

CASE STUDY OF PRIMITIVE REFLEXES IMPACT ON SWIMMING SKILL ACQUISITION BY HEALTHY CHILDREN

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Abstract. *Primitive reflexes is an automatic muscle reactions which are only present in the first few months, but can remain active in healthy children, thus, impacting on motor proficiency. There is little evidence how primitive reflexes influence on swimming skills acquisition by healthy children. The aim of the study is to examine how primitive reflexes influence swimming skills acquisition by healthy children. Subjects: two 7-year-old girls. Methods: Checklists by Oh et al., (2011) were used to evaluate swimming skill proficiency at swimming lesson 8 and 16. The results were represented as a percentage of the possible maximal score. The testing of the asymmetrical tonic neck reflex, the symmetrical tonic neck reflex, and the tonic labyrinthine reflex was done using Blythe's, 5-point rating scale. The analysis was carried out using descriptive method. The first girl showed two reflexes at level 1, while the second girl demonstrated all tested reflexes at level 1, 2 and 3. The girl with less total score of reflexes (8%) achieved a better level of swimming proficiency (from 73% to 77%) than the girl with higher (25%) severity of these reflex (from 21% to 33%). The obtained data evidence about influence of primitive reflexes on swimming skill acquisition by healthy children.*

Keywords: *primitive reflexes, swimming skill acquisition.*

Introduction

Primitive reflexes are stereotypical, unconscious muscle reactions in response to a specific stimulus (Sohn, Ahn, & Lee, 2011). They are developing in the womb (Zoia et al., 2006), are represented at birth in the full-term neonate, and gradually get inhibited as the central nervous system when an infant matures (Schott & Rossor, 2003; Zafeiriou, 2004; Sharma, Ford, & Calvert, 2014). The primitive reflexes should not remain active in the general population beyond one year old. The tonic labyrinthine reflex (TLR), asymmetrical tonic neck reflex (ATNR) and symmetrical tonic neck reflex (STNR), along with the other primitive reflexes, if retained in children above this age can therefore disrupt maturation processes and provide indication of neuro-motor immaturity (Blythe, 2009, 2011). In this case

residual presence of primitive reflexes reduce children's ability to process sensory information effectively (Blythe, 2011).

The researches in this area are usually linked with a medical diagnosis such as cerebral palsy (Zafeiriou, 2004; Pavão, Neves dos Santos, Woollacott, & Cicuto Ferreira Rocha, 2013), delirium (Nicolson et al., 2011), neuropsychiatric disorders as Attention – Deficit/Hyperactivity Disorder (Konicarova & Bob, 2013) and psychological disabilities both Asperger's syndromes (Teitelbaum et al., 2004) as well as autism spectrum disorders (Chinelloa, Gangib, & Valenzab, 2018). However, the evidence suggests that primitive reflexes, as residual reflexes can remain active in children in the absence of a medical diagnosis (Gieysztor, Choińska, & Paprocka-Borowicz, 2018).

Residual reflexes can affect the child's educational outcomes. In this case children can learn, but it takes more effort (Montgomery et al., 2015; Grzywniak, 2016). For example, both reading (McPhillips & Jordan-Black, 2007) as well as writing, paying attention, and movement coordination, may be difficult for these children (Blythe, 2009, 2011; Vaculíková, Skotáková, & Sebera, 2017). Each reflex has been identified as playing a part in specific aspects of learning (Montgomery et al., 2015) and behaviour (Bilbilaj, Gjipali, & Shkurti, 2017), but when neuro-motor immaturity is present in a school-aged child a cluster reflexes are usually involved and could be considered as factors related to learning difficulties (Bilbilaj et al., 2017; Vaculíková et al., 2017). These residual primitive reflexes can affect an individual in many different ways. The research in this area, associated with swimming skill learning, is limited and needs extending. Blythe, (2009) confirmed that residual STNR affects the poor upper-and lower-body integration during learning breaststroke. She stated, "Breaststroke is affected because each time the head is lifted up to keep it above water, the feet start to sink, making it very difficult to keep the body on the top of water. Some children with STNR learn to swim under water more easily because when the head goes down, the feet starts to come up, and the weight of water helps to keep the body level" (Blythe, 2009, p.100).

