Neurosensorimotor Reflex Integration - A New Modality in Work with a Child with Autism: Assessment and Intervention Results

Renata Chodyko, MA, Defectologist, MNRI® Specialist;
Denis Masgutov, Director of ISMI, Warsaw, Poland

History and Diagnosis

Erik (born October 14, 2008) was 3 years old when he started Masgutova Neurosensorimotor Reflex Integration (MNRI®). He was diagnosed with severe Autism Spectrum Disorder (ASD) in November of 2010, at two years of age. His symptoms included a lack of verbal communication, hyperactivity, lack of eye contact, severe tactile defensiveness, poor muscle tone, poor gross motor coordination, poor oral motor skills including chewing, and intense crying when encountering new environments. Erik's parents were very concerned with his behavior and his mother consulted with many specialists for prognoses about his future development.


Renata Chodyko


Denis Masgutov

Presenting Concerns

At the beginning of MNRI® in October of 2011, Erik demonstrated very severe symptoms of autism – refusal of any touch or interaction, anxiety, frequent crying and tantrums, and an inability to function in social situations. When anxious, he would physically go into a 'fight or flight' response, sometimes screaming for hours. As he was a completely nonverbal three year old, it was difficult to understand his needs and feelings, anticipate his anxiety, and to find ways to help him cope with different situations. His ability to sit, crawl, and stand was compromised by very low muscle tone and poor muscle bulk throughout his body. Erik had started walking very late, at close to three years. His posterior leg muscles were very tight, resulting in a strong toe-walking posture with poor grounding and stability and an tendency to turn the feet inward. His motor skill development ranged from the 4th to the 6th percentile. This was related to his severe delay in motor planning, especially in cross-lateral gross and fine motor coordination. Erik also had very significant sensory integration dysfunction, especially in the areas of auditory processing, tactile and visual perception, and vestibular-proprioceptive-motor control.

Erik's emotional development was also significantly delayed. His protective behavior and fight or flight responses were excessive: any new environment or new person approaching him was perceived as a potential danger. He never stayed in the therapy room and his sessions were done in the 'corner' of the room or in a corridor to provide a more calming environment for him when beginning the MNRI® sessions; his behavior was still one of 'flight' from touch and interaction.

MNRI® Intervention Method

Erik has participated in MNRI® reflex integration therapy for the past year and a half, since the age of 3. Erik's family brought him to Poland from Estonia to attend three MNRI® International Camps starting in October 2011. During these events he received interventions based on the Masgutova Neurosensorimotor Reflex Integration® program during 6-7 hours a day for 12 days and was given MNRI® exercises to continue the program at home. Erik's local specialists also attended MNRI® Conferences to learn this program and to continue it at home on a professional level.

The MNRI® program, based on the Masgutova Method® of Neurosensorimotor Reflex Integration, developed by Svetlana Masgutova, Ph.D, is aimed at restoration of neurophysiological and sensory-motor functioning of dysfunctional, pathological or delayed sensory-motor patterns (Masgutova, Akhmatova, 2004; Masgutova, 2006, 2012; Masgutova, Akhmatova, Kiselevsky, 2008; Masgutova, Akhmatova, Lebedinskaya, 2013). This program offers a unique approach to rehabilitation: neurosensorimotor reflex integration (Masgutova, Akhmatova, 2004; S. Masgutova, D. Masgutov, 2013). Results from work with thousands of children have proven that this modality opens new perspectives for intervention with rapid, optimum and stable results, saving valuable neurodevelopmental time for individuals with developmental deficits (Masgutova, 2012). The MNRI® program is designed to build a physiological foundation for neurodevelopment and sensorimotor integration, resulting in the improvement and maturation of physical, emotional and cognitive function (Masgutova, Akhmatova, 2004; Masgutova, 2006, 2012; Masgutova, Akhmatova, Kiselevsky, 2008; Masgutova, Akhmatova, Lebedinskaya, 2013; Pilecki, Masgutova et al., 2012). In their use of MNRI® as the primary tool in their interventions with Erik and many other children, the authors of this article draw upon four aspects of the program:

1) The real possibility to work with reflex patterns on the level of neurosensorimotor links within a genetic structure, "a reflex pattern as an inherent unit of the nerve system" (Sechenov, 1863/1960; Pavlov, 1927/1960; Luria, 1978; Badalian, 1984; Haines, 2002; *Child Neurology*, 2000) that naturally opens the door for genetic sensory-motor long-term memory (Masgutova, Akhmatova, 2004; Masgutova, 2006, 2012).

2) MNRI® works with retained reflex patterns using integration techniques rather than traditional inhibition. The concept of integration is logical from the point of view of individual psychology and human species survival: retained reflexes must not be inhibited or interrupted; they "must complete their development to be available and reliable when needed for protection" (Sechenov, 1863/1960; Pavlov, 1935/1960; Luria, 1978). Equally important, they must be properly supported in order to mature and become integrated within their circuitry, where they serve as the basis for further development. "Inhibition as part of nerve system function must mature" itself and serve not just for interrupting the immature reactive response, but also "for assuring the freedom from automatic/reactive responses" (Sechenov, 1863/1960; Pavlov, 1935/1960; Badalian, 1984; Anokhin, 1973, Masgutova, 2012).

3) True integration takes place within the following reflex components: a) sensory receptors and neurons, b) six levels of synaptic connections for nerve system processing (peripheral nerve system, spinal cord, upper medulla, midbrain, thalamus, cortex), and c) motor neurons with effector organs (muscles, glands) (Sechenov, 1836/1960; Pavlov, 1927/1960; Asratian,1974; Badalian, 1984; Anokhin, 1973). This approach leads to integration on all levels of the nerve system (Masgutova, 2012).

4) Reflex integration manifests in the coordination of the biomechanical/neuro-structural aspect of the motor response with its protective task (Masgutova, Akhmatova, 2004; Masgutova, 2006, 2012). Thus, work with reflex patterns in their automatic unconditioned phases must be targeted in intervention to reach this result.

