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Self-reported symptoms of developmental dyslexia predict impairments in everyday cognition in adults☆

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ABSTRACT

Background: Research into the impact of dyslexia on everyday cognition in adults with dyslexia is relatively limited and has tended to focus on university students.
Aims and methods: The present online study aimed to add to this small corpus by investigating the everyday effects of dyslexia on memory and attention in a larger community-based sample. One hundred and seventy-two adult volunteers completed five well-established self-report questionnaires, assessing dyslexia and Attention Deficit Hyperactivity Disorder symptomatology and everyday experiences with memory, attention, and mind-wandering.
Results: After controlling for ADHD symptomatology, hierarchical regression analyses revealed that higher levels of dyslexia-related symptomatology were associated with greater, more frequent everyday memory and attentional problems, but not with a greater propensity to mind-wandering. Increased levels of dyslexia symptomatology were positively associated with the frequency of both everyday attentional lapses (at least when performing a pair of tasks or easy tasks while inhibiting intervening stimuli) and everyday memory failures. No significant associations were found between dyslexia symptomatology and attentional lapses when performing difficult tasks in the presence of concurrent stimuli or between dyslexia symptomatology and the propensity to mind-wandering.
Conclusions and implications: Dyslexia symptomatology was perceived as being associated with more everyday memory and attention problems in adulthood. Adjustments to educational and workplace settings and interventions to compensate for these difficulties are proposed.

What this paper adds

While research on the impact of developmental dyslexia on reading and spelling is abundant, research into the effect that dyslexia can have on daily cognitive functioning in adulthood is relatively small and has tended to focus on the experiences of young adults who also tend to be university students with formal diagnoses. The present study added to the limited research on the influence of dyslexia on the everyday cognition of adults and, particularly, its impact on everyday memory and attention. By adopting an online survey approach, the study reached a considerably larger number of respondents than previous research and, thus, assessed the experiences of

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a wider range of participants, in terms of age and educational background. Further to this, self-reported dyslexia symptomatology, rather than formal dyslexia diagnosis, was explored. Both these aspects were also novel contributions to the study of everyday cognition in adults with dyslexia. The results showed that adults with dyslexia-related impairments report more memory failures and attentional lapses in their everyday lives, even after accounting for co-occurring ADHD-related symptomatology. The findings enhance the understanding of the detrimental effects that dyslexia has on daily functioning and emphasise the need to raise awareness of the "hidden'' effects of dyslexia in order to enhance the support given to individuals with dyslexia in educational and workplace settings. Moreover, this research has identified a potential distinction between the role of distractibility in dyslexia and its role in ADHD and this should be investigated further.

1. Introduction

Developmental dyslexia (hereafter referred to as dyslexia) is the most prevalent learning disability, believed to affect 5–10% of the worldwide population (Knight, 2018). The Diagnostic and Statistical Manual of Mental Disorders (5th ed.; American Psychiatric Association, 2013) classifies dyslexia as a learning disorder that is specifically associated with difficulties in reading and/or accuracy and spelling. Such difficulties cannot be accounted for by low intelligence, sensory or neurological damage, or insufficient educational opportunity (Rack et al., 1992). Dyslexia has been conventionally linked with phonological deficits (e.g., Snowling, 1987; Stanovich, 1988; Vellutino et al., 2004) but a broader range of cognitive impairments has also been documented, including problems with attention (e.g., Hari & Renvall, 2001; Ruffino et al., 2014), working memory (e.g., Menghini et al., 2011; Provazza et al., 2019; Smith-Spark & Fisk, 2007), and executive functioning (e.g., Brosnan et al., 2002; Smith-Spark, Henry et al., 2016; Varvara et al., 2014). These difficulties have usually been identified under laboratory conditions and there is only a small literature examining the effects of dyslexia on everyday cognition (e.g., Khan, 2014; Leather et al., 2011; Smith-Spark et al., 2004; Smith-Spark & Zięcik, 2016). The focus of the current research was, therefore, to expand upon this small corpus of evidence; firstly, by investigating the effects of dyslexia on everyday memory and attentional processes in adults and, secondly, by broadening the sample to extend beyond the experiences of university-educated participants with dyslexia. Attention deficit hyperactivity disorder (ADHD) is frequently associated with dyslexia, as the two disorders have a 25–40% bidirectional co-occurrence rate (DuPaul et al., 2013; Willcutt & Pennington, 2000). The condition is characterised by developmentally inappropriate levels of inattention (short attention span), impulsivity and hyperactivity (American Psychiatric Association, 2013) and it is highly co-occurrent with many neurodevelopmental conditions and specific learning difficulties, like developmental coordination disorder (dyspraxia) and autism spectrum disorder (Gillberg et al., 2004). Considering the overlap in symptomatology between dyslexia and ADHD, and the fact that executive function and sustained attention impairments have also been associated with ADHD (Barkley, 1997), the current research aimed to statistically control for this potential confound, in order to make more accurate conclusions about the everyday impact of the presence of dyslexia.

Smith-Spark et al. (2004) explored the effects of dyslexia-related cognitive deficits in the everyday lives of adults. They administered the Cognitive Failures Questionnaire (Broadbent et al., 1982), a self-report measure, to identify the areas of cognition that individuals with dyslexia struggled with in everyday life. Compared with university students without dyslexia, those with dyslexia reported more cognitive failures in relation to absentmindedness, planning, language skills, and slips of attention. These cognitive failures highlight a general impairment in attentional and memory processes and indicate that dyslexia-related problems in adulthood extend beyond reading, writing, and spelling to affect cognition across a variety of settings and tasks. The accuracy of the participants' self-reports was corroborated by close associates of the participants. They also reported that the individuals with dyslexia were more distractible, absentminded and disorganised in their day-to-day lives. Similar increased levels of susceptibility to everyday cognitive failure have also been found in a wider sample of adults with dyslexia, again using the Cognitive Failures Questionnaire, with the majority of those respondents being in employment (Leather et al., 2011).

