

PAULINA KRZESZEWSKA*
EMILIA MIKOŁAJEWSKA**, ***

* University of Silesia in Katowice;

** Department of Physiotherapy, Faculty of Health Sciences,
Ludwik Rydygier Collegium Medicum in Bydgoszcz,
Nicolaus Copernicus University in Toruń;

*** Neurocognitive Laboratory, Centre for Modern Interdisciplinary Technologies,
Nicolaus Copernicus University in Toruń

ORCID ID: <https://orcid.org/0000-0003-2222-3726>; <https://orcid.org/0000-0002-2769-3068>

Coexistence of Preserved Primary Reflexes and Speech-Language Disorders in Children – State-of-the-Art

SUMMARY

Assessment of primary reflexes belongs to the neurological assessment of newborns. Physiologically primitive reflexes are involuntary responses to external stimuli, substituted during next months of life by more and more complex voluntary movements. It seems completely inhibited primary reflexes may hamper the process of psychomotor child's development. Preserved primary reflexes are described mainly by physiotherapists and other medical specialists, but increased consciousness is common also among other specialists such as pedagogues. Knowledge concerning clinical picture of primitive reflexes and their consequences may influence deeper diagnostic approach of motor development and more effective therapeutic activities provided by physiotherapists, speech therapists, and occupational therapists.

The aim of this article is analysis of the scientific sources concerning coexistence of preserved primary reflexes and disorders of speech and language development in children. Aforementioned topic requires deeper understanding. There is a need for further detailed studies concerning aforesaid coexistence.

Key words: primitive reflex, abnormal reflex, speech development

INTRODUCTION

According to the definition of Medical Subject Headings (MeSH) a reflex is “an involuntary movement or exercise of function in a part, excited in response to a stimulus applied to the periphery and transmitted to the brain or spinal cord”.

Primitive reflex

The academic literature on reflexes includes such scientific terms as: “primal reflexes” (Mikołajewska, 2017a) or “primitive reflexes” (Goddard-Blythe, 2015; Marcidante, 2012; Tink, 2007). They are also named as “inborn reflexive reactions” or “infantile reflexes” (Nowotny et al., 2003).

The system of primitive reflexes appears in prenatal development and is inhibited during the first year after birth (McPhillips, Jordan-Black, 2007). Thanks to it children are able to meet the needs, e.g. sucking, swallowing. They determine reactions to specific stimuli. Reflexes are non-volitional and simultaneously essential for developing intentional movement. Physiologically, they accompany the development of a child during first months of its life and then allow to expand new and more complex acts. Next, they should be inhibited due to maturation of central nervous system (CNS) and replaced with volitional movements.

Preserved reflexes inhibition/integration

Concerning the end of primitive reflexes influence on an organism so that volitional movements are approachable, the literature uses such expressions as: “reflex integration” or “reflex inhibition”.

Scientific term “inhibition” indicates the process, in which repetitive reflexes through months slowly disappear. It is in accordance with clinical observations. A few different approaches apply also the term of “reflexes integration”. This one indicates that primitive reflexes combine somehow and thanks to this volitional movements appear. In fact it is not in accordance with medical concept of primitive reflexes, since there is a lack of neuroimaging research on this issue, confirming such statement (Mikołajewska, 2017a). As this process is not that univocal, we do not know, whether we are considering inhibiting or integrating primitive reflexes. This is why it appears to be legitimate not to attach importance to these terms or discussions on them before receiving significant neuroimaging research results describing this process. Nevertheless, it is essential to mind that as time goes by physiologically, the reflexes stop controlling children’s bodies. Only trials of explaining movement control, including primitive reflexes, were made, as well as motor development and its deficits – all based on laws of physics (Latash, 2016; Latash, 2017; Latash et al., 2010).

Pathologic reflexes

In developmental progress there might appear pathologic response to a stimuli. Then reflexes which are: too strong, too weak or absent are observed¹.

Preserved/Retained reflexes

Interferences in development of nervous system may contribute persistence of infantile reflexes. E. Mikołajewska (2017b) indicates that retained reflexes become impediments or even preventions from volitional moves or specific motor abilities. Manifestation of preserved reflexes are observed in preschool children, pupils and even adults. Retained reflexes disturb postural and motor development, disarrange the process of accomplishing volitional moves, because of which new movement patterns may constitute pathologically. Mechanism of exposing particular preserved primitive reflexes is presented below.

