task: Stacking Blocks	
Observation Length: 15 minutes	
Target Behavior: crossing midline with each individual upper extremity while retrieving blocks from a designated green square in sit position at table top	
Behavior Definition: moving the hand, forearm, or elbow across the midline of the body over to the opposite side of the body	
Right Upper Extremity Crossing Midline Tally	Total
Left Upper Extremity Crossing Midline Tally	Total

How long to stack six blocks with right hand crossing midline? ______________

How long to stack six blocks with left hand crossing midline? ______________

Comments (additional observations):

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Intervention

The participant engaged in OT sessions involving the MNRI protocol to integrate the ATNR in an outpatient pediatric clinic. The intervention protocol was completed by an occupational therapist trained in MNRI. The participant was followed for 16 intervention sessions lasting 45 to 50 minutes between the months of June and July 2019. The participant had a 100% attendance rate. The protocol consisted of activating the ATNR with gentle stretches with the participant positioned in the right and left ATNR postures, passive stretches according to the reflex pattern, passive stretches against reflex pattern, active exercises according to the reflex pattern, active exercises against reflex pattern, and variant exercises of the reflex patterns. Active exercises were performed with motions held for five to seven seconds. These neuromodulation exercises were completed on both sides of the body. The use of music and math was incorporated in the intervention sessions to stimulate cerebral lateralization.

The participant’s skills were assessed prior to and following the 8-week intervention by an occupational therapist who was blinded to the intervention process and nature of the study. The study design, intervention sessions, and data analysis were coordinated and completed by the author. The study aimed to find the pre and post effects of the MNRI protocol to integrate the ATNR on bilateral coordination, auditory-visual integration, and crossing midline motor skills needed for play and participation in leisure activities of a child with ASD. Refer to Appendix F for the participant’s pretest result forms and Appendix G for posttest result forms.

Results

Schilder Test

Results from the Schilder Test show that the participant attained a negative score for the ATNR post-intervention as depicted in Table 1. The MNRI protocol appeared successful at integrating the ATNR in the participant. The participant in the study improved from having 1) the presence of a retained ATNR in both sides of his body at pre-intervention to 2) not having any indications of a retained ATNR in both sides of his body at post-intervention.

Table 1

Pre and Post Results of Schilder Test

Schilder Test	ATNR Pre Intervention	ATNR Post Intervention
ATNR Interpretation	Positive	Negative
ATNR Score	6	0

BOT-2

The results of upper-limb coordination and bilateral coordination using the BOT-2 motor subtests pre and post MNRI intervention are depicted in Table 2. During the pre-assessment, the participant scored 22 on upper-limb coordination with a scale score that lies in the *Below Average* range and with an age equivalent in the range of 6 years 3 months (6:3) through 6 years 5 months (6:5). His upper-limb coordination subtest score was equivalent to the average point score earned by BOT-2 examinees between the ages of 6:3 and 6:5 in the norm sample. His standard deviation pre-assessment was -1.6 below the mean of the norm sample (children with the same age as the participant).

During the post-assessment, the participant scored 20 on upper-limb coordination with a scale score that lies in the *Below Average* range and with an age equivalent in the range of 6 years 0 months (6:0) through 6 years 2 months (6:2). His upper-limb coordination subtest score was equivalent to the average point score earned by BOT-2 examinees between the ages of 6:0 and 6:2 in the norm sample. His standard deviation post-assessment was -1.8 below the mean of the norm sample (children with the same age as the participant).

During the pre-assessment, the participant scored 0 on bilateral coordination with a scale core that lies in the *Well-Below Average* range and with an age equivalent of below 4 years of age (<4). His bilateral coordination subtest score was equivalent to the average point score earned by BOT-2 examinees below 4 years of age in the norm sample. His standard deviation pre-assessment was -2.8 below the mean of the norm sample (children with the same age as the participant).

During the post-assessment, the participant scored 6 on bilateral coordination with a scale score that lies in the *Well-Below Average* range and with an age equivalent in the range of 4 years 2 months (4:2) through 4 years 3 months (4:3). His bilateral coordination subtest score was equivalent to the average point score earned by BOT-2 examinees between 4:2 and 4:3 in the norm sample. His standard deviation post-assessment was -2.0 below the mean of the norm sample (children with the same age as the participant).

Table 2

Pre and Post Results of BOT-2

BOT-2 Pre-Intervention							
Subtest	Total Point Score	Scale score	Confidence Interval *Band*	*Interval*	Age equivalent	Descriptive Category	Standard Deviation
Upper-limb Coordination	22	7	± 3	4 - 10	6 years 3 months – 6 years 5 months	Below Average	-1.6
Bilateral Coordination	0	1	± 3	-2 - 4	Below 4 years	Well Below Average	-2.8
BOT-2 Post-Intervention							
Subtest	Total Point Score	Scale score	Confidence Interval *Band*	*Interval*	Age equivalent	Descriptive Category	Standard Deviation

Upper-limb Coordination	20	6	± 3 3 - 9	6 years 0 months - 6 years 2 months	Below Average	-1.8
Bilateral Coordination	6	5	± 3 2 - 8	4 years 2 months – 4 years 3 months	Well Below Average	-2.0

Standard errors of measurement (SEM) were used to determine the reliability of individual scores in upper-limb and bilateral coordination motor subtests. The participant's scale scores were banded using SEM creating a score range called the confidence interval (Bruininks & Bruininks, 2005). The confidence interval measured how much uncertainty there was in the participant's score using a margin of error at pre and post intervention.

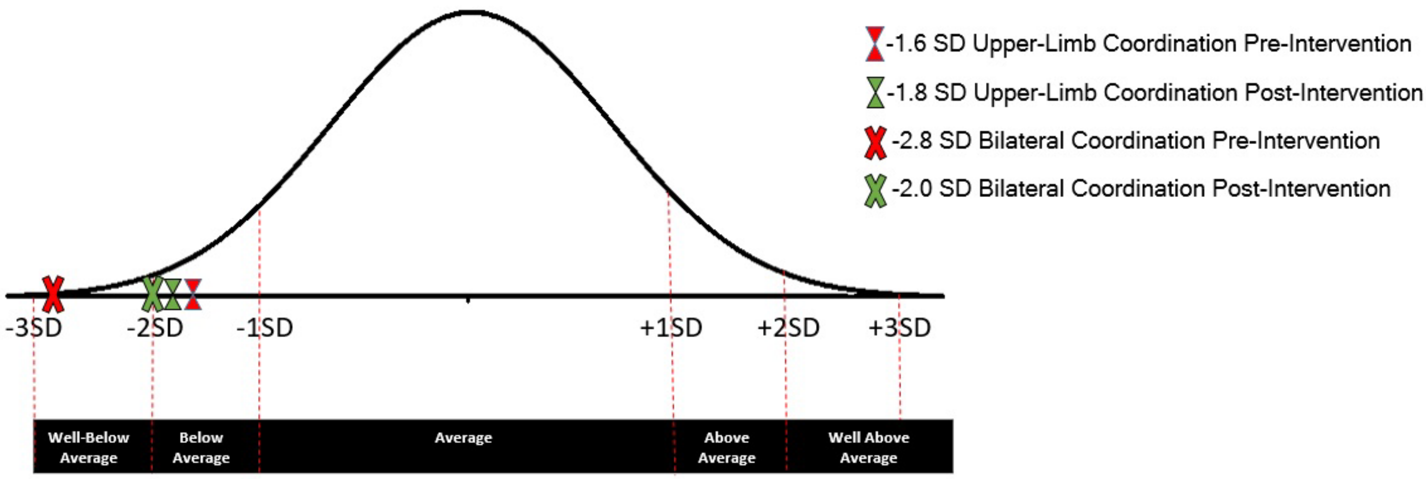
The results at pre-assessment for *upper-limb coordination* stated that the confidence level was 90% with a ± 3 margin of error meaning that the participant's true scale score range between 4 and 10. The results at post-assessment for *upper-limb coordination* stated that the confidence level was 90% with a ± 3 margin of error meaning that the participant's true scale score ranged between 3 and 9.

The results at pre-assessment for *bilateral coordination* stated that the confidence level was 90% with a ± 3 margin of error meaning that the participant's true scale score ranged between -2 and 4. The results at post-assessment for *bilateral coordination* stated that the confidence level was 90% with a ± 3 margin of error meaning that the participant's true scale score ranged between 2 and 8.

The standard deviation for the upper-limb coordination subset in the BOT-2 shows that the participant's scores at post assessment moved away from the mean of the norm sample. The standard deviation for the bilateral coordination subtest in the BOT-2 shows that the participant's scores at post assessment moved towards the mean of the norm sample. Refer to the bell curve in Figure 5 for the standard deviation representations.

Figure 5

Upper-Limb and Bilateral Coordination Standard Deviations (SD)



The data collected in the BOT-2 assessment shows that the participant did not improve his upper-limb coordination skills post intervention. No significant change was obtained for his visual tracking skills in relation to hand and arm movements. Using the pre and post standard deviation and SEM data, significant change in bilateral coordination was detected. The patient specifically improved in his motor abilities to perform jumps in place (same side and opposite sides synchronized) and to touch his nose with his index finger with his eyes closed. The results show evident correlation between the intervention and the bilateral coordination motor skills.

Sensory Profile 2

The results of auditory and attentional skills using the Sensory Profile 2, pre and post MNRI intervention are presented in Table 3. The participant attained scores with average performance classified as "Just like Majority of Others" for auditory and attentional sensory processing patterns at pre and post intervention. It is important to note that the participant demonstrated behaviors of covering his ears to the sound of music and math (counting, addition, & multiplication) during the first two weeks of the intervention. But, during the intervention, the participant demonstrated increased tolerance to music with interest in singing and dancing. The participant also demonstrated behaviors of counting during exercises.

Table 3

Pre and Post Results of Sensory Profile 2

Sensory Profile Sections	Pre Intervention	Post Intervention
Auditory Raw Score	23	20
Auditory Classification	Just like Majority of Others	Just like Majority of Others
Attentional Raw Score	19	18
Attentional Classification	Just like Majority of Others	Just like Majority of Others

Crossing Midline Event Frequency

The results of the total crossing midline motor patterns observed during a retrieve/stack blocks activity using an event frequency observation form pre and post MNRI intervention are presented in Table 4. The participant improved his crossing midline skills in his left upper extremity (LUE) from 0 out of 6 trials at pre-intervention to 2 out of 6 trials at post-intervention. No changes were noted in the right upper extremity (RUE) with the participant crossing midline in 4 out of 6 trials at pre and post intervention. No changes were recorded in speed to cross midline with either upper extremity. The participant required >1 minute to retrieve blocks one at a time, crossing midline to the opposite side of the body of the upper extremity being used, and stacking them on a designated area closer to the upper extremity being used.

Table 4

Pre and Post Results of Crossing Midline during Block Stacking Task

Play Task	Pre Intervention	Post Intervention
Total crossing midline RUE	4	4
Total crossing midline LUE	0	2

Time to stack with RUE	>1 minute	> 1 minute
Time to stack with LUE	> 1 minute	>1 minute
Note: RUE= right upper extremity, LUE= left upper extremity		

Intervention Observations

The participant completed 16 intervention sessions in a private therapy room. During each session, the occupational therapist recorded the observations of the participant. These observations are outlined by week in table 5.

Table 5

MNRI Intervention for ATNR Observations

Week	Activities Completed	Observations	Comments
Week 1	Swinging in lycra swing for 6 to 7 minutes Passive ATNR integration exercises to both sides of the body Activation of ATNR Music and Math	Verbal and tactile cues needed to sustain ATNR position Tolerating passive exercises Unable to perform active or variant exercises Covering his ears to sound	Required one to two breaks during the intervention Needed constant verbal cues to cooperate appropriately
Week 2	Swinging in lycra swing for 6 to 7 minutes Passive and active ATNR integration exercises to both sides of the body towards and against reflex pattern Activation of ATNR Music and Math	Verbal and tactile cues needed to sustain ATNR position Maximal tactile and verbal cues needed to activate correct body movements during active exercises towards and against reflex pattern. Less than 5 second hold Covering his ears to the sound of math	Required one to two breaks during the intervention Needed constant verbal cues to cooperate appropriately (defiance present)
Week 3	Swinging in lycra swing for 6 to 7 minutes Passive and active ATNR integration exercises to both sides of the body towards and against reflex pattern	Tactile cues needed to sustain neck rotated during active exercises Moderate tactile and verbal cues to complete active exercises towards reflex pattern on left side and maximal tactile cues to perform all other active	Required one break during the intervention Participant given choice to select music

	Activation of ATNR Music and Math Two ATNR variant exercises	exercises in both sides of his body. Less than 5 second hold. No signs of covering ears to music or math Unable to perform variant exercises	
Week 4	Swinging in lycra swing for 6 to 7 minutes Passive and active ATNR integration exercises to both sides of the body towards and against reflex pattern Activation of ATNR Music and Math Three variant exercises	Verbal cues needed to sustain ATNR position Minimal tactile and verbal cues to complete active exercises towards and against reflex pattern on left side and moderate tactile cues/maximal verbal cues for right side. 5 second hold Maximal tactile cues to complete variant exercises on both sides of the body. Less than 5 second hold	Participant given choice to select music Defiance present (participant changing body positions during exercises) Snack breaks given
Week 5	Swinging in lycra swing for 6 to 7 minutes Passive and active ATNR integration exercises to both sides of the body towards and against reflex pattern Activation of ATNR Music and Math Four to five variant exercises	Tactile and verbal cues needed to sustain ATNR position Minimal tactile and verbal cues to perform active exercises towards, against reflex pattern, and five variant exercises on left side. 5 to 7 second hold Minimal tactile and verbal cues to perform active exercises towards and against reflex pattern and maximal tactile and verbal cues to perform four variants on right side. 3 to 5 second hold	Participant given two breaks during intervention Pt with increased energy
Week 6	Swinging in lycra swing for 6 to 7 minutes Passive and active ATNR integration exercises to both sides of the body towards and against reflex pattern Activation of ATNR Music and Math All variant exercises	Minimal tactile and verbal cues to perform active exercises towards, against, and all variant exercises on left side. 5 to 7 second hold Moderate tactile and verbal cues to perform active exercises towards and against reflex pattern, and all variant exercises on right side. 5 second hold	Decreased tolerance to treatment Movement breaks given to decreased hyperactivity A preferred food provided as reward

Week 7	Swinging in lycra swing for 8 to 10 minutes Passive and active ATNR integration exercises to both sides of the body towards and against reflex pattern Activation of ATNR Music and Math All variant exercises	100% tolerance of intervention Minimal tactile and verbal cues to perform active exercises towards, against, and all variant exercises on left side. 4 to 7 second hold Minimal tactile and verbal cues to perform active exercises towards and against reflex pattern and moderate tactile and verbal cues to complete variant exercises on right side. 3 to 7 second hold	Required one break during the intervention
Week 8	Swinging in lycra swing for 8 to 10 minutes Passive and active ATNR integration exercises to both sides of the body towards and against reflex pattern Activation of ATNR Music and Math All variant exercises	100% tolerance of intervention Minimal tactile and verbal cues to perform active exercises towards, against, and all variant exercises on left side. 4 to 7 second hold Minimal tactile and verbal cues to perform active exercises towards and against reflex pattern and moderate tactile and verbal cues to complete variant exercises on right side. 5 to 7 second hold Engaged in counting second holds	Required one break during the intervention

Discussion

The data suggests that the MNRI protocol for the ATNR implemented for 8-weeks was successful at integrating the reflex and improving bilateral coordination and crossing midline skills for the participant. The MNRI was not successful at improving the participant's upper-limb coordination. No effects were identified in regards to auditory-visual integration.

Motor skills such as bilateral coordination and crossing midline are needed in order to complete self-care activities and daily living skills (Ashori, Norouzi, & Jalil-Abkenar, 2018). Having poor motor skills can affect a child's ability to participate in the occupations of play and leisure. Similar to the case study findings, the research conducted by Gieysztor, Choinska, &

Paprocka-Borowicz (2015) on the motor problems associated with retained reflexes revealed that the greater the severity of the reflex, the lower the motor efficiency. Understanding the reasons why a child with ASD has poor motor skills and addressing these underlying reasons can increase their social participation in physical activities (Todd, 2012). The participant in the study improved his bilateral jumping skills, which are needed for play and participation in physical and recreational activities.

The results gathered from the Sensory Profile 2 to assess auditory and attention skills pre and post intervention demonstrated no changes in skills due to the participant not having deficits in these areas at pre-intervention. There was no room for sensory improvement. He presented with skills like majority of children his age at pre and post intervention. Proponents of reflex-based interventions claim that these interventions can improve sensory processing (Barrett et al., 2016). But, the case study data was unable to generate new findings in this area.

The crossing midline results gathered using the crossing midline observation form to stack blocks demonstrated that the participant progressed from not crossing midline to crossing midline with his LUE and no changes were noted in his crossing midline skills for his RUE. The research work by Melillo (2011) explains that the two hemispheres of the brain do not develop at the same time, possibly explaining the participant's asymmetrical responses. No changes were recorded in the speed to cross midline and stack six blocks with either upper extremity. This may be due to behavioral defiance during assessment, distraction, and fixation to retrieve and stack blocks following a ritualized behavior pattern, based on the blinded occupational therapist's observations.

The participant completed 16 intervention sessions and his willingness to participate in ATNR active exercises progressed throughout the 8-weeks of the study. The participant became more tolerant of the MNRI intervention. His ability to voluntarily control motor patterns according to the reflex pattern, against the reflex pattern, and variants of the reflex pattern also progressed. His voluntary motor responses on each side of his body improved throughout the 8-weeks of intervention. The research conducted by McPhillips, Hepper, & Mulhem (2000) suggested that the repetition of primitive reflex movements plays a major role in the integration or inhibition of primitive reflexes. The case study results also show that the repetition of the neuromodulation exercises according to and against the reflex pattern were key to integrate the ATNR and to increase voluntary bilateral motor control.

At pretest, posttest, and during the intervention period, the participant presented with behavioral defiance. He demonstrated difficulties to assume correct body position for passive exercises and impulsivity to complete active exercises. He benefited from calming sensory activities of swinging in a lycra swing prior to intervention to increase tolerance and attention to treatment. He also benefited from rewards at the end of the intervention including snacks, playing board games, and/or painting. He demonstrated behaviors of ignoring directions or performing the opposite of what he was told to do during pretest and posttest. Reversed psychology principles were used at times to achieve desired behaviors. During the posttest, he exhibited behaviors of sitting on assessment materials, refusals, temper tantrums, poor cooperation, and increased defiance. The post assessment was completed in the course of two days, in order to provide accurate results. This could have impacted the results negatively as the participant had the opportunity to rehearse the assessments. Additionally, final posttest was delayed, and it may have not captured immediate effects post intervention. It is important to notice that modifications to the intervention, pretest, and posttest were made to accommodate the participant’s deficits.

OT practitioners work with children, youth, caregivers, family members, and teachers to promote active participation in daily activities. Based on the Person-Environment-Occupation (PEO) model, the role of OT practitioners is to provide the following intervention approaches: create/promote, restore, maintain, modify, and prevent (American Occupational Therapy Association, 2014). OT practitioners can use MNRI for neurodevelopment and to restore neurological function. The research work completed by Masgutova et al. (2016a; 2016b) suggested that the MNRI method was successful at improving physical neurodevelopment in children with ASD. In this case, the MNRI appeared to improve the participant’s physical neurodevelopment (bilateral coordination). MNRI should be further examined to better understand how this intervention can be used effectively in OT practice to treat physical motor deficits in children with ASD or children with other neurological deficits.

What is unique about the MNRI program is that goes back to the innate form of a reflex motor pattern to create a more efficient sensory-motor neurological pathway (Masgutova, 2012). Creating a clear connection between the stimulus and motor response helps the body to naturally incline to use the most adaptive and efficient motor skills. In this particular case, the innate ATNR was activated to re-pattern and re-educate the reflex pattern to develop appropriate sensory-motor responses to further mature and enhance bilateral motor skills and crossing midline motor skills. The MNRI method can supply OT practitioners and other clinicians with a combined sensory-motor intervention that aims to restore innate neurophysiological aspects of a reflex that may be dysfunctional, underdeveloped, or unintegrated in order to increase neurodevelopment.

Study Strengths and Limitations

This case study used a blinded occupational therapist to complete the pre and post assessments and the participant was selected at random from a purposive sample to reduce bias. The study used objective data measurement with the BOT-2 and a replicable crossing midline activity. The BOT-2 is a common assessment tool used in OT practice to measure motor skills. Developmental maturation was not a factor in the study results.

Although, the information from this case can be useful to OT practitioners and other professionals who work with children diagnosed with ASD and/or children who present with retained primitive reflexes, these results cannot be generalized because it is a case study. Secondly, there was limited objective data collected from the Sensory Profile 2, due to the assessment relying on parent report. Rater bias also became a limitation to the study results. Limited research on the effects of MNRI to serve as a comparison to the case study results is another limitation to the study. Finally, the participant's behaviors are a limitation to the study. The participant had defiant behaviors at pretest and posttest possibly impacting the results negatively because his behavior and motor responses may not have been completely accurate. Reflex integration takes repetition to re-educate or train motor control patterns. The study would be strengthened by adding objective pretest and posttest measures of occupational performance such as the Pediatric Evaluation of Disability Inventory (PEDI) or the Canadian Occupational Performance Measure (COPM).

Directions for Future Research

The case study findings do not represent all children with ASD. More research and additional studies are needed to validate the case study findings with a bigger sample of children diagnosed with ASD who present with a persistent ATNR. A study on the effects of MNRI on daily skills is needed to determine if the MNRI intervention can ultimately improve occupational performance. More research is recommended to determine if the MNRI neuromodulation techniques can benefit motor skills and daily functional skills in children with other diagnoses.

Implications to Occupational Therapy Practice

The results of this case study report contribute new knowledge to the OT field that can influence pediatric research and practice:

- The case study generated preliminary data for the field of OT to understand the effectiveness of reflex-based interventions on motor skills and occupational performance for children with ASD.
- The MNRI intervention integrated the ATNR and improved bilateral coordination skills as measured by standardized testing commonly used in OT practice.
- The MNRI improved the participant' ability to cross midline in one upper extremity but not effects were found for auditory-visual integration.
- OT practitioners must orient themselves to choose evidence-based interventions to provide best care.

