Available online at www.sciencedirect.com

SCIENCE DIRECT®

Learning and Individual Differences 15 (2005) 89–98

Learning and Individual Differences

www.elsevier.com/locate/lindif

Does Daltonism influence young children's learning?

María I. Suero, Ángel L. Pérez, Francisca Díaz, Manuel Montanero*, Pedro J. Pardo, Julia Gil, María I. Palomino

Facultad de Educación, Campus Universitario, Universidad de Extremadura, 06071 Badajoz, Spain

Received 30 October 2003; received in revised form 16 August 2004; accepted 31 August 2004

Abstract

Anomalies in colour vision constitute a particular type of sensory deficiency whose influence in educational contexts has attracted surprisingly little research attention given its ubiquitous use in various learning activities as a code, an aid, or even as the focus of the activity itself, especially during early education. We here describe a three-part investigation of the incidence and influence of Daltonism in a sample of 1039 preschool children. In the first study, the incidence of Daltonism was found to be more than 5% of the boys and less than 0.5% of the girls. The second study looked at how well certain standard classroom tasks involving colour perception were performed, and confirmed the expected negative influence of Daltonism. In the third study, however, no significant differences were found between the two groups in their scores on standard preschool tests of acquired concepts and skills, whereas their teachers, who still did not know which of their pupils had colour vision problems, in responding to a curricular competence questionnaire assessed the Daltonic pupils as somewhat poorer achievers than the non-Daltonic group. The present results should help parents and teachers improve their awareness of this deficiency and of the limitations that it imposes on the early stages of learning.

Keywords: Individual differences in colour vision; Colour vision deficiency; Special educational needs; Early childhood; Early education

* Corresponding author. Tel.: +34 924262770.
E-mail address: mmontane@unex.es (M. Montanero).

1041-6080/$ - see front matter © 2004 Elsevier Inc. All rights reserved.
doi:10.1016/j.lindif.2004.08.002

1. Introduction

Many of the problems of learning that appear at the earliest ages are directly linked to easily detectable visual problems (Keymer, 1999). It has been demonstrated, for instance, that the visual skills of binocular fusion and accommodation are closely related to resistance to fatigue and to the successful performance of school tasks such as reading that require processing of visual stimuli (Hennessey, Losue, & Rouse, 1984; Scheiman & Wick, 1994). The growing awareness of these issues by physicians, vision specialists, and educators has led many countries to institute ophthalmologic testing in schools, especially for the first years of education. There remain, nevertheless, some visual parameters that seem to have attracted hardly any attention. One is the capacity for colour vision. What is usually known as Daltonism is a specific type of visual deficiency that is usually detected very late in development, even though it can play an important part in affecting early learning.

A person is considered to have standard colour vision when he or she is able to match any given colour to a mixture of three primary colours in the appropriate proportions (within a small margin of error). The most frequent anomalies are manifest in confusion of red and green hues (or colours that contain one or the other in their mixture), although there also exists a blue–yellow anomaly. The severest and rarest deficiency is achromatopsy, when the affected individual has hardly any colour discrimination and sees the world as if in black and white. These pathologies may have a genetic or an acquired origin. Classic genetic studies of the red–green anomalies showed them to be linked to the X chromosome, reflected in a much higher incidence in men.

There is some quite reasonable doubt about whether Daltonism really affects school performance at the earliest ages. The hypothesis that it does have an influence is based on two educational assumptions that almost all pre-primary teachers would support. One is that much of children's visual experiences from 3 to 6 years old is based on the use of colour as an attribute of objects, and in the first years of their schooling colour is routinely used to motivate and facilitate the assimilation of new concepts. The other is that colour perception is essential in a multitude of tasks in which the child's prior knowledge of the distinction of primary colours is taken for granted.

The importance of these considerations is particularly manifested in the learning processes of the area of "Communication and Representation", where colour is both an educational resource of normal use in various activities and a part of the learning content itself. The following are some applications of colour to just the basic concepts as examples:

- In many textbooks and in activities that teachers use spontaneously, colour is often used as a visual support for everyday concepts, objects, drawings, or vocabulary that still does not form a solid part of the pupil's linguistic repertoire (Gil, 1999).
- Concepts related to numbers and quantification procedures are usually worked on with abacus analogues and coloured objects.
- Spatial representation is frequently linked to the teaching of such concepts as geometrical bodies, flat shapes, and their relationships in space. Much of the curricular material that we have reviewed uses colour to aid in differentiating the said geometrical figures. In working on spatial orientation, teachers also often have recourse to colour in order to identify the objects in an illustration when they are presenting the relationships "up–down", "on–off", "inside–outside", etc.