Normal development of speech and speech pathology

Describing development of speech requires interdisciplinary approach. To demonstrate complexity of this process, the researchers refer to different sciences, such as: speech and language pathology, medicine, psychology, educational studies, sociology and linguistics. This knowledge enables holistic conceptualization of “set of actions that a person performs using language while learning about reality and relying his or her interpretations of reality to other participants of social life” (Grabias, 1997).

Learning of speech starts in prenatal period, when a child gets first language experiences and the central and peripheral nervous system develops. In the third month the auditory system is developed and the brain is being stimulated by coming sounds. Between fourth and fifth month we notice changes in activities of a child as response to acoustic signals – motor reactions, mimics, cardiac cycle (Kornas-Biela, 1993).

It is necessary to remember that these signals are distorted by amniorrhea. Nevertheless, since the sixth month a child experiences speech sounds, mostly their prosodic components. After birth, a newborn discovers combinations of sounds, which ones appear most frequently, word and sentence stress. Studies show that before the first birthday children understand approximately 10 words and 18-month-olds – around 100 words. Speech understanding begins when

¹ Based on MeSH definition: Reflex, Abnormal – an abnormal response to a stimulus applied to the sensory components of the nervous system. This may take the form of increased, decreased, or absent reflexes – PubMed MeSH Thesaurus, <https://www.ncbi.nlm.nih.gov/mesh/68012018> [access: 11.02.2018].

a child realizes that a word means something. Discovering that a materialised designatum can be replaced with a word is vital and challenging step in an infant development (Kielar-Turska, 2012).

While getting to understand the phenomenon of situational context, an infant displays will to express his or her state. Firstly, this expression assumes shouting and becomes more complex, so that it transforms into sayings. From the very first months of life, a child produces vowels, usually during everyday activities with adults, for instance, bathing, dressing up, later on, there appear consonants. Before the first birthday, a child knows a few words of permanent meaning, repetitive syllables and words, creating sentences (Cieszyńska, 2001).

This operation reveals the child's ability to imitate, while trying to repeat heard speech sound, to form syllables and, as the effect of these activities, to establish origins of phonological system. Speech development during preschool education is the period of precise moves done by articulation organs. Standardly, a six-year-old is supposed to produce all Polish speech sounds.

This brief description of speech and language development includes not only linguistic aspects, but also the neurobiological and socio-emotional ones. A healthy child produces correctly all the speech sounds of his or her language, maintains appropriate prosody, pragmatics, grammar rules, creates narrative forms. These are only few abilities that are essential for a proper speech and language development.

“If linguistic competence are not evolving in an infant or are developing on insufficient level or when during the process of forming speech and language, there appears decay in language or there is any kind of paresis – we usually observe language delay” (Jastrzębowska, 2003). Except for this disorder, speech and language pathologists distinguish many other, depending on which classification is presupposed. Yet, the most common pediatric speech and language disorders are: aphasia, apraxia, stuttering, language disorders in autism spectrum disorder, in Asperger Syndrome and mental disability.

AIM

The purpose of this paper is to familiarize speech therapists, occupational therapists and other specialists with an important but still omitted in speech and language therapy programming issue, which are preserved primitive reflexes. Awareness of their consequences in pre-school and school education period enables planning more effective strategies, which are supposed to improve gross, fine and oral motor skills.

REVIEW OF SELECTED PRIMITIVE REFLEXES

J. Nowotny et al. (2003) have emphasized that infantile reflexes peculiarly initiate and facilitate psychomotor development in neuromotor processes. Their presence in the proper time is indispensable for the normative child's development. The author emphasizes the primitive reflexes significance and the ability to maintain normal posture for the holistic motor development. Selected reflexes are presented below.

Palmar grasp reflex

Healthy neonates have active Palmar reflex as a result of having one's palm touched – then child's fingers flex to grasp. After 3–4 months of life, it should be inhibited. If it preserves, most common consequences are: limiting the ability to prop up on open hands, which is inevitable to fourfold position, difficulties opening and closing hands volitionally, poor fine motor and manipulation skills, inappropriate pencil grip, and poor handwriting (Mikołajewska, 2017a; 2017b).