Smith-Spark, Henry et al. (2016) used both self-report and laboratory measures of executive functioning in their study of executive functioning in adults with dyslexia. The adults with dyslexia self-reported more everyday executive functioning problems relating to metacognitive processes, such as organisation, working memory, task monitoring and planning, in comparison with the control group without dyslexia. The findings from the laboratory tasks also showed significant deficits in working memory, set shifting, and inhibition in the same adults with dyslexia, thus corroborating their self-reports and, again, indicating that executive functioning difficulties extend beyond tasks and settings demanding phonological processing. Other studies have also identified executive functioning difficulties in dyslexia that are not linked to the phonological domain, in both children and adults (e.g., Brosnan et al., 2002; Smith-Spark & Fisk, 2007; Varvara et al., 2014), but Smith-Spark, Henry et al. (2016) investigated a broader range of executive functions compared with previous research.

The findings of Smith-Spark et al. (2004) and Smith-Spark, Henry et al. (2016) challenge the specificity of the dominant accounts in dyslexia that focus solely on phonological deficits (e.g. Snowling, 1987; Stanovich, 1988; Vellutino et al., 2004), and are consistent with Nicolson and Fawcett (1990) Dyslexic Automatisation Deficit (DAD) hypothesis, which argues for a more broad explanation of the condition. Specifically, Nicolson and Fawcett (1990) proposed that difficulty with reading is only a symptom of a more general and pervasive deficit in skill automatisation. According to the DAD hypothesis, individuals with dyslexia have difficulty performing tasks that should usually be automatic, and such difficulties relate to impairments in the automatisation of both cognitive and motor skills. However, children and adults with dyslexia are able to mask these difficulties by consciously allocating additional attentional resources to tasks and, therefore, perform at a similar level to their peers who do not have dyslexia. Due to the limited nature of attentional resources, the capacity to control attention consciously diminishes as task demands get more challenging, for example in more complex tasks or in tasks that involve dual-task performance, so dyslexia-related impairments may emerge when task demands exceed the spare attentional capacity of the individual.

Self-report questionnaires have also been used to study prospective memory in dyslexia (e.g., Khan, 2014; Smith-Spark & Zięcik, 2016; Smith-Spark et al., 2017). This memory system is responsible for memory for delayed intentions (e.g., remembering to attend an appointment) and plays a vital role in successful everyday functioning (e.g., McDaniel & Einstein, 2007). Smith-Spark et al. (2017) measured prospective memory in adults with and without dyslexia, using both a self-report questionnaire and a clinical measure. The group with dyslexia self-reported more frequent prospective memory failures, compared with the group without dyslexia, and this was in line with their performance on the clinical task, on which they also performed significantly worse. The researchers also included a naturalistic task at the end of the testing session, which required participants to leave a voicemail to the experimenter, stating some specific information, exactly 24 h after the testing session had ended. The participants with dyslexia were found to be more likely to forget to carry out the intended task, thereby providing further support for prospective memory deficits in dyslexia. Khan (2014), using a self-report measure, also reported more frequent everyday retrospective memory problems in children with dyslexia.

Dyslexia would, therefore, seem to have a detrimental effect on daily cognitive functioning in adulthood and that this is even the case on everyday tasks that do not require reading or writing (e.g., Smith-Spark, 2017). Moreover, objective measures taken under everyday conditions beyond the laboratory bear out the self-perceptions of individuals with dyslexia. Taken together, these findings appear to provide a clear indication that the effects of dyslexia on cognitive functions pervade everyday life, being found across a range of cognitive domains (everyday memory, executive functioning, and prospective memory) and highlight a need for further, detailed research into everyday cognitive impairments in dyslexia. As a consequence, the present study sought to investigate the everyday impact of dyslexia in adults on memory and attention. Given that previous research has tended to focus on the everyday cognitive experiences of university students (e.g., Smith-Spark et al., 2004; Smith-Spark & Zięcik, 2016; Smith-Spark et al., 2017; Smith-Spark, Henry et al., 2016), the current study aimed to recruit a wider range of respondents, including both students and individuals in employment and with a potentially broader range of ages.

Traits associated with dyslexia were measured using the Adult Reading Questionnaire (Snowling et al., 2012), which is designed to assess aspects of language, literacy and organization. Since dyslexia frequently co-occurs with ADHD (e.g., DuPaul et al., 2013), ADHD symptomatology was screened and controlled using the World Health Organisation ADHD Self-Report Scale (Kessler et al., 2005). Memory failures in everyday life were measured using the Everyday Memory Questionnaire-Revised (Royle & Lincoln, 2008). This measure is a shorter version of Sunderland et al., (1983) Everyday Memory Questionnaire. The Everyday Memory Questionnaire-Revised includes items assessing both prospective memory and issues with the retrieval and recall of recent events from retrospective memory. Further questions tackle attentional shifts during conversation or when reading.

The Everyday Attention Questionnaire (Martin, 1986) and the Daydreaming Frequency Subscale of the Imaginal Processes Inventory (Singer & Antrobus, 1970) were used as measures of different aspects of everyday attention.

The everyday experience of sustained, selective, and divided attention was measured using the Everyday Attention Questionnaire, which consists of three distinct components (Easy, Difficult and Pairs) measuring the self-reported ease with which individuals feel that they could carry out either an (a) easy or (b) difficult task in the presence of intervening stimuli, or (c) a pair of stimuli. This self-report measure has been used to study the everyday use of attention in a diverse range of populations, such as patients with chronic fatigue syndrome (Ray et al., 1993), people with Parkinson's disease (Poliakoff & Smith-Spark, 2008), and people with chronic schizophrenia (López-Luengo & Vázquez, 2003). Of direct relevance to the current study, it has also been administered to children with and without dyslexia by Khan (2014). The children with dyslexia reported more difficulty with working with their attentional resources when doing a task that they found easy, when carrying out a task that they found difficult, and when carrying out two tasks at the same time.

