Vision screening outcomes of Grade 3 children in Australia: Differences in academic achievement

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A B S T R A C T

Learning is multisensory, thus impaired vision may impact on classroom learning and subsequently, academic achievement. This research investigated the impact of impaired vision on academic achievement in a sample of 109 Grade 3 Australian children. Approximately 30% of the sample were identified as borderline or unsatisfactory by a vision screening and were referred for a full eye examination. Children who were referred at the vision screening scored significantly lower on national standardised tests of reading, grammar and punctuation, spelling and numeracy, when compared to their not referred peers. This research has important implications for teachers and eye health professionals, as the findings highlight the importance of early vision screening in identifying children who may be achieving below their potential.

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1. Introduction

Multisensory stimulation is essential in early development, as it encourages learning and brain plasticity (Shams & Seitz, 2008). For example, reading and spelling are inherently multisensory, requiring processing of both phonological (verbal) and orthographical (visual) representations (Labat, Ecalle, Baldy, & Magnan, 2014). Impairment in any one of the sensory systems is thus likely to impact on cognitive processing and learning. The current study addressed this issue with a specific focus on the role of the visual system, by exploring the impact of impaired vision on academic achievement in primary school aged children.

Recent studies suggest that the visual demands of the classroom are likely to contribute to a child's early learning and achievement. When preparing classroom lessons, the importance of visual attention is well established (Fisher, Godwin, & Seltman, 2014), however, teachers assume that children possess the visual capabilities required to take advantage of in class learning opportunities. These opportunities might include the ability to rapidly change focus from near to distance, as required when changing visual attention from workbooks to the board, or sufficient colour vision discrimination to distinguish colours that a teacher might use to highlight important information. Indeed, a recent study of Grade 5 and Grade 6 Australian classrooms suggested that up to 70% (263 ± 37 min) of daily classroom time involved academic related tasks with visual input (Narayanasamy, Vincent, Sampson, & Wood, 2016). These visual related academic tasks were shown to

largely involve near tasks (47%), distance tasks (29%), distance to near tasks (15%), and computer tasks (9%) (Narayanasamy et al., 2016). For example, children who are long sighted and not wearing appropriate spectacles (uncorrected hyperopia) may experience blurred vision at near and eye strain, which could affect their ability to complete near tasks (e.g. reading), which constitute a large proportion of academic related tasks, thus limiting their opportunities to learn and achieve their full potential. Indeed, Thurston (2014) in his review of this area highlighted the importance of a visual system that is optimally focused (visual acuity and refraction), free of any eye disease, uses efficient and coordinated eye movements to scan and quickly change focus over a range of working distances, with appropriate cortical integration and processing of visual input. These key visual components are necessary before any higher level cognitive processing can occur (Paivio, 2013).

While a large body of research has investigated the impact of vision impairment on academic achievement in school aged populations, the findings are mixed and dependent on which specific visual functions were assessed and the academic outcome measures employed (e.g. Hannum & Zhang, 2012; Kulp et al., 2016; Ma et al., 2014; Roch-Levecq, Brody, Thomas, & Brown, 2008; Yi et al., 2015). Given the importance of multisensory stimulation in early reading development, the Vision in Preschools – Hyperopia in Preschoolers (VIP-HIP) Study (Kulp et al., 2016) reported interesting findings regarding the role of accurate visual focusing on literacy performance, particularly in light of the relatively high level of near work involved in modern classrooms (Narayanasamy et al., 2016). Kulp et al. (2016) found that overall, preschool children with uncorrected hyperopia scored significantly worse on the Test of Preschool Early Literacy (TOPEL) when compared to children who were emmetropic (no refractive error). Further analysis of the TOPEL subtests (print knowledge, definitional vocabulary and phonological awareness) showed that children with uncorrected hyperopia performed significantly worse on the print knowledge subtest (Kulp et al., 2016). This indicates that uncorrected vision impairment may differentially contribute to learning outcomes dependent on the visual demands of specific tasks. For example, print knowledge requires visual identification and distinguishing of written letters (e.g. distinguishing *p, d, q, and p*) and words, whereas the phonological awareness subtest is conducted verbally with no written (visual) element. In a study of Grade 4 and Grade 5 Chinese children, Yi et al. (2015) reported that 24% had reduced habitual visual acuity and that poor vision was associated with reduced mathematics achievement. Importantly, in both the Kulp et al. (2016) and Yi et al. (2015) studies only one academic domain was selected as an indicator of overall academic achievement. The association between vision impairment and academic achievement therefore requires further detailed examination across multiple academic domains that involve a range of visual demands.

Another area that represents a gap in evidence is the wide variation in the vision screening protocols used to assess children in the early stages of school. Many vision screenings concentrate on assessment of distance vision, with minimal consideration of near visual functions, which are arguably the visual skills most relevant to classroom performance (Hopkins, Sampson, Hendicott, & Wood, 2013). In Hopkins et al's (2013) review of children's vision screenings, it was demonstrated that the eye conditions most commonly targeted were amblyopia (lazy eye) and its risk factors, focusing errors, colour vision deficiencies and eye disease. This review concluded that there is a lack of a universally agreed policy or strategy around children's vision screenings in Australia and other countries, most likely due to the paucity of evidence available on which to base screening protocols (Hopkins et al., 2013). Importantly, early detection of visual problems depends on and impacts upon both education and optometry professionals. Vision screening of a large sample (n = 2697) of Australian children aged 3–12 years, identified approximately 27% of children (n = 669) as having borderline and unsatisfactory visual outcomes, with nearly 20% being referred for further assessment, while 7% were already under the care of an eye care professional (Junghans, Kiely, Crewther, & Crewther, 2002). In the majority of cases, children were referred because of binocular vision anomalies (poor eye coordination), focusing errors or a combination of the two, which all contribute to a child's visual efficiency and ability to achieve comfortable, clear, single vision. Given that around 1 in 4 children were identified as having vision problems in these screenings (between 20% and 30%) (Junghans et al., 2002), it is possible that they may also have experienced difficulties with the visual demands of school based learning, resulting in academic achievement that was below their true potential.

The present research addressed some of the gaps in knowledge regarding the association between vision screening outcomes and academic performance in primary school children. The aim of this study was to undertake a clinical vision screening assessment in a cohort of Grade 3 children, to identify those with uncorrected vision problems, including assessment of both distance and near visual function. The links between the referral outcomes of the vision screening and academic achievement were explored using a national standardised test related to early literacy and numeracy.

2. Methods

2.1. Schools

Three schools agreed to participate in this study through contact by the authors at a regional cluster meeting. The schools were medium large government primary schools from the outer north metropolitan region of Brisbane, Australia, each with enrolments of above 500. All three participating schools had Index of Community Socio-Economic Advantage (ICSEA) values between 940 and 986; all below the national mean of 1000. The ICSEA values are derived from both community- and child-level data. Child-level data includes parent occupation and education, while community-level data includes remoteness and percent Indigenous enrolment. With a national mean of 1000 (±100), ICSEA values range from approximately 500 (schools with children with extremely educationally disadvantaged backgrounds) to approximately 1300 (schools with children with