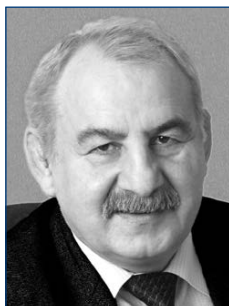




# Assessment of locomotion: binary interaction of features in children aged 5-6 years

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## Abstract

**Objective of the study** was to study of catching a falling object provides a framework for evaluating the quality of children's natural locomotion at the age of 5-6 years, with the binary interaction of symmetry-dissymmetry and symmetry-asymmetry serving as criteria for assessment.

**Methods and structure of the study.** To assess the quality of motor skills, researchers have employed objective techniques that involve analyzing video footage and measuring the bioelectric activity of muscles through the recording and analysis of surface electromyography.

**Results and conclusions.** It was discovered that at the age of five, a program is created that enables the execution of movements at a convenient speed. At the age of six, the program is modified to alter the speed and tempo of movement, with the aim of increasing it.

The concept of symmetry is a complex interplay of symmetry and asymmetry. Dissymmetry is the initial phase of reducing symmetry, which can manifest as the loss of a component or minor deviations from the ideal state.

Dissymmetry is a form of contradictory or partially disrupted symmetry, which can be seen as a form of unstable symmetry that retains the stability inherent in symmetry while also allowing for variation.

**Keywords:** *symmetry-asymmetry, symmetry-dissymmetry, binary interaction, signs of symmetry-asymmetry, stability and variability, assessment of motor action, motor skill, children aged 5-6 years.*

**Introduction.** The concepts of «asymmetry» and «dissymmetry» denote a violation of symmetry at different levels, and their opposition, which is part of the binary system, is symmetry. Deviation of indicators in any direction violates symmetry, as a result of which the phenomenon of dissymmetry can be taken as a type of asymmetry. At the same time, the nature of the permissible variations in the change of the two principles of the binary system of symmetry-asymmetry – right and left – are themselves symmetrical. At the same time, the fact that the degree of deviation from symmetry of various indicators can vary within significant limits supports the idea of using the term «dissymmetry», which contains the potential need to determine the magnitude and direction of deviation of a feature from a symmetrical state. Symmetry and

asymmetry are interacting factors that follow from the definition of symmetry. Dissymmetry is the initial stage of a decrease in the level of symmetry, expressed either in the loss of some element, or in minor deviations of the indicator (indicators) from symmetry. Thus, dissymmetry is a certain contradictory symmetry or partially upset symmetry, which can be assessed as unstable symmetry, providing the stability function inherent in symmetry, and simultaneously allowing for the manifestation of variability.

The mechanisms of interaction of «symmetry-dissymmetry» and «symmetry-asymmetry» in a complex living system, which includes humans, follow from the natural interaction of symmetry - the manifestation of stability and dissymmetry or asymmetry – as a reflection of variability, which corresponds to the philosophi-



cal law of the unity and struggle of opposites. The stability of the system or its symmetrical state does not allow it to be enriched functionally. The emergence of new, more advanced forms of organization or unique events can only occur in an unstable system, and this circumstance reduces the process of adaptation or development to a compromise between diversity and redundancy.

It was assumed that the study of the binary interaction of the features of symmetry-dissymmetry and symmetry-asymmetry will lead to the possibility of assessing the quality of mastering motor skills. It was decided to test this assumption by assessing the development of motor skills in performing natural locomotion in children aged 5-6 years.

Objective of the study was to study of catching a falling object provides a framework for evaluating the quality of children's natural locomotion at the age of 5-6 years, with the binary interaction of symmetry-dissymmetry and symmetry-asymmetry serving as criteria for assessment.

**Methods and structure of the study.** The study was conducted at the Health Center of the Research Institute of Complex Problems of the Adyghe State University and in the preschool educational institution No. 6 in Maikop in groups of children aged 5-6 years. The survey involved 60 practically healthy children of the same age and approximately the same constitution. Children of this age studied in a preparatory group according to the traditional education system.

The study was conducted in accordance with the consent of the parents of preschoolers. Catching a falling ball was used as a test task. Registration of the spatio-temporal characteristics of this motor action was carried out using a three-dimensional video analysis system of movements (Biosoft Video).

The basis for the study is the study of the stereotypical nature of limb movements during the locomotor act. Under normal conditions, stereotypicality can be an indicator of the stability of the action program or the formation of the action algorithm.