Conclusion

OT practitioners provide various intervention approaches to children with ASD including motor skill development and functional restoration, with the goal to promote active participation in daily activities. Primitive reflexes play a role in motor development and research data shows that persistent or retained reflexes can lead to poor performance of fine and gross motor skills (McPhillips, et al., 2000; McPhillips & Sheehy, 2004; Alibakhshi et al., 2018). Motor skills are a pre-requisite for executing daily occupational performance (Ashori, Norouzi, & Jalil-Abkenar, 2018). Children with ASD tend to retain primitive reflexes for a longer period of time

(Teitelbaum, Teitelbaum, Fryman, & Maurer, 2002). This may lead to difficulty to participate in daily activities due to poor developed motor skills.

Although reflexes are a precursor to motor development, research on the effectiveness of reflex-based interventions in OT is limited. There is an ongoing controversy when discussing the effects of retained reflexes on development (Jordan-Black, 2005). Major findings in the literature suggest that reflex-based interventions can improve sensory-motor integration, physical development, behavioral control, emotional regulation, cognitive functioning, social development, neuro re-patterning, and communication (Masgutova et al., 2016a; Masgutova et al., 20l6b; Pilekci et al., 2012; Grigg, Fox-Turnbull, & Culpan, 2018). This case study investigated the effects of one reflex-based intervention; MNRI, on the motor skills needed for play of a child diagnosed with ASD.

The MNRI program combines a sensory-motor intervention approach that aims to restore neurological function. The case study showed that the MNRI intervention integrated the ATNR improved bilateral coordination skills as measured by a standardized test. The participant's ability to cross midline in one upper extremity improved post MNRI. No effects were noted for auditory-visual integration.

This case study provides preliminary data of a specific reflex-based intervention in OT practice. Currently there is no sufficient evidence to support the use of reflex integration; however research has not concluded that the intervention is ineffective (Barrett et al., 2016). Further research will provide the necessary information to support or not support the use of reflex-based intervention in OT practice. In this case, the MNRI intervention appeared effective at increasing bilateral coordination skills needed for participation in play and recreational activities. The use of the MNRI in OT needs to be further researched to validate these findings with a bigger sample. Ultimately, more research is needed to determine if MNRI can ultimately improve occupational performance.

The American Occupational Therapy Association (AOTA) Vision 2025 calls for effective practice that is evidence based, client centered, and cost-effective (AOTA, 2016). The profession of OT continues to evolve and in order to demonstrate its value, research on emerging areas must continue. Research will validate the use of evidence-based practice in OT and provide the necessary evidence to demonstrate the effectiveness of OT intervention. More research in this topic is needed to advance OT evidence-based practice.

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Appendix A

Critically Appraised Topic (CAT) Paper

Effectiveness of Reflex Integration as an Intervention for Occupational Therapy Practice

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Clinical Scenario

A reflex can be best defined as an automatic motor response by the central nervous system elicited by a specific stimuli such as visual, tactile, olfactory, vestibular, or proprioceptive input (Masgutova, Masgutov, Akhmatova, & Akhmatov, 2015). Primitive reflexes develop in utero and integrate over time during the lifespan development and become more complex motor movements. Primitive reflexes are the first foundation of the nervous system used for protection and survival. Reflex responses are viewed as a milestone in the child development because they are believed to disappear by toddler age. However, reflexes never disappear, they integrate and become more sophisticated movements that aid in the development of more complex motor patterns and movements. A child's development depends on motor activity and motor activity develops out of reflex patterns that start in utero and integrate over time (Fiorentino, 1965). Motor development is required in order to perform activities of daily living including self-care, education, and play in children.

In the United States, one in five children have some type of neurological disorder including but not limited to developmental delays, autism, attention deficit, cerebral palsy, and cognitive deficits (Brandes, 2015). There are many factors influencing the cause a neurological disorders and unintegrated reflexes are one cause because when one or more reflexes do not integrate and work appropriately in the central and peripheral nervous systems, neurological deficits appear. Unintegrated reflexes can cause physical dysfunction because of the constant battle of the brain to control or suppress automatic reflex motor activity due to environmental demands. Children with unintegrated reflexes exhibit various maladaptive behaviors and physical dysfunction such as short attention span, hyperactivity, poor coordination, motor delays, low endurance, and poor body awareness (Masgutova et al., 2015).

The purpose of reflex integration intervention is to facilitate maturation and integration of any unintegrated reflex by activating its components and re-patterning the motor response until there is a link between the reflex circuit memory and the reflex circuit to elicit conscious processes (Masgutova et al., 2015). Reflex integration programs continue to grow and develop for children with developmental delays and other dysfunctional conditions to provide new developmental possibilities across the world (Masgutova, 2008). However, this intervention is not being used specifically in occupational therapy or in conjunction with occupational therapy. Pediatric training in occupational therapy university programs encompass approximately 20% of the school curriculum. Most common theories taught in the curriculum include sensory integration, neurodevelopment, self-care skills training, play-based therapy, and instructions on how to perform pediatric assessments. Occupational therapy school curriculums do not provide training on reflex integration (Rodger, Brown, Brown, & Roever, 2009). University education programs provide the basic skills to work as occupational therapists in the pediatric field, but those who wish to specialize in working with children have to pursue advanced education and continuing education to implement best and most current practice (Brown, Brown, & Roever, 2005).

The purpose of this report is to generate evidence of the effectiveness of reflex integration programs to determine if this practice can be added as an evidence-based intervention to the occupational therapy practice. This review will develop new knowledge on reflex integration and implications for occupational therapy to lead and provide the highest level of professional practice to support children's full participation in daily activities.

Focused Clinical Question

What is the efficacy of reflex integration exercises to improve motor coordination, sensory integration, attention, and cortical organization in children with neurological dysfunction to increase independence with activities of daily living (ADL)?

Limitation to CAT

This critically appraised topic has not been peer-reviewed by other independent person/lecturer.

Search Strategy

Terms used to guide the search strategy
• **P**atient/Client Group: Children with neurological dysfunction • **I**ntervention: Reflex integration • **C**omparison: N/A • **O**utcome(s): Increase independence in ADL The formal search question: What is the efficacy of reflex integration exercises to improve motor coordination, sensory integration, attention, and cortical organization in children with neurological dysfunction to increase independence with activities of daily living (ADL)?

Databases and Sites Searched	**Search Terms/ Limits Used**	**Articles Found**
Web of Science	"neurosensorimotor reflex integration" combined with (AND) "cerebral palsy"/English, years 2000-2018	Yielded 1 result. 1 relevant result. Pilecki, et al., (2012), *Advances in Clinical and Experimental Medicine*
PubMed	"reflex integration" combined with (AND) "pediatrics"/ English, years 2000-2018	Yielded 8 results. No relevant results.
PubMed	"primary reflex movements" combined with (AND)	Yielded 22 results. 2 relevant results.

	"children"/Full text, years 2000-2018, humans	McPhillips, M., Hepper, P. G., & Mulhem, G. (2000), *Lancet* McPhillips, M., & Jordan-Black, J. A. (2007). *Neuropsychologia*
PubMed	"reflex integration" combined with (AND) "Autism"/ Full text, years 2000-2018, humans	Yielded 4 results. 1 relevant result. Accardo, P. J., & Barrow, W. (2015). *Journal of Child Neurology*
Ovid (Medline)	"reflex integration"/English, years 2000-2018	Yielded 8 results. 1 relevant result. Gieysztor, E. Z., Sadowska, L., Choinska, M., & Paprocka-Borowicz, M. (2014), *Advances in Clinical and Experimental Medicine*
Google Scholar	"reflex integration" combined with (AND) "neurosensorimotor"/ years 2000-2018, terms in the title	Yielded 58 results. 6 relevant results. Bilbilaj, S., Aranit, G., & Fatlinda, S. (2017*), European Journal of Multidisciplinary Studies.* Koberda, J. L, Akhmatova, N., Akhmatova, E., Bienkiewicz, K. N., & Nawrocka, H. (2016), *Journal of Neurology and Neurobiology* Masgutova, S. (2008), *SMEI* [PDF document] Masgutova, S., Akhmatova, N., Sadowska, L., Shackleford, P., & Akhmatov, E. (2016), *Journal of Neurology and Psychology* Masgutova, S. K., Akhmatova, N. K., Sadowska, L., Shackleford, P., & Akhmatov, E. A. (2016), *Journal of Pediatric Neurological Disorders* Masgutova, S., Sadowska, L., Kowalewska, J., Masgutov, D., Akhmatova, N., & Filipowski, H. (2015), *Journal of Neurology and Neuroscience*

Google Scholar	"Move to learn program" combined with (OR) "masgutova", "rhythmic training"/ years 2000-2018	Yielded 19 results. 1 relevant result. Kulesza, E. M. (2011), In *Movement, vision, hearing: The basis of learning [Book]*

Inclusion and Exclusion Criteria

Inclusion Criteria
• Studies from any geographical location • Publication date: 2000-present • Children age: 0-19 • Children diagnosed with any neurological dysfunction • Children receiving reflex integration treatment • Outcomes in relation to cortical organization, motor coordination, sensory integration, attention and/or function and participation in daily activities • Evidence Levels I, II, & III
Exclusion Criteria
• Studies published prior to 2000 • Children over age of 19 • Children with no neurological or developmental diagnosis • Children receiving treatment that did not involve reflex integration • Evidence Level IV & V

Results of Search

Seven relevant studies met inclusion criteria and were analyzed. The studies were categorized by levels of evidence described by Gutman (2009) in Table 1.

Table 1. Summary of Study Designs of Articles Retrieved

Study Design/ Methodology of Articles Retrieved	Level	Number Located	Author (Year)
Randomized Control Trial	I	One	McPhillips, Hepper, & Mulhem (2000)
Non-randomized control study	II	Four	Kulesza (2011) Masgutova, Akhmatova, Sadowska, Shackleford, & Akhmatov (2016a)

			Masgutova, Akhmatova, Sadowska, Shackleford, & Akhmatov (2016b) Masgutova, Sadowska, Kowalewska, Masgutov, Akhmatova, & Filipowski (2015)
Pretest-Posttest Design	III	Two	Masgutova (2008) Pilecki et al., (2012)

Summary of Findings

Summary of Levels I, II, and III

In this summary, only studies presenting evidence at levels I, II, and III were included according to the levels of evidence described by Gutman (2009). One Level I study, four Level II studies, and two Level III studies were included in this review, all evaluating the effectiveness of various reflex integration programs for specific developmental disabilities and/or neurological dysfunction. No studies on the effects of reflex integration for attention deficit disorder and/or attention-deficit/hyperactivity disorder (ADD/ADHD) were found. One Level III study on the effects of reflex integration on various neurological dysfunctions did not meet inclusion criteria. The reflex integration programs included in this review were Masgutova Neurosensorimotor Reflex Integration (MNRI), Rhythmic Movement Training International (RMTi), and Move to Learn Program.

Autism Spectrum Disorder (ASD)

Two Level II studies on the use of MNRI with children diagnosed with ASD met inclusion criteria (Masgutova, Akhmatova, Sadowska, Shackleford, & Akhmatov, 2016a; Masgutova, Akhmatova, Sadowska, Shackleford, & Akhmatov, 2016b). MNRI protocol delivered for 8 days by MNRI core specialists to re-pattern 30 reflexes proved to be effective in improving reflex patterns/expressions in children with ASD. MNRI also proved to be beneficial in the areas of sensory-motor integration (tactile sensitivity), physical development (posture and balance), behavioral control, emotional regulation, cognitive functioning (self-awareness), and communication.

Cerebral Palsy (CP)

Two level III studies on the use of MNRI with children diagnosed with CP met inclusion criteria (Masgutova, 2008; Pilecki et al., 2012). MNRI program implemented for 1 to 14 days to re-pattern reflexes and identify a new outcome measure for neuro-motor rehabilitation. MNRI was found to be effective at improving reflex pattern expressions in children with CP; improvement significance level was dependent on diagnosis severity. MNRI intervention also proved to be effective in improving motor function, postural control, stability, and sense of equilibrium. The use of MNRI also caused changes in the brain stem and neuro-motor rehabilitation.

Down Syndrome

One Level II study on the effectiveness of MNRI use with children diagnosed with Down syndrome met inclusion criteria (Masgutova et al., 2015). MNRI program delivered for 8 days by MNRI core specialists to re-pattern 24 reflexes proved to be effective at improving sensory-motor function.

Developmental Delays

One Level I study on the use of RMTi and one Level II study on the use of Move to Learn program on children exhibiting developmental deficits met inclusion criteria (McPhillips, Hepper, & Mulhem, 2000; Kulesza, 2011). The use of RTMi helped decrease persistent reflex reactions and proved to be effective with children exhibiting reading difficulties. The use of both the RMTi and the Move to Learn programs proved to be effective at increasing cognitive development. The Move to Learn program also proved to be effective at increasing graph-motor skills and social development.

Table 2. Characteristics of included studies

Study (Authors)	Intervention	Comparison Intervention	Outcome Measures used	Findings	Study Strengths and Weaknesses
Kulesza (2011)	Move to Learn Program for 10 weeks	No participation in Program	1.Clinical Observations 2. Drawing a person portrait 3.Handwriting from listening	General functioning in the school improved for children participating in the program Improvement in social and emotional development in children who participated in the program No statistical difference for handwriting skills from listening	*Strengths* 1.Good sample size 2.Outcome measures clearly defined *Weaknesses* 1.Outcome measure not valid and very subjective 2. Contextual factors not identified
Masgutova, Akhmatova, Sadowska, Shackleford, & Akhmatov (2016a)	MNRI protocol for 8 days	No participation in MNRI	1.Reflex Pattern Assessment: 30 reflexes graded 2.Questionnaire of Dynamic Changes of Children's Abilities	Reflex patterns moved one level higher in children with autism who received the intervention No statistical difference noted between the groups. Progress depends on severity of autism diagnosis	*Strengths* 1.Results can be generalized to ASD population 2.Outcome measures clearly defined *Weaknesses* 1.Outcome measures not standardized 2.Contextual factors not identified 3.Short length of study
Masgutova, Akhmatova, Sadowska, Shackleford,	MNRI protocol for 8 days	No participation in MNRI	1.Reflex Pattern Assessment: 30 reflexes graded	Statistical difference in reflex pattern improvement.	*Strengths* 1.Results can be generalized to ASD population

& Akhmatov (2016b)			2.Questionnaire of Dynamic Changes of a Child's Ability	MNRI effective with children diagnosed with autism in the areas of physical behavioral, emotional and cognitive development	2.Outcome measures clearly defined *Weaknesses* 1.Contextual factors not identified 2.Short length of study
Masgutova, Sadowska, Kowalewska, Masgutov, Akhmatova, & Filipowski (2015)	MNRI protocol for 8 days	No participation in MNRI	1. Reflex Pattern Assessment: 24 reflexes graded	Positive effect of intervention on children with Down syndrome in their sensory-motor function Correction of reflex patterns is dependent on age	*Strengths* 1.Outcome measures clearly defined 2.Clear outcome measures 3.Contextual factors identified and analyzed *Weaknesses* 1.Short length of study
Masgutova (2008)	MNRI program (10 days)	None	1. Function z= f(x) from the Diagnostic Function of the Non-Observable Phenomena in 3 groups of motor coordination systems: Medial-lateral, superior-inferior, and anterior-posterior	Significant changed found to improve reflex pattern expressions in children with cerebral palsy receiving MNRI program intervention	*Strengths* 1.Results can be generalized to CP population *Weaknesses* 1.Contextual factors not provided 2.No clear documentation 3.Short-length of study
McPhillips, Herper, & Mulhem (2000)	Specific movement sequence related to primitive reflexes (Moro, Tonic Labyrinthine Reflex (TLR), Asymmetrical	Movement exercises non-specific or related to reflex No participation in program	ATNR Assessment using the Schilder test Neale Analysis of reading ability	Experimental group showed decreased persistence of ATNR reflex over the course of the study All groups showed increased positive difference in reading skills but the	*Strengths* 1.Results can be generalized to school age children 2.Groups were randomized 3.Study was double-blind 4.Enough study length (12mos)

	tonic neck reflex (ATNR) & Symmetrical tonic neck reflex (STNR): RMTi		Wechsler objective reading dimensions (WORD)	intervention group demonstrated greater increase in reading scores Persistent reflexes hinder cognitive development	*Weaknesses* 1.Power to detect significant below of standard measures
Pilecki et al., (2012)	MNRI Neuro-sensorimotor rehab	None	Brainstem Auditory Evoked Potentials (BAEP) examination	Improvement in the transmission of brain stem section of the auditory pathway was observed Rehabilitation results were prolonged after MNRI	*Strengths* 1.Use of an objective and standard measure *Weaknesses* 1.Small sample 2.Incomplete results due to 2 participants not completing study

Clinical Bottom Line

Research shows that reflex integration can be an effective intervention to increase cortical organization, sensory-motor integration, physical development, behavioral control, emotional regulation, cognition, motor function, communication and social development in children with various neurological disabilities. The studies appraised did not provide information about the use of reflex integration specific to occupational therapy practice and did not provide implications for practice. However, the literature search results may contribute to the knowledge of pediatric occupational therapy regarding the strengths and limitations of reflex integration intervention for motor development. This intervention uses neurological concepts to facilitate maturation and integration of any unintegrated reflex by re-patterning motor responses to elicit conscious processes. Due to the lack of knowledge in reflex integration interventions and lack of trained occupational therapists in reflex integration, many children do not have the opportunity to receive this treatment. Occupational therapists can be trained in reflex integration principles and start using an evidence-based treatment in a variety of settings. The changes noted in children's environments over the years limiting physical movement are placing stress in the nervous system impacting development. This intervention helps the nervous system mature optimally and teaches the correct progression of motor development. The information gathered from the literature review demonstrates a lack of use of reflex integration in occupational therapy practice. The bottom line of this critically appraised topic has led me to the conclusion that a systematic review on the effectiveness of reflex integration intervention and a study on the effects of reflex integration use in occupational therapy practice as a treatment approach are needed to produce new evidence based interventions.

Implications for Practice, Education and Future Research

Practice: Given the limited research involving effectiveness of reflex integration and no research involving reflex integration use in occupational therapy treatments, it is difficult to provide evidence based facts on the implications for practice. Occupational therapists treat children with numerous neurological dysfunctions and developmental disabilities in a variety of practice settings. Considering the evidence analyzed on reflex integration programs, persistent reflexes hinder development (McPhillips, Hepper, & Mulhem, 2000). Occupational therapists working with children diagnosed with ASD, CP, Down syndrome, and developmental delays should consider reflex integration intervention to support children's full participation in daily activities by increasing cortical organization, sensory-motor integration, physical development, behavioral control, self-regulation, cognitive functioning, social participation and communication. It would be valuable for occupational therapists to get trained on reflex integration. An occupational therapist could combine reflex integration concepts with a rehabilitation and/or a biomechanical approach to increase motor development. Occupational therapists can also educate caregivers on the benefits of reflex integration and provide them with the appropriate exercises to increase integration of reflexes and help the reflexes remain integrated.

Education: The amount of pediatric training in occupational therapy school programs is limited and any therapist who wishes to specialize in working with children has to pursue advanced education and continuing education. Occupational therapy students would benefit from reflex integration education and not just the concepts of developmental milestones. Students would benefit from information on how to implement interventions that address motor and sensory development using reflex integration components. Continuing education classes on MNRI, RMTi, and Move-to-Learn programs are currently being offered to occupational therapists who wish to learn reflex integration interventions.

Future Research: Future research on the effects of reflex integration use as part of occupational therapy treatment is needed. Also, the effectiveness of reflex integration exercises treating symptoms of ADHD/ADD needs to be researched. More research is needed on how effective reflex integration exercises can be at decreasing pharmacological needs in children with neurological dysfunctions. Interventions work differently on every individual but, the need to assess reflex integration is crucial for motor development as scientific research already shows that movement and motor development are important for appropriate function in daily activities.