MNRI® Assessments and Results

The MNRI® Reflex Development Assessment can easily identify normal or abnormal sensory-motor reflex pattern expression. An MNRI® practitioner administers specific stimuli in multiple tests for each reflex to determine whether it is:

- present to an age-appropriate degree
- appropriately developed and functional
- integrated with sensory-motor functions and skills used in learning and movement (Masgutova, Akhmatova, 2004; Masgutova, 2006, 2012).

Basic reflex patterns consist of coordinated movements of the sensory-motor system's three-part circuit and are evaluated in each of five parameters: integrity of the circuit, sequence and direction of movement, timing and speed, intensity (muscle tone regulation of those muscles that serve specific reflex patterns), and symmetry of the response (see the article, *MNRI® Assessment for Determining the Level of Reflex Development* in this book). Each reflex parameter is evaluated based on functional state of four distinct features as in the example below:

Table 1. Reflex Pattern: Hands Pulling Parameters
(based on: S. Masgutova, N. Akhmatova, 2004; S. Masgutova, 2006, 2012)

1		2		3		4		5	
***Circuit* (sensory-motor coordination)**		***Direction of the movement in a reflex response***		***Intensity of the motor response***		***Latency of the motor response***		***Symmetry in the reflex response***	
1.1. Sensory sensitivity corresponds to age		2.1. Motor reaction corresponds to age		3.1. Strength of motor reaction corresponds to age		4.1. Motor reaction emerges with Appropriate speed		5.1. Circuit (sensory-motor coordination)	
Proper	improper	proper	Improper	proper	improper	Proper	improper	Proper	improper
1.2. Motor reaction corresponds to age		2.2. Sequence: 1) flexion of elbows, 2) flexion of head, 3) *flexion* of the core		3.2. Flexion of elbows triggers muscles in area of: a) neck, b) abdomen		4.2. Timing in: 1) flexion of elbows, 2) flexion of head, 3) flexion of core		5.2. Direction of the movement is balanced equilaterally	
Proper	improper	proper	Improper	proper	improper	Proper	improper	Proper	improper
1.3. Sequence of flexion: 1) elbows, 2) head, 3) core		2.3. Abduction/ adduction of arms (15-20 degrees away from body sides)		3.3. Muscle tone of arms		4.3. Timing in flexion and abduction/ adduction of arms		5.3. Intensity of the motor response is balanced equilaterally	
Proper	improper	proper	Improper	proper	improper	Proper	improper	Proper	improper
1.4. Core flexion and extension coordinates with visual convergence and divergence		2.4. Core flexion and extension coordinates with visual convergence and divergence		3.4. Muscle tone of neck area		4.4. Timing in core flexion and extension coordinates with visual convergence and divergence		5.4. Latency of the motor response is balanced equilaterally	
Proper	improper	proper	Improper	proper	improper	Proper	improper	Proper	improper

Corresponding tests for 30 reflex patterns were administered and scored on a scale of 0 to 20 points (five parameters with four features each). The evaluation of test results was based on the criteria developed by Prof. Anna Krefft (Krefft, 2007), in which 10.00-11.75 points indicates that the reflex pattern is in a transitional state on the boundary of normal function and dysfunction, containing elements of both correct and incorrect features. A result below 10.00 means the pattern is dysfunctional. A score above 11.75 means the pattern is functional and represents low-average or average development.

Erik has participated in three MNRI® Reflex Assessments conducted by Svetlana Masgutova, Ph.D (at Camp 1: 10/24/2011, Camp 2: 05/24/2012, and Camp 3: 11/25/2012). The purpose of the Assessments was: to define his actual level of reflex development, to analyze the parameters of each reflex pattern, and to create a treatment program based on the results. Erik's initial reflex Assessment at Camp 1 (10/24/2011) indicated dysfunction, or non-integration, of a number of reflexes that typically should be integrated by the age of 12 months. At four years old Erik's reflexes were delayed due to poor muscle tone regulation, poor processing of sensory stimuli, poor motor responses, and his diagnosis of ASD. The specialized reflex repatterning program developed for Erik was based on this initial Assessment, which also served as a baseline for tracking his progress and modifying his treatment plan every six months.

The tables-graphs below show the dynamic of changes in Erik's reflex patterns that involve the sagittal plane of the body (see tables 1 - X_1 to X_{10}; 2 - X_{11} to X_{20}; and 3 - X_{21} to X_{30}) at six-month intervals.

MNRI® Reflex Assessment Results for Erik, ages 3.0, 3.7 and 4.1 yrs.

The data in Erik's initial evaluation (Test 1) demonstrates the immaturity, improper functioning, and dysfunctional state (below 10 points) of 90% of his reflex patterns. The red line marks the transition point between dysfunctional and functional. Only one reflex out of ten (10%), Core Tendon Guard (X_1) was in the positive range, though still on a very low level of development and hyperactivity.

X_n	Reflex Pattern (X_1 to X_{10})	Table 2. Level of Reflex Development in Sagittal (Right-Left) MCS (X_1 to X_{10})												
		Test	Points	Criteria in points										
				1	2	3	4	5	6	7	8	9	10	11
				0-1.75	2-3.75	4-5.75	6-7.75	8-9.75	10-11.75	12-13.75	14-15.75	16-17.75	18-19.75	20.00
1	Core Tendon Guard	*Test-1*	12.25											
		Test-2	13.25											
		Test-3	14.5											
2	Hands Grasp	*Test-1*	5.75											
		Test-2	6.5											
		Test-3	8.5											
3	Hands Pulling	*Test-1*	6.25											
		Test-2	7.25											
		Test-3	9.5											
4	Babkin	*Test-1*	5.25											
		Test-2	6.25											
		Test-3	8.5											
5	Babinski	*Test-1*	5.25											
		Test-2	7.25											
		Test-3	9.5											
6	Foot Grasp	*Test-1*	6.25											
		Test-2	8.25											
		Test-3	9.5											
7	Leg Cross Flexion-Extension	*Test-1*	9.25											
		Test-2	11.25											
		Test-3	13.5											
8	ATNR	*Test-1*	6.75											
		Test-2	8.25											
		Test-3	11.25											
9	Abdominal	*Test-1*	5.25											
		Test-2	8.25											
		Test-3	10.25											
10	Bonding	*Test-1*	5.25											
		Test-2	8.25											
		Test-3	11.25											