Swimming stroke technique is learnt during swimming classes with the expectation that it would provide individual water safety and will be useful during a lifetime (Revesz, Bognar, Salvara, Gita, & Biro, 2007; Franklin et al., 2015). Rational swimming technique consumes the less energy (Pyne & Sharp, 2014) and allows to extend the length of the swimming distance (Morouzo, Keskinen, Vilas-Boas, & Fernandes, 2011), what is very significant for prevention of accident in water. Thus, it becomes crucial that such motor skills are learned effectively. Motor skill learning refers to the cognitive process by which movements are executed more quickly and accurately with practice (Taubert et al., 2010; Landi, Baguear, & Della-Maggiore, 2011). Front crawl and backstroke technique consists of many components including both balance control in

horizontal body position and limb coordination (Donaldson, Blanksby, & Heard, 2010; Oh, Licari, Lay, & Blanksby, 2011). Due to complexity, its usually are learned in parts (Blanksby, Parker, Bradley, & Ong, 1995; Oh et al., 2011) in order to reduce cognitive load on the early stage in learning (Wulf & Shea, 2002; Magill & Anderson, 2016). Swimming coaches teach their pupils to perform different components of a stroke separately (e.g., leg kicks, arm pulls, and breathing) before combining them all together to produce the whole pattern of coordination at a later stage of practice. Few studies evidence that the fact thought as structured swimming lessons which are being applied for teaching swimming proficiency in healthy children did not reach a maximum point value (Donaldson et al., 2010; Oh et al., 2011). Researchers suggest that successful swimming skills acquisition in healthy children only depends on age and water experience (Blanksby et al., 1995; Langendorfer et al., 2009). There is no evidence how primitive reflexes influence on swimming skills acquisition during swimming lesson by healthy children. Using descriptive method, the aim of the study is to examine how residual primitive reflexes influence on swimming skill acquisition by healthy children.

Methodology

Participants and Procedure

The two 7-year-old girls, with similar height and weight, health condition were defined by their General Practitioner as “practically healthy”, none of them used to have preliminary physical activity, neither they attended any other trainings except for swimming; both of the girls were diligent pupils without learning difficulties at school and demonstrated good cognitive behaviour forms of self-regulation. At the beginning of study their water competence was the same level including submerging, floating, breathing, and self-propulsion through the water on the front and back without a flotation device. They also could swim rudimentary crawl, but not proficient at front crawl and backstroke. The subjects got down to learning swimming at the same time, having two classes a week with the duration of 40 minutes. A part practice learning method has been applied and only kick-boards were used to enhance the learning process, but no other flotation devices. Lessons were held in a 25 x12 m heated (28–29 C), covered pool, in which pupils could not stand on the bottom. Both girls were conscientious and attentive at swimming lessons, though with different motorics of swimming skill performance. Therefore, it was suggested to analyse the process in view of primitive reflexes. Progress of Swimming Proficiency was evaluated at swimming lesson 8 and 16. The results have been gained while researching the children during swimming lessons. Front crawl and backstroke were put into practice together with other tasks, so the children were unaware of being checked.

Primitive Reflex Tests (ATNR, STNR, TLR) were measured before the lesson. Each girl was assessed individually.

Measures

The Primitive Reflex Tests of ATNR and STNR were carried out with the child in a quadruped position with hips flexed to 90, elbows extended, hands flat, fingers extended, and head in a neutral position. In the asymmetrical tonic neck reflex (ATNR) test, the examiner gently and slowly rotated the child's head to both sides. The procedure was carried out passively with a stop point at the midline. This sequence was repeated 4 times. The ATNR was measured on both the left side (ATNR L) and the right side (ATNR R). The symmetrical tonic neck reflex (STNR) was tested by the examiner with the child's head passively bent and extended. The STNR was measured for flexion (STNR FLX) and extension (STNR EXT). The tonic labyrinthine reflex (TLR) was tested in standing position, feet pushed together, hands along the trunk. The child was asked to tilt the head back "as if looking at the ceiling" and close the eyes. The child was supported by the examiner. After 10 s the child was asked to bend the head slowly "as if looking at the toes" and stand in the position for 10 s. The movement was repeated four times. The TLR was measured for flexion (TLR FLX) and extension (TLR EXT). The classification of the reflexes was done using Blythe's 5-point rating scale (0-4) (Gieysztor, Choińska, & Paprocka-Borowicz, 2018). The higher the children scored on the primitive reflex test, the lower the degree of primitive reflex integration they presented. The maximal total score for primitive reflexes were the summation of the scores of each reflexes (24 points) and were represented as a percentage of the possible maximal score.