Susceptibility to internal sources of distraction in daily life (propensity to mind-wandering) was measured using the Daydreaming Frequency Subscale. The Daydreaming Frequency Subscale has been used to study, for example, the effects of ageing on attentional shifting (Giambra, 1993), psychological wellbeing (Stawarczyk et al., 2012), and sleep quality (Carciofo et al., 2014). A positive relationship between Attention Deficit Hyperactivity Disorder (ADHD) symptomatology and Daydreaming Frequency Subscale scores has been reported (Franklin et al., 2017; Seli et al., 2015).

In line with the corpus of evidence implicating dyslexia-related impairments in everyday cognition (e.g., Khan, 2014; Leather et al., 2011; Smith-Spark et al., 2004; Smith-Spark, Henry et al., 2016; Smith-Spark & Zięcik, 2016; Smith-Spark et al., 2017), it was hypothesised that participants who reported a higher incidence of dyslexia-related traits would also report more memory and attentional difficulties in their everyday lives. More specifically, it was predicted that adults scoring higher on the Adult Reading Questionnaire would also self-report either more frequently occurring or greater problems on the Everyday Memory Questionnaire-Revised, the Everyday Attention Questionnaire and the Daydreaming Frequency Subscale. The relationship between the Adult Reading Questionnaire and the Everyday Memory Questionnaire-Revised and the Daydreaming Frequency Subscale was predicted to be positive, while the relationship between the Adult Reading Questionnaire and the Everyday Attention Questionnaire was hypothesised to be negative. Since the Everyday Attention Questionnaire consists of three distinct components, separate predictions were made for the strength of the relationship of each component with dyslexia-symptomatology. In line with Nicolson and Fawcett's DAD hypothesis (1990), a strong, negative relationship between the Adult Reading Questionnaire and the Difficult and Pairs components of the Everyday Attention Questionnaire was predicted, as complex tasks or tasks that require dual-task performance require a more conscious allocation of attention, which may negatively impact performance. A weak, negative relationship was predicted between the Adult Reading Questionnaire and the Easy component of the Everyday Attention Questionnaire, as the simplicity of the tasks requires less conscious allocation of attentional resources.

The study was carried out during the 2020 Covid-19 global pandemic. The pandemic has had widespread negative consequences for people's mental health across the world (see Rajkumar, 2020, for a review). Given that elevated levels of stress, anxiety and depression have previously been found to affect everyday cognition (e.g., Boals & Banks, 2012; Gualtieri & Morgan, 2008; Harvey, 2011), the Depression, Anxiety and Stress Scale-21 (Lovibond & Lovibond, 1995) was used to control for this extraneous variable.

2. Method

2.1. Participants

The sample comprised 227 adult volunteers (154 female, 72 male, 1 non-binary), aged between 18 and 49 years (mean = 25.06, *SD* = 4.78; N = 6 did not disclose their age). All the participants were at least 18 years old and were recruited online, using advertising on social media platforms, including but not limited to Facebook, LinkedIn and Instagram. No compensation was offered for participation. Sixteen volunteers stated that they had received a formal diagnosis of dyslexia from an educational psychologist, while 16 volunteers considered themselves to have dyslexia but did not have a formal diagnosis. Five of the participants without dyslexia, six of the participants with dyslexia and two of the participants with self-declared dyslexia status indicated that they had been diagnosed with at least one further developmental disorder. These included Autism Spectrum Disorder, Attention Deficit Hyperactivity Disorder (ADHD), Developmental Coordination Disorder (Apraxia), and Marfan's Syndrome.

Those participants (N = 37) who failed to provide answers to all the questions were eliminated on the basis of incomplete data provision and were excluded from further analyses. Additionally, participants (N = 8) who stated that they had a neurodevelopmental disorder, other than ADHD that was controlled in the study, were also removed from the data analyses. Moreover, participants (N = 10) who scored in the severe or extremely severe range on all three scales of the Depression, Anxiety and Stress Scale-21 questionnaire (i.e., the Stress, Anxiety, and Depression scales) were also excluded.

The final sample thus consisted of 172 adults (117 female, 54 male, 1 non-binary) with a mean age of 24.98 years (*SD* = 4.98; N = 4 did not disclose their age). The frequency counts for the background information measures obtained from the participants used in the analyses are shown in Table 1 (N = 4 did not disclose whether they were currently in education).

2.2. Materials

All measures obtained were self-report in nature and were completed using the Qualtrics® platform (http://www.qualtrics.com).

The Adult Reading Questionnaire (Snowling et al., 2012), a 15-item scale, was administered to obtain a measure of traits associated with dyslexia. Its items are drawn from numerous well-established sources (for example, the Adult Dyslexia Checklist; Smythe & Everatt, 2001) and it includes specific questions about a diagnosis of dyslexia. The authors have reported good reliability ($\alpha > 0.60$) for the measure when used with adult populations. The Adult Reading Questionnaire has been used as a parental self-report measure in family risk studies, to identify parents who self-report as having dyslexia and to determine the risk status of their child developing the disorder (Dilnot et al., 2017; Gooch et al., 2014; Hayiou-Thomas et al., 2017). Seven of the items required respondents to rate typical 'symptoms' of dyslexia, such as problems with word finding, literacy skills and organization, on a five-point scale which ranged from never to always (e.g., "Do you find it difficult to find the right word to say?"). Overall scores ranged from a minimum of 0 to a maximum of 43.

The ADHD Self-Report Scale (Kessler et al., 2005) was used to screen for ADHD symptoms. Internal consistency of this measure has been found to be satisfactory to high, with studies reporting alpha values of at least 0.60 (Adler et al., 2006; Kessler et al., 2007). The scale comprised six items, four of which targeted difficulties with prospective memory, sustained attention and organization (e.g., "How often do you have problems remembering appointments or obligations?") and two which targeted hyperactivity (e.g., "How often do you feel overly active and compelled to do things, like you were driven by a motor?"). All items were rated on a five-point scale ranging from 'Never' to 'Very Often'. In line with the scoring instructions for frequency of occurrence of symptoms, the minimum score was 0 and the maximum score was six.