Coefficient	Features	Test 1 - Before Camp 1		Test 2 - After Camp 2		Test 3 - After Camp 3	
		Average	SD	Average	SD	Average	SD
Z_1	Level of integration of reflexes, including X_1 to X_{10}	0.3881	0.1790	0.5912	0.1940	0.6512	0.2940
Test ANOVA		$p < 0.001$				$p < 0.001$*	

Table 2. Reflex patterns in the group of sagittal plane ($X_1 - X_{10}$) in Erik with diagnostic features scored on a scale of 0-20 points and mathematic significance of synthesized diagnostic function Z_{1-10} measuring the level of reflex integration/development with verification by statistic tests (see the Assessments chapter in this book) before MNRI® Program at Camp 1 (10/24/2011), after MNRI® Programs at Camp 2 (05/24/2012) and Camp 3 (11/25/2012) (* $P < 0.001$ - Compared with 'Before MNRI® Program' at Camp 1).

Subsequent MNRI® Assessments show significant changes in Erik's level of reflex development:

• After participating in the MNRI® Program at Camp-2, improvements were noted in 80% of Erik's reflex patterns in the sagittal plane (Hands Grasp, Babkin, Babinski, Abdominal Sleep Posture, Foot Grasp, ATNR, Leg Cross Flexion-Extension, Bonding). Additionally, Leg Cross Flexion-Extension moved to the transitional point (in the direction of positive function): it was no longer dysfunctional.

• After participating in MNRI® at Camp-3, improvements were observed in 90% of Erik's reflex patterns in the sagittal plane. Forty percent of these reflexes moved to the next higher level within the dysfunctional range (Hands Grasp, Hands Pulling, Babkin, Babinski) and 30% moved to the transitional point (ATNR, Abdominal Sleep Posture, Bonding). Twenty percent of these reflexes moved to a higher level of positive dynamics in the scale (Core Tendon Guard and Leg Cross Flexion-Extension) though he still needed to work further to reach the norm.

• When Erik's scores are compared from his first camp to his third camp improvements were seen in 100% of reflex patterns involving the sagittal plane.

Reflexes of the Sagittal Plane

Special attention was given to several reflex patterns in this group (X_1 to X_{10}) for the reasons described below:

• *Core Tendon Guard Reflex*, a protective response of the whole body to stress by flexion (withdrawal - freezing) or extension (flight or flight), was hypersensitive and hyperactive in Erik. When this reflex is dysfunctional it causes a tendency for excessive withdrawal, vulnerability to stress, fears, and worries, and feeling unsafe. It is seen in the response to traction/stretching of the limbs (instead of stretching easily, resistance against stretch presents with compression as a non-productive protective response) and in poor postural control (Masgutova, Akhmatova, 2004; S. Masgutova, D. Masgutov, 2005, 2013; Masgutova, 2012). The Core Tendon Guard in Erik was asymmetrical by ¾" for upper and lower Tendon Guard.

• *Hands Grasp Reflex,* a response to stimulation of the upper part of the palm and lower level of phalanges (Badalian, 1984; Masgutova, Akhmatova, 2004; Masgutova, 2012), was hyposensitive and hypoactive in Erik. This reflex pattern was definitely not integrated within its biomechanical structure and protective function, which resulted in poor grasp and manual skills, lack of interest in manipulating objects and toys, and poor hand-eye coordination. Erik's level of development of Hands Grasp was equal to that of an 11 month old child.

- *Hands Pulling*, a response to being grasped by the wrists to activate a sitting up movement based on sequential flexion of: a) the elbows, b) head, c) core (Masgutova, Akhmatova, 2004; S. Masgutova, D. Masgutov, 2013; Masgutova, 2012), was hyposensitive and hypoactive in Erik, with a tendency for delay of head righting and elbow extension (instead of flexion). This reflex pattern was dysfunctional, resulting in poor coordination of core flexion with visual convergence, hyperactive gaze and visual staring (over-reactive 'territorial instinct'), poor hand-eye coordination, poor postural control when sitting, and poor neck muscle tone regulation. The development of the Hands Pulling Reflex was equal to that of a 10 month old child.
- *Babinski Reflex,* a response of the foot to stimulation on the external plantar surface, inward rotation, dorsi flexion of the big toe, and fanning out of the other toes used in crawling, walking, and running on uneven ground (Badalian, 1984; Masgutova, Akhmatova, 2004), was hypersensitive, hyperactive, and dysfunctional in Erik. The direction of the movement was also improper as his foot moved in the opposite direction. Delay in development of the Foot Tendon Guard and Babinski Reflexes is usually attributed to poor neurological functioning of the lower motor neurons (extrapyramidal nerve system) leading to overall delays in sensory-motor integration (Badalian, 1984).
- *Leg Cross Flexion-Extension* is a response to stimulation of the middle of the foot arch on one leg expressed by flexion of the other leg at the hip and knee, followed by extension. This pattern is used in crawling, walking, running, and climbing. Its physiological circuit accesses the upper medulla area where the cross over of nerve fibers take place, thus it affects the formation and myelination of neural connections. This pattern is very important for the organization of nerve transmission to higher brain levels (Magnus, 1925; Badalian, 1984; Masgutova, Akhmatova, 2004; Masgutova, 2012). Erik's score for Leg Cross Flexion-Extension was below the transitional point. This reflex was observed to be hyposensitive, hypoactive, and dysfunctional. The direction of the movement in this reflex was also improper and opposite which is why Erik walked on his toes with an unstable and poorly coordinated gait. The delay in this reflex leads to poor neurological functioning of the lower motor neurons (extrapyramidal nerve system) responsible for integration of early motor and sensory-motor system.

Although the above reflexes are singled out for this report, it is important to note that overall attention was given just as thoroughly to every reflex pattern.