List of Articles Selected for Appraisal in CAT

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Appendix B

Case Study Literature Review

Authors, Year, Location	Hypothesis or Purpose	Study Design, Intervention, Outcome Measures, And Level of Evidence	Study Populations or Groups	Results	Significance of these findings to OT	Study limitations
Accardo & Barrow 2015 United States	Examine association between toe walking to sensory difficulties, language age and persistent signs of the tonic labyrinthine reflex	Case series design (observational study) Intervention: none Outcome Measures: -Toe walking grading on a scale from 0-5. -The Clinical Linguistic and Auditory Milestone Scale -Sensory assessment as per caregiver report in a scale from 0-2. Evidence Level: IV	Children aged 19-36mos diagnosed with ASD according to DSM-IV 61 participants 54 males 7 females	No association between the presence of toe walking and sensory symptoms and language age Association between toe walking and the presence of components of the tonic labyrinthine reflex	Toe walking in ASD is residual from retained primitive reflexes. Primitive reflexes can be used to determine early motor abnormalities	Outcome measures not standardized Contextual and confounding variables not identified
Note: ASD= Autism Spectrum Disorder; DSM-IV= Diagnostic and Statistical Manual of Mental Disorders (4th edition)						
Alibakhshi, Salmani,	Examine relationship between	Cross-sectional study	Children with learning disability N=39	Significant correlation between poor	Persistent of primitive reflexes can lead	Observational study

Ahmadizadeh, & Siminghalam 2018 Iran	persistence reflexes and fine motor skills in children with learning disabilities.	Intervention: None (observation) Outcome Measure: Purdue Pegboard Evidence Level: IV	Children with no disability N=38	fine motor skills and ATNR	to poor performance on fine motor skills Primary reflex inhibition can be useful to improve motor function.	Small sample
Note: ATNR= Asymmetrical Tonic Neck Reflex						
American Occupational Therapy Association. 2014 United States	To examine the occupational therapy framework	Book Intervention: None Outcome Measures: None Evidence Level: IV	None: Educational book	None: Educational book	Guide to occupational therapy practice	None
Brandes 2015 United States	To examine interventions for human development using reflex integration	Book Intervention: Quantum Brain Boost Outcome Measures: None Evidence Level: IV	None: Educational book	None: Educational book	Quantum Brain Boost reflex integration exercises protocol to increase motor function	None
Chinello, Di Gangi, & Valenza, 2016 Italy	Explore the relationship between persistence of primitive reflexes that involve hand or	Observational Study Intervention: none Outcome Measures: -Goddard Scale Evidence Level: IV	Healthy infants N=34 15 males 19 females	Persistent reflexes decrease infant's performance and interaction with objects	Persistence reflexes can be a promising marker for early identification of ASD	Small sample Children in the study were not later diagnosed with ASD

	mouth motor function			Persistent reflexes correlate with ASD	Persistent reflexes might alter developmental trajectory of future motor ability	Outcome measures relied on observation
Note: ASD= Autism Spectrum Disorder						
Desorbay 2013 Switzerland	Explain primitive reflexes and the purpose of neuro-developmental delay therapy to integrate reflexes	Educational article Intervention: None Outcome Measure: None Evidence level: V	Educational article	Educational article	Education on intervention available to integrate reflexes to improve motor control, visual functioning, and perceptual abilities	None
Ferguson, Cassells, MacAllister, & Evans 2013 United States	Review the evidence for relations between child development and the physical environment	Narrative Literature review Intervention: none Outcome Measure: none Evidence level: V	Children	Toxins, pollutants, mercury, polychlorinated biphenyls, pesticides, air pollution, sanitation, noise, crowding, household chaos, housing, school, child care, and physical activity play a role in children's cognitive and socioemotional development.	A child's early home environment from utero across the lifespan can have long-term effects on development	None

Gieysztor, Choinska, & Paprocka-Borowicz, 2015 Poland	Analyze the occurrence of primitive reflexes and their impact on psychomotor development.	Observational study Intervention: None Outcome Measures: -Goddard Scale -MOT 4-6 Evidence level: IV	Preschool children N=35	The greater the severity of the retained reflex, the lower the motor efficiency was	Training in reflex integration principles can improve accessibility to motor delay treatment interventions Reflex integration can reduce psychomotor delays in elder children	Study consisted of health children and not special needs. Small sample
Note: Motor Proficiency Test for children aged 4 and 6 years.						
Gieysztor, Sadowska, Choinska, & Paprocka-Borowicz 2018 Poland	Determine prevalence of trunk asymmetry and the persistence of primitive reflexes and their inter-relationships in school-age children	Observational Study Intervention: None Outcome Measure: -Goddard Scale -Scoliometer Evidence Level: IV	School-age children N=61	Asymmetry of trunk rotation positively correlated with non-integrated spinal galant reflex. Presence of trunk rotation associated with gender. Girls with higher frequency of asymmetry.	Assessing and treating spinal galant reflex could help improve scoliosis, trunk rotation, and postural control.	Small sample Confounding variables not identified
Grigg, Fox-Turnbull, & Culpan	Investigate the use of RMT as an intervention for retained	Qualitative phenomenological study	Parents of children with developmental delays.	RMT is an easy to use intervention, cost-effective,	Recognition of developmental delays including retained reflexes	Small sample Differing developmental

2018 New Zealand	primitive reflexes	Intervention: None Outcome Measure: -semi-structured interviews Evidence Level: V	N= 7 families	and low impact intervention. The families noticed a range of benefits in development.	at an early age can reduce further developmental delays Families need easier access to a variety of treatment interventions	and behavioral challenges of the children do not permit detailed comparisons Families consisted of two-parent families with at least 1 working full-time.
Note: RMT = Rhythmic Movement Training						
Haglund, & Henriksson 2003 Sweden	Clarify similarities and differences between concepts in occupational therapy and the ICF	Analysis of Outcomes Intervention: none Outcome Measures: -ICIDH-2 - AMPS -ACIS-S	Learning disabilities and mental health problem N=33	The ICF classification can serve as a useful tool for occupational therapists and support communication between professions, but it is not sufficient as a professional language for occupational therapists.	Occupational therapists also need their own terminology to describe a client's capacity in a way that guides intervention	ACIS-S and AMPS include many concepts cannot be identified by one category of the ICF. The time between the different ratings varied
Note: ICF= International Classification of Functioning, Disability and Health, AMPS= Assessment of Motor and Process Skills, ACIS-S= Assessment of Communication and Interactions Skills						
Jordan-Black 2005 Ireland	Evaluates the effect of a movement programme on the	Comparative Study (Pretest- Posttest)	683 children attending primary school	ATNR persistence was significantly associated with levers of	Integration of ATNR can increase school related attainments	Evaluations were conducted in small time frames

	development of core educational skills (reading, spelling, mathematics)	Intervention: Primary Movement Programme Outcome Measures: -Schilder Test - WORD -WOND -NRIT Evidence level: III		attainments in reading spelling and mathematics Male more at riks for ATNR persistence than females. The movement programme reduced levels of ATNR persistence	(reading, spelling, and mathematics) Using a movement programme in school setting may have higher academic progress	
Note: WORD= Weschler objective reading dimension, WOND=Weschler objective numerical dimensions, NRIT= non-reading intelligence tests						
Konicarova, & Bob 2012 Czech Republic	Determine to which extent ADHD will be related to persisting Moro and Galant reflexes in school age children	Case control study Intervention: Moro and Galant assessment Outcome Measure: -Goddard Scale Evidence level: II	Children diagnosed with ADHD Control group: healthy children N=20	Strong correlation between retained primitive reflexes and ADHD diagnosis.	Children diagnosed with ADHD may exhibit persisting primitive reflexes.	Small sample Lack of validity and reliability Confounding factors not identified
Note: ADHD= Attention Deficit-Hyperactivity Disorder						
Konicarova, Bob, & Raboch 2013 Czech Republic	testing to what extent the persisting primitive asymmetric tonic neck reflex and symmetric tonic neck	Case-control study Intervention: Reflex assessment Outcome Measure: -Schilder test - Bender–Purdue Reflex Test	Female children diagnosed with ADHD Control group: healthy children	ADHD symptoms are linked to the persisting primitive ATNR and STNR in girls	Children with ADHD may exhibit higher levels of unintegrated reflexes	Small sample Sample limited to females

	reflex are related to ADHD symptoms	-Conners' Parent Questionnaire Evidence level II	N=65	ADHD symptoms may present a process related to primitive reflexes, interfering with higher-level brain functions due to insufficiently developed cognitive and motor integration		
Note: ADHD= Attention Deficit-Hyperactivity Disorder						
Kulesza 2011 Poland	Determine efficacy of the Move to Learn program in preschool children	Pilot study Intervention: Move to Learn program Outcome Measures: -observation -drawing self -parent questionnaire Evidence level: IV	Preschool children N=147	Move to Learn program helps improve school functioning Move to Learn program help with emotional and social development. Move to Learn program benefited children in the intervention group with graphmotor skills.	Move to learn program uses reflex integration exercises. Movement programs should be implemented in schools.	Treatment period short Confounding variable not identifies

Masgutova 2008 Poland	Determine the important clinical parameters in the assessment of children with developmental delays Assess effectiveness of MNRI	Pretest-posttest design Intervention: MNRI Outcome Measure: Observation of reflex expressions at media-lateral, superior-inferior, and anterior-posterior levels Level V	Children diagnosed with Cerebral Palsy N=42	MNRI program demonstrates measurable results in reflex pattern expression, with these implications for primary motor system function: improved postural control, stability, and sense of equilibrium in children with Cerebral Palsy	MNRI can facilitate growth and decrease developmental challenges (posture, stability, and equilibrium) n children diagnosed with CP	Unpublished study Lack of intervention documentation Short-length study (14days) Contextual factors not identified
Note: MNRI = Masgutova Neurosensorimotor reflex integration						
Masgutova 2012 Poland	Provide educational opportunities with a guide to assess and integrate dynamic and postural reflexes	Book Intervention: None Outcome Measure: none Level: V	Educational Book	Educational Book	Guide to assess pretest-posttest and integrate dynamic and postural reflexes passively and actively MNRI is a reflex integration program that could be added to OT treatment interventions	None
Note: MNRI = Masgutova Neurosensorimotor reflex integration						

Masgutova, Akhmatova, Sadowska, Shackleford, & Akhmatov, 2016a Poland	Describe the efficacy of the MNRI program in improving neurodeve-lopment in children with ASD	NRS (pretest-posttest) Intervention: MNRI Control: No intervention Outcome Measures: -Analysis of results of the Questionnaire of Dynamic Changes of Children's Abilities -Reflex Pattern Assessment: 30 reflexes graded Level II	Children diagnosed with ASD (intervention) Children with ASD (control 1) Children with neurotypical development (control 2) N= 1039	Significant statistical difference: reflex pattern expressions moved one level higher. Progress depends on severity of ASD. Reflex progress correction was dependent on age	Children with ASD exhibit neurological dysfunction and MNRI program was developed to assess and improve neurological functions Facilitation and re-patterning o reflexes should begin as early as possible	Outcome measures not standardized Contextual factors not identified Short length of treatment (8 days)
Note: MNRI = Masgutova Neurosensorimotor reflex integration, ASD=Autism Spectrum Disorder, NRS=non-randomized study						
Masgutova, Akhmatova, Sadowska, Shackleford, & Akhmatov, 2016b United States	Evaluate the effect of the Masgutova Neurosensorim otor Reflex Integration (MNRI) therapy modality in improving the behavioral, cognitive, and physical functioning of	NRS (pretest-posttest) Intervention: MNRI Control: No intervention Outcome Measures: - Questionnaire of Dynamic Changes of Children's Abilities	Children diagnosed with ASD (intervention) Children with ASD (control 1) and neurotypical development (control 2) N= 1301	Statistical difference: Improvement in 83.3% of reflex patterns of children with ASD. MNRI intervention 80% effective and beneficial to address sensorimotor, physical,	MNRI intervention appears to have a beneficial effect on children with autism	Outcome measures not valid Short length of intervention (8 days)

	individuals diagnosed with autism Spectrum Disorder (ASD)	-Reflex Pattern Assessment: 30 reflexes graded Level II		behavioral, and cognitive development in children with ASD.		
Note: MNRI = Masgutova Neurosensorimotor Reflex Integration, ASD=Autism Spectrum Disorder, NRS=non-randomized study						
Masgutova, sadowska, Kowalewska, Masgutov, Akhmatova, & Filipowski 2015 United States, Poland, Canada	Document the effectiveness of MNRI for improving the functioning of children with Down syndrome. Evaluate efficacy of MNRI for improving sensory-motor function.	NRS (pretest-posttest) Intervention: MNRI Control: no intervention Outcome Measure: - Reflex Pattern Assessment: 24 reflexes graded	Children diagnosed with Down Syndrome (intervention) Children with Down syndrome (control 1) and neurotypical development (control 2)	Positive effect of intervention on children with Down syndrome in their sensory-motor function. Correction of reflex patterns in dependent on age.	Neurosensory development in children with Down syndrome is not static and can be improved MNRI offers ways to improve overall functioning of children with Down syndrome	Outcome measures not standardized Contextual factors not identified Short length of treatment (8 days)
Note: MNRI = Masgutova Neurosensorimotor Reflex Integration, NRS=non-randomized study						
McPhillips, Hepper, & Mulhem 2000 United Kingdom	Examine the effects of a specific movement programme, which replicates the reflex movements of the primary-reflex system, on the inhibition of	RCT Intervention: reflex movement program placebo: movement exercises non-related to reflexes control: no intervention Outcome Measures:	Children with developmental delays and diagnosed with dyslexia N=60	Experimental group showed significant decrease in the level of persistent reflex and other two groups showed no significant difference All groups showed increased	Persistent reflexes hinder cognitive development Educational learning is impacted from an early neurodevelop-mental system.	Confounding variables not mentioned or measured

	persistent primary reflexes, specifically the ATNR. Determine if reading skills improved as ATNR persistence decreased	- ATNR Assessment using the Schilder test -Neale Analysis of reading ability -WORD		positive difference in reading skills but the intervention group demonstrated greater increase in reading scores		
Note: RCT= randomized controlled trial; IQ= intelligence quotient; TLR= tonic labyrinthine; ATNR = asymmetrical tonic neck reflex, STNR= symmetrical tonic neck reflex; WORD= Weschler objective reading dimension						
McPhillips, & Jordan-Black 2007 Ireland	Assess the prevalence of ATNR in children with reading difficulties	Cross-Sectional Study ATNR assessment	Children with dyslexia Ages 7-9 years N=739	Persistent ATNR can significantly impact reading, spelling, non-word, reading, and verbal IQ Males have higher levels of persistent reflexes than females	Educational skills may be affected by persistent reflexes (mediated reflex system) Reflex persistence may be an early developmental risk	No genetics mentioned Regression model used Environmental factors not mentioned
Note: ATNR = asymmetrical tonic neck reflex						
McPhillips, & Sheehy 2004 North Ireland	Investigate the prevalence of persistent primary reflexes (ATNR) in primary school	Cross Sectional Study	Children attending primary school Ages 9-10 years N=409	Children in the lowest reading group had high levels of ATNR Significant difference in motor abilities	Association between persistent reflex and reading difficulties and movement difficulties	Only one primary reflex was assessed No mention of confounding variables

	population and determine how this related to cognitive and social factors		(Bottom, middle, and top readers)	between lowest reading group and top reading group		
Note: ATNR = asymmetrical tonic neck reflex						
Melillo 2011 United States	Review the literature to demonstrate the relationship between reflexes and cortical maturation delays	Educational Article (Literature review) Intervention: None Outcome Measure: None Level V	Emphasis of effects on ADHD, ASD, and Dyslexia	Persistent primitive reflexes are the earliest markers for this delay and that this delayed maturation will eventually lead to the presence of autism, ADHD, and other neurobehavioral disorders. ADHD, ASD, and dyslexia increased incidence is related to a combination of genetic and epigenetic factors mostly driven by environmental and lifestyle changes	Exercises specific to reflexes that inhibit or remediate persistent primitive reflexes are a possible early treatment option for children with ADHD, ASD, and dyslexia.	None

Note: ADHD= Attention Deficit-Hyperactivity-Disorder, ASD= Autism Spectrum Disorder						
Pilecki et al. 2012 Poland	Determine efficiency of rehabilitation carried out with the use of MNRI	NRS (pretest-posttest) Intervention: MNRI Outcome Measure: - Brainstem Auditory Evoked Potentials (BAEP) Evidence Level: IV	Children diagnosed with Cerebral Palsy Children aged from 1.3 to 5.9 years N=17	MNRI caused changes in the brain stem and neuro-motor rehabilitation of children with Cerebral Palsy.	MNRI can be advantageous for neuro rehabilitation	Confounding variables not mentioned or measured Data can't be generalized
Note: MNRI = Masgutova Neurosensorimotor Reflex Integration, NRS=non-randomized study						
Renard-Fontaine 2017 FL, USA	Describe the effects of MNRI method post-surgery in the recovery of arm function	Case Study Intervention: MNRI Outcome Measures: -MNRI pre and post assessment -AROM -MMT Evidence Level: IV	Child diagnosed with ABS Child 10 weeks of age	Use of MNRI caused significant restoration MNRI increased the level of reflex maturation of the infant Evident correlation found in functional motor assessments (AROM & MMT)	There is link between reflex integration and functional development. MNRI is suggested at an intervention tool for PT and OT.	Limited number of participants Data can't be generalized to ABS population
Note: MNRI = Masgutova Neurosensorimotor Reflex Integration, AROM= Active Range of Motion, MMT= Manual Muscle Testing, ABS=Amniotic Band Syndrome, PT= Physical Therapy, OT= Occupational Therapy						

Sankar & Mundkur 2005 India	Provide definition of Cerebral Palsy, etiology and its early diagnosis	Educational article Evidence Level: V	None	None	Primitive reflexes have been found to be prominent in cerebral palsy and cause motor delays.	None
Svetlana Masgutova Educational Institute (SMEI) 2015 United States	Provide theory and history of the MNRI program	Educational Source Intervention: none Outcome Measures: None Evidence level: V	None: Educational article	None: Educational article	When reflexes are delayed, hypo/hyperactive, or non-integrated, they interfere with cortical processing and impede proper development. MNRI techniques can re-route, re-connect or build new neural pathways and facilitate neurological maturation of its circuitry.	None
Note: MNRI = Masgutova Neurosensorimotor Reflex Integration						
Teitelbaum, Teitelbaum, Fryman, & Maurer	Provide information on reflexes and	Educational article Intervention: None	Observation of 17 infant videos of children	Movement disturbances in Autism and Asperger's	Assessment of ATNR is suggested as a	None

2002 USA	early diagnosis of autism.	Outcome Measure: EWMN Evidence Level: V	diagnosed with autism	syndrome are related to sequential development of infantile reflexes.	screening tool for autism	
Note: EWMN= Eshkol-Wachman Movement Notation						

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Appendix C
Case Study Needs Assessment

Clinical Question of Concern under Investigation: What is the efficacy of the Masgutova Neurosensorimotor Reflex Integration (MNRI) method in treating motor delays related to the asymmetrical tonic neck reflex (ATNR) in children diagnosed with Autism Spectrum Disorder (ASD) in order to increase independence with activities of daily living (ADL)?					
Current Outcomes: How things are…	Desired Outcomes: How things should be…	Needs: What is the source of the problem?	Evidence: What does the best available evidence tell us?	Project Steps: What are we going to do about it?	Evaluation Items: How do we measure indications of project success?
In the United States, 1 in every 68 children are diagnosed with ASD (Nevison, 2014). The ATNR has been found to persist for a longer time in children diagnosed with autism (Teitelbaum, Teitelbaum, Fryman, & Maurer, 2002). OT interventions specific to ASD include independent living skills training, motor development, motor planning skill development, sensory integration, self-	All children should exhibit typical motor development. All the developmental areas causing problems in a child's daily function, including reflexes, should be addressed during occupational therapy interventions. All occupational therapists should seek evidence-based practice to be aware of all the interventions available to treat motor delays. All occupational therapists should have access to evidence-	Children with ASD continue to present with persistent reflexes impacting motor abilities (Chinello, Gangi, & Valenza, 2018). Currently, there are no studies on the efficacy of reflex integration programs being used in OT (Hall, 2018). A majority of occupational therapists are unaware of reflex integration interventions due to the lack of available evidence on the	Primitive reflexes play a role in motor development (Gieysztor, Choinska, & Paprocka-Borowicz, 2015). Various studies have found a correlation between persistent primitive reflexes and motor delays (McPhillips, Hepper, & Mulhem, 2000; McPhillips & Sheehy, 2004; Geysztor, Choinska, & Paprocka-Borowicz, 2015; Sankar & Mundkur, 2005). Delayed motor responses and retained primitive	Conduct a single-subject design study to examine the effects of the MNRI method used in children with ASD who present with a persistent ATNR. Assess the skills of bilateral coordination, auditory processing, and self-care associated to ATNR during the study. Use of two OT outcome measures (BOT-2 & Sensory Profile 2) to assess the effects of the MNRI method on motor skills.	Obtain IRB approval. Measurement of bilateral coordination using BOT-2 with a raw score difference of 3-4 points at start and end of study. Measurement of auditory processing skills using the Sensory Profile 2 with a result of "*just like the majority of others*" at the end of study. Completion of study. Study results getting published in OT journals. Provide new implications for future research areas in relation to reflex

Clinical Question of Concern under Investigation: What is the efficacy of the Masgutova Neurosensorimotor Reflex Integration (MNRI) method in treating motor delays related to the asymmetrical tonic neck reflex (ATNR) in children diagnosed with Autism Spectrum Disorder (ASD) in order to increase independence with activities of daily living (ADL)?					
Current Outcomes: How things are…	Desired Outcomes: How things should be…	Needs: What is the source of the problem?	Evidence: What does the best available evidence tell us?	Project Steps: What are we going to do about it?	Evaluation Items: How do we measure indications of project success?
regulation, cognitive-behavioral approaches, social emotional development, compensatory supports, and work readiness skill development (Crabtree, 2018). Currently, there is a lack of trained occupational therapists in reflex integration interventions. Reflex integration interventions are learned through continuing education courses.	based data on reflex integration programs. Research studies should include the efficacy of the use of reflex integration programs in OT. Occupational therapists should seek appropriate continuing education courses based on evidence-based data.	efficacy of reflex integration programs. *Overall, there is a need for: 1. Interventions specific to the treatment of persistent reflexes 2. Available evidence on the efficacy of reflex integration programs. 3. Available evidence of reflex integration programs used in OT.	reflexes can ultimately have an impact on how children participate in daily activities (Chinello, Gangi, & Valenza, 2018). The persistence of the ATNR is a clinical indicator of abnormal development (McPhillips & Jordan-Black, 2007). The ATNR reflex plays a role in motor development as a precursor for early visual inspection of the hand, eye-hand coordination, and auditory processing (Sidaway et al., 2015; Geffner & Ross-Swain, 2013).	Examine the completion of one self-care activity to determine the efficacy of MNRI program at integrating ATNR and its impact in the completion of ADL. Use the ICF model to explain the health and participation of children with ASD. Gather preliminary data to be used in OT literature to continue to advance OT practice with evidence-based research. Publish the data found from the study and make it available to occupational therapists to guide	integration interventions and OT for different diagnoses.

Clinical Question of Concern under Investigation: What is the efficacy of the Masgutova Neurosensorimotor Reflex Integration (MNRI) method in treating motor delays related to the asymmetrical tonic neck reflex (ATNR) in children diagnosed with Autism Spectrum Disorder (ASD) in order to increase independence with activities of daily living (ADL)?					
Current Outcomes: How things are…	Desired Outcomes: How things should be…	Needs: What is the source of the problem?	Evidence: What does the best available evidence tell us?	Project Steps: What are we going to do about it?	Evaluation Items: How do we measure indications of project success?
			A persistent ATNR, can lead to poor performance of fine motor and gross motor skills (McPhillips, et al., 2000; McPhillips & Sheehy, 2004; Alibakhshi et al., 2018). The MNRI method has been found to be positive at improving sensorimotor, physical, cognitive, and behavioral development in children with ASD (Masgutova et. al, 2016a; 2016b). The MNRI has been suggested as an intervention tool for physical and	clinical reasoning towards or away from the use of reflex integration interventions when treating children with ASD.	

Clinical Question of Concern under Investigation: What is the efficacy of the Masgutova Neurosensorimotor Reflex Integration (MNRI) method in treating motor delays related to the asymmetrical tonic neck reflex (ATNR) in children diagnosed with Autism Spectrum Disorder (ASD) in order to increase independence with activities of daily living (ADL)?					
Current Outcomes: How things are…	Desired Outcomes: How things should be…	Needs: What is the source of the problem?	Evidence: What does the best available evidence tell us?	Project Steps: What are we going to do about it?	Evaluation Items: How do we measure indications of project success?
			occupational therapy practices (Renard-Fontaine, 2017).		
Note: ASD = Autism Spectrum Disorder; ATNR= asymmetrical tonic neck reflex; OT= occupational therapy; MNRI = Masgutova Neurosensorimotor Reflex Integration; BOT-2=Bruininks-Oseretsky Test of Motor Proficiency, second edition; ADL=activities of daily living; ICF= International Classification of Functioning, Disability, and Health model; IRB= international review board.					