The Everyday Memory Questionnaire-Revised (Royle & Lincoln, 2008) was used to measure the frequency of everyday memory failures. A high reliability ($\alpha = 0.91$) has been reported by Royle and Lincoln. This questionnaire has a good pedigree as a self-report measure of everyday memory, having been administered, for example, to people with chronic pain (Baker et al., 2018), stroke survivors (Evans et al., 2020), and shift workers (Thun et al., 2020). Thirteen examples of everyday events were rated on the basis of how often they occurred over the past month, using a five-point scale which ranged from 1 = once or less in the last month, 3 = about once a week and 5 = once or more in a day (e.g., "Having to check whether you have done something that you should have done"). Overall scores ranged from a minimum of 0 to a maximum of 52.

The Everyday Attention Questionnaire (Martin, 1986), a well-established and reliable measure (e.g., $\alpha = 0.74$ in Khan, 2014, study of children with dyslexia), was used to evaluate the ease with which participants can complete concurrent everyday tasks of varying

Table 1
Frequency counts (and percentages) for the background measures obtained.

Background measure	Number of participants (%)
Official Dyslexia Diagnosis	7 (4.07%)
Self-declared dyslexia status	10 (5.81%)
Did not have dyslexia	155 (90.12%)
Currently in Education	121 (72.02%)
Currently Out of Education	47 (27.98%)
Native English Speakers	78 (45.35%)
Non-Native English Speakers	82 (47.67%)
Bilingual/Trilingual	12 (6.98%)

complexity. The questionnaire consisted of 18 items rated on two different scales. A five-point scale ranging from 1 = very distracting, 3 = no effect to 5 = very helpful, was used to rate how six simultaneously occurring stimuli (i.e., music from the radio/record/CD) affected participants' ability to carry out either a task that they found easy (e.g., peeling potatoes) or a task that they found difficult (e.g., studying). These responses respectively contributed to the Easy and Difficult components of the questionnaire. A second five-point scale, ranging from 1 = very poor, 3 = average to 5 = very good, was used to rate the ease of performing a pair of tasks at the same time (e.g., "Hearing a nearby conversation while continuing your own conversation"). These responses contributed to the Pairs component of the questionnaire. The minimum possible total score was 18 and the maximum possible total score was 90. For each component (Easy, Difficult and Pairs), the minimum possible total score was six and the maximum possible total score was 30.

The Daydreaming Frequency Subscale (Singer & Antrobus, 1970) provided an indication of how well individuals cope with internally generated distractions. Reliability of this measure has been found to be high, with Stawarczyk et al. (2012) reporting a Cronbach's α-value of 0.91. The Daydreaming Frequency Subscale consisted of 12 items directly assessing participants' propensity towards daydreaming and mind-wandering (e.g., "When I am not paying close attention to some job, book or TV, I tend to be daydreaming"). Responses were made using a five-point scale, with response options differing between items. Higher scores on the scale corresponded to increased experiences of daydreaming and mind-wandering. Total scores could range between a minimum of 12 and a maximum of 60.

The Depression, Anxiety and Stress Scale-21 (Lovibond & Lovibond, 1995), a shorter version of the Depression, Anxiety and Stress Scale-42 (Lovibond & Lovibond, 1993), was used to measure the participants' self-reported levels of depression, anxiety and stress. Evidence for the internal consistency of the Depression, Anxiety and Stress Scale-21 has been reported by Norton (2007) and Crawford et al. (2009), who found acceptable reliability coefficients ($\alpha > 0.78$) across all subscales. The questionnaire consisted of 21 items, seven items for each of the three subscales; namely stress (e.g., "I found it hard to wind down"), anxiety (e.g., "I felt I was close to panic") and depression (e.g., "I felt downhearted and blue"). Items were rated on a four-point scale from zero ("Did not apply to me at all") to three ("Applied to me very much or most of the time"), to indicate the severity and frequency of negative emotional experience over the previous week.

2.3. Design

Separate hierarchical multiple regression analyses were used to determine whether dyslexia-related symptomatology was a significant predictor of memory and/or attention deficits, after accounting for ADHD symptomatology. For all hierarchical regressions, scores from the Adult Reading Questionnaire and ADHD Self-Report Scale acted as the predictor variables, with ADHD Self-Report Scale score entered as a predictor in Block 1 and Adult Reading Questionnaire score in Block 2. Higher scores in the predictor variables, indicated higher dyslexia-related traits. The dependent variables were the measure of memory provided by the Everyday Memory Questionnaire-Revised and the measures of attention provided by the Everyday Attention Questionnaire and the Daydreaming Frequency Subscale. To be consistent with the original scoring of the measures, numerical values of 0–4 were assigned to the response options for the Everyday Memory Questionnaire-Revised, while values of 1–5 were assigned to the response options for the Everyday Attention Questionnaire and the Daydreaming Frequency Subscale. Higher scores on the Everyday Memory Questionnaire-Revised and the Daydreaming Frequency Subscale indicated an increased frequency of memory or attention problems respectively. Lower scores on the Everyday Attention Questionnaire indicated an increased frequency of self-reported attention deficits.

2.4. Procedure

Full ethical approval was obtained from the appropriate ethics committee at the authors' host institution. A detailed information brief outlining the procedure and purpose of the study was presented to the participants and informed consent was acquired prior to

Table 2
Means and SDs for the self-report questionnaires.