Reflexes of the Horizontal Plane

Analysis of the next group of reflexes (X_{11} to X_{20}) shows a positive dynamic in development of reflex patterns that involve the horizontal plane of the body (X_{11} to X_{20}). (see Table 3.) Again the data from Erik's initial evaluation at Camp 1 clearly demonstrate the immaturity and dysfunctional state of his reflex development. 100% of Erik's reflex patterns that involve the horizontal plane scored below the transitional 10-11.75 point level.

MNRI® Assessments after Camps 2 and 3 show the following changes in Erik's level of reflex development:

- After Camp 2 improvements were noted in 90% of reflex patterns in the horizontal plane (all except Fear Paralysis). One reflex, Automatic Gait (X_{11}), moved up to the transition point between dysfunctional and functional. The other eight reflexes moved up to the next level of development within the dysfunctional state (Bauer Crawling, Moro, Flying and Landing, Hands Supporting, Grounding, Segmental Rolling, Landau, and Head Righting).
- After Camp 3 further improvements were observed in 90% of Erik's reflex patterns in the horizontal plane. 20% moved up to the next level within the dysfunctional state (Segmental Rolling and Landau), 20% moved up to the transitional point (Moro and Fear Paralysis), and 50% (Automatic Gait, Bauer Crawling, Hands Supporting, Grounding, Head Righting) in the horizontal body plane group achieved a functional level though he still needed to work further to reach the norm.
- When Erik's scores from his first camp to his third camp are compared, improvements are noted in 100% of reflex patterns involving the horizontal plane.

Special attention was targeted at several reflex patterns in this group (X_{11} to X_{20}) for the reasons described below:

- *Hands Supporting,* a protective response occurring when the individual extends the arms toward a horizontal or vertical surface to avoid harm from a fall or an approaching object (Badalian, 1984; Masgutova,

#	Reflex Pattern (X_{11} to X_{20})	Table 3. Level of reflex development in Horizontal (Upper-Lower) MCS												
		Test	Point	Criteria in points										
				1	2	3	4	5	6	7	8	9	10	11
				0-1.75	2-3.75	4-5.75	6-7.75	8-9.75	10-11.75	12-13.75	14-15.75	16-17.75	18-19.75	20.00
11	Automatic Gait	Test-1	6.75											
		Test-2	10											
		Test-3	12.5											
12	Bauer Crawling	Test-1	6											
		Test-2	8.25											
		Test-3	12.75											
13	Moro	Test-1	7.25											
		Test-2	8.75											
		Test-3	11											
14	Fear Paralysis	Test-1	8.75											
		Test-2	9.75											
		Test-3	11											
15	Hands Support	Test-1	6.25											
		Test-2	8.25											
		Test-3	12.5											
16	Segmental Rolling	Test-1	5.75											
		Test-2	8.75											
		Test-3	9.75											
17	Landau	Test-1	0.5											
		Test-2	4.25											
		Test-3	7.5											
18	Flying/ Landing	Test-1	5.25											
		Test-2	6.5											
		Test-3	7.75											
19	Grounding	Test-1	6.75											
		Test-2	8.75											
		Test-3	12.5											
20	Righting	Test-2	9.75											
		Test-3	13.5											

Coefficient	Features	Test 1 - Before Camp 1		Test 2 -After Camp 2		Test 3-After Camp 3	
		Average	SD	Average	SD	Average	SD
Z_{LP}	Level of integration of reflexes including X_{11} to X_{20}	0.3667	0.1670	0.4914	0.1837	0.5911	0.2738
Test ANOVA		p < 0.001				p < 0.001*	

Table 3. Reflex patterns in the group of horizontal plane (X_{11} – X_{20}) in Erik with diagnostic features scored on a scale of 0-20 points. The mathematic significance of synthesized diagnostic function Z_{11-12} measuring the level of reflex integration/development was verified by statistic tests before MNRI® Program at Camp 1 and after MNRI® Program at Camp 2 and MNRI® Program at Camp 3 (* P< 0.001 - Compared with 'Before MNRI® Program at Camp 1').

Akhmatova, 2004; Masgutova, 2012), was hyposensitive, hypoactive and dysfunctional in Erik, resulting in inability to protect himself, lack of emotional stability, poor 'hand-eye' coordination and weak postural control. The development of his Hands Supporting reflex was equal to that of a 4 month old child.

- *Fear Paralysis Reflex,* a protective startle response to unexpected sensory stimulation: tactile, visual, and auditory (Kaada, 1986), was extremely hypersensitive and hyperactive, especially for tactile and auditory stimuli.
- *Moro,* another protective response, in this case to vestibular-proprioceptive stimulation from the loss of stability in space (Vygotsky, 1986; Badalian, 1984; Masgutova, Akhmatova, 2004; Masgutova, 2012), was retained, hypersensitive, hyperactive, and had a negative effect on Erik's balancing and grounding.
- *Automatic Gait* is an automatic stepping response to movement of the gravity center forward, away from a vertical body position. This pattern is used in crawling, walking, running, jumping, and climbing (Badalian, 1984; Masgutova, Akhmatova, 2004; Masgutova, 2012). It was dysfunctional, hyposensitive, and hypoactive in Erik. The direction of the movement in this reflex was also improper causing toe walking, instability, and poor coordination. A delay in the development of this reflex leads to poor neurological functioning and affects other milestones in early motor development (Haines, 2002; Masgutova, Akhmatova, 2004; Masgutova, 2012).
- *Bauer Crawling* is a response to stimulation of the plantar surface of the feet expressed by sequential flexion-extension of hips/knees and pushing with the feet for crawling forward. This pattern is used in walking, running, climbing. Its physiological circuit is rather complicated and involves parallel processing on several neural pathways, thus helping the development of future multitasking in motor planning and control (Badalian, 1984; Doman, 1984; Masgutova, Akhmatova, 2004; Masgutova, 2012). It was dysfunctional, hyposensitive, and hypoactive in Erik. The direction of his movement in this reflex was also improper. A delay in the development of this reflex leads to poor functioning of the lower motor neurons (extrapyramidal nerve system) and cortical areas responsible for integration of early motor and cognitive development (Badalian, 1984; Doman, 1984; Masgutova, Akhmatova, 2004; Masgutova, 2012).