List of Articles in Case Study Needs Assessment

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Appendix D

Case Study Consent Forms (English & Spanish)

Effects of Reflex Integration in Autism (English)

You are being asked to take part in a research study/case study on the effects of the Masgutova Neurosensorimotor Reflex Integration (MNRI) program on bilateral coordination and auditory-visual integration in a child diagnosed with Autism Spectrum Disorder (ASD) with a persistent asymmetrical tonic neck reflex (ATNR). You are being asked to take part in the study because there is a child in your household with the Autism diagnosis who receives occupational therapy services at Kids Developmental Clinic. Please read the form carefully and ask any questions you may have before agreeing and signing to take part in the study.

What is the study about: The purpose of the study is to learn the effects of the Masgutova Neurosensorimotor Reflex Integration (MNRI) program on bilateral coordination and auditory-visual integration in a child diagnosed with Autism. The results of the study will provide implications of MNRI program as it relates to occupational therapy practice. The child must be receiving occupational therapy services two times per week and be between the ages of 4 to 14 years old.

What we will ask you to do: The child will initially participate in a *pre-screening* to determine if the child has an active or persistent asymmetrical tonic neck reflex (ATNR) and to determine if the child is showing ipsilateral motor movements. <u>If the child does not present with an active ATNR or ipsilateral motor patterns, the child will not qualify to participate in the study.</u> If the child meets the pre-screening criteria, the child may be selected to participate in the study. The child will complete a pre-assessment consisting of commonly used occupational therapy evaluation tools: BOT-2 and Sensory Profile 2. The child will participate in an ***eight-week*** intervention protocol with a total of 16 sessions utilizing the MNRI program to integrate the ATNR. Each intervention session will take 45-50 minutes to complete. The MNRI protocol is a non-invasive, natural, and replicable neuromodulation technique to increase cortical organization that consists of activating the ATNR with gentle stretches with the child positioned in the right and left ATNR postures, passive stretches according to the reflex pattern, passive stretches against reflex pattern, active exercises according to the reflex pattern, active exercises against reflex pattern, and variant exercises of the reflex patterns.

Risks and benefits: There is a risk that your child may not increase his motor coordination skills when using a treatment based solely on the MNRI protocol.
There are no specific benefits to you. Occupational therapy demands and interventions are constantly changing and research is needed for areas that lack evidence. We hope to learn more about the MNRI intervention as it relates to occupational therapy.

Compensation: There is no specific compensation for participating in the study.

Your information and results will be kept confidential: The records of this study will be kept private. In any sort of report we make public will not include any information that will make it possible to identify you. Research records will be kept in a locked file; only researchers will have access to the records. Pictures or videos, if any taken during the study will blur the child's face.

Taking part is voluntary: Taking part in this study is completely voluntary. You may have the opportunity to re-schedule intervention session appointments to accommodate all the intervention sessions needed for the study. If you decide not to take part in the study, it will not affect your current therapy services. If you do decide to take part in the study, you are free to withdraw at any time.

If you have questions: The person conducting the research is the occupational therapist, Jennifer Padilla Melendez who currently attends the University of Texas Medical Branch and this study is her capstone project to graduate. Please ask any questions you have now. If you have questions later, you may contact Jennifer Padilla Melendez at jennifer@kidsdevelopmentalclinic.com, work phone at 713-910-5437, or personal phone at 409-996-6423. If you have any concerns or complaints you can contact the director of the occupational therapy program in the University of Texas Medical Branch, Dr. Patricia Fingerhut at 409- 772-3060.

You will be given a copy of this form to keep for your records.

Statement of consent: I have read the above information, and have reviewed answers to any questions I asked. I consent to the following:

______ No consent to take part in the study.

______ Take part in the pre-screening of the study.

______ Take part in the eight-week intervention study if selected.

Your Signature ____ Date ______________
Your name (printed) ____

If the participant is a minor or unable to consent:
I, ______________________________________ am the mother, father, guardian, or authorized
(Legal guardian printed name)
person to consent for _________________________________ to take part in the study.
(Minor printed name)

_______________________________ _____________________________
Signature Date

This consent form will be kept confidential by the student researcher for at least three years beyond the end of the study.

Efectos de la Integración de Reflejos en Autismo (Spanish)

Se le pide que participe en un estudio de investigación sobre los efectos del programa de Integración de Reflejo Neurosensoriomotora de Masgutova o MNRI en la coordinación bilateral y la integración auditiva-visual de un niño con Trastorno del Espectro Autista (TEA) con un reflejo tónico asimétrico del cuello (RTAC) persistente o activo. Se le pide que participe en el estudio porque hay un niño en su hogar con el diagnóstico de Autismo que recibe servicios de terapia ocupacional en Kids Developmental Clinic. Lea el formulario detenidamente y haga cualquier pregunta que pueda tener antes de aceptar y firmar para participar en el estudio.

En qué consiste el estudio: El propósito del estudio es conocer los efectos del programa de Integración del Reflejo Neurosensoriomotora de Masgutova o MNRI en la coordinación bilateral y la integración auditiva-visual de un niño con un diagnóstico de Autismo. Los resultados del estudio proporcionarán implicaciones del programa de MNRI para la práctica de la terapia ocupacional. El niño debe recibir servicios de terapia ocupacional dos veces por semana y tener entre 4 y 14 años de edad.

Lo que le pediremos que haga: El niño participará inicialmente en una *preselección* para determinar si tiene un reflejo tónico asimétrico del cuello (RTAC) activo o persistente y para determinar si el niño está mostrando movimientos motores ipsilaterales. Si el niño no presenta un RTAC activo o patrones motores ipsilaterales, el niño no calificará para participar en el estudio. Si el niño cumple con los criterios de la preselección, el niño puede ser seleccionado para participar en el estudio. El niño completará una evaluación previa que consiste en herramientas de evaluación normalmente usadas en terapia ocupacional: BOT-2 y perfil sensorial 2. El niño participará en un protocolo de intervención de ocho semanas con un total de 16 sesiones que utilizan el programa MNRI para integrar el RTAC. Cada sesión de intervención durará entre 45 y 50 minutos. El protocolo MNRI es una técnica de modulación neurológica no invasiva, natural, y replicable para aumentar la organización cerebral que consiste en activar el RTAC con estiramientos suaves posicionado el niño en las posturas del RTAC derecha e izquierda, estiramientos pasivos según el patrón del reflejo, estiramientos pasivos contra el patrón del reflejo, ejercicios activos de acuerdo con el patrón del reflejo, ejercicios activos contra el patrón del reflejo y ejercicios de variante de los patrones del reflejo.

Riesgos y beneficios: Existe el riesgo de que su hijo no aumente sus habilidades de coordinación motora cuando usa un tratamiento basado únicamente en el protocolo MNRI.
No hay beneficios específicos para usted. Las demandas e intervenciones de terapia ocupacional cambian constantemente y se necesita investigación para las áreas que carecen de evidencia. Esperamos aprender más sobre la intervención del MNRI y lo que implica para terapia ocupacional.

Compensación: No hay una compensación específica por participar en el estudio.

Su información y resultados se mantendrán confidenciales: Los registros de este estudio se mantendrán en privado. En cualquier tipo de informe que hagamos público, no incluiremos ninguna información que permita identificarlo. Los registros de investigación se mantendrán en un archivo bloqueado; Sólo los investigadores tendrán acceso a los registros. Fotos o videos, si se llegaran a tomar durante el estudio, empañarán la cara del niño.

Participar es voluntario: Participar en este estudio es completamente voluntario. Es posible que tenga la oportunidad de re-programar citas de terapia para acomodar todas las sesiones de intervención necesarias para el estudio. Si decide no participar en el estudio, no afectará sus servicios de terapia actuales. Si decide participar en el estudio, puede retirarse en cualquier momento.

Si tiene preguntas: La persona a cargo de la investigación es la terapeuta ocupacional, Jennifer Padilla Meléndez, que actualmente asiste a la universidad University of Texas Medical Branch y este estudio es su proyecto final para graduarse con su doctorado. Por favor haga cualquier pregunta que tenga ahora. Si tiene preguntas más adelante, puede comunicarse con Jennifer Padilla Meléndez en jennifer@kidsdevelopmentalclinic.com, teléfono de trabajo al 713-910-5437 o teléfono personal al 409-996-6423. Si tiene alguna inquietud o queja, puede comunicarse con la directora del programa de terapia ocupacional de University of Texas Medical Branch, la Dra. Patricia Fingerhut, al 409-772-3060.

Se le entregará una copia de este formulario para sus registros.

Declaración de consentimiento: He leído la información anterior y he revisado las respuestas a todas las preguntas que hice. Doy mi consentimiento para lo siguiente:

______ No hay consentimiento para participar en el estudio.

______ Participar en la preselección del estudio.

______ Participar en el estudio de intervención de ocho semanas si se le selecciona.

Su firma ____ Fecha ______________

Su nombre (impreso) ____

Si el participante es menor de edad o no puede dar su consentimiento:

Yo, ______________________________________ soy la madre, padre, tutor o persona
(Nombre impreso del tutor legal)

autorizada a dar su consentimiento para que _________________________________ forme parte
(Nombre impreso del menor)
del estudio.

_____________________________________ _________________________
Firma Fecha

El estudiante investigador mantendrá este formulario de consentimiento confidencial por lo menos tres años después del final del estudio.

Appendix E

Deliverable: Crossing Midline Event Frequency Data Form

Event Frequency Recording Data Sheet

Directions: This recording data sheet is to be used as an observation checklist to determine crossing midline motor patterns. The participant will stack *six* blocks while retrieving blocks from a designated green square placed at a distance of 10 inches from the participant's midline on the opposite side of the body of the hand being used and stack them by positioning them on a designated red square placed at a distance of 10 inches from the participant's midline on the side of the hand being used. Use tally marks or X's to record the number of target behavior occurrences. Record how long it took the participant to stack 6 blocks while crossing midline from a designated green square to a red square. Both upper extremities to be measured individually.

Participant:	Date:
Observer:	Credentials:

Directions to the participant: Say "let's get the blocks from the green square and stack them on the red square with the right hand only to make a tall tower". Repeat for left hand saying "let's get the blocks from the green square and stack them on the red square with the left hand only to make a tall tower".

Play Task: Stacking Blocks	
Observation Length: 15 minutes	
Target Behavior: crossing midline with each individual upper extremity while retrieving blocks from a designated green square in sit position at table top	
Behavior Definition: moving the hand, forearm, or elbow across the midline of the body over to the opposite side of the body	
Right Upper Extremity Crossing Midline Tally	Total
Left Upper Extremity Crossing Midline Tally	Total

How long to stack six blocks with right hand crossing midline? _______________

How long to stack six blocks with left hand crossing midline? _______________

Comments (additional observations):

Effects of reflex integration in Autism: An occupational therapy case report

Appendix F

Participant's Pre-Intervention Results

Schilder Test

Pre-Assessment Results

Schilder Test

During this test, the participant stands upright with feet together and arms extended in front at shoulder level with wrists and hands relaxed. The tester stands behind the participant and provides specific instructions to passively turn the head to each side of the body. The tester turns the participant's head slowly to one side, 70-80' of neck rotation until chin is over the shoulder and pauses for 5 seconds, then slowly turns the participant's head to the other side and pauses for 5 seconds. *Participant's eyes are closed during the assessment.* This rotation sequence is repeated **two** times. Positive indicators of the ATNR include movement of the arms in the same direction the head is turned, dropping the arms, or swaying and loss of balance. Each side of the body is scored separately and then a total is obtained for both sides.

The scores are defined as follows:

0= no response

1 = slight movement of the arms (up to 20') to the same side as the head is turned, or slight dropping of the arms

2= movement of the arms (up to 45') as the head is turned, or marked dropping of the arms

3= movement greater than 45' either to the side or down, swaying and loss of balance

Participant: G	Date: 5/20/2019
Observer: Jesley Joseph	Credentials: OTR

Head Rotation	ATNR Score
Right Side	3
Left Side	3
Total	6

Comments (additional observations):

Loss of balance to both sides.
Moving BUE greater than 45° bilaterally.

Effects of Reflex Integration in Autism: An Occupational Therapy Case Report

Crossing Midline Observation Form

Event Frequency Recording Data Sheet

Directions: This recording data sheet is to be used as an observation checklist to determine crossing midline motor patterns. The participant will stack ***six*** blocks while retrieving blocks from a designated green square placed at a distance of 10 inches from the participant's midline on the opposite side of the body of the hand being used and stack them by positioning them on a designated red square placed at a distance of 10 inches from the participant's midline on the side of the hand being used. Use tally marks or X's to record the number of target behavior occurrences. Record how long it took the participant to stack 6 blocks while crossing midline from a designated green square to a red square. Both upper extremities to be measured individually.

Participant: G	Date: 5/20/2019
Observer: Jesley Joseph	Credentials: OTR

Directions to the participant: Say "let's get the blocks from the green square and stack them on the red square with the right hand only to make a tall tower". Repeat for left hand saying "let's get the blocks from the green square and stack them on the red square with the left hand only to make a tall tower".

Play Task: Stacking Blocks	
Observation Length: 15 minutes	
Target Behavior: crossing midline with each individual upper extremity while retrieving blocks from a designated green square in sit position at table top	
Behavior Definition: moving the hand, forearm, or elbow across the midline of the body over to the opposite side of the body	
Right Upper Extremity Crossing Midline Tally	Total
||||	4
Left Upper Extremity Crossing Midline Tally	Total
0	0

How long to stack six blocks with right hand crossing midline? > 1 min

How long to stack six blocks with left hand crossing midline? > 1 min

Comments (additional observations):
RUE: Pt. used L hand to pick up and transfer to R hand X2.
LUE: Pt. required max A to utilize L hand, to pick up 1 block at a time, and to not rotate torso. Unable to cross midline w/o assistance.

Effects of Reflex Integration in Autism: An Occupational Therapy Case Report

BOT-2 Upper-Limb Coordination Subtest Scoring Sheet/Record Form

BOT™ 2

Bruininks-Oseretsky Test of Motor Proficiency, *Second Edition*

Robert H. Bruininks & Brett D. Bruininks

	Year	Month	Day
Test Date	2019	05	20
Birth Date	2009	01	22
Chronological Age	10	3	28

Preferred Drawing Hand: (Right) Left

Preferred Throwing Hand/Arm: (Right) Left

Norms Used: ☐ Female ☒ Male ☐ Combined

Fine Motor Record Form

Examinee Name G. Sex M Grade

Examiner Name Jesley Joseph School/Clinic /UTMB

	Total Point Score	Scale Score Mean = 15, SD = 5 (Tables B.1–B.3)	Standard Score Mean = 50, SD = 10 (Tables B.4–B.6, S.3)	Confidence Interval: 90% or 95% (Tables C.1, C.2, S.4) Band	Interval	%ile Rank (Tables B.4–B.6, S.3)	Age Equiv. (Tables B.14–B.16)	Descriptive Category (Table C.13)	Z-score
1 Fine Motor Precision									
2 Fine Motor Integration									
Fine Manual Control		Sum							
3 Manual Dexterity									
7 Upper-Limb Coordination	22	7		3	4 - 10		6:3-6:5	BA	-1.6
Manual Coordination		Sum							
Fine Motor Composite		Sum							

DIRECTIONS

During the testing session, record the examinee's performance on each item.

After the testing session, convert each item raw score to a point score using the conversion table provided. For items needing two trials, convert the better of the two raw scores. Then, record the point score in the appropriate oval in the Point Score column.

For each subtest, add the item point scores, and record the total in the oval labeled Total Point Score and on the appropriate line on the cover page.

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Product Number 58036

Note: BA= Below Average

BOT-2 Bilateral Coordination Subtest Scoring Sheet/Record Form

BOT™ 2

Bruininks-Oseretsky Test of Motor Proficiency, *Second Edition*

Robert H. Bruininks, PhD, & Brett D. Bruininks

Gross Motor Record Form

	Year	Month	Day
Test Date	2019	05	20
Birth Date	2009	01	22
Chronological Age	10	3	28

Preferred Foot/Leg: (Right) Left

Norms Used: ☐ Female ☒ Male ☐ Combined

Examinee Name [illegible] Sex M Grade

Examiner Name Jesley Joseph School/Clinic /UTMB

	Total Point Score	Scale Score Mean = 15, SD = 5 (Tables B.1–B.3)	Standard Score Mean = 50, SD = 10 (Tables B.4–B.6, S.5)	Confidence Interval: 90% or 95% (Tables C.1, C.2, S.6) Band	Interval	%ile Rank (Tables B.4–B.6, S.5)	Age Equiv. (Tables B.14–B.16)	Descriptive Category (Table C.13)	SD/Z-Score
(4) Bilateral Coordination	0	1		3	2 - 4		Below 4	WBA	-2.8
5 Balance	\								
Body Coordination		Sum							
6 Running Speed and Agility	\								
8 Strength Push-up: Knee Full	\								
Strength and Agility		Sum							
Gross Motor Composite		Sum							

DIRECTIONS

During the testing session, record the examinee's performance on each item.

After the testing session, convert each item raw score to a point score using the conversion table provided. For items needing two trials, convert the better of the two raw scores. Then, record the point score in the appropriate oval in the Point Score column.

For each subtest, add the item point scores, and record the total in the oval labeled Total Point Score and on the appropriate line on the cover page.

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Note: WBA= Well-below average

BOT-2 Upper-Limb Coordination and Bilateral Coordination Point Score Forms

Subtest 7: **Upper-Limb Coordination**

For Items 5 and 6, conduct the second trial only if the examinee does not earn the maximum score on the first trial.

Item	Raw Score Trial 1	Raw Score Trial 2										Point Score
1 Dropping and Catching a Ball—Both Hands	2 catches		Raw	0	1	2	3	4	5			2
			Point	0	1	2	3	4	5			
2 Catching a Tossed Ball—Both Hands	2 catches		Raw	0	1	2	3	4	5			2
			Point	0	1	2	3	4	5			
3 Dropping and Catching a Ball—One Hand	5 catches		Raw	0	1	2	3	4	5			5
			Point	0	1	2	3	4	5			
4 Catching a Tossed Ball—One Hand	2 catches		Raw	0	1	2	3	4	5			2
			Point	0	1	2	3	4	5			
5 Dribbling a Ball—One Hand	7 dribbles	10 dribbles	Raw	0	1	2	3	4–5	6–7	8–9	10	7
			Point	0	1	2	3	4	5	6	7	
6 Dribbling a Ball—Alternating Hands	3 dribbles	2 dribbles	Raw	0	1	2	3	4–5	6–7	8–9	10	3
			Point	0	1	2	3	4	5	6	7	
7 Throwing a Ball at a Target	1 throws		Raw	0	1	2	3	4	5			1
			Point	0	1	2	3	4	5			

Notes & Observations

22

Total Point Score Subtest 7 (max = 39)

Subtest 4: **Bilateral Coordination**

Conduct the second trial only if the examinee does not earn the maximum score on the first trial.

Item	Raw Score Trial 1	Raw Score Trial 2							Point Score
1 Touching Nose with Index Fingers—Eyes Closed	0 touches	0 touches	Raw	0	1	2	3	4	0
			Point	0	1	2	3	4	
2 Jumping Jacks	0 jumping jacks	0 jumping jacks	Raw	0	1	2–4	5		0
			Point	0	1	2	3		
3 Jumping in Place—Same Sides Synchronized	0 jumps	0 jumps	Raw	0	1	2–4	5		0
			Point	0	1	2	3		
4 Jumping in Place—Opposite Sides Synchronized	0 jumps	0 jumps	Raw	0	1	2–4	5		0
			Point	0	1	2	3		
5 Pivoting Thumbs and Index Fingers	0 pivots	0 pivots	Raw	0	1	2–4	5		0
			Point	0	1	2	3		
6 Tapping Feet and Fingers—Same Sides Synchronized	0 taps	0 taps	Raw	0	1	2–4	5–9	10	0
			Point	0	1	2	3	4	
7 Tapping Feet and Fingers—Opposite Sides Synchronized	0 taps	0 taps	Raw	0	1	2–4	5–9	10	0
			Point	0	1	2	3	4	

Notes & Observations

0

Total Point Score Subtest 4 (max = 24)

Sensory Profile 2 Form (Spanish)

CHILD (SPANISH)

CHILD SENSORY PROFILE 2

Winnie Dunn, PhD, OTR, FAOTA

Cuestionario para padres o tutores

3:0 a 14:11 años

FOR OFFICE USE ONLY			
Calculation of Child's Age	Year	Month	Day
Test Date	2019	05	20
Birth Date	2009	01	22
Age	10	3	28

Nombre(s) del niño(a): [illegible] Apellido: ____

Nombre preferido del niño(a) (si es diferente al nombre de arriba): ____

Número de ID: ____

Sexo: ☐ Masculino ☐ Femenino Fecha de nacimiento: ___/___/___ Fecha de la prueba: ___/___/___

Nombre del examinador(a)/proveedor(a) de servicios: ____

Profesión del examinador(a)/proveedor(a) de servicios: ____

Nombre de la persona que llenó la forma/persona encargada de cuidar al niño(a): ____

Relación con el niño(a): mother

Nombre de la escuela/guardería: ____

Grado escolar: ____

¿En qué orden nació su niño(a) en comparación con sus hermanos(as) [por ejemplo, fue el primero(a), tercero(a), etc.]?
☐ Hijo(a) único(a) ☐ Primero(a) ☐ Segundo(a) ☒ Tercero(a) ☐ Cuarto(a) ☐ Quinto(a) ☐ Otro ____

¿Ha habido más de tres niños(as) entre las edades de nacimiento a 18 años viviendo en su hogar en los últimos 12 meses? ☐ Sí ☐ No

INSTRUCCIONES

Las páginas siguientes contienen enunciados que describen cómo se pueden comportar los niños. Por favor lea cada frase y seleccione la opción que describe mejor qué tan seguido su niño(a) muestra estos comportamientos. *Por favor marque una opción para cada enunciado.*

Use la siguiente guía para marcar sus respuestas:

Cuando se le presenta la oportunidad, mi niño(a)...