Questionnaire measure	Mean	*SD*
DASS-21 Stress scale	12.59	8.01
DASS-21 Anxiety scale	6.97	6.42
DASS-21 Depression scale	9.37	8.67
ARQ	12.49	6.36
ASRS	1.70	1.70
EMQ-R	12.31	9.95
EAQ	48.44	9.64
DDFS	32.38	10.81
EAQ-Easy component	17.58	4.35
EAQ-Difficult component	11.87	4.30
EAQ-Pairs component	18.99	3.98

Key to abbreviations: DASS-21 = Depression, Anxiety and Stress Scale-21 (Lovibond & Lovibond, 1995; ARQ = Adult Reading Questionnaire (Snowling et al., 2012); ASRS = ADHD Self-Report Scale (Kessler et al., 2005); EMQ-R = Everyday Memory Questionnaire-Revised (Royle & Lincoln, 2008); EAQ = Everyday Attention Questionnaire (Martin, 1986); DDFS = Daydreaming Frequency Subscale (Singer & Antrobus, 1970)

the commencement of the data collection. Following consent, demographic information was collected, including information about neurodevelopmental diagnoses (e.g., dyslexia or ADHD). The participants were then required to complete six self-report questionnaires in the following order: the Depression, Anxiety and Stress Scale-21, the Adult Reading Questionnaire, the ADHD Self-Report Scale, the Everyday Memory Questionnaire-Revised, the Everyday Attention Questionnaire and the Daydreaming Frequency Subscale. After the completion of the questionnaires, a written debrief was presented.

3. Results

Table 2 shows the descriptive statistics for each of the measures used in the study.

Table 3 shows the correlation between participant age, ADHD Self-Report Scale score, Adult Reading Questionnaire score, and the scores on the self-report measures of everyday cognition (Everyday Memory Questionnaire-Revised, Everyday Attention Questionnaire, and Daydreaming Frequency Subscale). There was a significant but weak correlation between age and the Easy component of the Everyday Attention Questionnaire ($p = .038$) but no other significant correlations involving this variable (all p-values $\geq$0.176). There were significant weak to moderate correlations between the Adult Reading Questionnaire score (all p-values $\leq$.046). Greater self-reported dyslexia symptomatology tended to be associated with higher ADD symptomatology scores, a higher frequency of memory failures on the Everyday Memory Questionnaire-Revised, and more attentional difficulties on the Everyday Attention Questionnaire and its components. Higher scores on the ADHD Self-Report Scale were highly significantly and moderately associated with more frequent memory problems on the Everyday Memory Questionnaire-Revised and more frequent mind wandering on the Daydreaming Frequency Subscale ($p < .001$ in both cases). There was a significant moderate correlation between ADHD Self-Report Scale scores and the Everyday Attention Questionnaire Pairs component ($p < .001$), with greater ADHD symptomatology being associated with greater reported difficulty in performing two tasks at the same time, but there were only weak and non-significant correlations between ADHD Self-Report Scale score and the Everyday Attention Questionnaire Easy and Difficult components. There was a significant but weak to moderate positive correlation between Everyday Memory Questionnaire-Revised and Daydreaming Frequency Subscale scores ($p <$ .001), such that more frequent memory problems were associated with more frequent mind wandering. The Everyday Memory Questionnaire-Revised and Everyday Attention Questionnaire scores did not correlate significantly, indicating a separation of memory and attentional processes ($p = .183$). Scores on the Everyday Attention Questionnaire and Daydreaming Frequency Subscale were also weakly but significantly negatively correlated ($p = .004$), with more self-reported difficulties with attention being associated with a greater propensity to mind wandering.

Hierarchical multiple regression analyses were carried out to determine whether dyslexia-related symptomatology significantly predicted memory and/or attention deficits. ADHD Self-Report Scale scores were entered in Block 1 of the regression to control for co-occurring ADHD symptomatology and Adult Reading Questionnaire scores were entered in Block 2. Three separate regression analyses were performed for each of the dependent variables, namely the Everyday Memory Questionnaire-Revised, the Everyday Attention Questionnaire and the Daydreaming Frequency Subscale. As mentioned previously, the Everyday Attention Questionnaire consists of three distinct components measuring the self-reported ease with which the participants felt that they could carry out either an easy or difficult task in the presence of intervening stimuli or a pair of stimuli. To determine where possible relationships might lie for each EAQ component (Easy, Difficult, and Pairs), separate regression analyses were run.

3.1. Everyday memory questionnaire-revised

The hierarchical multiple regression revealed that in Block 1, ADHD Self-Report Scale scores contributed significantly to the regression model, $F(1, 171) = 93.90$, $p < .001$, accounting for 35.6% of the variance in Everyday Memory Questionnaire-Revised scores. When the Adult Reading Questionnaire scores were introduced into the model in Block 2, an additional variance of 1.9% in Everyday Memory Questionnaire-Revised scores was explained. This change in R^2 was highly significant, $F(2, 171) = 50.70$, $p < .001$. The analysis, summarised in Table 4, showed that both ADHD Self-Report Scale scores and Adult Reading Questionnaire scores were

Table 3
Pearson's correlations between age, ARQ score, ASRS score, and the measures of everyday cognition.

	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Age	–								
2. ARQ	-0.059	–							
3. ASRS	-0.030	.503 * **	–						
4. EMQ-R	.032	.419 * **	.597 * **	–					
5. EAQ	-0.105	-0.288 * **	-0.207 * *	-0.102	–				
6. EAQ-Easy	-0.160 *	-0.187 *	-0.045	.010	.734 * **	–			
7. EAQ-Difficult	.008	-0.152 *	-0.144	-0.055	.839 * **	.445 * **	–		
8. EAQ-Pairs	-0.087	-0.329 * **	-0.296 * **	-0.198 * *	.712 * **	.204 * *	.464 * **	–	
9. DDFS	-0.028	.226 * *	.389 * **	.267 * **	-0.219 * *	-0.213 * *	-0.213 * *	-0.260 * *	–

Key: * = p ≤ .05, * * = p ≤ .01, * ** = p ≤ .001.
Key to abbreviations: ARQ = Adult Reading Questionnaire (Snowling et al., 2012); ASRS = ADHD Self-Report Scale (Kessler et al., 2005); EMQ-R = Everyday Memory Questionnaire-Revised (Royle & Lincoln, 2008); EAQ = Everyday Attention Questionnaire (Martin, 1986); DDFS = Daydreaming Frequency Subscale (Singer & Antrobus, 1970).

significant positive predictors of Everyday Memory Questionnaire-Revised scores in their own right. The relationship is shown in Fig. 1.