Reflexes of the Dorsal Plane

Data from the last group of reflexes (X_{21} to X_{30}) demonstrates the following positive dynamics in the development of Erik's reflex patterns involving the dorsal plane of the body. (See Table 4.)

Data from Erik's initial evaluation at Camp 1 demonstrates the immature and dysfunctional (below 10 points) state of 100% of his reflex patterns in the dorsal plane. The recorded level of change in his reflex development after MNRI® again indicates significant growth:

#	Reflex Pattern (X_{21} to X_{30})	Test	Point	Criteria in points: 1 (0-1.75)	2 (2-3.75)	3 (4-5.75)	4 (6-7.75)	5 (8-9.75)	6 (10-11.75)	7 (12-13.75)	8 (14-15.75)	9 (16-17.75)	10 (18-19.75)	11 (20.00)
	Table 4. Level of reflex development in Dorsal (Front-Back) MCS													
21	Trunk Extension	*Test-1*	9.25											
		Test-2	11.75											
		Test-3	14											
22	STNR	*Test-1*	7.25											
		Test-2	9.25											
		Test-3	12											
23	Spinal Galant	*Test-1*	6.25											
		Test-2	7.5											
		Test-3	10.5											
24	Spinal Perez	*Test-1*	6.25											
		Test-2	7.75											
		Test-3	9.75											
25	TLR	*Test-1*	5.25											
		Test-2	7.75											
		Test-3	11.25											
26	Foot Tendon	*Test-1*	5.25											
		Test-2	7.25											
		Test-3	9.75											
27	Spinning	*Test-1*	6.5											
		Test-2	8.25											
		Test-3	11.5											
28	Locomotion	*Test-1*	4.25											
		Test-2	5.25											
		Test-3	7.75											
29	Balancing	*Test-1*	5.25											
		Test-2	8.75											
		Test-3	11.25											
30	Pavlov Orientation	*Test-1*	5.25											
		Test-2	8.50											
		Test-3	11.75											

Coefficient	Features	Before Program		1-After Program		2-After Program	
		Average	SD	Average	SD	Average	SD
Z_3	Level of integration of reflexes including X_{21} to X_{30}	0.3583	0.1473	0.52924	0.1646	0.6314	0.2534
Test ANOVA		$p < 0.001$				$p < 0.001$*	

Table 4. Reflex patterns in group of dorsal plane (X_{21} – $X2_{30}$) in Erik with diagnostic features scored on a scale of 0-20 points. The mathematical significance of synthesized diagnostic function $Z_{21\text{-}30}$ measuring the level of reflex integration/development was verified by statistic tests before MNRI® at Camp 1, and after MNRI® at camp 2 and after MNRI® at Camp 3 (* P< 0.001 - Compared with 'Before MNRI® Program' at Camp 1).

- After Camp 2 70% of the reflexes in the dorsal plane (STNR, Spinal Galant, Foot Tendon Guard, Spinning, TLR, Balancing, Pavlov) moved one or more levels closer to the transitional (10-11.75) point range and 10% (Trunk Extension) reached as far as 11.75 points.
- After Camp 3 (six months later) improvements were noted in 100% of his reflex patterns in the dorsal plane. 30% (Spinal Perez, Foot Tendon Guard, Locomotion) moved to the next higher level within the dysfunctional state, 50% (Spinal Galant, TLR, Spinning, Balancing, Pavlov) moved to the transitional level (10-11.75 points), and 20% of the reflex patterns (Trunk Extension and STNR) moved to the level of positive functional development and were no longer deemed dysfunctional.
- When all camps considered together, it shows improvement in 100% of Erik's reflex patterns.
- When Erik's scores are compared from his first camp to his third camp improvements were seen in 100% of his reflex patterns involving the dorsal plane.

The synthesized diagnostic functions (Z_2, Z_3) measuring the level of changes at Camp 2 and Camp 3 are statistically significantly higher (with a p value of <.001) in each post-test (Camp 2 and Camp 3) in comparison with initial tests (Z_1, at Camp 1).

Our focus in repatterning the reflex patterns in this third group was on the following reflex patterns:

- *Foot Tendon Guard Reflex*, part of the whole body Tendon Guard response to stress, manifests in plantar and dorsi flexion of the feet, and trains our ankle joints in the flexion-extension necessary for crawling, standing, walking, and running (Mahoni, 1999; Badalian, 1984; Masgutova, Akhmatova, 2004; Masgutova, 2012). This reflex was hypersensitive, hyperactive and dysfunctional in Erik and partly responsible for his toe walking.
- *Spinal Galant*, a protective response of the whole body to a stimulus on the side of the spine by lateral flexion of that same side away from the stimulus. It is an intense fight or flight response (Badalian, 1984; Masgutova, Akhmatova, 2004). In Erik it was extremely hypersensitive and hyperactive. Dysfunction in this reflex causes poor spinal and overall postural control, poor head righting, and vulnerability to stress, fears, worries, and feelings of being in danger.
- *Spinal Perez* is also a protective response of the whole body to tactile stimulation on the spine by spinal extension with anterior pelvic tilt and hip flexion. This pattern is based on the 'fight or flight' response (Badalian, 1984; Masgutova, Akhmatova, 2004) and was very hypersensitive and hyperactive in Erik. A dysfunctional Perez Reflex has a negative effect on spinal and overall postural control, head righting, stress tolerance, emotional stability, and immune system function (Badalian, 1984; Masgutova, Akhmatova, 2004; Masgutova, Akhmatova, Kiselevsky, 2008; Masgutova, Akhmatova, Lebedinskaya, 2013).

• *Spinning* is an active response by the whole body to turning from front to back, starting by flexing and turning one leg across the midline, followed by spine rotation with support of all limbs. This pattern activates the entire body for changing its position in space, thus training the body in spatial orientation and flexibility, skills needed for crawling, walking, and all rotational movements of the spine (Sadowska, 2001; S. Masgutova, D. Masgutov, 2012). In Erik this reflex pattern was hyposensitive and hypoactive, limiting his flexibility, his kinesthetic cognition of space, and his orientation in the visual and auditory fields. A dysfunctional Spinning Reflex pattern has a negative effect on postural and motor control, head righting, flexibility, movement dynamics, stress tolerance, and cognition (Sadowska, 2001; S. Masgutova, D. Masgutov, 2012).