Casi siempre	responde de esta manera **Casi siempre** (90% o más del tiempo).
Frecuentemente	responde de esta manera **Frecuentemente** (75% del tiempo).
La mitad del tiempo	responde de esta manera **La mitad del tiempo** (50% del tiempo).
Ocasionalmente	responde de esta manera **Ocasionalmente** (25% del tiempo).
Casi nunca	responde de esta manera **Casi nunca** (10% o menos del tiempo).
No aplicable	Si no puede contestar porque no ha observado ese comportamiento o cree que no es aplicable a su niño(a), por favor marque **No aplicable**.

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Sensory Profile 2 Auditory and Attention Scores

Casi siempre = 90% o más	Frecuentemente = 75%	La mitad del tiempo = 50%	Ocasionalmente = 25%	Casi nunca = 10% o menos

Procesamiento AUDITIVO

Cuadrante	Ítem	Mi niño(a)...	Casi siempre 5	Frecuentemente 4	La mitad del tiempo 3	Ocasionalmente 2	Casi nunca 1	No aplicable 0
AV	1	reacciona fuertemente a sonidos inesperados o altos (por ejemplo, sirenas, perros ladrando, secadora de pelo).	✓					
AV	2	se cubre los oídos con las manos para protegerlos de sonidos.	✓					
SN	3	le cuesta trabajo completar las tareas cuando hay música o la televisión está prendida.				✓		
SN	4	se distrae cuando hay mucho ruido a su alrededor.			✓			
AV	5	se vuelve improductivo(a) con el ruido de fondo (por ejemplo, ventilador, refrigerador).			✓			
SN	6	parece ignorarme o no escuchar lo que estoy diciendo.				✓		
SN	7	parece no oír cuando lo(a) llamo por su nombre (a pesar de que puede oír bien).				✓		
RG	8	disfruta de ruidos extraños o hace ruido(s) solo por diversión.					✓	
		AUDITIVO Puntuación cruda	23					

Comentarios sobre procesamiento AUDITIVO: ______

Casi siempre = 90% o más	Frecuentemente = 75%	La mitad del tiempo = 50%	Ocasionalmente = 25%	Casi nunca = 10% o menos

Respuestas de ATENCIÓN asociadas con el procesamiento sensorial

Cuadrante	Ítem	Mi niño(a)...	Casi siempre 5	Frecuentemente 4	La mitad del tiempo 3	Ocasionalmente 2	Casi nunca 1	No aplicable 0
RG	76	tiene muy poco contacto visual conmigo durante nuestras interacciones diarias.				✓		
SN	77	tiene dificultad para poner atención.		✓				
SN	78	aparta la vista de sus tareas para observar todas las actividades en la habitación.				✓		
RG	79	parece no estar consciente de un ambiente activo (por ejemplo, no se da cuenta de las actividades que ocurren).					✓	
RG	80	mira fijamente a los objetos.					✓	
AV	81	mira fijamente a las personas.					✓	
SK	82	observa a todas las personas que se mueven alrededor de la habitación.			✓			
SK	83	brinca de una cosa a otra, a tal grado que interfiere con las actividades.		✓				
SN	84	se pierde fácilmente.						✓
RG	85	le cuesta trabajo encontrar cosas en situaciones que complican el problema (por ejemplo, zapatos en un cuarto desordenado, lápiz en un cajón lleno de trastos o trebejos).					✓	
		ATENCIÓN Puntuación cruda	19					
RG	86	parece no darse cuenta cuando las personas entran a la habitación.*						

* This item is not part of the ATTENTIONAL Raw Score.

Comentarios sobre respuestas de ATENCIÓN: ______

Sensory Profile 2 Summary Score Form and Classification

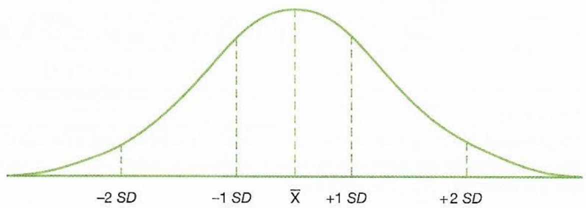
Summary Scores

Instructions

Transfer each Quadrant Raw Score Total from the Quadrant grids to the corresponding Quadrant Raw Score Total box. Then, transfer the section Raw Score Totals from the Caregiver Questionnaire to the corresponding Raw Score Total box. Plot these totals by marking an X in the appropriate classification column (e.g., Less Than Others, More Than Others, Just Like the Majority of Others).

The Normal Curve and Sensory Profile 2 Classification System

Scores one standard deviation or more from the mean are expressed as More Than Others or Less Than Others, respectively. Scores two standard deviations or more from the mean are expressed as Much More Than Others or Much Less Than Others, respectively.



				◄ Less Than Others			More Than Others ►	
		Raw Score Total	Percentile Range[a]	Much Less Than Others	Less Than Others	Just Like the Majority of Others	More Than Others	Much More Than Others
Quadrants	Seeking/Seeker	/95		0-------6	7-------19	20-------47	48-------60	61-------95
	Avoiding/Avoider	/100		0-------7	8-------20	21-------46	47-------59	60-------100
	Sensitivity/Sensor	/95		0-------6	7-------17	18-------42	43-------53	54-------95
	Registration/Bystander	/110		0-------6	7-------18	19-------43	44-------55	56-------110
Sensory Sections	Auditory	23 /40		0-------2	3-------9	10-----X24	25-------31	32-------40
	Visual	/30		0-------4	5-------8	9-------17	18-------21	22-------30
	Touch	/55		0	1-------7	8-------21	22-------28	29-------55
	Movement	/40		0-------1	2-------6	7-------18	19-------24	25-------40
	Body Position	/40		0	1-------4	5-------15	16-------19	20-------40
	Oral	/50		**	0-------7	8-------24	25-------32	33-------50
Behavioral Sections	Conduct	/45		0-------1	2-------8	9-------22	23-------29	30-------45
	Social Emotional	/70		0-------2	3-------12	13-------31	32-------41	42-------70
	Attentional	19 /50		0	1-------8	9---X--24	25-------31	32-------50

[a] For percentile ranges, see Appendix A in the Sensory Profile 2 User's Manual.
** No scores are available for this range.

Quadrant Definitions	
Seeking/Seeker	The degree to which a child *obtains* sensory input. A child with a Much More Than Others score in this pattern seeks sensory input at a higher rate than others.
Avoiding/Avoider	The degree to which a child is *bothered* by sensory input. A child with a Much More Than Others score in this pattern moves away from sensory input at a higher rate than others.
Sensitivity/Sensor	The degree to which a child *detects* sensory input. A child with a Much More Than Others score in this pattern notices sensory input at a higher rate than others.
Registration/Bystander	The degree to which a child *misses* sensory input. A child with a Much More Than Others score in this pattern misses sensory input at a higher rate than others.

Appendix G

Participant's Post-Intervention Results

Schilder Test

Post-Assessment Results

Schilder Test

During this test, the participant stands upright with feet together and arms extended in front at shoulder level with wrists and hands relaxed. The tester stands behind the participant and provides specific instructions to passively turn the head to each side of the body. The tester turns the participant's head slowly to one side, 70-80' of neck rotation until chin is over the shoulder and pauses for 5 seconds, then slowly turns the participant's head to the other side and pauses for 5 seconds. *Participant's eyes are closed during the assessment.* This rotation sequence is repeated **two** times. Positive indicators of the ATNR include movement of the arms in the same direction the head is turned, dropping the arms, or swaying and loss of balance. Each side of the body is scored separately and then a total is obtained for both sides.

The scores are defined as follows:

0= no response

1 = slight movement of the arms (up to 20') to the same side as the head is turned, or slight dropping of the arms

2= movement of the arms (up to 45') as the head is turned, or marked dropping of the arms

3= movement greater than 45' either to the side or down, swaying and loss of balance

Participant:	Date: 7/19/19
Observer: Jesley Joseph	Credentials: OTR

Head Rotation	ATNR Score
Right Side	0
Left Side	0
Total	0

Comments (additional observations):

- ↓ cooperation

Crossing Midline Observation Form

Event Frequency Recording Data Sheet

Directions: This recording data sheet is to be used as an observation checklist to determine crossing midline motor patterns. The participant will stack ***six*** blocks while retrieving blocks from a designated green square placed at a distance of 10 inches from the participant's midline on the opposite side of the body of the hand being used and stack them by positioning them on a designated red square placed at a distance of 10 inches from the participant's midline on the side of the hand being used. Use tally marks or X's to record the number of target behavior occurrences. Record how long it took the participant to stack 6 blocks while crossing midline from a designated green square to a red square. Both upper extremities to be measured individually.

Participant:	Date: 7/19/19
Observer: Jesley Joseph	Credentials: OTR

Directions to the participant: Say "let's get the blocks from the green square and stack them on the red square with the right hand only to make a tall tower". Repeat for left hand saying "let's get the blocks from the green square and stack them on the red square with the left hand only to make a tall tower".

Play Task: Stacking Blocks	
Observation Length: 15 minutes	
Target Behavior: crossing midline with each individual upper extremity while retrieving blocks from a designated green square in sit position at table top	
Behavior Definition: moving the hand, forearm, or elbow across the midline of the body over to the opposite side of the body	
Right Upper Extremity Crossing Midline Tally	Total
1111	4
Left Upper Extremity Crossing Midline Tally	Total
11	2

How long to stack six blocks with right hand crossing midline? > 1 min

How long to stack six blocks with left hand crossing midline? > 1 min

Comments (additional observations):

↓ cooperation

Effects of Reflex Integration in Autism: An Occupational Therapy Case Report

BOT-2 Upper- Limb Coordination Subtest Scoring Sheet/Record Form

BOT™ 2

Bruininks-Oseretsky Test of Motor Proficiency, *Second Edition*

Robert H. Bruininks & Brett D. Bruininks

Fine Motor Record Form

	Year	Month	Day
Test Date	2019	07	24
Birth Date	2009	01	22
Chronological Age	10	6	2

Preferred Drawing Hand: (Right) Left

Preferred Throwing Hand/Arm: (Right) Left

Norms Used: ☐ Female ☑ Male ☐ Combined

Examinee Name [illegible] Sex M Grade

Examiner Name Jesky Joseph, OTR School/Clinic [illegible]

	Total Point Score	Scale Score Mean = 15, SD = 5 (Tables B.1—B.3)	Standard Score Mean = 50, SD = 10 (Tables B.4—B.6, S.3)	Confidence Interval: 90% or 95% (Tables C.1, C.2, S.4) Band	Interval	%ile Rank (Tables B.4—B.6, S.3)	Age Equiv. (Tables B.14—B.16)	Descriptive Category (Table C.13)	SD/ z-score
1 Fine Motor Precision									
2 Fine Motor Integration									
Fine Manual Control		Sum							
3 Manual Dexterity									
7 Upper-Limb Coordination	20	6		3	3 - 9		6:0-6:2	BA	-1.8
Manual Coordination		Sum							
Fine Motor Composite		Sum							

DIRECTIONS

During the testing session, record the examinee's performance on each item.

After the testing session, convert each item raw score to a point score using the conversion table provided. For items needing two trials, convert the better of the two raw scores. Then, record the point score in the appropriate oval in the Point Score column.

For each subtest, add the item point scores, and record the total in the oval labeled Total Point Score and on the appropriate line on the cover page.

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Product Number 58036

Note: BA = Below Average

BOT-2 Bilateral Coordination Subtest Scoring Sheet/Record Form

BOT™ 2

Bruininks-Oseretsky Test of Motor Proficiency, *Second Edition*

Robert H. Bruininks, PhD, & Brett D. Bruininks

Gross Motor Record Form

	Year	Month	Day
Test Date	2019	07	24
Birth Date	2009	01	22
Chronological Age	10	6	2

Preferred Foot/Leg: (Right) Left

Norms Used: ☐ Female ☒ Male ☐ Combined

Examinee Name ______ Sex M Grade ______

Examiner Name Jesley Joseph, OTR School/Clinic ______

	Total Point Score	Scale Score Mean = 15, SD = 5 (Tables B.1—B.3)	Standard Score Mean = 50, SD = 10 (Tables B.4–B.6, S.5)	Confidence Interval: 90% or 95% (Tables C.1, C.2, S.6) Band	Interval	%ile Rank (Tables B.4–B.6, S.5)	Age Equiv. (Tables B.14—B.16)	Descriptive Category (Table C.13)	SD/Z-score
(4) Bilateral Coordination	6	5		± 3	2 – 8		4:2-4:3	WBA	-2
5 Balance				±	–				
Body Coordination		Sum		±	–				
6 Running Speed and Agility				±	–				
8 Strength Push-up: Knee Full				±	–				
Strength and Agility		Sum		±	–				
Gross Motor Composite		Sum		±	–				

DIRECTIONS

During the testing session, record the examinee's performance on each item.

After the testing session, convert each item raw score to a point score using the conversion table provided. For items needing two trials, convert the better of the two raw scores. Then, record the point score in the appropriate oval in the Point Score column.

For each subtest, add the item point scores, and record the total in the oval labeled Total Point Score and on the appropriate line on the cover page.

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Product Number 58043

Note: WBA = Well-below Average

BOT-2 Upper-Limb Coordination and Bilateral Coordination Point Score Forms

Subtest 7: Upper-Limb Coordination

For Items 5 and 6, conduct the second trial only if the examinee does not earn the maximum score on the first trial.

Item	Raw Score Trial 1	Raw Score Trial 2	Raw	Point	Point Score
1 Dropping and Catching a Ball—Both Hands	4 catches		0, 1, 2, 3, 4, 5	0, 1, 2, 3, 4, 5	4
2 Catching a Tossed Ball—Both Hands	4 catches		0, 1, 2, 3, 4, 5	0, 1, 2, 3, 4, 5	4
3 Dropping and Catching a Ball—One Hand	2 catches		0, 1, 2, 3, 4, 5	0, 1, 2, 3, 4, 5	2
4 Catching a Tossed Ball—One Hand	0 catches		0, 1, 2, 3, 4, 5	0, 1, 2, 3, 4, 5	0
5 Dribbling a Ball—One Hand	2 dribbles	0 dribbles	0, 1, 2, 3, 4–5, 6–7, 8–9, 10	0, 1, 2, 3, 4, 5, 6, 7	2
6 Dribbling a Ball—Alternating Hands	7 dribbles	2 dribbles	0, 1, 2, 3, 4–5, 6–7, 8–9, 10	0, 1, 2, 3, 4, 5, 6, 7	5
7 Throwing a Ball at a Target	3 throws		0, 1, 2, 3, 4, 5	0, 1, 2, 3, 4, 5	3

Notes & Observations

Total Point Score Subtest 7 (max = 39): 20

Subtest 4: Bilateral Coordination

Conduct the second trial only if the examinee does not earn the maximum score on the first trial.

Item	Raw Score Trial 1	Raw Score Trial 2	Raw	Point	Point Score
1 Touching Nose with Index Fingers—Eyes Closed	0 touches	1 touches	0, 1, 2, 3, 4	0, 1, 2, 3, 4	1
2 Jumping Jacks	0 jumping jacks	0 jumping jacks	0, 1, 2–4, 5	0, 1, 2, 3	0
3 Jumping in Place—Same Sides Synchronized	1 jumps	5 jumps	0, 1, 2–4, 5	0, 1, 2, 3	3
4 Jumping in Place—Opposite Sides Synchronized	1 jumps	3 jumps	0, 1, 2–4, 5	0, 1, 2, 3	2
5 Pivoting Thumbs and Index Fingers	0 pivots	0 pivots	0, 1, 2–4, 5	0, 1, 2, 3	0
6 Tapping Feet and Fingers—Same Sides Synchronized	0 taps	0 taps	0, 1, 2–4, 5–9, 10	0, 1, 2, 3, 4	0
7 Tapping Feet and Fingers—Opposite Sides Synchronized	0 taps	0 taps	0, 1, 2–4, 5–9, 10	0, 1, 2, 3, 4	0

Notes & Observations

Total Point Score Subtest 4 (max = 24): 6

Sensory Profile 2 Form (Spanish)

CHILD (SPANISH)

CHILD Sensory Profile 2

Winnie Dunn, PhD, OTR, FAOTA

Cuestionario para padres o tutores

3:0 a 14:11 años

FOR OFFICE USE ONLY

Calculation of Child's Age

	Year	Month	Day
Test Date	2019	07	24
Birth Date	2009	01	22
Age	10	6	2

Nombre(s) del niño(a): ______________ Apellido: ______________

Nombre preferido del niño(a) (si es diferente al nombre de arriba): ______________

Número de ID: ______________

Sexo: ☐ Masculino ☐ Femenino Fecha de nacimiento: ____/____/____ Fecha de la prueba: ____/____/____

Nombre del examinador(a)/proveedor(a) de servicios: ______________

Profesión del examinador(a)/proveedor(a) de servicios: ______________

Nombre de la persona que llenó la forma/persona encargada de cuidar al niño(a): ______________

Relación con el niño(a): Mother

Nombre de la escuela/guardería: ______________

Grado escolar: ______________

¿En qué orden nació su niño(a) en comparación con sus hermanos(as) [por ejemplo, fue el primero(a), tercero(a), etc.]?
☐ Hijo(a) único(a) ☐ Primero(a) ☐ Segundo(a) ☒ Tercero(a) ☐ Cuarto(a) ☐ Quinto(a) ☐ Otro ______________

¿Ha habido más de tres niños(as) entre las edades de nacimiento a 18 años viviendo en su hogar en los últimos 12 meses? ☐ Sí ☐ No

INSTRUCCIONES

Las páginas siguientes contienen enunciados que describen cómo se pueden comportar los niños. Por favor lea cada frase y seleccione la opción que describe mejor qué tan seguido su niño(a) muestra estos comportamientos. *Por favor marque una opción para cada enunciado.*

Use la siguiente guía para marcar sus respuestas:

Cuando se le presenta la oportunidad, mi niño(a)...

Casi siempre	responde de esta manera **Casi siempre** (90% o más del tiempo).
Frecuentemente	responde de esta manera **Frecuentemente** (75% del tiempo).
La mitad del tiempo	responde de esta manera **La mitad del tiempo** (50% del tiempo).
Ocasionalmente	responde de esta manera **Ocasionalmente** (25% del tiempo).
Casi nunca	responde de esta manera **Casi nunca** (10% o menos del tiempo).
No aplicable	Si no puede contestar porque no ha observado ese comportamiento o cree que no es aplicable a su niño(a), por favor marque **No aplicable**.

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Sensory Profile 2 Auditory and Attention Scores

Casi siempre = 90% o más	Frecuentemente = 75%	La mitad del tiempo = 50%	Ocasionalmente = 25%	Casi nunca = 10% o menos

Procesamiento AUDITIVO

Cuadrante	Ítem	Mi niño(a)...	Casi siempre 5	Frecuentemente 4	La mitad del tiempo 3	Ocasionalmente 2	Casi nunca 1	No aplicable 0
AV	1	reacciona fuertemente a sonidos inesperados o altos (por ejemplo, sirenas, perros ladrando, secadora de pelo).			✓			
AV	2	se cubre los oídos con las manos para protegerlos de sonidos.			✓			
SN	3	le cuesta trabajo completar las tareas cuando hay música o la televisión está prendida.			✓			
SN	4	se distrae cuando hay mucho ruido a su alrededor.			✓			
AV	5	se vuelve improductivo(a) con el ruido de fondo (por ejemplo, ventilador, refrigerador).				✓		
SN	6	parece ignorarme o no escuchar lo que estoy diciendo.				✓		
SN	7	parece no oír cuando lo(a) llamo por su nombre (a pesar de que puede oír bien).				✓		
RG	8	disfruta de ruidos extraños o hace ruido(s) solo por diversión.				✓		
		AUDITIVO Puntuación cruda	20					

Comentarios sobre procesamiento AUDITIVO: ______________________________

Casi siempre = 90% o más	Frecuentemente = 75%	La mitad del tiempo = 50%	Ocasionalmente = 25%	Casi nunca = 10% o menos

Respuestas de ATENCIÓN asociadas con el procesamiento sensorial

Cuadrante	Ítem	Mi niño(a)...	Casi siempre 5	Frecuentemente 4	La mitad del tiempo 3	Ocasionalmente 2	Casi nunca 1	No aplicable 0
RG	76	tiene muy poco contacto visual conmigo durante nuestras interacciones diarias.			✓			
SN	77	tiene dificultad para poner atención.			✓			
SN	78	aparta la vista de sus tareas para observar todas las actividades en la habitación.				✓		
RG	79	parece no estar consciente de un ambiente activo (por ejemplo, no se da cuenta de las actividades que ocurren).					✓	
RG	80	mira fijamente a los objetos.					✓	
AV	81	mira fijamente a las personas.					✓	
SK	82	observa a todas las personas que se mueven alrededor de la habitación.				✓		
SK	83	brinca de una cosa a otra, a tal grado que interfiere con las actividades.				✓		
SN	84	se pierde fácilmente.					✓	
RG	85	le cuesta trabajo encontrar cosas en situaciones que complican el problema (por ejemplo, zapatos en un cuarto desordenado, lápiz en un cajón lleno de trastos o trebejos).				✓		
		ATENCIÓN Puntuación cruda	18					
RG	86	parece no darse cuenta cuando las personas entran a la habitación.*						✓

* This item is not part of the ATTENTIONAL Raw Score.

Comentarios sobre respuestas de ATENCIÓN: ______________________________

Sensory Profile 2 Summary Score Form and Classification

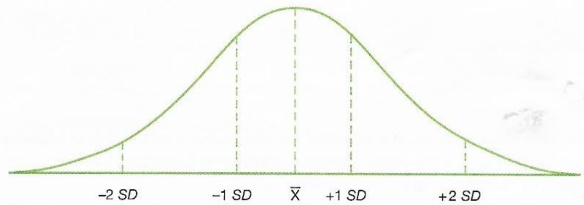
Summary Scores

Instructions

Transfer each Quadrant Raw Score Total from the Quadrant grids to the corresponding Quadrant Raw Score Total box. Then, transfer the section Raw Score Totals from the Caregiver Questionnaire to the corresponding Raw Score Total box. Plot these totals by marking an X in the appropriate classification column (e.g., Less Than Others, More Than Others, Just Like the Majority of Others).