Moro reflex

Physiologically Moro reflex is active until the fifth month of a newborn's life. It is set off by a sudden stimuli – visual, auditory, tactile ones or an unexpected stimulation of the balance mechanism or change of position in space.

Retained Moro reflex may be associated with: hypersensitivity to sudden noise, light or touch, impulsive behaviour, hyperactivity, poor grasp control, dropping or squeezing objects, difficulties drawing to a pattern under the influence of unpredictable outer stimulus activating the reflex (Mikołajewska, 2017a). First reaction is putting arms and hands wide open. The second phase is approaching the limbs to the vertical line of the body around child's chest with hands flexed in grasps. At times it is surrounded by straightening lower limbs (Fenichel, 2007).

Tonic Labyrinthine Reflex (TLR)

TLR occurs in two forms as a response to a change in position of head towards base. The first form is rear (posterior) TLR, in which aberrance of head back activates extensor muscles. This should be inhibited after the first month of a newborn's life. The second form is frontal TLR, in which approaching head toward chest activates flexor muscles and is supposed to be inhibited after second month of life (Cheatum, 2000).

If not integrated, the reflex leads to: poor balance, muscle tension regulation problems, difficulties in activation of STNR and crawl on all fours in consequence (Mikołajewska, 2017a), acrophobia, motion sickness. It might also contribute to difficulty with solving mathematical operations and spatial orientation skills (Goddard-Blythe, 2015).

Asymmetrical Tonic Neck Reflex (ATNR)

When an infant's head is turned to one side, he or she takes "fencing position", in which upper and lower limb are straighten in the same side as the head is turned, simultaneously pulling upper and lower limb on the other side. ATNR should be active until six months of a child's life. This reflex enables evolution of homolateral moves, alternation in activities of left and right side of the body, as well as eye-hand coordination. Its residual forms may be later on manifested as: difficulties with crossing the vertical midline, unspecified laterality, reading difficulties (Goddard-Blythe, 2015). ATNR retention may also lead to difficulty: cycling, skating, playing basketball or handball, driving a car, playing piano or violin (Mikołajewska, 2017a; 2017b).

Symmetrical Tonic Neck Reflex (STNR)

Inhibited after 6 months of life, STNR has two forms, dependently on head movement: frontal STNR when the head moves up, the upper limbs straighten and the lower bend; rear (posterior) STNR when the head moves down toward chest, the upper limbs bend and the lower ones straighten (Mikołajewska, 2017b). If the reflex maintains active after 8 months, it incapacitates progress of independent actions of right and left hand, resulting homologous movement, e.g. crawling on all fours (Cheatum, 2000). In school-age children who exhibit retained STNR we can observe: "W" seat, poor posture at the table, tendency to lie on a desk, trials to keep good posture by sustaining one's head on a hand or belaying legs round the chair (Blomberg, 2015). Last two symptoms are effects of compensating the influence of the reflex and trials to control reactions of the body (Mikołajewska, 2017a).

INFLUENCE OF PRIMITIVE REFLEXES ON PSYCHOMOTOR DEVELOPMENT

The issue of retained reflexes was taken up only in impairment or deficits in development of central nervous system. Preservation of primitive reflexes is mostly observable in children with cerebral palsy. They are not in full control of

their bodies. What is more, the reflexes seem to manage their bodies and determine their abilities to make any moves.

However, clinical observations show that the primitive reflexes may retain and affect children and adults without disability certificate. Preserved primitive reflexes or their residual forms may cause difficulties in psychomotor sphere. Speaking of psychomotor development, there are distinguished 5 self-dependent elements: posture, locomotion, eye-hand coordination, speech and language, and social skills. Results of studies indicate influence of brainstem mediated reflex system on accomplishing elementary academic skills by pupils. This system should be inhibited within the first year of a child's life².

Investigations also prove that retention of selected reflexes, for instance STNR, may be associated with motor and cognitive deficits, which are observed in children with partial hearing loss (Livingstone, McPhillips, 2014). Nevertheless, greater caution is required while interpreting such co-occurrence. Motor difficulties in children manifesting retained primitive reflexes have already been studied and observed. Individuals with preserved reflexes and hearing loss may expose the same motor issues. This only confirms the negative power of primitive reflexes retention, either in children with or without hearing loss. However, it does not indicate hearing loss dependence on preserved primitive reflexes.