During application of the MNRI® Program, Erik demonstrated significant changes in all these reflex patterns (X_1-X_{30}) as seen in the tables and graphs above.

Other Assessments

Erik was given several other pre and post tests at Camp 1 including: Evoked Brain Potentials of Visual (VEP) and Auditory nerves (BAER), Wii Balance and GMFM 66 (Gross Motor Function Measure 66), and the Peabody Developmental Motor Scales (PDMS 2).

Evoked Brain Potentials Research on measurement of Evoked Brain Potentials (organized by the Masgutova Institute and provided by Prof. W. Pilecki of the Department of Pathological Physiology of the Medical Academy of Poland) was aimed at measuring the excitation wave evoked by a stimulus to Erik's brainstem with Auditory Evoked Potentials (BAEP) and Visual Evoked Potentials (VEP). These measurements show transmission efficiency and provide a basis for prognostic assessment of children at risk for central nervous system deficits (Pilecki, Masgutova, et al., 2012). Erik's VEP test results was within the norm, thus only his BAEP results are presented here.

BAEP testing consisted of 2 parameters: 1) Peak I Latency and 2) Inter Peak Latency I-V. The Interpeak Latency I-V parameter is very important for this study because it describes transmission in the brainstem segment of the auditory pathway. The results specify in milliseconds (ms) the time that elapses between electrogenesis of the I segment (auditory nerve, located in the ear), and electrogenesis of the V segment (inferior colliculi of the mesencephalon, part of the brainstem). (Pilecki, Masgutova, et al., 2012)

During normal maturation, the speed of transmission increases and the IPL value decreases. Prolongation of this parameter indicates a delay in maturation. Of high interest to those working with motor development is the fact that changes in the auditory pathway correlate with changes in a motor neuron located very close by. This makes possible an indirect diagnosis, in which we see the connection between the work of the auditory pathway and the motor neuron pathway (Pilecki, Masgutova, et al., 2012).

Table 5. Peak I and Inter Peak I-V Latency test results before and after MNRI®.

	10/24/2011, pre-test		11/7/2011, post-test		Norm
	Right	Left	Right	Left	
Peak I	1.50 ms	1.64 ms	1.62 ms	1.82 ms	≤1.75 ms
Change			+.12 ms	+.17 ms	
Diff. R - L	Right side .14 ms faster		Right side .20 ms faster		
IPL I-V	4.34 ms	5.28 ms	4.35 ms	4.50 ms	3.85 – 4.25 ms
Change			-.01ms	-.78 ms	
Diff. R - L	Right side .94 ms faster		Right side .15 ms faster		

The BAEP Test (70 dB given at a frequency of 10 Hz) was administered to Erik before (10/24/2011) and after 12 days of MNRI® exercises (11/7/2011).

BAEP Rest Results: The norm for Peak I Latency is a value no higher than 1.75 ms. Higher than 1.75 ms indicates deficient auditory acuity. The slight prolongation (1.82 ms on left side) is without clinical significance. The testing showed no significant change in Erik's auditory acuity after MNRI®.

IPL I-V Latency: Prolongation of the IPL I-V (i.e. speeds slower than the norm) is evident both before and after rehabilitation. However, lower values in the second examination show significant improvements, which indicate that transmission was much faster after MNRI®, especially on the left side, which improved by .78 ms. These results are statistically significant at the level of $p < 0.001$.

The BAEP assessment clarifies an interesting aspect of Erik's behavior, one often noticeable in other children with ASD. Eric was and still is demonstrating some hyperactive responses (running away, covering or rubbing his ears) to noises, loud voices, or sudden unexpected and high-pitched auditory stimuli. His MNRI® Assessment at Camp 1 showed that his ATNR pattern was mixed with the Abdominal Sleep Posture pattern. According to our previous research on the brain wave spectrum (Masgutova, Regner, 2007; also unpublished research by Skhomorokchov, Zakharov, et al., 2006-2007, material of the SMEI) ATNR activates rapid frequency brain waves (alpha and beta) and triggers the Auditory Stapedius Reflex, while the Abdominal Sleep Posture activates slow brain waves (delta and theta), inhibits the Stapedius Reflex, and encourages the auditory system to ignore stimuli and to rest.

In testing the ATNR at Camp 1, turning Erik's head to the left triggered an ATNR response and turning to the right triggered the Abdominal Sleep Posture reflex. Turning to the right is understood to activate primarily auditory processing in the left hemisphere of stimuli coming into the right ear. The link between the right ear and the left hemisphere is especially important for language development because of the brain's left side location of Broca's and Wernike's areas, where language is processed. In Erik's case, his Abdominal Sleep Posture caused him to shut down in the presence of stimuli coming to these areas. This was evident in his behavior as well: Erik often ignored instructions, explanations, and logical speech directed to him. Instead he liked to listen to songs and poems when they were combined with tactile stimuli.

According to our interpretation, Erik's Auditory Stapedial Reflex had been improperly activating his Abdominal Sleep Reflex instead of his ATNR. The conflict between his ATNR and Abdominal Sleep Posture Reflexes was preventing him from developing efficient binaural hearing.

This explains perfectly Erik's tendency to use his mixture of patterns to calm down his hypersensitive auditory perception by compensating with the Abdominal Sleep Posture pattern and favoring more monaural auditory perception with his left ear. Like many compensatory strategies, this was difficult, inefficient, and ultimately stressful. Thus, his need to escape auditory stimuli and avoid auditory decoding, which in turn may have inhibited his development of receptive and expressive language.

Before MNRI®, Erik's brain was responding to auditory input from his right ear .94 ms faster than from his left ear. How confusing would one's experience of the auditory world be if sounds arrived in the brain with a delay of .94 ms between reception from the right and left ears? Only twelve days later, after MNRI®, Erik's IPL – IV speeds increased by .01 ms on the right and .78 on the left. Now the left ear has improved and instead of a difference in speed of .94 ms between his two ears, the difference is only .15 ms. How much might this change help Erik to make sense of what he hears?