**Results of the study and discussion.** The quality of catching a falling object was assessed by determining the maximum acceleration and velocity of the elbow and shoulder joints; establishing the speed and acceleration of the hand by studying the locomotion parameters (phase duration, amplitude of movements in the joints, etc.). The indicators of the time of execution of the movement when catching a flying object at the age of five remain unchanged in all three series.

Considering the same picture in the pre-movement phase, it can be assumed that already at the age of five, the time picture of the performance of a motor action in familiar conditions has already been formed. This position is confirmed by the stability of the speed of movement of the hand (between the indicators of the series  $p > 0,05$ ). However, a stable reproduction of the time of implementation of the movement and the speed of movement of the hand is formed with unstable components due to internal mutual compensations. Thus, the angular velocity in the shoulder joint in the third series (day 3) and the angular acceleration in the shoulder joint in the second series (day 2) reliably ( $p < 0.05$ ) differs from the previous result. This circumstance allows us to state that in this age group the temporal pattern of movement has already been formed, and the spatial program of movement is in a state of uncertain execution and search. In addition, the children of this group have a stable idea of habituality and temporal comfort in the execution of this motor action.

Despite the reliable decrease in the time costs for the implementation of the movement in the second series of attempts relative to the first and the preservation of this advantage subsequently, reliable changes in any temporal-spatial parameter are not observed in six-year-old children ( $p > 0,05$ ). Probably, this phenomenon is determined by tendential aggregate changes in the parameters.

The fact that an increase in the speed of habitual movement does not lead to significant changes in the implementation of the temporal-spatial characteristics of movements allows us to state that in this age group the temporal-spatial pattern of movement has already been formed, that is, both the temporal, spatial and dynamic programs of movement have been formed. In this case, there should be differences between the features characterizing the activity program in five-year-olds and six-year-olds. Let us check this assumption.

Let us compare the parameters of movement obtained in the first and last series of testing, due to the fact that these data reflect the final result of the reorganization of the movement program with the awareness and understanding of the essence of the motor task. In the first series, there are no differences between the indicators of different age groups characterizing the time of movement, angular velocity in the shoulder and elbow joints, as well as in the features of the speed and acceleration of the hand, that is, the



preservation of the signs of symmetry is ensured. However, here a change is detected in the action program, which is characterized by an age-related decrease in angular acceleration in the shoulder joint with an increase in angular acceleration in the elbow joint. In other words, the signs of symmetry are unstable, there is a decrease in the role of the link in the execution of the movement, which has a large mass and requires greater efforts to accelerate, while the role of the link that is easier to control and less massive increases, mutual compensation of the components of the motor support is observed to maintain and stabilize the signs of symmetry during the period of manifestation of dissymmetry. That is, at the age of six, there is a search for internal reserves that allow optimizing movements, and, consequently, a change in the program occurs, which is reflected in the nature of the binary interaction of the features of symmetry-dissymmetry.

It can be assumed that at the age of five, a program of action is created that allows the implementation of movements at a comfortable pace. At the age of six, coordination changes are made to the existing program in order to change the speed of a comfortable pace of movement towards its increase, as well as to stabilize the temporal-spatial characteristics and ensure symmetry in the implementation of a motor action.

These tendential phenomena are more clearly manifested in the final series of tests. After a certain amount of purposeful execution of the movement, six-year-old children spend significantly less time on performing the movement, they have higher results in angular acceleration and angular velocity of the elbow joint with an equal angular velocity of the shoulder joints and a lower value of angular acceleration of the shoulder joint. With an unchanged value of acceleration developed by the hand, six-year-old children achieve significant differences in the speed of the hand. That is, changes in the movement control program that occur at the age of six allow us to talk about

economization and a higher quality of movement control itself, as well as about the stabilization of the time-spatial characteristics of movement corresponding to the patterns of manifestation of symmetry signs. Thus, it was revealed that at the age of five, an action program is created that allows for the implementation of movements at a comfortable pace. At the age of six, coordination changes are made to the existing program in order to change the speed of a comfortable pace of movement towards its increase.

**Conclusions.** Symmetry and asymmetry are interacting factors that follow from the definition of symmetry. Dissymmetry is the initial stage of a decrease in the level of symmetry, expressed either in the loss of some element or in minor deviations of the indicator (indicators) from symmetry. Dissymmetry is some contradictory symmetry or partially upset symmetry, which can be assessed as an unstable symmetry that provides the stability function inherent in symmetry and simultaneously allows for the manifestation of variability.

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