Early assessments show possible correlation between reading difficulties and poor motor control in children. In particular, educational progress might be associated with primitive reflexes system. If this concept will be proved in results of neuroimaging research on this case (which we lack), it may become vital to deploy new neurodevelopmental therapy strategies in children with reading difficulties (McPhillips et al., 2000).

Presented researches results stress interrelation between retained primitive reflexes and psychomotor development.

INFLUENCE OF RETAINED REFLEXES ON SPEECH-LANGUAGE DEVELOPMENT

Primitive reflexes are originally associated with motor abilities. Retained reflexes therapy is the domain of physiotherapists mostly. The most vivid form of preserved primitive reflexes may be observed in individuals with cerebral palsy. J. Nowotny (2005) highlighted basic neurorehabilitation methods, which include primitive reflexes: Vojta, NDT-Bobath and supplementary methods such as: Sensory Integration (SI), neuromotor developmental Castillo Morales method. There

² What is more, dyslexia is not a special form of poor reading skill and not all the pupils who have difficulty reading are dyslectics. It is not supposed to be perceived independently from their intelligence quotient – IQ (McPhillips, Jordan-Black, 2007).

are children whose psychomotor development indicate some deficits, although without central nervous system impairment. These deficits are manifested in language behaviours and speech therapist may be the first specialist visited by parents of the child with specific difficulties. Knowledge about symptoms of preserved primitive reflexes not only enables leading parents to a proper therapist, but also incorporating more effective speech and language therapy strategies.

Institute for Neuro Physiological Psychology (INPP) is an affiliate which contributed evolution of awareness about primitive reflexes retention, their influence on child's development and deficits in academic skills caused by them. The founders defined "neuromotor immaturity", which was which was displayed by children without classical neurological pathology but with learning difficulties (Goddard-Blythe, 2017). Assessing neurological maturity with tests only can never be taken as a diagnosis of central nervous system impairment. It may just inform about the level of consequences occurrence. Neuromotor immaturity is beginning to be the object of medical researches interest and methods of therapy which may improve functional results are only being developed (Eickmann et al., 2016; Rogers, Hintz, 2016; Sandman et al., 2012).

University of Vlora conducted a research on retained primitive reflexes and learning difficulties correlation. In the study, there were INPP assessment tools applied. The results showed that 71.4% of children with language development delay revealed preserved grasp and tonic labyrinthine reflexes (Bilbilaj, 2017). These are one of the very few investigation results which feature language disorders among other deficits, such as specific mathematics disability, specific reading and writing disorders. Distinguishing the speech and language aspects in such studies might conduce improvement of therapeutic procedures in speech and language advancement.

Among speech and language pathologists it is very common to state that gross motor development influence the proper constitution of fine and oral motor. L. Sadowska considers motor development to be precisely related to cognitive and social skills as well as speech and language development. "Motor is a mode of connection with society and provides its recognition" (Sadowska, 2000). However, despite relation between development of motor and social skills, it is not competent to go so far as to consider gross motor determines fine motor and further – oral motor. According to this statement, individuals with palsy in a muscle responsible for gross and fine motor would never be able to speak, read or eat without difficulties.

In one Polish paper can we find assumptions referring co-occurrence of retained primitive reflexes with speech and language disorders (Pniewska-Kosiorek, 2014). Based on her own therapeutic experience, the author signalized correlation of:

- interdental pronunciation of sounds with open occlusion and preserved: juvenile suck reflex, TLR, Palmar reflex;

- lateral pronunciation of sounds with cross-bite occlusion and retained: ATNR, STNR, TLR;
- specific language disorder or language delay with retention of: ATNR, STNR, TLR, Moro reflex;
- stuttering with Moro reflex.

It is essential to remember that mentioned appearance is certainly a co-occurrence, not cause-and-effect relationship. Present state of research does not allow to reliably state, whether speech and language disorders are a set of symptoms in another brain impairment. Therefore, it appears legitimate to withdraw empirical investigations on relation between language pathology and retained primitive reflexes.