3.2. Everyday attention questionnaire

The results of the regression indicated that ADHD Self-Report Scale scores accounted for 4.3% of the variance in overall Everyday Attention Questionnaire scores and this contribution to the model was significant, $F(1, 171) = 7.58$, $p = .007$. An additional 4.5% of the variance was explained after the introduction of the Adult Reading Questionnaire scores into the model and the R^2 change was found to be significant, $F(2, 171) = 8.17$, $p < .001$.

3.2.1. Easy component

In the case of the Easy component of the Everyday Attention Questionnaire, ADHD Self-Report Scale scores accounted for 2.7% of the variance in scores and the predictive power of this model was not statistically significant, $F(2, 167) = 2.31$, $p = .103$. However, the introduction of the Adult Reading Questionnaire scores into the model explained an additional 3.8% of the variance, and the predictive power of this model was found to be significant, $F(3, 167) = 3.84$, $p = .011$.

3.2.2. Difficult component

For the Difficult component of the Everyday Attention Questionnaire, ADHD Self-Report Scale scores accounted for 2.1% of the variance in scores but this contribution to the model was not significant, $F(1, 171) = 3.602$, $p = .059$. Entering Adult Reading Questionnaire scores in Block 2 only explained an additional 0.9% of the variance in Everyday Attention Questionnaire Difficult scores and the R^2 change was not statistically significant $F(2, 171) = 2.55$, $p = .081$.

3.2.3. Pairs component

In the case of the Pairs component of the Everyday Attention Questionnaire, ADHD Self-Report Scale scores contributed significantly to the regression model, $F(1, 171) = 16.29$, $p < .001$, and accounted for 8.7% of the variance in the scores. Following the introduction of the Adult Reading Questionnaire scores in Block 2, an additional 4.4% of the variance in Everyday Attention Questionnaire Pairs scores was explained and the R^2 change was highly significant, $F(2, 171) = 12.73$, $p < .001$.

As Table 5 shows, ADHD Self-Report Scale scores only significantly predicted overall Everyday Attention Questionnaire scores, Everyday Attention Questionnaire-Difficult scores and Everyday Attention Questionnaire-Pairs scores, while Adult Reading Questionnaire scores only significantly predicted overall Everyday Attention Questionnaire scores, Everyday Attention Questionnaire-Easy scores, and Everyday Attention Questionnaire-Pairs scores. The negative β-values reflect the negative relationship between the predictor variables and the Everyday Attention Questionnaire; higher ADHD Self-Report Scale and Adult Reading Questionnaire scores predicted lower scores on the Everyday Attention Questionnaire. Fig. 2 illustrates the negative, linear association between Adult Reading Questionnaire scores and overall Everyday Attention Questionnaire scores. Figs. 3 and 4 show the relationships between Adult Reading Questionnaire scores and Everyday Attention Questionnaire-Easy and Everyday Attention Questionnaire-Pairs scores respectively.

3.3. Daydreaming frequency scale

Scores on the ADHD Self-Report Scale accounted for 15.1% of the variance in Daydreaming Frequency Subscale scores and this contribution to the regression model was significant, $F(1, 171) = 30.27$, $p < .001$. The introduction of the Adult Reading Questionnaire scores in Block 2 accounted for just 0.1% of the variance in Daydreaming Frequency Subscale scores and, thus, the R^2 change was not statistically significant. However, the predictive power of the model remained highly significant, $F(2, 171) = 15.192$, $p < .001$. As shown in Table 6, ADHD Self-Report Scale scores significantly predicted Daydreaming Frequency Subscale scores, whereas Adult Reading Questionnaire scores did not.

4. Discussion

The present study aimed to add to the limited research on the implications of dyslexia for the everyday cognition of adults and,

Table 4
Summary of the hierarchical multiple regression analysis for the variables predicting Everyday Memory Questionnaire-Revised scores.

Variable	*B (standardized)*	*t*	*R*	*R^2 (adjusted)*	*ΔR^2*
Block 1			0.597	0.352	0.356
ASRS score	0.597	9.69 * **			
Block 2			0.612	0.368	0.019
ASRS score	0.516	7.34 * **			
ARQ score	0.160	2.28 *			

Key: *p < .05; * *p < .01; * **p < .001. # Overall regression model was not significant.
Key to abbreviations: ARQ = Adult Reading Questionnaire (Snowling et al., 2012); ASRS = ADHD Self-Report Scale (Kessler et al., 2005).

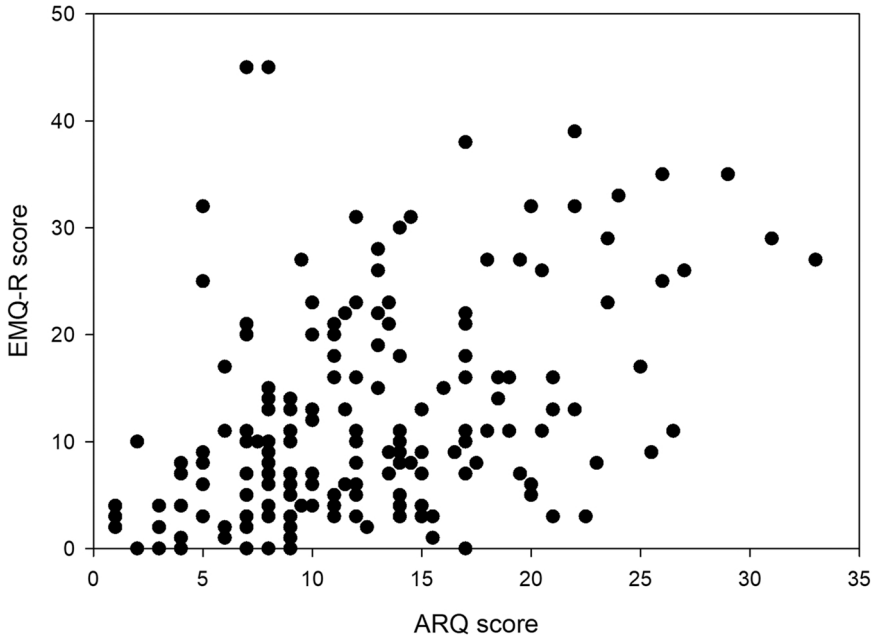

Fig. 1. The relationship between Adult Reading Questionnaire (ARQ) scores and Everyday Memory Questionnaire-Revised (EMQ-R) scores.