The results of the BAEP strongly suggest that improvements in Erik's reflexes contributed to improved functioning of his auditory processing skills. Improvements in transmission speed observed on the BAEP correspond to improvements in MNRI® Assessments of the ATNR during Camps 2 and 3. Erik's work towards integrating his ATNR, Stapedius, and other reflex patterns allowed him to begin to resolve the issue of the improper links between his ATNR and Abdominal Sleep Posture. It is to be expected that maturation and integration of these two reflexes would result in more synchronized functioning of his two ears and with it more efficient binaural hearing. This opens the possibility for Erik to improve in language decoding and expressive speech, which is now growing rapidly day by day and has surprised many specialists.

The Wii Balance Board – Center of Balance: This test is considered a valid and reliable means of assessing standing balance (Clark, Bryant, Pua, McCrory, Bennell, et al., 2010). At Camp 1 in this test Erik demonstrated a strong asymmetry in his center of balance: 63% of his body weight was distributed on his left foot and only 37% on the right. After 12 days of participating in MNRI®, Erik demonstrated a significant improvement in his center of balance: 51% of his body weight was distributed on his left foot and 49% on his right. These results show 8 months growth in ability to balance, according to the test standards.

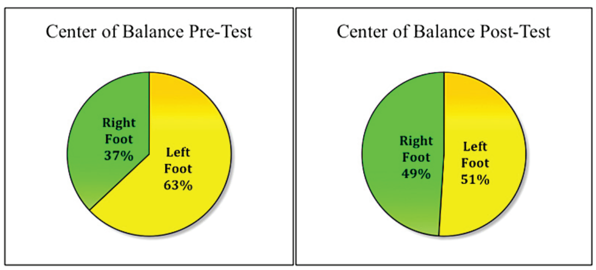

Chart 1. Wii Balance test results for Erik – Before and After 12 days of MNRI® at Camp 1 (10/24/2011 - 11/07/2011) carried out by physical therapy specialists.

The Gross Motor Function Measure-66 (GMFM-66): is a criterion based clinical assessment designed to evaluate change in gross motor skills and their progress in children with developmental delays and neurodeficits. The GMFM measures traditional gross motor milestones. The GMFM-66 is a subset of tasks taken from the GMFM-88 that are entered into a scoring program called Gross Motor Ability Estimator (GAME) in order to produce an estimate of the child's gross motor function. The GAME program has been shown to estimate gross motor skills within a 95% confidence interval with as few as 13 tasks scored; therefore all 66 tasks do not necessarily need to be tested and scored if time constraints or physical impairments prevent it. When an item is not tested it is entered into the GAME program as "not tested" and not used as part of the gross motor skill estimate score (Linder-Lucht, Othmer, Walther, et al., 2007.)

Table 6. GMFM-66 scores.

Date	Age	GMFM-66 Score	Standard Error	95% Confidence Interval	Items Tested	GMFCS	Change in Score
11/7/2011	4y	61.80	1.29	59.27-64.33	31	Level 2	9.71
10/24/2011	4y	52.09	1.23	49.68-54.50	26	Level 2	N/A

The mean score for a child of a similar age and GMFCS level is 60.8 (standard deviation of 7.2, n=29). The mean change in a child's score after 1 year of skilled intervention is 2.23 (standard deviation of 6.48, n=9). Erik's GMFM score improved by 9.71 points in 13 days! This is a highly significant result.

Peabody Visual Motor (Folio, Fewell, 2000; Goyen, Lui, Woods, 2008; Hartingsveldt, Cup, Oostendorp, 2006). The Peabody Developmental Motor Scale Revised II (PDMS-2) is a test of early motor abilities that was designed to assess the gross and fine motor skills of children from birth through six years of age in the areas of reflexes, static balance, locomotion, object manipulation, grasping, and visual-motor integration. The visual-motor integration subtest of the PDMS-2 was administered to assess Erik's fine motor skills.

The data in the table at right demonstrates that at the beginning of Camp 1 Erik had a standard score of 2 in the Visual Motor Integration subtest and in the post-test 12 days later he achieved a standard score of 3. Erik's visual-motor integration scores improved by one standard score and he demonstrated a four month improvement in skills.

Table 7. Results of Peabody Visual Motor test.

Visual-Motor Integration	Standard Score	Standard Score Performance	Percentile Rank
Camp 1: 10/24/11	2	Very Poor	<1%
11/8/11 (14 days later)	3	Very Poor	1%

Height Measurement

Erik's height at Camp 1 (10/24/2011) initially measured 94 cm. (37 inches), and twelve days later, 101 cm (39.76 inches), a difference of 7 cm (2.76 inches). We attribute this significant difference in height to improved structural alignments due to MNRI® work with postural reflex patterns. When he was measured again after Camp 3 a year and two months later he had grown an additional 8 cm (3.15 inches).

MNRI® Program for Erik

Based on the results of the MNRI® Assessment described above, an individualized program for Erik was established for MNRI® Camp specialists and for parents at home for the following 6 months. The purpose of the individualized program was to strengthen and support physical, emotional, and cognitive growth through work with non-integrated and dysfunctional reflex patterns. Erik's MNRI® Camp program included the following:

- MNRI® Repatterning of Dysfunctional Dynamic and Postural Reflexes
- MNRI® Neuro-Structural Reflex Integration
- MNRI® Neuro-Tactile Integration
- MNRI® Archetype Movement and Lifelong Reflex Integration
- MNRI® Birth & Post-Birth Reflex Integration
- MNRI® Oral-Facial Reflex Integration
- MNRI® Proprioceptive & Cognitive Integration
- MNRI® Visual & Auditory Reflexes Integration
- Art Creation & Reflex Integration

Parents' report on Erik's changes at Camp-1 (10/24/2011 - 11/07/2011)

"Erik attended his first camp in October 2011 at age three. He neither spoke, nor maintained eye contact. He also did not understand basic words and orders, didn't use the potty, and couldn't dress himself. He was also a very picky eater. He did not seek active contact with children or adults.