To evaluate the progress of swimming skill levels objectively, Swimming Proficiency Assessments checklists by Oh et al., (2011) were used. Certain components of the body position, head position and, use of upper limbs, use of lower limbs were evaluated.

Front crawl components included: horizontal alignment of the trunk in water, minimal body rotation; head remains horizontal in water with the chin on the chest, head turning to either side to inhale with ear in water, bubbles are blown out slowly into water, regular breathing patterns linked to arm action; upper limbs fingers are closed together, slow, straight arm freestyle, long pull with back on the hand catching raindrops, hand enters the water near to the top catching the imaginary board; kick initiated at the hips, knees extended with straight legs kicking action, relaxed feet with ankles pointed, kicking feet just break surface. Backstroke components were following: horizontal alignment of the trunk in water, tummy pushed up, minimal body rotation; head remains horizontal in water, with eyes looking up to the top; fingers are closed together, slow, straight arm backstroke, little finger leads and enters water first, hand pull through and exits

water at upper thigh level; kick initiated at the hips, knees extended with straight legs kicking action, relaxed feet with ankles pointed down, kicking feet just break surface.

Each individual component in the checklist was rated on a four-point scale: 0 = Not at all; 1 = Sometimes; 2 = Most of the time; 3 = All the time. The maximal total score for Swimming Proficiency were the summation of the scores of each stroke individual component and were represented as a percentage of the possible maximal score (78 point) (Oh et al., 2011).

Results

The present study has been focused on the three primitive reflexes due to its impact on coordination and balance (Blythe, 2009), which is crucial in swimming stroke acquisition. The occurrence of residual primitive reflexes and the associated swimming stroke progress were analysed between cases. The case analysis was carried out using descriptive method. A comparison of the data from the study is shown in Table 1.

Table 1 Occurrence of primitive reflexes in relation to swimming proficiency

Measures	Primitive reflexes						Swimming proficiency	
	ATNR R	ATNR L	STNR FLX	STNR EXT	TLR FLX	TLR EXT	Lesson 8	Lesson 16
Case 1	0	1	0	1	0	0	73%	77%
Case 2	0	2	1	0	3	0	21%	33%

The participants of present study were healthy children without learning difficulties. However, they showed persistence of primitive reflexes. The first girl showed two marginally persistent ATNR L and STNR EXT, both at level 1 with the total scores of each reflexes 8% of the possible maximal score (24 point). The second girl demonstrated all tested primitive reflexes: STNR FLX, ATNR L and TLR FLX at level 1, 2 and 3 subsequently. The total score of each reflex was 25% of the possible maximal score. The level of retained primitive reflexes in both cases during testing remained without changes. The studies in this area are limited, but they all evidence about persistence of primitive reflexes in healthy children. Gieysztor, Choińska, & Paprocka-Borowicz (2018) suggested that over 60% of 35 tested healthy 4–6 years old children with no reported special needs demonstrated at least one primitive reflex at level 1–2 and 25% of them at levels 3 and 4. According to the study of Gieysztor et al. (2017) with one hundred thirty-five healthy preschool and early school age children (64 boys and 71 girls), where their primitive reflexes were tested by Blythe’s tests, the more conserved

reflexes among the surveyed healthy 4–9 year-old children were ATNR, STNR and TLR (Gieysztor, Sadowska, & Choińska, 2017).

During swimming skill acquisition the first girl best results in swimming proficiency was 60 points that indicate 77% of the possible maximal score, while the second girl showed 26 points that indicate 33% of the possible maximal score. Having non - integrated primitive reflexes, none of the girls received a 78 maximum point value for the swimming proficiency nor at the 8-th one neither at the 16-th lesson. Our study could be confirmed by Gieysztor, Choińska, & Paprocka-Borowicz (2018) analysis of primitive reflexes and associated motor problems in healthy preschool children. They concluded that even marginally persistent reflexes, affect the motor proficiency. Authors suggested that, none of the tested children in their research with non – integrated primitive reflexes received a maximum point value for motor proficiency test.

