

**Edu World 2016**  
**7th International Conference**

**EFFECTS OF MOTOR STIMULATION PROGRAMS ON  
CHILDREN WITH DOWN SYNDROME DEVELOPMENT**

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**Abstract**

The paper brings forward the issues of motor activities importance in the psychological development, and especially mental development of children with disabilities, from the embodied cognition theory perspective. In the context of embodied cognition approach, we expanded variable "any age" (meaning chronological age) to variable any mental age, and we assumed that if the cognitive system includes body and his conditions, than improvement of sensorimotor skills contribute to an improvement in cognitive functioning in children with development delay. This study presents some results of motor stimulation activities for 16 children with Down Syndrome, beneficiaries of the project "*Development of motor skills in people with Down syndrome*" implemented by Special Olympics Romania in partnership with other educational institutions. The aim of the study was to identify cognitive development valences of motor stimulation program for children with Down syndrome. Hypothesis: we suppose the motor stimulation program contributed to improvement of cognitive functioning in children with Down Syndrome. The study was conducted on two groups, one of 10 children (ages 5-8 years), and the other of 6 children (aged 9-14 years). Research showed improved cognitive functioning in both groups, but to a greater extent in children from the first group, which underscores the importance of early intervention in the recovery of children with retarded development. The study values embodied cognition theory for the opening of new directions for designing educational programs for children with Down syndrome, in particular, but also for other categories of children with intellectual disabilities.

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**Keywords:** Motor stimulation program; embodied cognition; children with Down syndrome; cognitive development.



## **1. Introduction**

Educational and social integration of children with disabilities is an important goal of modern educational systems. The process takes time, requires early intervention and related actions of several rehabilitation services. In recent decades, the development of the cognitive sciences and neuropsychology emphasized the importance of early motor stimulation of the child, from the first year of his life, for an optimal cognitive and even socio-emotional development. For children with intellectual disabilities to stimulate the neuromotor development is essential for the recovery process and for school integration, especially for children with Down Syndrome, which manifests retardation in motor development, have low muscle tone, a slower rate of growth of bones and muscles, have difficulty in acquiring basic motor skills and attitudes (such as sitting, standing up, walking, gripping, holding etc.). Given these issues, the Special Olympics Foundation has designed and developed a series of programs and projects aimed at stimulating and recovering through movement children and adults with intellectual disabilities. One of them is the project titled "The development of motor skills in people with the Down syndrome - essential step towards independent life", implemented by the Special Olympics in partnership with fifteen institutions in the country, including Valahia University of Targoviste, Faculty of Humanities, Department Physical Education and Sport. The project was funded by SEE grants 2009 - 2014, in The NGO Fund in Romania, and was intended to create and apply a program of early motor initiation for children with Down syndrome, to increase social interaction and acquisition of life skills through a system of unified sports training and competition for children and youth with and without Down syndrome. (<http://specialolympics.ro/programe/sport/dezvoltarea-de-abilitati-motorii-la-persoanele-cu-sindrom/>). The project activities were implemented in six cities (Bucuresti, Brasov, Cluj, Craiova, Iasi, Targoviste) and in the Jiu Valley between April 1st 2014 and March 31th. 2016. In the context of the project activities developed in Targoviste, but independent of the purposes set out in the project, we aimed at highlighting some valences for cognitive development that the motor stimulation program can have in children with Down syndrome.

## **2. Paper Theoretical Foundation**

The research is based on the embodied cognition theory, developed in the last two decades in the field of cognitive psychology. The new paradigm argues for consideration of the motor elements as fundamental to "the emergence and existence of cognition" (Ionescu, 2011, p.327). For traditional cognitive psychology the cognition was seen as a set of mechanisms and operations that processed the primary information (sensations and perceptions) to give action. So, for the psychological system, the cognition subsystem (or higher cognitive processes) is located between the input subsystem (sensations and perceptions) and output subsystem (represented by action), being relatively independent of these two (Ionescu, 2011). Traditionally cognitive researchers thought higher cognitive processes can be studied independently of sensory-motor processes (input-output elements), irrelevant for abstract processing mechanisms of cognition, that are using amodal symbols (Laakso, 2011). This perspective can resemble a functionalist philosophical perspective, by that the content of a process is determined by its function in the system, regardless of means, environments in/by which the function is performed. Respectively, explaining cognition imply explaining transformation tool for input data (symbols) to output

data/symbols, the mind being the "black box" that performs this function, independent of the body. So cognition is limited only to the processing of information. But traditional cognitive psychology can't answer the question of substantiation symbols / information processed by the mind, namely how and where they are located in the brain and how they are functional, that is loaded with different meanings and generating different effects. Embodied cognition paradigm attempts to provide solutions to this problem, by considering the higher cognitive processes as dependent on the anatomy and physiology of the body, the sensory and the motor systems (Ionescu, 2011).