Table 5
Summary of the hierarchical multiple regression analysis for variables predicting Everyday Attention Questionnaire scores.

	Variable	β (standardized)	*t*	R	R^2 (adjusted)	ΔR^2
EAQ Overall	Block 1			0.207	0.037	0.043
	ASRS	-0.207	-2.75 * *			
	Block 2			0.297	0.077	0.045
	ASRS	-0.083	-0.97#			
	ARQ	-0.247	-2.90 * *			
EAQ-Easy	Block 1			0.045	-0.004	0.002
	ASRS	-0.048	-0.05#			
	Block 2			0.196	0.027	0.036
	ASRS	0.029	0.07#			
	ARQ	-0.158	-0.22 *			
EAQ-Difficult	Block 1			0.144	0.015	0.021
	ASRS	-0.144	-1.90#			
	Block 2			0.171	0.018	0.009
	ASRS	-0.090	-1.03#			
	ARQ	-0.107	-1.219#			
EAQ-Pairs	Block 1			0.296	0.082	0.087
	ASRS	-0.296	-4.04 * **			
	Block 2			0.362	0.121	0.044
	ASRS	-0.174	-2.10 *			
	ARQ	-0.241	-2.91 * *			

Key: *p < .05; * *p < .01; * **p < .001. # Overall regression model was not significant.
Key to abbreviations: ARQ = Adult Reading Questionnaire (Snowling et al., 2012); ASRS = ADHD Self-Report Scale (Kessler et al., 2005); EAQ = Everyday Attention Questionnaire (Martin, 1986).

more particularly, its effects on everyday memory and attention. Dyslexia-related symptomatology was assessed by the Adult Reading Questionnaire (Snowling et al., 2012), while the influence of ADHD symptomatology, as measured by the ADHD Self-Report Scale (Kessler et al., 2005), was controlled statistically. A series of hierarchical regression models were used to determine the influence of dyslexia-related symptoms on everyday memory (as measured by the Everyday Memory Questionnaire-Revised; Royle & Lincoln, 2008) and everyday attention (as measured by Martin, 1986, Everyday Attention Questionnaire and Singer & Antrobus, 1970, Daydreaming Frequency Subscale). Overall, respondents who displayed higher levels of dyslexia symptomatology also tended to self-report more memory failures and attentional lapses in their everyday lives. However, dyslexia symptomatology was not found to predict scores on the Daydreaming Frequency Subscale.

The results of the Everyday Memory Questionnaire-Revised (Royle & Lincoln, 2008) demonstrated a significant association between everyday memory failures and dyslexia-related traits. After controlling for ADHD symptomatology, higher scores on the Adult

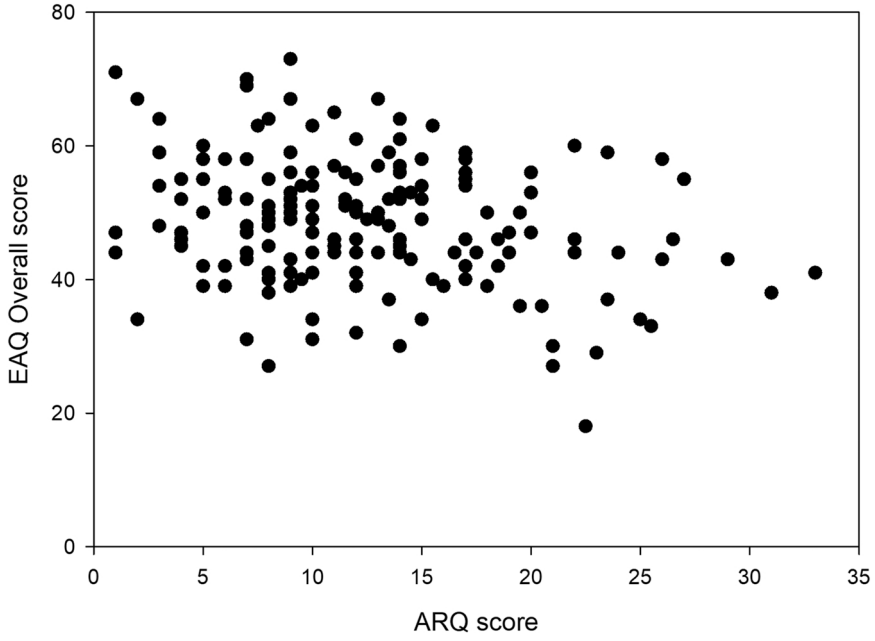

Fig. 2. The relationship between Adult Reading Questionnaire (ARQ) scores and overall Everyday Attention Questionnaire (EAQ) scores.