Subsistence of involuntary body reactions may also hamper the process of nourishment. Prevention of speech and language disorders includes the subject of feeding and associated acts of: sucking, biting, chewing and swallowing. D. Pluta-Wojciechowska calls them “primary functions” and indicates their significance as it comes to developing oral motor (Pluta-Wojciechowska, 2015). It is also D. Emiluta-Roza (2017), who distinguishes primary functions in the “Holistic speech and language assessment” diagnosis. When symptoms of preserved reflexes attend the process of feeding, the improper model of primary function might be solidified. Thereby, the influence of retained reflexes would stand limitation of motor tongue, lips and jaw motor improvement. Poor oral motor skills are significant cause for speech-language difficulties.

DISCUSSION

The question of preserved primitive reflexes needs acknowledgement of existing research. We still lack consistent, objective, repetitive and commonly accepted survey methodology. There is no publication with a complex study, conducted in a big population of children in different age, on the physiological reflexes development, inhibiting pathological reflexes, short-term and long-term effects of functional therapy. There is also no randomised surveys in big populations. Few results of neuroimaging research or EEG-fMRI on retained reflexes are available. Furthermore, there are no computational model, connecting theoretical concepts with experimental research results.

Limitation of self report are caused by few publications, taken into account extension and differentiation of the problem as well as the number of possible methodological and therapeutical approaches in this case. This is why not only original papers but also state-of-art must be taken in consideration. Additionally, it is necessary to focus on publication year and survey methodology, since nowadays we experience revolution of central nervous system and its functioning studies

(The Virtual Brain or Human Brain Project). Further research on co-occurrence of speech-language disorders and retained primitive reflexes should acknowledge: methodology composition, pilot studies, randomised clinical trials, long-term effects analysis, influence of deficits and therapy on individuals' development.

CONCLUSIONS

Researchers postulate managing researches on diagnostic utility of primitive reflexes, enhancing therapeutic practise in international papers (Blasco, 1994). Polish therapists are mostly aware of preserved orofacial reflexes consequences. However, co-occurrence of primitive reflexes retention with psychomotor disorders is only being linked with reading and writing difficulties. Few studies are dedicated to relation between primitive reflexes preservation and speech-language disorders. This case requires evolution and empirical proofs, including evaluation, whether these phenomena are in cause and effect relation or rather co-occurrent with other brain impairment.

Ability to diagnose primitive reflexes enables early detection of motor development deficits. After observation and assessment, therapist can introduce corrective procedures (Goddard-Blythe, 2015). Such actions are essential to volitional movement development, either in postural, or in orofacial sphere (Mikołajewska, 2017a). It seems justified to implement primitive reflexes therapy into speech-language therapy. It is necessary to verify effectiveness of different therapy methods. Applied exercises are often unfounded, minding process of inhibiting preserved reflexes, as well as negative effects of retained reflexes. Therapists are not able to motivate the influence of the applied movement patterns on nervous and motor system or their adequacy to developmental age.

REFERENCES

- Bilbilaj S., 2017, *Measuring primitive reflexes in children with learning disorders*, "European Journal of Multidisciplinary Studies", 2(5): 285–298.
- Blasco P., 1994, *Primitive reflexes. their contribution to the early detection of cerebral palsy*, "Clinical Pediatrics", 33(7): 388–397.
- Blomberg H., 2015, *The Rhythmic Movement Method: A Revolutionary Approach to Improved Health and Well-Being*, Lulu Publishing Services, Morrisville.
- Cheatum B.A., 2000, *Physical activities for improving children's learning and behavior: A guide to sensory motor development*, "Human Kinetics".
- Cieszyńska J., 2001, *Od słowa przeczytanego do wypowiedzianego. Droga nabywania systemu językowego przez dzieci niesłyszące w wieku poniemowlęcym i przedszkolnym*, WNAP, Kraków.
- Eickmann S.H., Emond A.M., Lima M., 2016, *Evaluation of child development: beyond the neuro-motor aspect*, "Journal of Pediatrics", 92(3 Suppl. 1): 71–83.