The Normal Curve and Sensory Profile 2 Classification System

Scores one standard deviation or more from the mean are expressed as More Than Others or Less Than Others, respectively. Scores two standard deviations or more from the mean are expressed as Much More Than Others or Much Less Than Others, respectively.



		Raw Score Total	Percentile Range[a]	Much Less Than Others (◄ Less Than Others)	Less Than Others (◄ Less Than Others)	Just Like the Majority of Others	More Than Others (More Than Others ►)	Much More Than Others (More Than Others ►)
Quadrants	Seeking/Seeker	/95		0-------6	7-------19	20-------47	48-------60	61-------95
	Avoiding/Avoider	/100		0-------7	8-------20	21-------46	47-------59	60-------100
	Sensitivity/Sensor	/95		0-------6	7-------17	18-------42	43-------53	54-------95
	Registration/Bystander	/110		0-------6	7-------18	19-------43	44-------55	56-------110
Sensory Sections	Auditory	20/40		0-------2	3-------9	10---X-24	25-------31	32-------40
	Visual	/30		0-------4	5-------8	9-------17	18-------21	22-------30
	Touch	/55		0	1-------7	8-------21	22-------28	29-------55
	Movement	/40		0-------1	2-------6	7-------18	19-------24	25-------40
	Body Position	/40		0	1-------4	5-------15	16-------19	20-------40
	Oral	/50		**	0-------7	8-------24	25-------32	33-------50
Behavioral Sections	Conduct	/45		0-------1	2-------8	9-------22	23-------29	30-------45
	Social Emotional	/70		0-------2	3-------12	13-------31	32-------41	42-------70
	Attentional	18/50		0	1-------8	9---X-24	25-------31	32-------50

[a] For percentile ranges, see Appendix A in the Sensory Profile 2 User's Manual.
** No scores are available for this range.

Quadrant Definitions	
Seeking/Seeker	The degree to which a child *obtains* sensory input. A child with a Much More Than Others score in this pattern seeks sensory input at a higher rate than others.
Avoiding/Avoider	The degree to which a child is *bothered* by sensory input. A child with a Much More Than Others score in this pattern moves away from sensory input at a higher rate than others.
Sensitivity/Sensor	The degree to which a child *detects* sensory input. A child with a Much More Than Others score in this pattern notices sensory input at a higher rate than others.
Registration/Bystander	The degree to which a child *misses* sensory input. A child with a Much More Than Others score in this pattern misses sensory input at a higher rate than others.

8 CHILD Sensory Profile 2

Appendix H

Case Study Poster

Effects of Reflex Integration in Autism: An Occupational Therapy Case Report

utmb Health
Jennifer Padilla Melendez, OTR
Department of Occupational Therapy
University of Texas Medical Branch

Learning Objectives

- Learn about one reflex-based intervention
- Discover the effects of one reflex-based intervention in the motor skills of a child diagnosed with Autism Spectrum Disorder (ASD)

Introduction

- Primitive reflexes play a role in motor development by preparing an infant to move against gravity and gradually moving voluntarily to interact with the environment.[1]
- The ATNR reflex plays a role in motor development as a precursor for early visual inspection of the hand and eye-hand coordination. [2]
- The ATNR has been found to persist for a longer time in children with ASD. [3]
- ASD is a term used to describe a group of neurodevelopmental conditions characterized by social communication deficits and repetitive sensory-motor behaviors.[4]
- The persistence of primitive reflexes have been found to interfere with motor skills.[5]
- The Masgutova Neurosensorimotor Reflex Integration (MNRI) is a non-invasive, natural, and replicable neuromodulation technique that utilizes reflex integration components to create mature neurological pathways in the reflex circuit to aid in the development of mature motor patterns.[6]
- In this case, the child (10-year-old male) had a diagnosis of ASD with significant motor delays, persistent ATNR, ipsilateral motor responses, and lack of independence for activities of daily living (ADL).

Purpose

- Describe the effects of the MNRI intervention method on bilateral coordination, auditory-visual integration, and crossing midline motor patterns needed for play on a child diagnosed with ASD presenting with a persistent ATNR
- Discuss the implications of the MNRI intervention to occupational therapy (OT) practice

Methods

- Random participant selection from a purposive sample
- Participation in an 8-week MNRI intervention to integrate the ATNR
- Assessments pre and post intervention:
  - Schilder Test - assessed the ATNR
  - Bruininks-Oseretsky Test of Motor Proficiency, 2nd edition (BOT-2) assessed Upper-Limb and Bilateral Coordination
  - Sensory Profile 2 assessed auditory and attentional
  - An observation form assessed crossing midline skills

Results

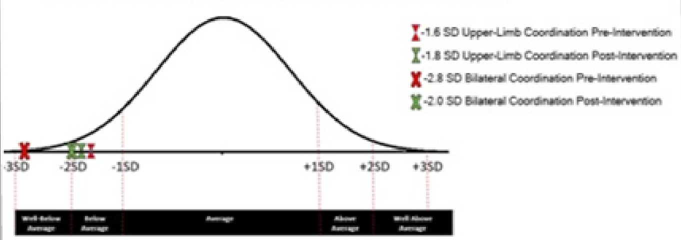
- The child participated in 16 intervention sessions (45-50 minutes each)
- The data suggests that the MNRI intervention was successful at:
  - Integrating the ATNR
  - Improving bilateral coordination
  - Improving crossing midline skills

Pre and Post Schilder Test

Schilder Test	ATNR Pre Intervention	ATNR Post Intervention
ATNR Interpretation	Positive	Negative
ATNR Score	6	0

Pre and Post BOT-2

BOT-2 Upper-Limb and Bilateral Coordination Standard Deviations (SD)



Pre and Post Sensory Profile 2

Sensory Profile Sections	Pre Intervention	Post Intervention
Auditory Raw Score	23	20
Auditory Classification	Just like Majority of Others	Just like Majority of Others
Attentional Raw Score	19	18
Attentional Classification	Just like Majority of Others	Just like Majority of Others

Pre and Post Crossing Midline Play Task

Play Task	Pre Intervention	Post Intervention
Total crossing midline RUE	4	4
Total crossing midline LUE	0	2
Time to stack with RUE	>1 minute	> 1 minute
Time to stack with LUE	> 1 minute	>1 minute
Note: RUE= right upper extremity, LUE= left upper extremity		

- The MNRI was not successful at improving upper-limb coordination
- No effects were identified in regards to auditory-visual integration

Conclusion

- OT practitioners provide various intervention approaches to children with ASD.
- Although, reflexes are a precursor to motor development, research on the effectiveness of reflex-based interventions in OT is limited.
- The case study had similar results to other research articles
  - The greater the severity of the reflex, the lower the motor efficiency.[1]
  - The constant repetition of neuromodulation exercises were key to the integration and inhibition of the ATNR. [5]
- This case study provides preliminary data researching a specific reflex-based intervention in OT practice which could advance the science of OT to further define the American Occupational Therapy Association (AOTA) Vision core tenets of effective practice.
- Currently there is no sufficient evidence to support the use of reflex integration but, research has not concluded that the intervention is ineffective either. [7]
- Further research could validate these findings and determine if MNRI can ultimately improve occupational performance.

Implications to OT

- Research is needed in order to advance evidence-based practice in OT
- OT practitioners must orient themselves to choose evidence-based interventions in order to provide best care
- The case study delineates the importance of researching sensory-motor interventions and their impact on motor skills and occupational performance
- OT practitioners play a role in motor development and they are in a position to implement reflex integration principles to their practice for neurodevelopment

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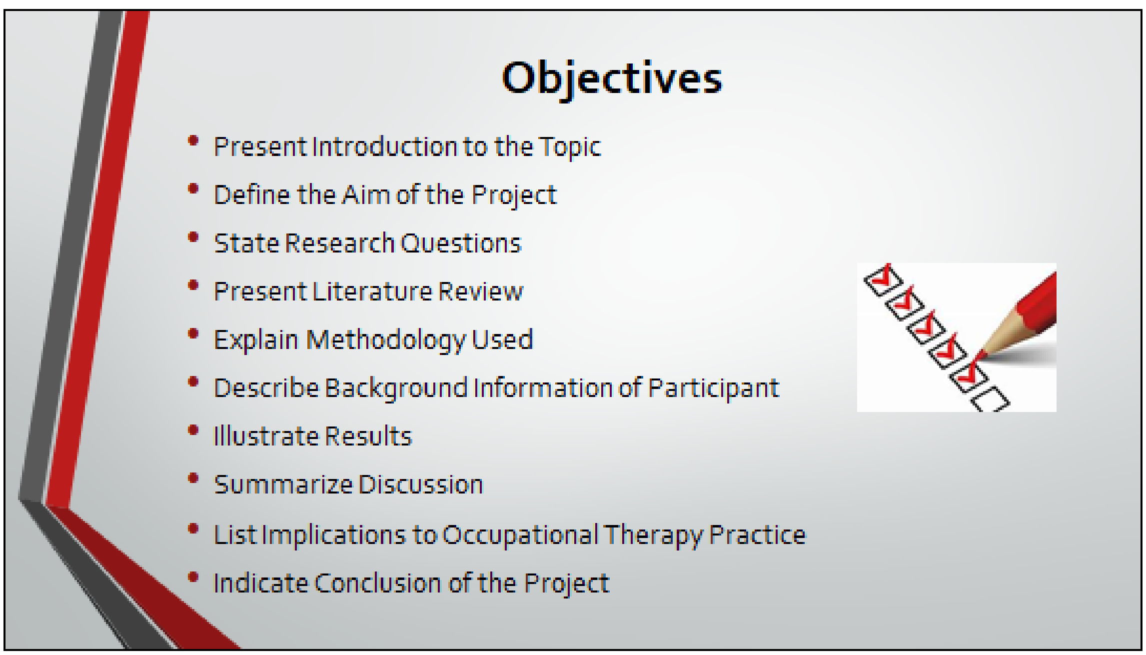
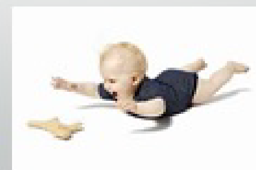
Appendix I

Case Study Final Defense Presentation



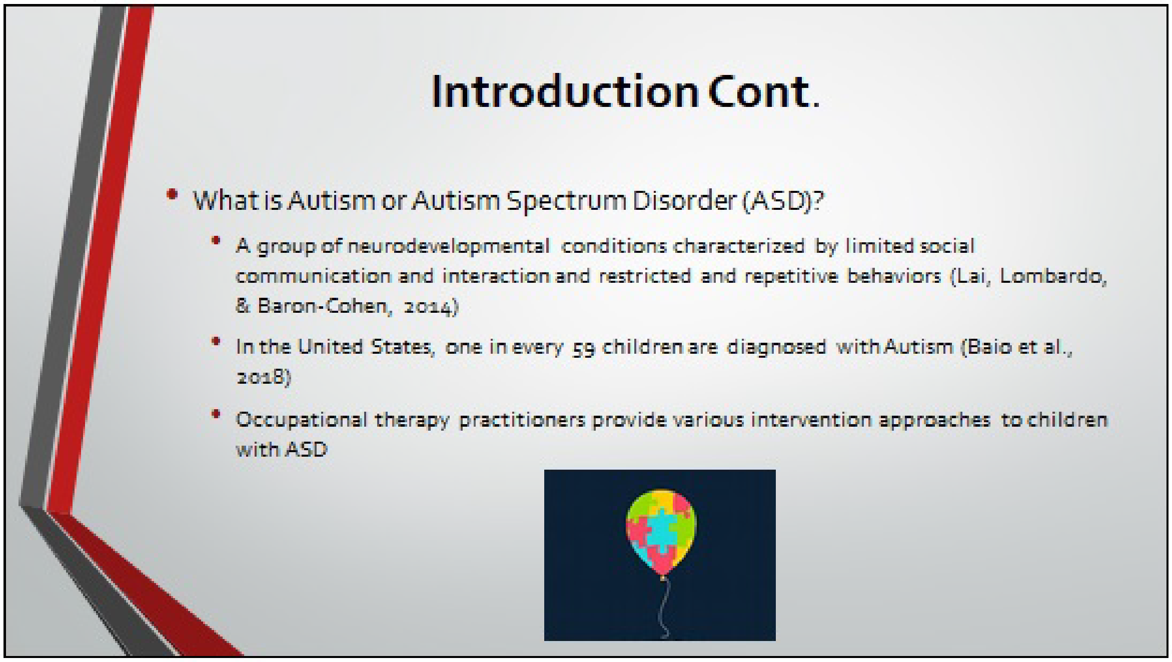
Introduction

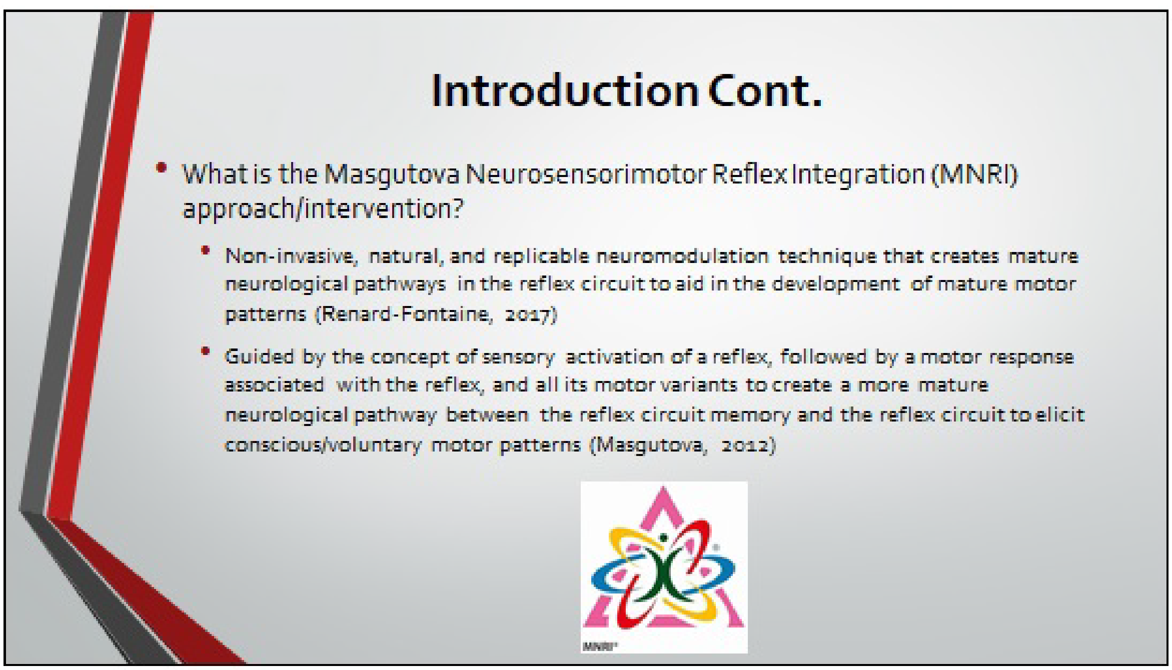
- What are primitive reflexes?
  - Stereotypical movement patterns elicited by a specific sensory stimuli that are frequently used as indicators of central nervous system (CNS) maturity or immaturity (Zafeiriou, 2004)
  - Play a role in motor development by preparing an infant to move against gravity and gradually moving voluntarily to interact with the environment (Gieysztor, Choinska, & Paprocka-Borowicz, 2015)
  - Help an infant engage with the environment and develop sensory organs and receptors (Melillo, 2011)

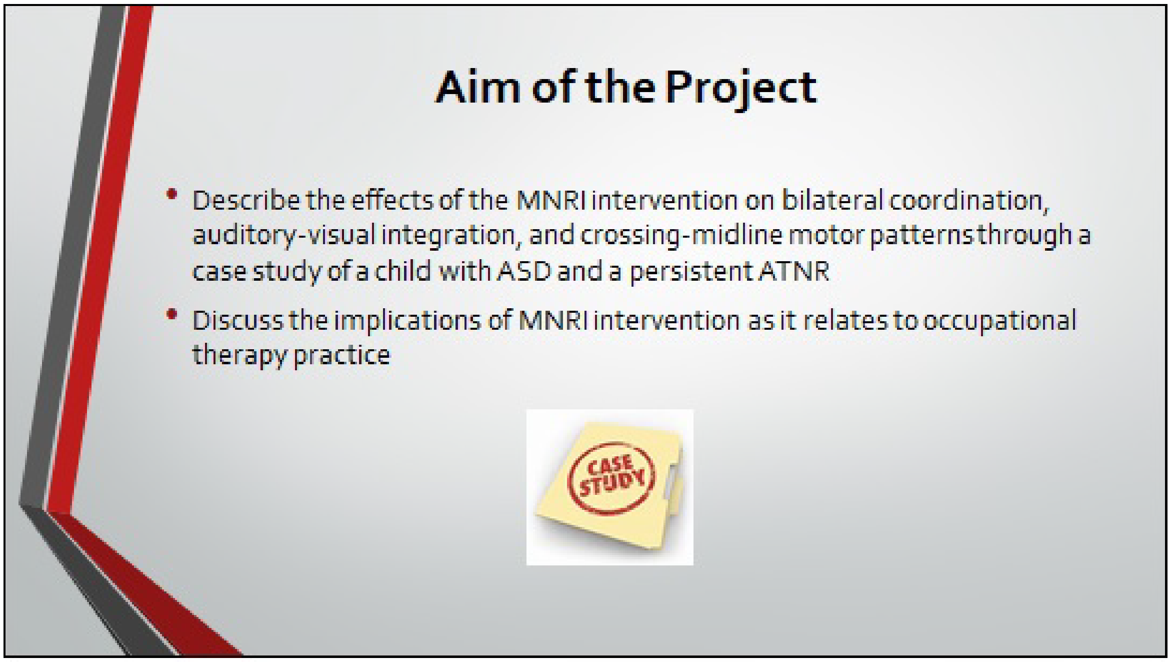


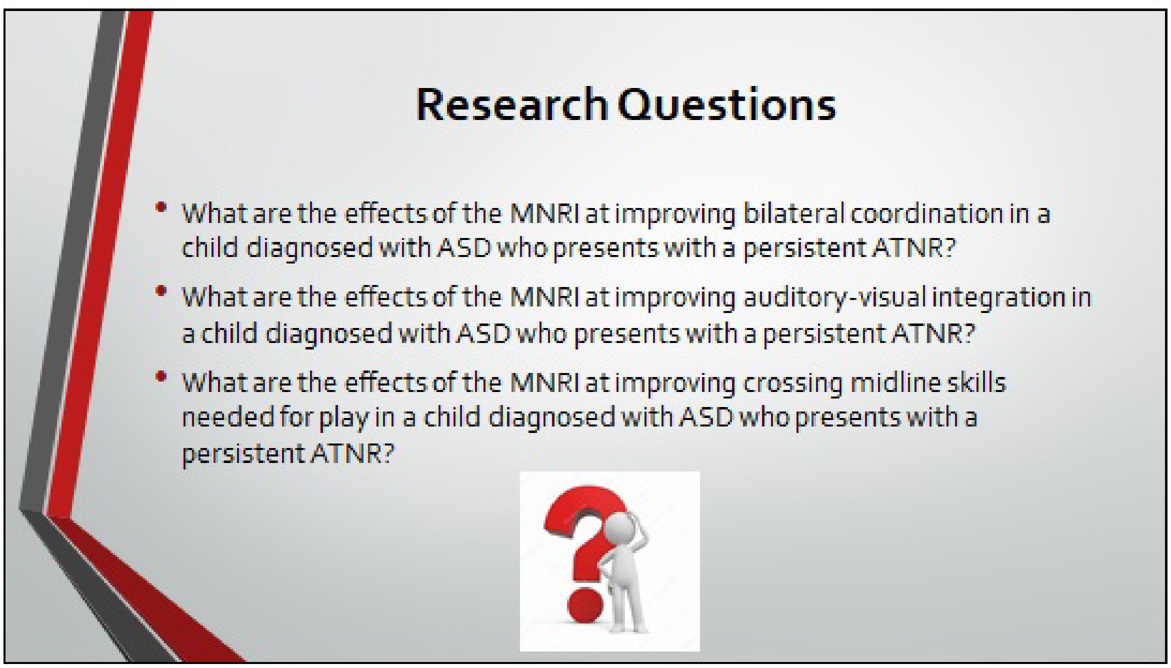
Introduction Cont.

- What is the asymmetrical tonic neck reflex (ATNR)?
  - Characterized by a movement response caused by head turning in which the upper and lower extremities on the side to which the head is turned extend and the contralateral extremities flex (Konicarova & Bob, 2013)
  - Plays a role in motor development as a precursor for early visual inspection of the hand and eye-hand coordination (Sidaway et al., 2015)
  - Plays a role in auditory-visual integration (Renard-Fontaine, 2017)
  - Has been found to persist for a longer time in children diagnosed with Autism (Teitelbaum, Teitelbaum, Fryman, & Maurer, 2002)


Introduction Cont.
What is Autism or Autism Spectrum Disorder (ASD)?
A group of neurodevelopmental conditions characterized by limited social communication and interaction and restricted and repetitive behaviors (Lai, Lombardo, & Baron-Cohen, 2014)
In the United States, one in every 59 children are diagnosed with Autism (Baio et al., 2018)
Occupational therapy practitioners provide various intervention approaches to children with ASD


Introduction Cont.
What is the Masgutova Neurosensorimotor Reflex Integration (MNRI) approach/intervention?
Non-invasive, natural, and replicable neuromodulation technique that creates mature neurological pathways in the reflex circuit to aid in the development of mature motor patterns (Renard-Fontaine, 2017)
Guided by the concept of sensory activation of a reflex, followed by a motor response associated with the reflex, and all its motor variants to create a more mature neurological pathway between the reflex circuit memory and the reflex circuit to elicit conscious/voluntary motor patterns (Masgutova, 2012)
MNRI


Aim of the Project
Describe the effects of the MNRI intervention on bilateral coordination, auditory-visual integration, and crossing-midline motor patterns through a case study of a child with ASD and a persistent ATNR
Discuss the implications of MNRI intervention as it relates to occupational therapy practice
CASE STUDY


Research Questions
What are the effects of the MNRI at improving bilateral coordination in a child diagnosed with ASD who presents with a persistent ATNR?
What are the effects of the MNRI at improving auditory-visual integration in a child diagnosed with ASD who presents with a persistent ATNR?
What are the effects of the MNRI at improving crossing midline skills needed for play in a child diagnosed with ASD who presents with a persistent ATNR?