Case study demonstrate individual integration of primitive reflexes by children at the same age. The first girl showed full integration of TLR and non-integrated ATNR L and STNR EXT, while the second girl demonstrated all non – integrated primitive reflexes. Gieysztor, Sadowska & Choińska (2017) also highlight individual characters of integrated reflexes with age. They found that the least integrated reflexes among the school 7–9 age children and preschool 4–6 years children are ATNR and TLR. TLR and STNR FLX were the best-integrated reflexes in the study group. Between these two groups, the biggest difference existed in the integration of TLR FLX where the full integration was reached by 95% of children in the school age group and 65% of children in the preschool group. Individual integration of primitive reflexes with age was also suggested by Skotáková, Vaculíková, & Sebera (2016). They studied 175 children at the age of 6 to 11 and find the persistent of TLR in 47 % of the tested children. Concerning ATNR the data showed almost the same level of persisted reflex in right (33%) and left (34%) side of the body. The highest number of TLR was found in children in the 1st class – 55%, while the number of persisted reflexes lowers to 40% in the 2nd class, and, consequently, decreases to 31% in the 3rd year (Skotáková, Vaculíková, & Sebera, 2016).

The data of present study demonstrated links between integration of primitive reflexes and swimming proficiency. Being of the same age, possessing the same level of competence before learning to swim and having attended the same number of lessons, nevertheless, the girl without persistent TLR and less residual reflexes (8%) achieved a better level of swimming proficiency (77%), than the girl with persisting TLR and higher severity of all tested reflexes (25%) who achieved only 33% of possible maximum score. Swimming proficiency consists of many components, including both balance control in horizontal body position and limb coordination (Donaldson et al., 2010; Oh et al., 2011). Those the children ability to coordinate all parts of the body in many different

combinations (use of upper limbs, use of lower limbs) or carry out movement independently of each body part (for example turning the head in front crawl) play a crucial role. Blythy, (2009) confirms that non – integrated primitive reflexes evidence about poor balance and coordination problems. There is no evidence about non-integrated reflexes and swimming skill acquisition in healthy children, but the study of Blanksby et al., (1995) has shown the relationship between age and numbers of swimming lessons. Authors confirmed that the same level of swimming proficiency (swim 10 m in front crawl with regular uni-lateral breathing and 5 m backstroke with basic displaying good kick) to be achieved for 5 year old child requires 39 lessons, for 7 years old -18 and 8 years old -15. While our study demonstrated that primitive reflexes also could impact on swimming proficiency during swimming skill acquisition. This confirms that age is not only a indicator for successful swimming skill acquisition in healthy children, but individual characters of non-integrated reflexes as well could impact on swimming skill learning.

During swimming skill acquisition the first girl showed progress in swimming skill acquisition for 4% from 57 to 60 points, that indicate 73% and 77% of the possible maximal score consequently. The second girl swimming proficiency became higher for 12% i.e. 16 to 26 points what made 21% and 33% of the possible maximal score consequently. The improvement in swimming proficiency in both cases can be grounded, as multiplied repetition of the same performance usually results in the skill mastering (Taubert et al., 2010; Landi, Baguear, & Della-Maggiore, 2011).

Conclusions

The case study confirms that primitive reflexes can remain active in healthy children without learning difficulties. Although individual character of the residual reflexes has been identified, the problem of acquiring effective swimming skills hasn't been solved within the given study.

Presence of higher level of retained stereotypical primitive muscles reaction with the children of the same age may take more time to make progress or requires to practise tasks longer than others to achieve similar outcomes during swimming skill acquisition.

A part practice learning method has been applied during swimming skill acquisition. The study suggest that part practice methods where sequences of movements are practiced separately as in the swimming example, what allows to acquire swimming skills, but can be complicated by residual impact of primitive reflexes, that influences the value of this common practical strategy.

The study demonstrated importance of the noticed individual reflexes integration in each child to help him to prevent many difficulties which children

might encounter during swimming learning, especially in group swimming classes. So, swimming coaches have been advised to seek strategies that reduce this impact. Due to the case study the data only reflect of residual primitive reflexes and common level of swimming skill acquisition individually, thus, some cautions should be taken during the results' interpretation. Results of the present study need further confirmation on a larger sample size. Testing of both the technique problems for each skill component and the individual nature of the retained reflex could bring additional useful information.

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