- Emiluta-Rozya D., 2017, *Całościowe badanie logopedyczne z materiałem obrazkowym*, APS, Warszawa.
- Fenichel G.M., 2007, *Neonatal Neurology*, Elsevier Health Sciences, UK.
- Goddard-Blythe S., 2015, *Jak oceniać dojrzałość dziecka do nauki?*, PWN, Warszawa.
- Goddard-Blythe S., 2017, *Attention, Balance and Coordination: The A.B.C. of Learning Success*, John Wiley & Sons, West Sussex.
- Grabias S., 1997, *Mowa i jej zaburzenia*, [in:] *Audiofonologia*, t. X, Warszawa–Lublin, 9–36.
- Jastrzębowska G., 2003. *Opóźnienie rozwoju mowy – przejaw nieprawidłowości rozwojowych*, [in:] *Logopedia. Pytania i odpowiedzi*, t. 2, red. G. Jastrzębowska, T. Galkowski, UO, Opole, 37–65.
- Kielar-Turska M., 2012, *Rozwój sprawności językowych i komunikacyjnych*, [in:] *Diagnoza logopedyczna. Podręcznik akademicki*, red. E. Czaplewska, S. Milewski, GWP, Gdańsk.
- Kornas-Bielka D., 1993, *Kształtowanie się zdolności słuchowych w prenatalnym okresie rozwoju dziecka*, [in:] *Opuscula logopaedica: in honorem Leonis Kaczmarek*, J. Bartmiński, UMCS, Lublin.
- Latash M.L., 2016, *Towards physics of neural processes and behavior*, “Neuroscience Biobehavioral Review”, 69: 136–146.
- Latash M.L., 2017, *Biological movement and laws of physics*, “Motor Control”, 21(3): 327–344.
- Latash M.L., Levin M.F., Scholz J.P., Schönner G., 2010, *Motor control theories and their applications*, “Medicina”, 46(6): 382–392.
- Livingstone N., McPhillips M., 2014, *Primary reflex persistence in children with partial hearing*, “Developmental Neuropsychology”, 39(3): 233–247.
- Marcdante K.J., 2012, *Nelson Pediatrics*, Elsevier Urban & Partner, Wrocław.
- McPhillips M., Jordan-Black J.A., 2007, *Primary reflex persistence in children with reading difficulties (dyslexia): A cross-sectional study*, “Neuropsychologia”, 45(4): 748–754.
- McPhillips M., Hepper P. G., Mulhern G., 2000, *Effects of replicating primary-reflex movements on specific reading difficulties in children: A randomised, double-blind, controlled trial*, “Lancet”, 355(9203): 537–541.
- Mikołajewska E., 2017a, *Odruchy pierwotne. Terapia w podejściu medycznym*, Bydgoszcz.
- Mikołajewska E., 2017b, *Materiały z kursu: „Odruchy pierwotne. Obraz fizjologiczny. Wygaszanie odruchów pierwotnych”*, Bydgoszcz.
- Nowotny J., 2005, *Podstawy fizjoterapii*, cz. III, Kasper, Kraków.
- Nowotny J., Nowotny-Czupryna O., Czupryna K., Plinta R., 2003, *Edukacja i reedukacja ruchowa*, Kasper, Kraków.
- Pluta-Wojciechowska D., 2015, *Zaburzenia czynności prymarnych i artykulacji. Podstawy postępowania logopedycznego*, Ergo-Sum, Bytom.
- Pniewska-Kosiorek Z., 2014, *Między piętą a ustami – trening neurorozwojowy w terapii logopedycznej*, „Forum Logopedy”, 4–8.
- PubMed MeSH Thesaurus, <https://www.ncbi.nlm.nih.gov/mesh/68012018> [access: 11.02.2018].
- Rogers E. E., Hintz S. R., 2016, *Early neurodevelopmental outcomes of extremely preterm infants*, “Semin Perinatol”, 40(8): 497–509.
- Sadowska L., 2000, *Rozwój dziecka. Podstawy anatomiczne i fizjologiczne*, [in:] *Neurokinezyologiczna diagnostyka i terapia dzieci z zaburzeniami rozwoju psychoruchowego*, red. L. Sadowska, cz. I, AWF, Wrocław, 5–63.
- Sandman C.A., Davis E.P., Buss C., Glynn L.M., 2012, *Exposure to prenatal psychobiological stress exerts programming influences on the mother and her fetus*, “Neuroendocrinology”, 95(1): 7–21.
- Tink M.S., 2007, *Techniki terapeutyczne w fizjoterapii neurologicznej*, Elsevier Urban & Partner, Wrocław.