

Infancy, Adolescence, Adult Age: The Neurophysiology Development of Color Vision Brain Pathway

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ABSTRACT

A comparison of both the number and the types of the mistakes that were made during reading of Ishihara plates by 3,926 students attending the secondary school in the province of Cosenza (Calabria, Southern Italy), and by 546 Calabria University students, all without inherited colorblindness. This sample was compared with 48 children from Infancy School in Catanzaro (Calabria, Southern Italy). In this study we show the color vision as biomarker to identify the physiological maturation of the visive areas in the Central Nervous System

Keywords: Infancy; University Students; Adolescence; Ishihara Test; Test Mistakes

Introduction

The red-green color vision deficiency or colorblindness is inherited as a X-linked recessive character and it is due to a genetic conversion towards the hybrid gene formations that code for the red and green colors. This anomaly is described as a small or great deficiency of green color vision (deuteranomaly or deuteranopy, respectively), or as a small or great deficiency of red color vision (protanomaly or protanopy, respectively). The blue color vision deficiency is very rare and it is inherited as an autosomal dominant character whose gene is located within the chromosome 7. Understanding how infants and children, until the adult age, see colors has the potential to provide insight into broader aspects of their minds and behaviors, for exam-

ple, object reasoning and language acquisition [1]. The development of color perception has relevance to clinical, educational contexts. Color perception is, generally, atypical in children with neuro-developmental disorders [2], congenital color vision deficiency, in children present barriers education [3]. All these deficiencies show its consequences in the adult age.

Objective of this work

The objective of this work was to evaluate the behavior of three different groups of male subjects (age range = 3-8 years; 11-14 years; 19-25 years) during their reading of the Ishihara plates, comparing the quantity, and the quality of their different mistakes.

Material and Methods

We compared three groups of subjects with respect to their reading of the Ishihara plates. First group was composed of 4,194 students attending the secondary school (age range = 11-14 years) who came from 136 of the 155 towns in which constitute the province of Cosenza (Calabria, Southern Italy); the 19 towns where the Albanian minority of Cosenza province live were excluded from the analysis. The 3,926 subjects out of the original 4,194 who were diagnosed as not being colorblind, were allowed to read Ishihara plates in order to determine the types and number of their mistakes. The same analysis was made on 546 out of a total of 582 University students who came from the three Calabrian provinces (Cosenza, Catanzaro and Reggio Calabria) and whose age range was 19-25 years. The same analysis was made on 33 males in Infancy (age range, 3-8 years in total coming from Catanzaro province reading the modified Ishihara test. All subjects were males, and fixed sampling allows to avoid the genetic Lyon phenomenon [4].

The reading of Ishihara plates [5] followed as carefully as possible all of the instructions of the same author: all the plates were 70 cm distant from the observer, under natural lighting coming back to the observer and the maximal time of reading for each plate was 5 seconds. All of the subjects who made more than 5 mistakes during their reading from the first 17 Ishihara plates were diagnosed as being colorblindness. Modified Ishihara test to study Infancy shows 11 tables containing a colored back with a colored image representing a little animal. Child must identify the little animal, rightly.

Results

The analysis of the distribution of the number of mistakes made by 3,926 pre-pubertal non-colorblind students during their reading of the Ishihara plates showed that only 16,8% of these subjects made no mistakes, while the rest of them made from 1 to 5 mistakes. The Ishihara plates which were read incorrectly were the numbers 9, 12 and 17 which described the number 74, 97, and 73, respectively. The wrong answers were 71, 21, and 87 and 13, 23, 76, respectively. The 546 University students who were non colorblind during their reading of the Ishihara plates showed that 25.1% made no mistakes, while the rest made from 1 to more 5 mistakes. These students also had more difficulties reading the same three Ishihara plates, number 9, 12, 17, and their wrong answer were 71, 24, 21, and 87, 13, 23, respectively. According with the Literature at to-day, we show in Infancy the most real trend regarding the color vision system in the brain development. At 3-4 age range, we have not any complete visive areas development, with the presence of the errors reading Ishihara plates; this picture is present until 5-6 age range to show a decrement of the errors at 7-8 age range.

Discussion and Conclusion

As the basic Neurobiology of mature color vision is relatively well understood investigating the development of color vision could provide insight into the development of the neural structures and pathways that underpin vision. As a result, there has been a concerted effort to understand the development of trichromatic color vision in infants and to identify changes in color discrimination across the life span [6]. Moreover, two conclusions can be drawn from a comparison of the two groups of subjects. First, in agreement with Chevalier and [6] color vision matures at about 25 years old. Second, there are no qualitative differences in the types of mistakes made by the two groups of subjects during their reading of the Ishihara plates. In conclusion, we can add that the analysis of both the number, and types of the mistakes made by all not colorblind subjects during different ages showed that the Ishihara test is very reliable during mass screening having the aim to obtain a rapid diagnosis of this anomaly and its phenotypes, as previously described by Somerfield [7-9].

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Conflict of Interest

Authors declare no conflicts of interest.

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