Research in Developmental Disabilities 34 (2013) 3936–3945

Contents lists available at ScienceDirect

Research in Developmental Disabilities

The effect of different stimulus attributes on the attentional performance of children with attention deficit/hyperactivity disorder and dyslexia

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ARTICLE INFO

Article history:
Received 24 June 2013
Received in revised form 23 August 2013
Accepted 26 August 2013
Available online 9 September 2013

Keywords:
Dyslexia
Attention deficit/hyperactivity disorder
Sustained attention
Selective attention
Stimulus attribute

ABSTRACT

While teachers have traditionally used the interesting objects to increase student attention in the classroom, evidence supporting the effectiveness of this method is lacking. The present study investigated the influence of different stimulus attributes for typical developing students and for students with attention deficit/hyperactivity disorder (ADHD) and dyslexia. Thirty children with ADHD, 30 children with dyslexia, and 30 typical developing students were tested using a measuring tool that was constructed by the authors to assess their sustained attention and selective attention on the geometric-figure assessment and the interesting-figure assessment. The geometric-figure assessment included a square, circle, trapezium, and triangle; and the interesting-figure assessment included a house, cat, hand, and tree. While the typical developing group showed better selective attention on the geometric-figure assessment, there was no difference between the dyslexic group and the ADHD group with respect to selective attention. Furthermore, the typical developing and dyslexic groups did not differ in the geometric-figure assessment in sustained attention and were both better in this area than the ADHD group. In the interesting-figure assessment, the typical developing and dyslexic groups performed similarly in sustained attention, but selective attention of the dyslexic group improved more than the ADHD group, similar to the typical developing group. Both selective attention of the dyslexic group and sustained attention of the ADHD group showed positive significant differences in the interesting-figure assessment, but sustained attention of the dyslexic group and selective attention of the ADHD group showed little difference in the interesting-figure assessment. Surprisingly, the typical developing group did not show any significant difference in the interesting-figure assessment, possibly because they had previously demonstrated a ceiling effect in the geometric-figure assessment.

1. Introduction

Attention deficit/hyperactivity disorder (ADHD), which is characterized by inattention or by impulsivity and hyperactivity, can significantly affect daily life at school and at home (American Psychiatric Association, 2000). Particular

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http://dx.doi.org/10.1016/j.ridd.2013.08.038

attention deficits of children with ADHD are sustained and selective attention, both of which have become subsequent research topics (Barkley, 1997; Slusarek, Velling, Bunk, & Eggers, 2001; Wang & Yang, 2008).

In contrast, while dyslexic children's main deficit emerges in their academic performance, abundant evidence has demonstrated that they also have deficits in selective attention regarding alphabetic languages (Bender, 2004; Golden & Golden, 2002; Hallahan, 1989; Heiervang & Hugdahl, 2003; Sterr, 2004) and logographic languages (Gao, Zhu, Sun, & Qin, 2005; Jing, Wang, Chen, & Yang, 2004).

According to Wang, Chang, and Ho's (2011) review, both ADHD and dyslexic children showed attentional deficits, though the differences between those attentional deficits are not clear. Therefore, their sustained and selective attention, two of the most important attentional functions, are carefully examined and compared in the present study. Because the elements of attentional measurements in all studies are inconsistent, the results of these studies will be carefully explained based on the re-examination of these measurements in the present study.

2. The definition of sustained attention and selective attention

Attention has been considered one of the most important components necessary for learning and successful participation in the educational process (Gianvecchio & French, 2002). Sturm (1996) classified attention into four subtypes: alertness, sustained attention, selective attention, and divided attention. Among this classification, Sturm considered sustained attention as individual alertness over a long period with the ability to discern a slight change of target.

Ruff, Capozzoli, and Weissberg (1998) considered sustained attention as "the ability to mobilize and maintain selectivity and concentration." Posner and Petersen (1990) described sustained attention as the ability to maintain focus continuously on specific stimuli and to direct and control one's attention innately (Reck & Hund, 2011). Gianvecchio and French (2002) defined sustained attention as a coordinate approach with other cognitive activities, such as memory, motivation, and self-regulation, to promote adaptation to environmental and internal demands. Some researchers have proposed that lapses in sustained attention can be detected within 4 min by reversing the response paradigm of vigilance tasks (Robertson, Manly, Andrade, Baddeley, & Yiend, 1997). From preschoolers to adults, researchers have used methodologies that test the ability to detect targets in long sequences of irrelevant distractors to measure sustained attention (DeWolfe, Byrne, & Bawden, 1999; Conners, 2000), and performance is typically evaluated in terms of commission errors (responding to distractor stimuli) and omission errors (missing target stimuli) (Reck & Hund, 2010). Several studies have identified sustained attention as an important predictor of subsequent achievement test scores (Cobb, 1972; Frederick & Walberg, 1980).

Selective attention is defined as the ability to filter out irrelevant or distracting information from that which is more central or relevant to a given task. Findings have consistently demonstrated that the strategies children use to selectively attend become more effective in terms of the relevant information recalled during middle childhood (Blumberg, Torenberg, & Randall, 2005). In selective attention, the control or regulation of behavior is restricted to some subset of information relevant to a current goal. The biased competition theory (Desimone & Duncan, 1995) indicates that top-down effects enhance processing for stimulus representations that are most relevant to the current behavior while reducing or gating this process for unwanted competing stimuli representations (Pritchard, Neumann, & Rucklidge, 2008).

3. Attentional deficit of children with attention deficit/hyperactivity disorders and dyslexia

ADHD is a common childhood-onset psychiatric disorder defined by age-inappropriate levels of inattention, hyperactivity, or impulsivity (DSM-IV, American Psychological Association, 1995). Barkley suggested one of the major attention deficits of ADHD is the deficit of sustained attention, such as the inability to maintain attention to finish a task or to notice details, and the tendency to make mistakes (Barkley, 1997).

Doctors typically use stimulant medications, such as methylphenidate, for ADHD, as such medications have effectively treated the cognitive and behavioral features of the disorder. Stimulants inhibit the re-uptake and promote the release of catecholamines (including dopamine and noradrenaline) (Krause, Dresel, Krause, La Fougere, & Aclenheil, 2003). A recent study shows that one major characteristic of ADHD is variability in response time (RT) on tasks that measure sustained attention capabilities (Castellanos & Tannock, 2002). Sustained attention is the intrinsic ability to mindfully and consciously process stimuli whose non-arousing qualities would otherwise lead to habituation and distraction (Robertson et al., 1997). The ability to sustain attention on a task and produce an appropriate response entails executive function. Although most studies have focused on explaining sustained attention deficits in ADHD, some researchers have argued that sustained attention deficit is due to a time-on-task effect based on the number of errors (van den Bergh et al., 2006).

Even though the major characteristic of children with dyslexia is issues with reading, their attention problems have also been examined for several years. For example, Johnson (1981) suggested that children with dyslexia typically demonstrate attention deficit in selecting objects, while Bender (2004) indicated that children with dyslexia have difficulty selecting that which they like or do not like. Hallahan (1989) found that children with dyslexia could not process related information continuously, and attributed this phenomenon to their difficulty with excluding irrelevant objects. Bowen and Hynd (1988) used dichotic listening studies to test the selective attention of children with dyslexia and found that children with dyslexia demonstrated a delay in speed of free recall and attention orientation. Ricards, Samuels, Turnure, and Ysseldyke (1990) used a continuous performance test and selective attentional tests to examine the selective attention of children with dyslexia and found that the participant performance was significantly delayed.