According to embodied cognition theory, cognitive functioning at any age depends on sensory-motor issues and the body. In other words, higher cognitive functions are not only influenced by these elements and processes, but they are components of the cognitive system itself. Cognition is not independent of the brain and body, perception and action, but there is a relationship of interdependence between them; intelligent behavior is the result of symbols processing operations at a given brain and body in a certain time and physical and social space. So we can consider cognition not only being "incorporated/ contained in the body" (embodied) but contained (embedded) into a more complex system of the body located and „in service” in certain space and time.

The roots of this approach are found with more than two centuries ago to John Dewey work, the phenomenological philosophy and this century in Piaget's work. In his work, John Dewey "not only claims that embodiment is crucial for understanding the mind but also acknowledges the developmental, dynamic nature of cognition." (Laakso, 2011, p.411). One of the phenomenologists who looked with more interest in scientific evidence, Merleau-Ponty, (cited in Laakso, 2011, p.412) "argued that embodiment in the three-dimensional, physical space of the actual world is a critical fact about human thought". Piaget showed that cognitive development is based on sensitive and motor development in the first years of children's life, but he neglected the implication of motor and sensorial actions in the cognitive functioning later in child's and adult's life. Researches accomplished in the last years on infants development and abilities confirmed Piaget's supposition regarding the role of sensorimotor actions in cognitive development. (e.g., Adolph and Avolio, 2000; Thelen et al., 2001, cited in Loeffler J, Raab M and Cañal-Bruland R, 2016). In the last thirty years numerous empirical researches made on language acquisition and development of verbal communication skills suggested that "language comprehension involves the activation of visual motion (i.e., sensorimotor) representations"(Laakso, 2011, p.414). However, the progress made in neuropsychology in the past decades, brings some argument that not sustain the embodied cognition theory. These arguments come from the cases of motor pathology (like apraxia or paraplegia) that do not affect cognitive abilities of the patient. But, this doesn't affect entirely the hypothesis of embodied cognition. Until now the researchers couldn't find solid arguments to completely exclude the fact there are some implication of motor and sensitive components in superior cognitive abilities.

The theory of embodied cognition, closed to its younger sister, the theory of embedded cognition, has important implications in terms of educational psychology and learning, both in children with typical development profiles, and especially for children with mental retardation or developmental retardation. In the theoretical context offered by paradigm embodied cognition, we expanded variable "any age" (meaning chronological age) to variable any mental age, and we assumed that if the cognitive system

includes body and his condition, then improved sensorimotor skills is associated with improved cognitive functioning in children with Down Syndrome.

### **3. Research Methodology**

As mentioned before, the aim of the micro-research presented in this paper was to identify the motor stimulation program's valences for cognitive development in the case of children with Down Syndrome. The study was conducted on two groups of children, 10 (children ages 5-8 years), respectively, 6 children (aged 9-14 years). The research involved two stages: I- application of the motor stimulation program, which was aimed at improving overall motor capabilities, and II - evaluation, after the motor stimulation program, of the cognitive functions of children involved in the program.

#### **3.1. The Motor Stimulation Program Methodology**

This activity was conducted over a period of one year, with one workout per week.

As mentioned before were formed two age groups, and each group undertook an hour of gymnastics per week. The activities were held in the gymnasium of the Valahia University, Physical Education and Sport Department. All sport that is done with children with Down syndrome was based on the voluntary participation of students and teachers.

Steps and types of motor stimulation activities:

a) Initial assessment; had two phases:

- Providing of assessment test for children general mobility; this was established by Special Olympics Romania Foundation and its partners, and involved the assessment of basic motor skills (walking, running, jumping, throwing and grip, drag, thrust.)

- Application of assessment tests and recording results.

The same tests were used at the end of the stimulation program, to measure the progress.

b) Completing the stimulation activities. These were of three types:

- WORKSHOPS of 5-7 minutes locations exercises, in which identical exercises are performed at the same location or with the same object for 10-15 minutes.

- CIRCUIT includes 6-10 locations of exercises, and proceeded after the skills are learned.

- UNIQUE WORKSHOPS involves repeating the same habit (for maximum 2 habits). If the children liked very much a skill you can work with it throughout the entire lesson or you can run another one.

#### **3.2. Methodology Used in the Second Stage (For The Cognitive Development Evaluation).**

The research strategy in the second stage was the case study. For reasons beyond our will, it was not possible to undertake a direct assessment of children's cognitive development (through psychological tests) before the motor stimulation program, so we decided to evaluate the development of their cognitive capabilities through alternative ways – by questioning parents and trainers about it. The research tools and methods used were the anamnesis, to obtain information about their mental development manifested before the program, and questionnaire (for trainers and parents), aimed to identify what tasks was the child able to do before and after running the stimulation program. This allowed to assess any changes in child's cognitive development. The questionnaire aimed at obtaining information on cognitive

functioning, respectively about the qualities of attention, memory, verbal communication and categorization skills, and about socio-emotional development. The items were constructed based on Child development assessment sheet (3-7 years) (elaborated by the working group of professors and students from Developmental Psychology Laboratory of Babes-Bolyai University in 2011) and tasks from the motor stimulation programs. The anamnesis, conducted with the parents/legal guardian, aimed to obtain data about the developmental history of motor abilities, autonomy skills, language, superior cognitive abilities (similar to those the questionnaire focused), social interactions, and other issues (e.g. medical history, educational history).

