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Brief Report

When visual stimulation of the surrounding environment affects children's cognitive performance

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ABSTRACT

Visual distraction is widely studied in children, particularly in visuospatial cognitive tasks. In these studies, targets and distractors are usually shown in the same display (e.g., the computer screen). However, children are constantly exposed to visually enriched environments (e.g., elementary school classrooms), and little is known about their influence on children's cognition. Although the importance of the surrounding environment is well recognized in the literature, few experimental studies have explored this question. We propose an alternative paradigm to study visual distraction in children that brings together the rigor of experimental psychology and more ecological validity on the exposure to potential environmental distractors. Our study was designed to investigate whether a high-load versus low-load visual surrounding environment influences children's cognitive performance as evaluated by four different cognitive tasks. A sample of 64 children (aged 8–12 years) completed two sessions in two environmental conditions: a high-load visual surrounding environment and a low-load environment. In each session, they performed visuospatial attention and memory tasks. Overall, the results suggested that the high-load visual environment affected children's cognitive performance given that children performed better in the low-load visual environment (e.g., higher percentage of hits, higher Corsi span). Understanding the impact that a visually rich surrounding

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environment has on children's cognitive processes that support more complex ones is important to support recommendations on how the environment should be organized to foster better daily activities.

Introduction

An increasing number of studies have been concerned with the influence of the surrounding environment in several contexts, particularly in learning settings (e.g., Fisher, Godwin, & Seltman, 2014); for example, children's learning environments typically display many colorful materials. Although these stimulating environments are designed to provide sensory enrichment during early phases of development and to motivate pupils to engage in learning activities (Barrett, Davies, Zhang, & Barrett, 2015), little is known about their real effect in cognitive processes that underlie other activities. Some authors have considered that such environments are "excessively stimulating and disrupting" (Stern-Ellran, Zilcha-Mano, Sebba, & Levit Binnun, 2016, p. 1) and can become a source of distraction (Godwin et al., 2016). Indeed, at a given moment, whereas some of the available stimuli might be relevant to the task at hand (targets), others are irrelevant and may work as distractors (Forster & Lavie, 2014). Attending and processing all visuospatial stimuli is impossible due to our limited processing capacity; this is specially true in children whose cognitive processes are still developing (Gaspelin, Margett-Jordan, & Ruthruff, 2015).

Most of the studies that have investigated visual distraction have used laboratorial paradigms in which both distractors and targets are presented in the same display, usually the computer screen (e.g., Gaspelin et al., 2015). From a theoretical standpoint, several cognitive processes seem to be involved in the processing of visuospatial information such as selective attention and working memory, two executive functions that interact in a bidirectional manner (Dixon, Fox, & Christoff, 2014). Working memory has been conceptualized as the interface between oriented executive control (endogenous attention) and stimuli-driven control (exogenous attention) and is considered a central agent in controlling for the interference of distractors (e.g., Konstantinou, Beal, King, & Lavie, 2014). In typical selective attention tasks, the capacity to ignore distractors depends on the level of perceptual load; distractors' interference is greater when these differ from the target stimuli (as compared with when they are similar), a situation that requires higher involvement from working memory (e.g., Konstantinou et al., 2014).

Although laboratory-based procedures are relevant, they might not reflect the potential influence of the surrounding environment present in children's daily lives. The environment–behavior model proposed by Barrett et al. (2015) provides a framework to better understand the environmental factors that could influence children's performance in several contexts such as classrooms. According to this model, there are three main environmental factors that influence learning gains: naturalness, individualization, and level of stimulation. The first refers to the idea that performance could be improved when individuals are linked with natural elements such as plants and pure air. The second denotes that children's performance (e.g., learning) is influenced by their own location in the environment (e.g., classrooms) and/or by their connection with the remaining people (e.g., learners). The level of stimulation relates to the color and complexity of the visual environment. Of main interest to the current study is the last element, which has also been considered in some previous studies (Fisher et al., 2014; Hanley et al., 2017; Mastroberardino & Vredeveldt, 2014; Stern-Ellran et al., 2016).

Fisher et al. (2014) investigated the impact of the classroom visual environment on children's ability to focus their attention during lessons and to learn their contents. Children ($N = 24$, $M_{age} = 5.37$ years) participated in several lessons over 2 weeks. Half of the lessons occurred in a decorated classroom, and the remaining lessons occurred in a sparse classroom; lessons were video-recorded. The decorated classroom consisted of a laboratory space containing several visual

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