



Executive functions in adults with developmental dyslexia



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ABSTRACT

Background: Executive functioning (EF) deficits are well recognized in developmental dyslexia, yet the majority of studies have concerned children rather than adults, ignored the subjective experience of the individual with dyslexia (with regard to their own EFs), and have not followed current theoretical perspectives on EFs.

Aims and Methods: The current study addressed these shortfalls by administering a self-report measure of EF (BRIEF-A; Roth, Isquith, & Gioia, 2005) and experimental tasks to IQ-matched groups of adults with and without dyslexia. The laboratory-based tasks tested the three factors constituting the framework of EF proposed by Miyake et al. (2000).

Results: In comparison to the group without dyslexia, the participants with dyslexia self-reported more frequent EF problems in day-to-day life, with these difficulties centering on metacognitive processes (working memory, planning, task monitoring, and organization) rather than on the regulation of emotion and behaviour. The participants with dyslexia showed significant deficits in EF (inhibition, set shifting, and working memory).

Conclusions and Implications: The findings indicated that dyslexia-related problems have an impact on the daily experience of adults with the condition. Further, EF difficulties are present in adulthood across a range of laboratory-based measures, and, given the nature of the experimental tasks presented, extend beyond difficulties related solely to phonological processing.

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1. What this paper adds?

Executive functioning (EF) deficits are well documented in children with dyslexia, but are less well explored in adults. Two studies addressed this issue, using the same participants: 30 adults with dyslexia and 30 age- and IQ-matched controls. Firstly, a self-report measure assessed the frequency of EF failure in everyday life in the last month. Secondly, EF tasks tapping the different facets of EF under a theoretically coherent account of EF were administered. Adults with dyslexia identified themselves as experiencing EF failures more frequently in day-to-day life. Particular difficulties emerged in working memory, task monitoring, and planning and organization. Whilst differences were found in metacognitive aspects of EF, the groups did not differ in emotional regulation. On the laboratory-based tasks, the group with dyslexia was less able to inhibit pre-potent responses, incurred a greater temporal cost in switching between cognitive operations, and was less able to update working

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memory. In the latter case, differences emerged on a non-phonological working memory task as well as on a phonologically-based measure. On the reflective level of cognition (Stanovich, 2009), the results show how EF failures affect everyday life in adults with dyslexia. These difficulties were also apparent when performance was measured in the laboratory, indicating similar problems on the algorithmic level of cognition. No previous work has considered both self-report and laboratory EF performance in the same sample of adults with dyslexia. The results thus offer a greater understanding of the EF problems facing adults with dyslexia.

2. General introduction

Developmental dyslexia (henceforth, dyslexia) is a learning disorder typically defined in terms of persistent difficulties with reading or spelling, or both (Lyon, Shaywitz, & Shaywitz, 2003; Siegel, 2006). Such problems with literacy have led to the phonological core deficit hypothesis of dyslexia being proposed (e.g., Stanovich, 1988; Vellutino, 1979), which assumes that phonological processing difficulties are at the root of the condition (for a review, see Vellutino, Fletcher, Snowling, & Scanlon, 2004). However, evidence has indicated that there are wider cognitive deficits associated with dyslexia (e.g., Facoetti, Paganoni, Turatto, Marzola, & Mascetti, 2000; Jorm, 1983; Tallal, 1985), and that its impact on cognition persists into adulthood (e.g., McLoughlin, Fitzgibbon, & Young, 1994). Given that day-to-day demands on cognition are likely to be very different in adulthood to those in childhood, it is important to study the cognition of adults with dyslexia in its own right. The current paper used self-report and laboratory measures to investigate one problematic area of cognition, executive functioning (EF), in which deficits are well documented in children (see Booth, Boyle, & Kelly, 2010, for a review) but less well explored in adults.

Executive functions allow self-regulation and the enactment of goal-directed behavior, permitting the coordination of different cognitive processes over time. They include such higher-order cognitive abilities as planning, problem solving, organizing behaviour, sequencing, self-monitoring, inhibiting verbal and motor responses, accessing information in long-term memory in a controlled and flexible manner, adapting responses to changes in task or environmental demands, dual-task management, and ensuring that task-relevant information is retained over the duration for which it is needed (e.g., Andrés, 2003; Barkley, 1997; Fisk & Sharp, 2004; Miyake & Friedman, 2012; Pennington & Ozonoff, 1996; Rabbitt, 1997; Stuss & Benson, 1997).

Previous research on EF in dyslexia has mainly concerned cognition in childhood (where general developmental evidence has indicated that the structure of EFs may differ from that of adults; Best, Miller, & Jones, 2009; van der Ven, Kroesbergen, Boom, & Leseman, 2013). Further, it has tended to use a range of EF measures in a piecemeal and theoretically ad hoc manner, often failing adequately to match participant groups for IQ, and ignoring the self-perspective of the individual with dyslexia on his or her own EFs. The current paper investigated EF in adults with dyslexia, taking into account their own views, and exploring EF in terms of an established theoretical framework (Miyake et al., 2000). Study 1 investigated where adults with dyslexia considered their problems with EF to lie in everyday life, whilst laboratory-based experimental work was conducted in Study 2, drawing on the components of EF identified within Miyake et al.'s three-factor structure. The specific predictions relating to Studies 1 and 2 are set out in Sections 3.1 and 4.1 respectively.

3. Study 1: Self-ratings of EF

3.1. Introduction

Some self-report measures have previously been used to assess the everyday cognitive performance of adults with dyslexia. For example, Smith-Spark, Fawcett, Nicolson, and Fisk (2004) administered the Cognitive Failures Questionnaire (CFQ; Broadbent, Cooper, Fitzgerald, & Parkes, 1982) to compare the relative frequency with which errors were reported as occurring in the day-to-day cognition of university students with and without dyslexia. Smith-Spark et al. found that the group with dyslexia reported significantly more frequent cognitive failures than a control group matched for age and IQ (for similar findings, see Leather, Hogh, Seiss, & Everatt, 2011). More particularly, respondents with dyslexia had problems with distractibility, over-focusing their attentional resources to the detriment of noticing peripheral information, and word-finding. Significant others (such as relatives and housemates) corroborated these problems with distractibility, absent-mindedness, and disorganization in the group with dyslexia. Some CFQ items may be interpreted as tapping into EF failure, but the CFQ is not sufficiently focused on particular aspects of EF for definitive conclusions to be drawn.

A more focused measure of EF, centered on everyday functioning, is the Behavior Rating Inventory of Executive Function (BRIEF; Gioia, Isquith, Guy, & Kenworthy, 2000). The BRIEF uses ratings from parents, teachers and participants themselves to assess behaviour relating to EF in the home and school environments of five- to 18-year-old children. Locascio, Mahone, Eason, and Cutting (2010) administered the BRIEF to parents of children aged 10 to 14 years, finding that respondents whose children had poor word recognition skills rated their offspring as having significantly higher levels of executive dysfunction than both children with comprehension problems and controls. However, only scores on the Global Executive Composite (GEC) were reported. This overall summary score, collapsed as it is across different facets of EF, does not reveal the specific aspects of EF that parents of children with dyslexia rate as problematic.

McLoughlin et al. (1994) advocate studying adults with dyslexia in their own right, not treating them as children with dyslexia who have grown up. Indeed, the daily experiences and demands on cognition of adults with dyslexia are different

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