After the first 12-day MNRI® Camp in Poland, Erik started demonstrating better stability and grounding and less toe-walking. His gross motor coordination improved. He became less hypersensitive, more tolerant for touch and sounds, less defensive, and more stable emotionally. His new ability for visual contact was such a happy moment! He demonstrated better postural control and his cross-lateral movement increased significantly, enabling him to walk in a more coordinated way. He began to articulate specific sounds (“ng”, “g”, “k”) as the result of work with the Oral-Facial Program and tried to repeat some simple syllables (“am”, “ma”, “ta”). He also became more curious about his surroundings and his own activities. His skill and interest in imitation increased as well, and he seems more motivated for activities that stimulate cognitive development.”

Erik at age four.

MNRI® Home Program

The Home Program that we suggested for Erik for the next six months included exercises from the following programs:

1. MNRI® Neuro-Structural Reflex Integration (30-40 min.) – 2 times a week
2. MNRI® Neuro-Tactile Integration (30-40 min.) – 2-3 times a week
3. MNRI® Archetype Movements Integration (20-25 min.) – 2-3 times a week
4. MNRI® Proprioceptive-Cognitive Integration (30 min.) – 2-3 times a week
5. MNRI® Oral-Facial/Visual-Auditory Reflex Integration (20 min.) – 2-3 times a week
6. MNRI® Repatterning and Integration of Reflex Patterns (20-40 min.)

Reflex Re-patterning in Erik’s home program especially targeted ATNR, Babinski, Core Tendon Guard, Grounding, Fear Paralysis, Foot Tendon Guard, Hands Supporting, Leg Cross Flexion-Extension, Locomotion, Segmental Rolling, Spinal Galant, Spinal Perez, Spinning, STNR, and Trunk Extension. His parents were encouraged to maintain a cycle of work during 1½ months followed by rest for 10 days, repeating for 6 months until his next Assessment.

Short Home Program

An optional Short Program served for periods when time for work with Eric was limited:

1. Core Tendon Guard Reflex pattern - 2 times a week
2. Embrace Squeeze - 5 times a week
3. Spinal Gallant – 4 times a week
4. Thoracic Embrace - 3 times a week
5. Foot Tendon Guard - 5 times a week
6. Spinal Perez – 3 times a week
7. Segmental Rolling - 2 times a week
8. Spinning – 3 times a week
9. Balancing Board – 5 times a week (5-10 minutes daily)
10. Visual-Auditory exercises - 2 times a week

Erik’s progress at home was fast and amazing.

Parents’ Report on Erik’s Changes

After following the Home Program for six months, Erik’s local professionals and parents shared his progress:

“… All of the improvements from the first Camp were stable, held with time, and even became much stronger. In six and a half months of work using our reflex integration program Erik became stronger with all reflex patterns and began to speak! (His first words were “Mama”, “Dad”, “dog”, “cow”, “lion”).

Parents’ report on Erik’s changes at Camp 2 (05/24/2012) and Camp 3 (11/25/2012)

“Now in 2013 Erik understands and follows simple and more complicated orders. He communicates in his own language, but actively uses about 100 words and sometimes 2-word sentences.

He maintains longer eye contact, is potty-trained, and with some help, also dresses himself. His menu is more varied and compared to earlier he needs less and less help with eating. He also seeks contact with other children and adults and smiles, while earlier he cried a lot and was often in a bad mood.

Within one year (at and after his third camp) of participating in MNRI® our dear Erik is showing significant


Erik with his mother.

changes: his gross-motor coordination is improving amazingly well, and his walking and running skills almost correspond with his age. Erik has begun to jump! He constructs simple sentences, his vocabulary and comprehension is growing very actively; he initiates communication even with new people; he sings and talks about his emotions, and explores the environment with great curiosity. Erik started to draw and he is very happy showing his drawings to our family. He uses pencils and paper as well as different chalks on the board. He always gives names to the objects he draws. His brother and parents are very happy with Erik's progress. He has become better friends with his brother.

He still prefers a limited number of foods, but he gets served the same menu as the whole family. He started using a spoon and a fork instead of eating only with his hands as he did earlier. He still is using his hands to feel the texture of a food. His balance improved very well: he can run and has begun galloping and jumping. He still needs to improve his space orientation and control, mostly in bigger rooms. His eye contact has improved significantly, but he needs to continue working on eye tracking and expanding his active visual work in a wider visual field. His internal world is changing, and his motivation for learning new things and communication is growing, which is beyond any expectation and amazes both his parents and specialists.

Erik started attending daycare for a few hours a day and he is doing well with other children and activities during these hours. His favorite subjects are the music lessons, dancing, and singing. His speech therapist is extremely happy about the progress Erik makes from day to day. He started to initiate new games and activities during the lessons. Erik has attended four Camps now and at Camp 4 (May-June, 2013) we have ongoing and stable success and we are very pleased by all the great changes in his neurodevelopment."

A local specialist states, that "Erik has a beautiful and dedicated family working with MNRI® on his physical, emotional, cognitive, and motivation development".

Conclusions

MNRI® programs aimed at restoration of neurophysiological and sensory-motor functioning of dysfunctional or delayed reflex patterns have been highly effective for Erik, a child with severe autism. The results of MNRI® Assessments, as well as standardized tests done concurrently, show significant and statistically valid changes as a result of this therapy.

The model of MNRI® Camps combined with MNRI® Home Programs has led to stable and on-going changes in a child with autism in many areas, his sensorimotor reflex integration, physical, cognitive, speech and emotional development.

Neurosensorimotor Reflex Integration as a specific modality can be an important element in treatment of children with autism. The rapid and stable results achieved by MNRI® Specialists with Erik are remarkable and open new perspectives for intervention for children with autism that can save neurodevelopmental treatment time for many individuals with developmental deficits.

The integration of reflex motor patterns achieved through the use of MNRI® programs serves as the physiological basis for neurodevelopment and sensorimotor integration and leads to rapid overall improvement.

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We congratulate Erik in each small and bigger success and watch with great pleasure the emergence of his wonderful personality and new interest in communication. We thank his Mom, Eva, for her endless love, patience, and faith in Erik as a Winner! – Denis Masgutov & Renata Chodyko