Literature Review

- The literature available examining the effectiveness of reflex-based interventions at improving motor skills and self-care skills is limited
- Currently there is no available evidence of reflex integration neuromodulation techniques being used in occupational therapy
- Various studies have found a correlation between persistent primitive reflexes and motor delays (McPhillips, et al., 2000; McPhillips & Sheehy, 2004; Geysztor, Choinska, & Paprocka-Borowicz, 2015; Sankar & Mundkur, 2005)

Literature Review Cont.

- Several studies have revealed that a persistent ATNR, can lead to poor performance of fine motor and gross motor skills (McPhillips, et al., 2000; McPhillips & Sheehy, 2004; Alibakhshi et al., 2018)
- The assessment of the ATNR has been suggested as a screening tool for ASD (Teitelbaum et al., 2002)
- The research work by Masgutova et al., (2016a; 2016b) on reflex integration techniques following the Masgutova Neursosensorimotor Reflex Integration (MNRI) protocol, revealed positive outcomes at improving sensorimotor, physical, cognitive, and behavioral development in children with ASD

Literature Review Cont.

- MNRI found to be effective at improving reflex pattern expressions, motor function, postural control, stability, sense of equilibrium, and neuro-motor rehabilitation in children with Cerebral Palsy (Masgutova, 2008; Pilecki et al., 2012)
- MNRI found to improve sensory-motor functions in children with Down Syndrome (Masgutova et al., 2015)
- MNRI found to provide a unique and faster motor milestone development by restoring voluntary motor and cognitive control of an immobile arm associated with Amniotic Band Syndrome (Renard-Fontaine, 2017)
- MNRI has been suggested by a physical therapist, Renard-Fontaine, as an intervention tool for physical and occupational therapy practices

Methodology

- A child randomly selected from a purposive sample of children diagnosed with ASD who receive occupational therapy services at Kids Developmental Clinic, an outpatient pediatric clinic.

Inclusion Criteria	Exclusion Criteria
1. Diagnosis of ASD (ICD-10 code: F84.0)	1. Other diagnoses or co-existing diagnoses with ASD
2. Age between 4-14 years old	2. Age <4 years or >14 years of age
3. Positive ATNR with a score of at least 1 using Schilder Test	3. Negative ATNR with a score of 0 using Schilder Test
4. Presence of Ipsilateral motor responses in at least one side of the body	4. Presence of contralateral motor responses in both sides of the body
5. Receving OT services	4. History of MNRI protocol used to integrate ATNR
6. No history of MNRI protocol use for ATNR reflex.	

Methodology Cont.

- Consent forms to participate in the study and a preliminary screening to identify a positive ATNR completed and signed in May 2019
- A preliminary screening to identify a positive ATNR and ipsilateral responses completed in May 2019
- One participant randomly selected from the sample of children who met inclusion and preliminary criteria.

Methodology Cont.

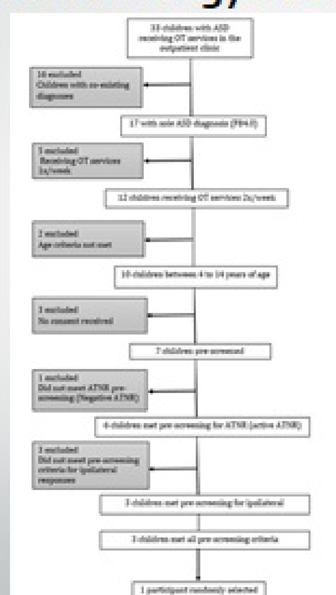
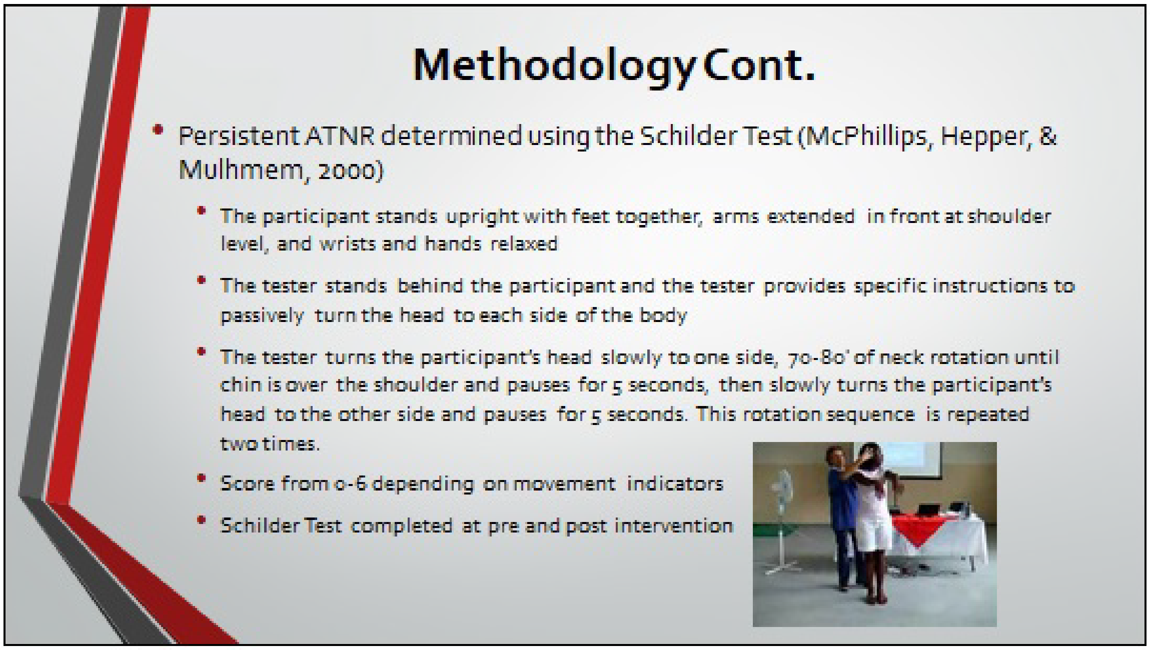
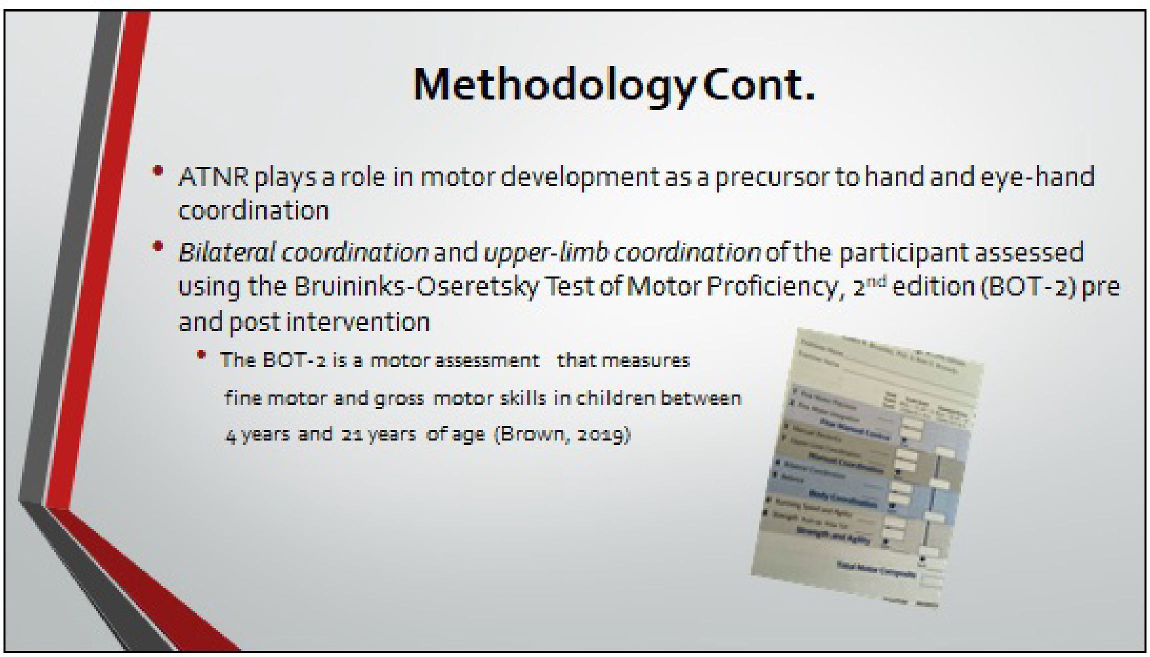


Figure 1.
Participant Selection Process


Methodology Cont.
Persistent ATNR determined using the Schilder Test (McPhillips, Hepper, & Mulhmem, 2000)
The participant stands upright with feet together, arms extended in front at shoulder level, and wrists and hands relaxed
The tester stands behind the participant and the tester provides specific instructions to passively turn the head to each side of the body
The tester turns the participant's head slowly to one side, 70-80° of neck rotation until chin is over the shoulder and pauses for 5 seconds, then slowly turns the participant's head to the other side and pauses for 5 seconds. This rotation sequence is repeated two times.
Score from 0-6 depending on movement indicators
Schilder Test completed at pre and post intervention


Methodology Cont.
ATNR plays a role in motor development as a precursor to hand and eye-hand coordination
Bilateral coordination and upper-limb coordination of the participant assessed using the Bruininks-Oseretsky Test of Motor Proficiency, 2nd edition (BOT-2) pre and post intervention
The BOT-2 is a motor assessment that measures fine motor and gross motor skills in children between 4 years and 21 years of age (Brown, 2019)

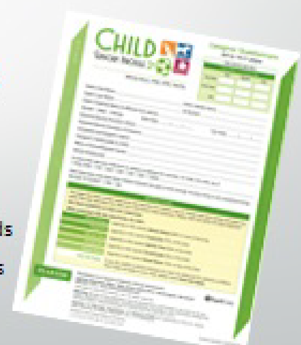
Methodology Cont.

- BOT-2 Subtests Completed

Bilateral Coordination: measures motor skills needed for playing sports and recreational activities	Upper-Limb Coordination: measures visual tracking skills coordinated with arm and hand movements
1.Touching nose with index finger (eye-closed)	1. Dropping and catching a ball with both hands
2.Jumping jacks	2. Catching a tossed ball with both hands
3.Jumping in place with same side synchronized	3. Dropping and catching a ball with one hand
4.Jumping in place with opposite side synchronized	4. Catching a tossed ball with one hand
5.Pivoting thumbs and index fingers	5. Dribbling a ball with one hand
6.Tapping feet and fingers with same side synchronized	6. Dribbling a ball alternating hands
7. Tapping feet and fingers with opposite side synchronized	7. Throwing a ball at a target (Bruininks & Bruininks, 2005)

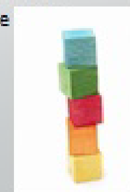
Methodology Cont.

- ATNR is theorized to play a role in auditory processing
- *Auditory* and *attentional* skills of the participant assessed using the Sensory Profile 2 pre and post intervention
  - The Sensory Profile 2 is an assessment tool that measures sensory processing patterns in children between birth and 14 years of age (Jorquera-Cabrera et al., 2017)
  - For this assessment, the parent of the participant completed the standardized forms
  - Auditory section included 8 questions about reactions to sounds
  - Attention section included 10 questions about attentional skills



Methodology Cont.

- A persistent ATNR has been found to affect eye tracking skills and the motor ability to cross the visual midline of the body (Gieysztor, Choinska, & Paprocka-Borowicz, 2015)
- The ability to *cross midline* during a play skill to retrieve and stack 6 blocks from/to designated areas was assessed using an observation form developed by the author pre and post intervention
  - The form measured the total of crossing midline motor patterns observed to retrieve blocks from a designated area in order to stack them with each upper extremity
  - Time component to determine how long it took the participant to retrieve and stack blocks was also recorded



Event Frequency Recording Data Sheet

Directions: This recording data sheet is to be used as an observation checklist to determine crossing midline motor patterns. The participant will stack six blocks while retrieving blocks from a designated green square placed at a distance of 10 inches from the participant's midline on the opposite side of the body of the hand being used and stack them by positioning them on a designated red square placed at a distance of 10 inches from the participant's midline on the side of the hand being used. Use tally marks or X's to record the number of target behavior occurrences. Record how long it took the participant to stack 6 blocks while crossing midline from a designated green square to a red square. Both upper extremities to be measured individually.

Participant:	Date:
Observer:	Credentials:

Directions to the participant: Say "let's get the blocks from the green square and stack them on the red square with the right hand only to make a tall tower". Repeat for left hand saying "let's get the blocks from the green square and stack them on the red square with the left hand only to make a tall tower".

Play Task: Stacking Blocks	
Observation Length: 15 minutes	
Target Behavior: crossing midline with each individual upper extremity while retrieving blocks from a designated green square in sit position at table top	
Behavior Definition: moving the hand, forearm, or elbow across the midline of the body over to the opposite side of the body	
Right Upper Extremity Crossing Midline Tally	Total
Left Upper Extremity Crossing Midline Tally	Total

How long to stack six blocks with right hand crossing midline? ____________

How long to stack six blocks with left hand crossing midline? ____________

Comments (additional observations):

Effects of reflex integration in Autism: An occupational therapy case report

Figure 2.
Crossing Midline Observation Checklist

Methodology Cont.

- Assessments administered by an occupational therapist blinded to the intervention process and nature of the study
- The child participated in an 8-week MNRI intervention protocol to integrate the ATNR 2x/week for 45-50 minutes
- Study completed in the months of June and July 2019
- MNRI protocol consisted of the following:
  - Activating the ATNR with sensory stimuli
  - Passive stretches according to the reflex pattern
  - Active exercises according to the reflex pattern
  - Active exercises against the reflex pattern
  - Active variant exercises of the reflex pattern

  * Exercises completed to both sides of the body

Background Information

- Participant
  - 10 years and 3 months old
  - Hispanic Heritage
  - Diagnosed with ASD at 3 years of age
  - Persistent ATNR
  - Ipsilateral motor responses on left upper extremity
  - History of receiving: speech therapy services and occupational therapy services
  - Bilateral motor skills below 4 years of age as per BOT-2
  - Lack of independence in activities of daily living (ADL) and instrumental activities of daily living (IADL)
  - Behavioral defiance

Results

- Pre and Post Schilder Test

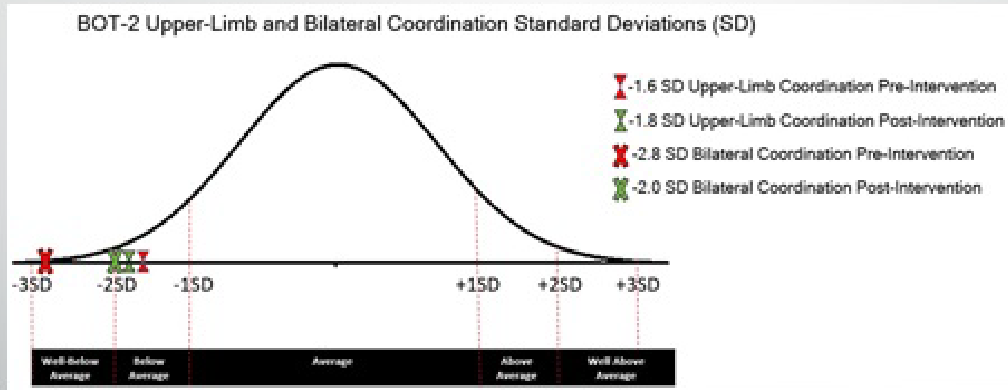
Schilder Test	ATNR Pre Intervention	ATNR Post Intervention
ATNR Interpretation	Positive	Negative
ATNR Score	6	0

Results Cont.

- Pre and Post BOT-2

	BOT-2 Pre-Intervention						
Subtest	Total Point Score	Scale score	Confidence Interval Band	Interval	Age equivalent	Descriptive Category	Standard Deviation
Upper-limb Coordination	22	7	±3	4 - 10	6 years 3 months – 6 years 5 months	Below Average	-1.6
Bilateral Coordination	0	1	±3	-2 - 4	Below 4 years	Well Below Average	-2.8
	BOT-2 Post-Intervention						
Subtest	Total Point Score	Scale score	Confidence Interval Band	Interval	Age equivalent	Descriptive Category	Standard Deviation
Upper-limb Coordination	20	6	±3	3 - 9	6 years 0 months - 6 years 2 months	Below Average	-1.8
Bilateral Coordination	6	5	±3	2 - 8	4 years 2 months – 4 years 3 months	Well Below Average	-2.0

Results Cont.



Using standard errors of measurement (SEM), a true change in bilateral coordination was detected for the participant

Results Cont.

- Pre and Post Sensory Profile 2

Sensory Profile Sections	Pre Intervention	Post Intervention
Auditory Raw Score	23	20
Auditory Classification	Just like Majority of Others	Just like Majority of Others
Attentional Raw Score	19	18
Attentional Classification	Just like Majority of Others	Just like Majority of Others

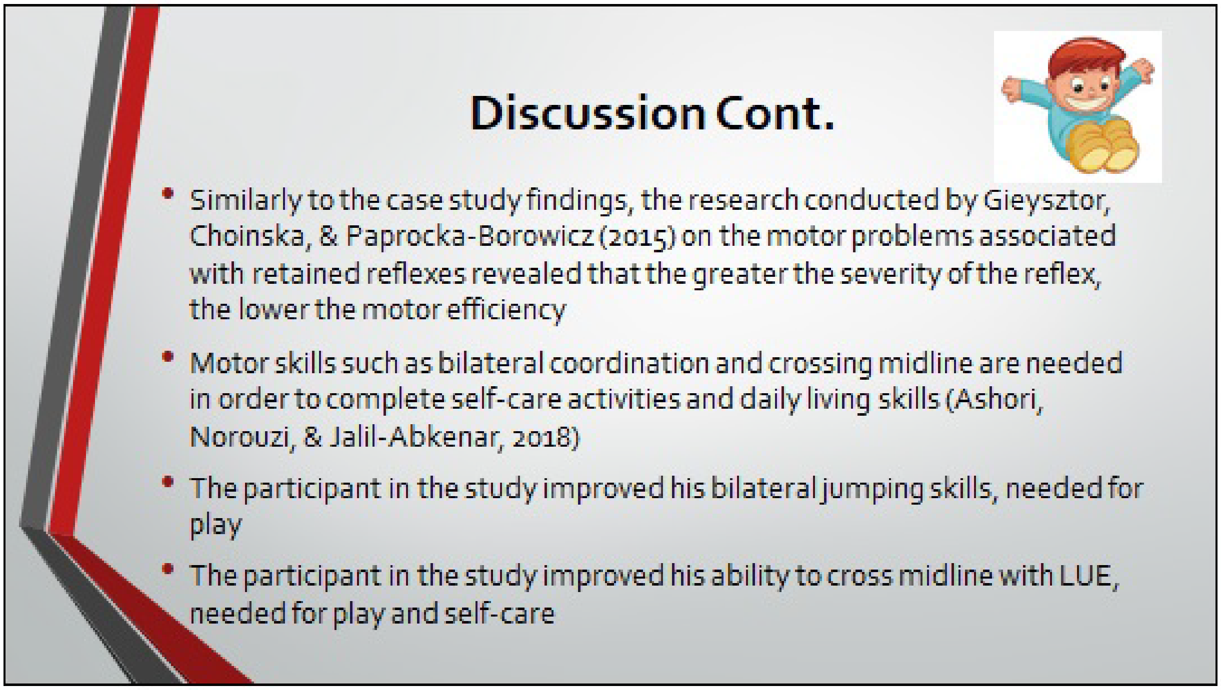
Results Cont.