#### **4. Results**

Data obtained from case history and questionnaires were related and analyzed for each case. Regarding the developmental level of the children, we found, from anamnesis, that six children had easy mental retardation (4 in the first group, and two in the second), and ten children had moderate mental retardation (6 in the first group and four in the second). All children have basic motor acquisitions (sit, standing, walking, grasping and running).

Answers collected from parents and trainers on questionnaire, related with the information from anamnesis, revealed the follows:

- Enhancements to executive attention – increased attention span, by a few minutes for all children in the first group and two children from the second group (ages nine and almost ten), and attention shifting rose to five children from the first group (age 6, 7 and 8) and two children from the second group (age 10 and 14).
- Improved working memory: towards the end of the program all children remembered better and faster the position and function of the objects viewed for the first time in the gymnastic hall, learned faster a series of actions (1-4) in the shown order etc.
- Improvement of verbal communication skills (better describe the shown image, or the activity they finished earlier, they recognize better all the words in the complex sentences they heard etc.) observed only in children from the first group.
- Regarding categorization skills, both parents and trainers perceived an improvement of the children's capacity to group items based on one or two criteria (by the end of the stimulation program it was easier for them to form groups of children by height or shirt color or to group balls by color and size). The children from the second group, who had difficulties in attentions tasks, had also difficulties in categorization tasks.

Also, the program had an impact on children social skills (children manifested improved cooperation during the play, better perseverance in accomplishing the exercises, supporting play-mate to finish the set of exercises etc.) and emotional development (children express their feelings congruent with the situation in which they are, show sympathy for an injured colleague, show little distress related to the difficulties during the activity, express better their desires, children have a better emotional state).

Besides some progress made on cognitive and emotional abilities, trainers also pointed an improvement of children's autonomy and self-confidence, due to group activities, interactions and support from peers with the same problem and also from children with normal development.

## **5. Discussions**

Trainers and parents observations based on specific criteria for cognitive functions revealed improvements on executive functions (like working memory, executive attention), on language (better semantics and vocabulary), and on thinking operations (categorization). There are differences noticed between the two groups: older children with Down syndrome manifest in a smaller measure progresses in cognitive functions (respectively attention, categorizations and verbal communication skills). These differences can support the importance of early intervention principle for the recovery programs of children with disabilities, especially for those with mental disability.

Although the research was not focused on identifying what kind of sensorimotor elements is involved in cognitive processes and how or to what extend are involved, the data gathered allow us to conclude that motor stimulation activities have the potential to contribute to the improvement of some cognitive functions in children, even for mental disabled ones. The contribution of motor abilities development (different movements, the balance, types of locomotion) to development of intellectual and academic abilities was also showed in previous research done by Bornstein et al. (2013). The research followed, in a longitudinal design, the relation between motor-exploratory competence of infants and academic competences of those children later, at different ages (at 4-, 10-, and 14-year). They found that good motor competence in infancy is associated with good mental, academic competences later in life.

One might say that some or all of the improvements observed in this research in cognitive functions of children with Down syndrome are the effects (even partially) of other factors (emotional or social) offered through the program. But these other factors, like emotional one, could also imply sensorimotor elements, and, on the other hand, embodied cognition refers to cognition dependence to all the body states: the morphology, sensations and actions, including emotional ones. In other words, cognition is situated, embedded, because cognition happens in a given body (with a specific morphological structure and specific state) and in a certain type of physical and social environment (Ionescu, 2011).

## **6. Conclusions**

The context of Special Olympics motor program for children with Down syndrome offered the opportunity to exam if a simple motor stimulation can improve mental functions in children with mental disabilities, based on embodied /embedded cognition theory. The research showed an improvement of a few cognitive functions in younger children with Down syndrome, compared to older children, highlighting the importance of early intervention in recovery and therapeutic programs of disabled children. Also, these cognitive improvements are evidence sustaining that, to some extent, cognition development, at least in childhood, is dependent to sensorimotor stimulation and achievements. The study is opening new directions for designing educational programs for children with Down syndrome, in particular, but also for other categories of children with intellectual disabilities.

## Acknowledgements

We are very grateful to all the teachers, students and parents/legal guardians that helped us accomplished this study. Without their help it couldn't have been carried out all the activities from the motor stimulation program and from the research.

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