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# The influence of manifest strabismus and stereoscopic vision on non-verbal abilities of visually impaired children

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ABSTRACT

This research was conducted in order to examine the influence of manifest strabismus and stereoscopic vision on non-verbal abilities of visually impaired children aged between 7 and 15. The sample included 55 visually impaired children from the 1st to the 6th grade of elementary schools for visually impaired children in Belgrade. RANDOT stereotest and polaroid glasses were used for the examination of stereoscopic vision, while Cover test and Hirschberg's pupils reflex test were used for the evaluation of strabismus. In the area of non-verbal abilities was evaluated visual discrimination, visuomotor integration, constructive praxia, visual memory, strategy formation, non-verbal reasoning and the representational dimension of drawings. Subtests of ACADIA test of developmental abilities were used for the evaluation of non-verbal abilities (Atkinson et al., 1972). Statistically significant relations between strabismus and constructive praxia ($p = 0.009$), visual memory ($p = 0.037$), strategy formation (0.040) and the quality of drawings were determined by the results analysis. According to our findings, children with divergent strabismus achieve the best results. Children with stereoscopic vision generally achieve better results in all the examined areas of non-verbal abilities, and statistically significant relations were determined in the areas of visuomotor coordination (0.002), constructive praxia (0.026) and non-verbal reasoning (0.015), which are directly connected to visuospatial abilities. Children with convergent strabismus achieve significantly lower results in the areas of constructive praxia, visual memory, strategy formation and representational dimension of drawings, and children with the lack of stereoscopic vision – in the areas of visuomotor integration, constructive praxia and non-verbal reasoning.



## 1. Introduction

Visual functioning and visual capacity do not relate only to the observation precision of the form, details, and colour of static or moving objects. They also include the success of processing and interpreting the received visual information. Actually, visual capacity is best expressed through visual efficacy, i.e. through the success in performing different visual tasks. Visual efficacy is very important for the development of integrative abilities and for the conceptualization of space and time (Atkinson, 2000). The ability to differentiate, as a prerequisite for establishing series and class systems, as foundations of logical thinking, is primarily based on visual perception. Children begin to create general categories very early, followed by subcategories, based upon the features of objects such as size, shape, colour etc. (Gligorović,

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2010). The critical period of visual maturation, during which the quality of visual experience is shaped, is crucial for the later development (Hyvärinen, 1994; Wickham, Stewart, Charnock, & Fielder, 2002). Difficulties in the area of visual functions hinder the creation of mental representation of an object. These difficulties may influence the child's ability to recognize and use letters, numbers, symbols, words or pictures, which impact academic skills, cognitive and adaptive abilities (Gligorović & Radić Šestić, 2010; Moguel-Ancheita, Ramírez-Sibaja, Reyes-Pantoja, & Orozco-Gómez, 2010). A type or a model of visual functioning depends on a range of constellational, physiological and psychological parametres. These parameters need to be monitored for the purpose of diagnostics, differential diagnostics and treatment programming for visually impaired persons (Gligorović & Vučinić, 2010). Visual system consists of more subsystems, which to a great extent act independently and mainly perform different functions. They may develop or be impaired almost independently from each other. Thus, a person may demonstrate exceptional abilities in one of them, whereas in others, the abilities may be medium or bad. For example, children with the same vision acuity, whether from the stratum of emotropic or normal vision, often realize different levels of visual efficacy in the teaching process or in other situations. This is conditioned by other parameters of visual functioning characteristic for some eye diseases, the quality of vision field, the quality of binocular or stereoscopic vision and other parameters, as well as by the child's cognitive and conative characteristics. The disorders of visual functions which most frequently affect learning are refraction anomalies, strabismus and amblyopia, system diseases of eyes and neuro-ophtalmological diseases (Koller, 1999).

The assessment of factors, which often with other factors affect the developmental level and quality of cognitive abilities in children with low vision, should include various aspects of perceptive and integrative functions. Thus, we conducted this research with the aim of examining the influence of manifest strabismus and stereoscopic vision on non-verbal abilities of low vision children of elementary-school age.

## 2. Methods

### 2.1. Participants

The sample consists of 55 low vision children aged between 7 and 15 (AS = 10.59, SD = 2.29), who attend schools for visually impaired children in Belgrade. There are 29 pupils from lower and 25 pupils from higher grades, 31 girls and 24 boys. Out of the total number of 98 children, low vision children who do not have any intellectual disabilities, autism, epilepsy or any additional sensory and/or motoric disorders were selected for the sample. The intellectual abilities of the participants range from slightly under average (16 participants) average (19 participants), to slightly above average (17 participants).

According to vision acuity, the participants were divided into three categories: 0.05–0.1 category (15 participants), 0.1–0.3 (26 participants) and above 0.3 category (13 participants). Manifest strabismus is present in 36 participants, i.e. esotropia in 18 participants, and exotropia in 12 participants. Stereoscopic vision is not present in 38 (69.1%).

### 2.2. Instruments and procedures

#### 2.2.1. Assessment of visual function

Manifest strabismus and stereoscopic vision were defined as independent variables. RANDOT-stereotest in the form of a booklet and polaroid glasses were used for examining stereoscopic vision. For the assessment of strabismus, we used Cover test for determining manifest and latent abnormal eye positions, and Hirschberg's Pupil reflex test as the orientation and qualitative method for measuring the objective angle in convergent strabismus.

#### 2.2.2. Assessment of non-verbal abilities

In the area of non-verbal abilities, the following dependent variables were assessed: visual discrimination, visuomotor integration, constructive praxia, visual memory, strategy formation, non-verbal reasoning and representational dimension of drawings.

For the assessment of non-verbal abilities, we used the subtests of Acadia Developmental Abilities Test (Atkinson et al., 1972), translated and adapted in Croatia in 1985 (Novosel et al., 1985), and additionally adapted and standardized in Serbia (Gligorović et al., 2005). The Acadia test consists of 13 subtests out of which seven subtests were chosen for the assessment of non-verbal abilities. These subtests assess various skills and abilities necessary for successful mastering of academic skills in elementary school. The test can be applied individually or in groups. Since speed is not important in this test, it can be adapted to the pace of each child.

Visuomotor integration was assessed by Subtest II of ACADIA test – *Visuomotor Coordination and Sequencing*. It consists of 10 tasks which test the ability to follow a marked path between different types of lines (concentric circle, square, triangle, etc.) and complete the shapes. A certain number of points is awarded for each task, counting mistakes, and the maximum number of points is 20.

Visual discrimination was assessed by Subtest III of ACADIA test – *Visual Discrimination*. It consists of 20 tasks in which a child is expected to choose one out of four options based on a given model. The first part consists of drawings, while the second and the third part consist of words arranged from simple to more complex. One point is awarded for each correct answer.