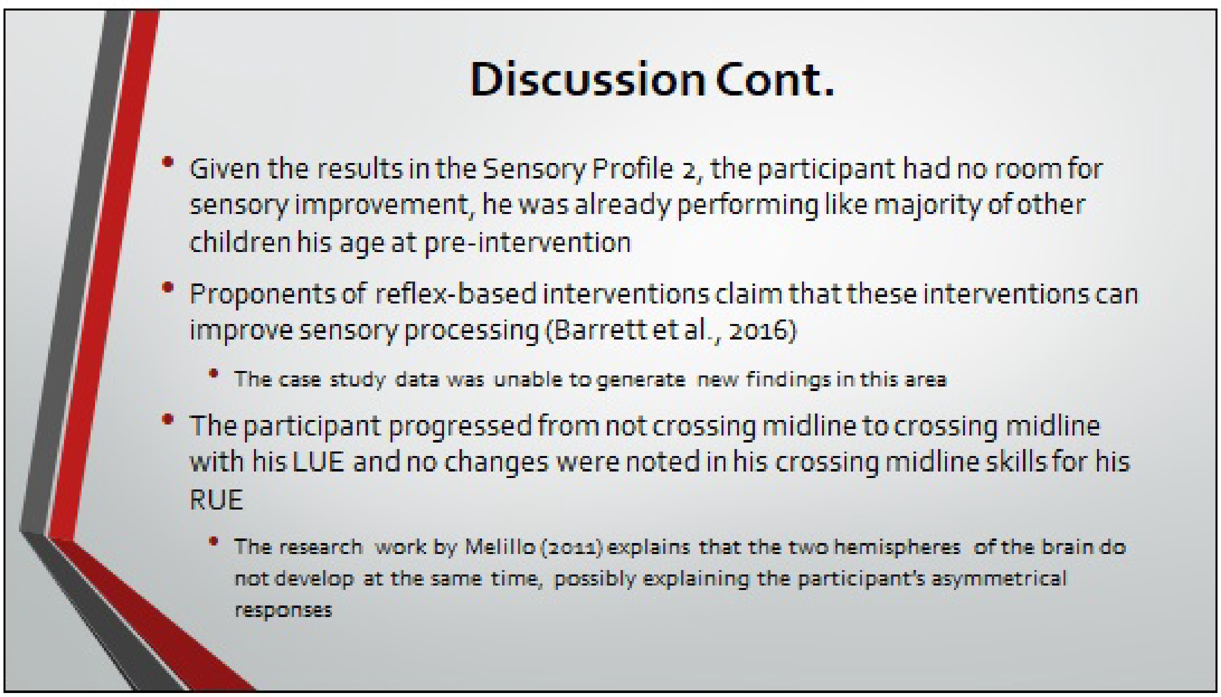
- Pre and Post Crossing Midline

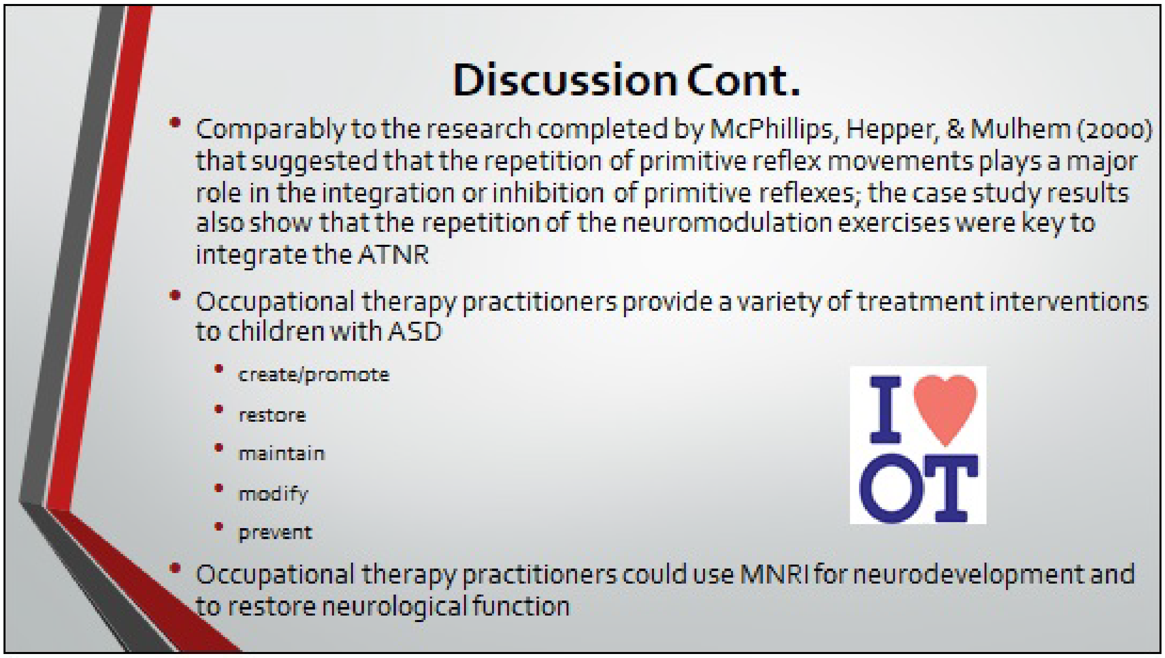
Play Task	Pre Intervention	Post Intervention
Total crossing midline RUE	4	4
Total crossing midline LUE	0	2
Time to stack with RUE	>1 minute	> 1 minute
Time to stack with LUE	> 1 minute	>1 minute
Note: RUE= right upper extremity, LUE= left upper extremity		

Discussion

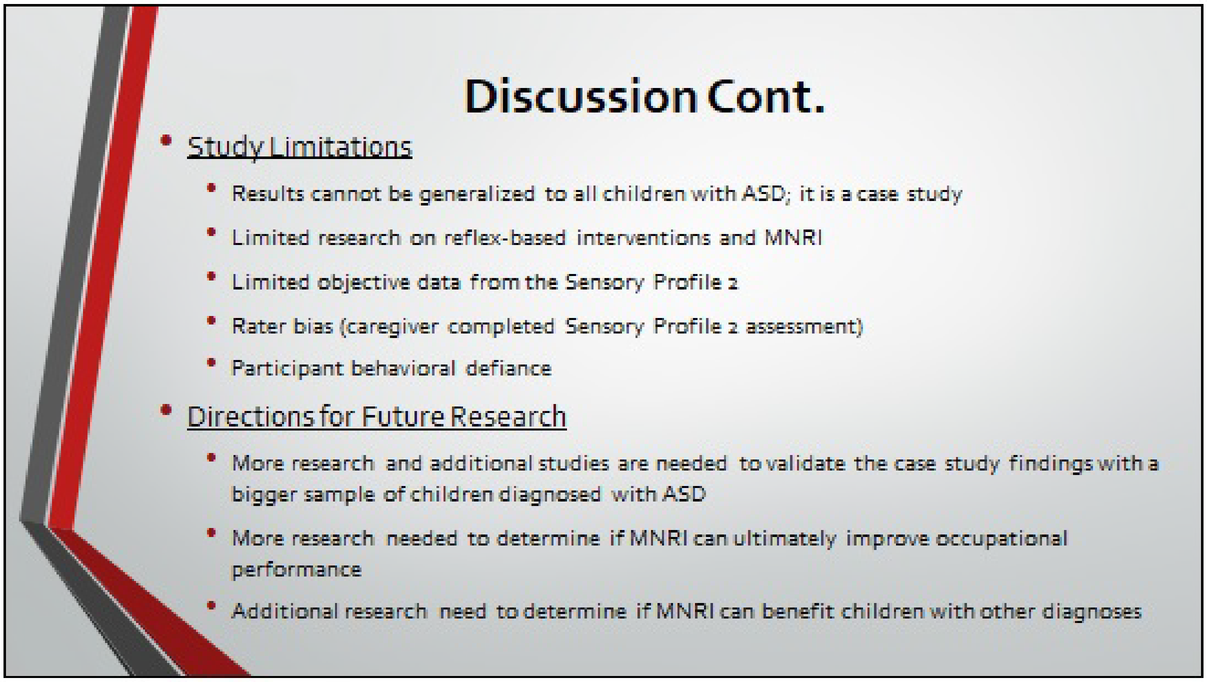
- The case data suggests that the MNRI protocol for the ATNR was successful at:
  - Integrating the ATNR
  - Improving bilateral coordination
  - Improving crossing midline motor skills
- The MNRI was not successful at:
  - Improving upper-limb coordination
- No effects found for auditory-visual integration

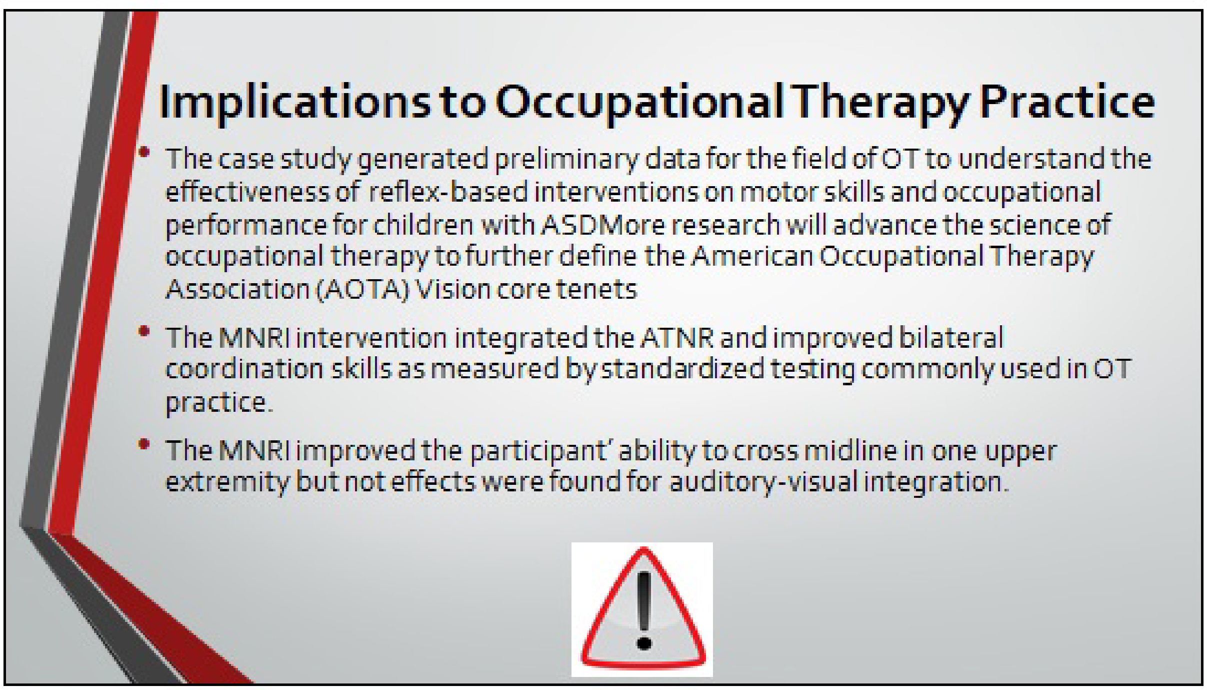

Discussion Cont.
Similarly to the case study findings, the research conducted by Gieysztor, Choinska, & Paprocka-Borowicz (2015) on the motor problems associated with retained reflexes revealed that the greater the severity of the reflex, the lower the motor efficiency
Motor skills such as bilateral coordination and crossing midline are needed in order to complete self-care activities and daily living skills (Ashori, Norouzi, & Jalil-Abkenar, 2018)
The participant in the study improved his bilateral jumping skills, needed for play
The participant in the study improved his ability to cross midline with LUE, needed for play and self-care


Discussion Cont.
Given the results in the Sensory Profile 2, the participant had no room for sensory improvement, he was already performing like majority of other children his age at pre-intervention
Proponents of reflex-based interventions claim that these interventions can improve sensory processing (Barrett et al., 2016)
The case study data was unable to generate new findings in this area
The participant progressed from not crossing midline to crossing midline with his LUE and no changes were noted in his crossing midline skills for his RUE
The research work by Melillo (2011) explains that the two hemispheres of the brain do not develop at the same time, possibly explaining the participant's asymmetrical responses


Discussion Cont.
• Comparably to the research completed by McPhillips, Hepper, & Mulhem (2000) that suggested that the repetition of primitive reflex movements plays a major role in the integration or inhibition of primitive reflexes; the case study results also show that the repetition of the neuromodulation exercises were key to integrate the ATNR
• Occupational therapy practitioners provide a variety of treatment interventions to children with ASD
• create/promote
• restore
• maintain
• modify
• prevent
• Occupational therapy practitioners could use MNRI for neurodevelopment and to restore neurological function
I ♥ OT


Discussion Cont.
• MNRI should be further examined to better understand how this intervention can be used effectively in occupational therapy practice to treat physical motor deficits in children with ASD or children with other neurological deficits
• More research is needed to determine if MNRI can ultimately improve occupational performance
RESEARCH
KNOWLEDGE


Discussion Cont.
Study Limitations
Results cannot be generalized to all children with ASD; it is a case study
Limited research on reflex-based interventions and MNRI
Limited objective data from the Sensory Profile 2
Rater bias (caregiver completed Sensory Profile 2 assessment)
Participant behavioral defiance
Directions for Future Research
More research and additional studies are needed to validate the case study findings with a bigger sample of children diagnosed with ASD
More research needed to determine if MNRI can ultimately improve occupational performance
Additional research need to determine if MNRI can benefit children with other diagnoses


Implications to Occupational Therapy Practice
The case study generated preliminary data for the field of OT to understand the effectiveness of reflex-based interventions on motor skills and occupational performance for children with ASDMore research will advance the science of occupational therapy to further define the American Occupational Therapy Association (AOTA) Vision core tenets
The MNRI intervention integrated the ATNR and improved bilateral coordination skills as measured by standardized testing commonly used in OT practice.
The MNRI improved the participant' ability to cross midline in one upper extremity but not effects were found for auditory-visual integration.

Implications to Occupational Therapy Practice

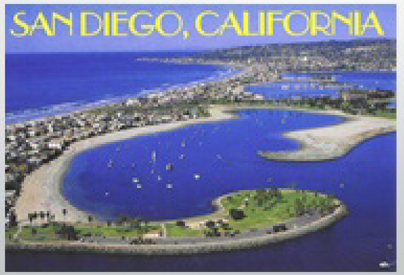
- The case study delineated the importance of researching sensory-motor interventions and their impact on motor skills and occupational performance
- Occupational therapists must orient themselves to choose evidence-based interventions to provide best care

Conclusion

- Although, reflexes are a precursor to motor development, research on the effectiveness of reflex-based interventions in occupational therapy is limited
- Occupational therapists provide various intervention approaches to children with ASD including motor skill development and restoring function to promote active participation in daily activities
- The MNRI program combines a sensory-motor intervention approach that aims to restore neurological function
- Currently there is no sufficient evidence to support the use of reflex integration but, research has not concluded that the intervention is ineffective either (Barrett et al., 2016)
- Further research will provide the necessary information to support or not support the use of reflex-based intervention in occupational therapy practice

2021 AOTA Annual Conference & Expo

- Who knows the location of the 2021 AOTA Annual Conference?



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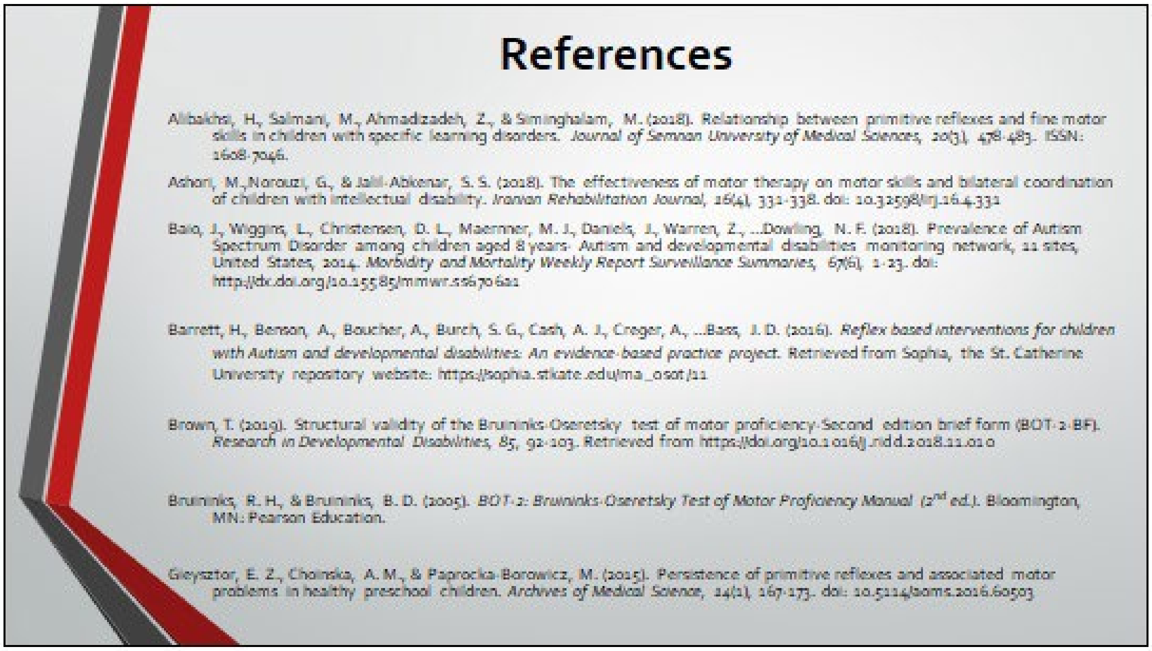
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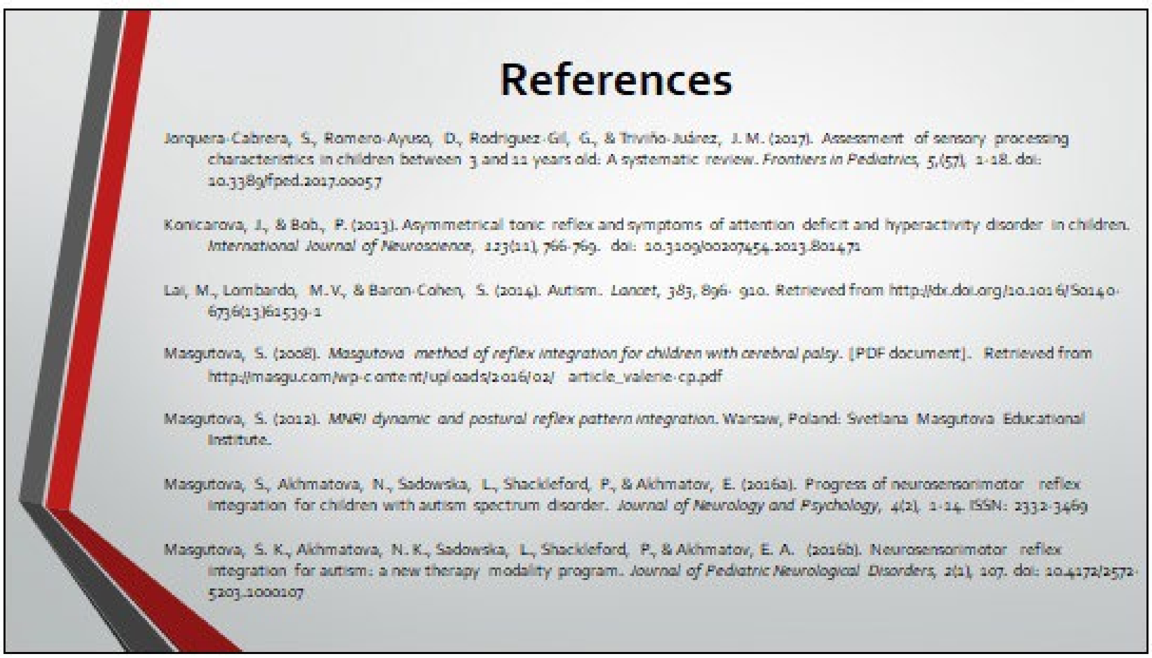
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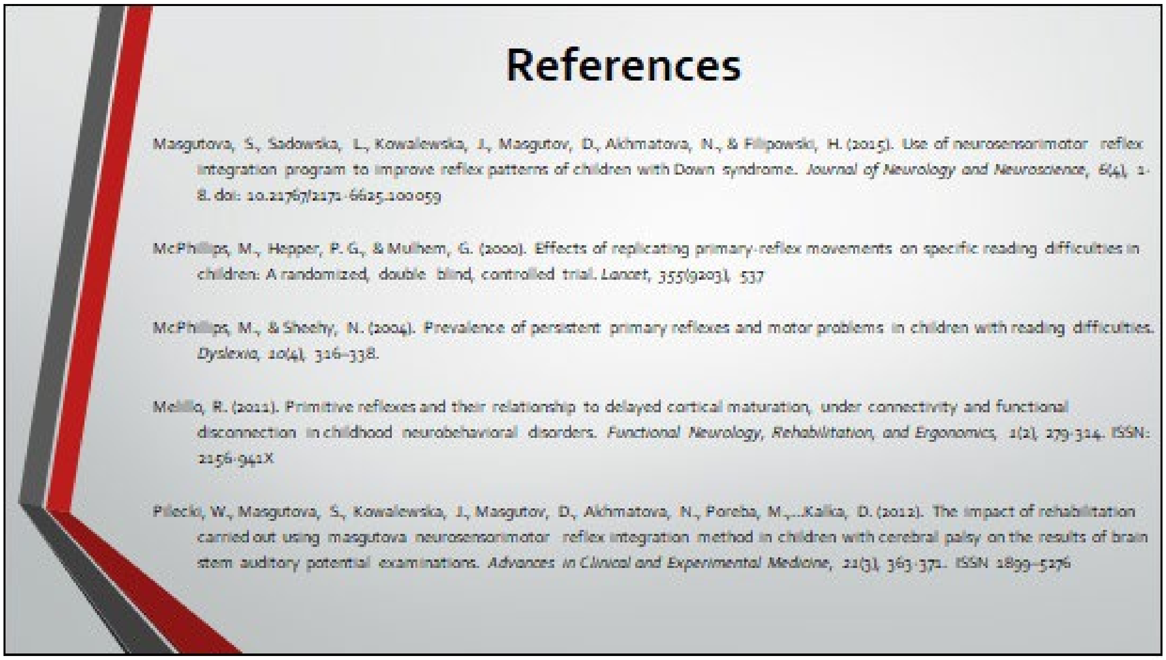
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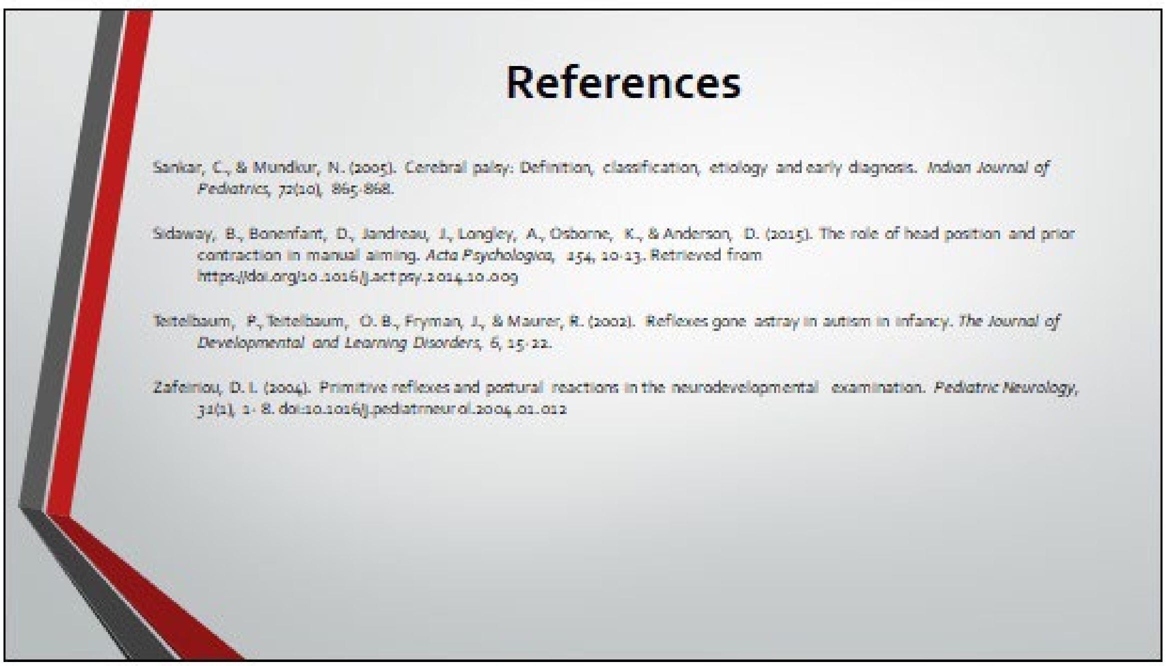
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