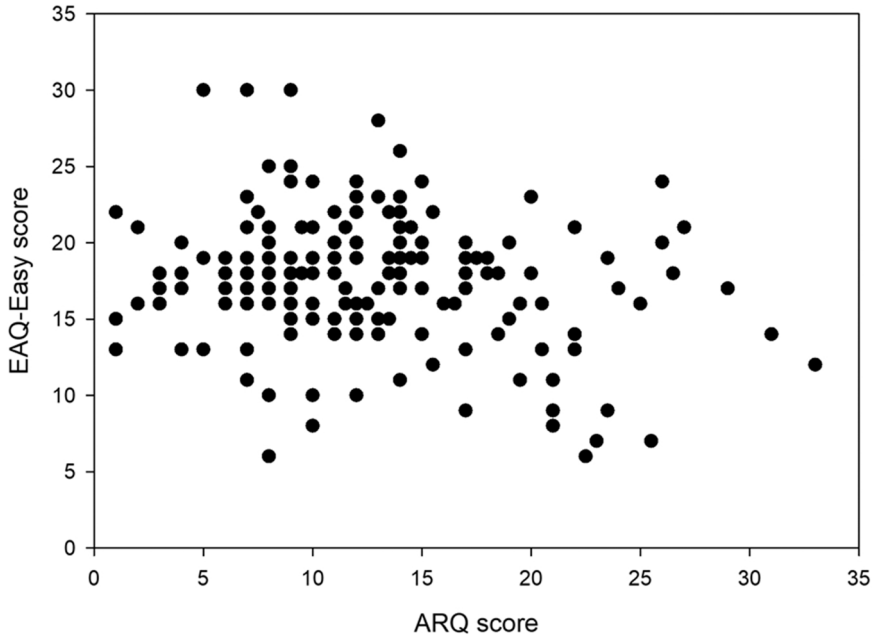

Fig. 3. The relationship between Adult Reading Questionnaire (ARQ) scores and scores on the Everyday Attention Questionnaire-Easy component (EAQ-Easy).

Reading Questionnaire (Snowling et al., 2012) were found to be significant predictors of self-reported deficits on the Everyday Memory Questionnaire-Revised. This finding is consistent with previous research that has identified memory impairments in adults with dyslexia and emphasises the negative impact of such deficits on everyday life and functioning (McLoughlin et al., 1994). The findings thus not only support previous work from laboratory experiments implicating dyslexia-related deficits in working memory (e.g., Smith-Spark & Fisk, 2007), prospective memory (e.g., Smith-Spark & Zięcik, 2016), and long-term memory (e.g., Menghini et al., 2010) and also research using either self-report measures (Leather et al., 2011; Smith-Spark et al., 2004) or a combination of laboratory tasks and self-report questionnaires (Smith-Spark et al., 2017; Smith-Spark, Henry et al., 2016). Therefore, it would appear that dyslexia-related memory deficits are not isolated in one memory domain but can be identified across a range of modalities.

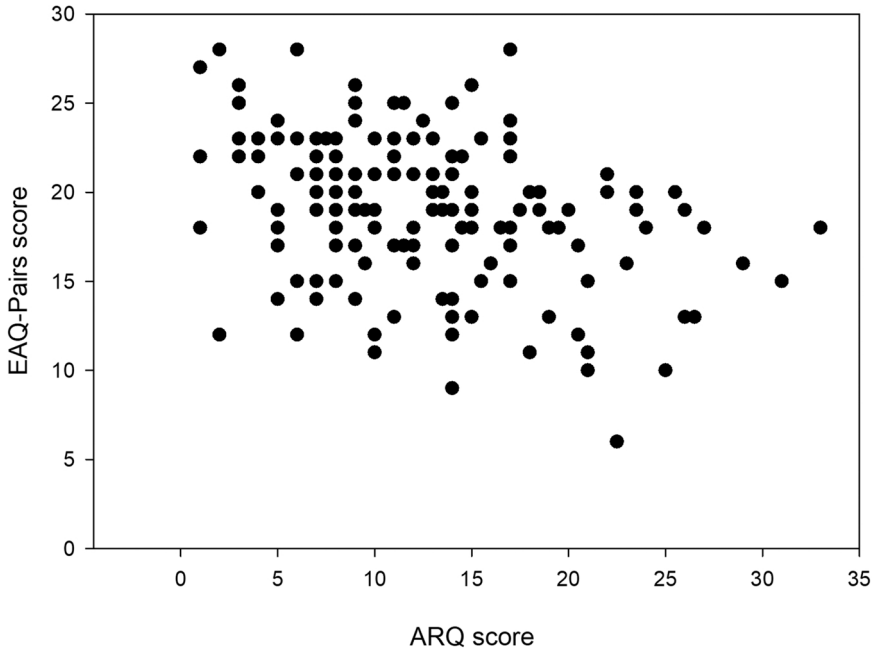

Fig. 4. The relationship between Adult Reading Questionnaire (ARQ) scores and scores on the Everyday Attention Questionnaire-Pairs component (EAQ-Pairs).

Table 6
Summary of the hierarchical multiple regression analysis for variables predicting Daydreaming Frequency Subscale scores.

Variable	β (standardized)	t	R	R^2 (adjusted)	ΔR^2
Block 1			0.389	0.146	0.151
ASRS score	0.389	5.50 * **			
Block 2			0.390	0.142	0.001
ASRS score	0.368	4.50 * **			
ARQ score	0.041	0.50#			

Key: *p < .05; * *p < .01; * **p < .001. # Overall regression model was not significant.
Key to abbreviations: ARQ = Adult Reading Questionnaire (Snowling et al., 2012); ASRS = ADHD Self-Report Scale (Kessler et al., 2005).

On the Everyday Attention Questionnaire (Martin, 1986), a significant relationship between traits associated with dyslexia and daily attentional lapses was found, with higher scores on the Adult Reading Questionnaire (Snowling et al., 2012) significantly predicting more difficulty in allocating attention to everyday tasks. Given that attention is a vital factor in everyday cognition (e.g., Pollina, Greene, Tunick, & Puckett, 1992), this finding was anticipated and is in line with the nature of the day-to-day cognitive problems reported by adults with dyslexia (e.g., Smith-Spark et al., 2004) and previous work in which the Everyday Attention Questionnaire has been administered to children with dyslexia (Khan, 2014). This finding is also broadly consistent with the conclusions of Smith-Spark and Fisk (2007) who argued for a potential supervisory attentional system (SAS) deficit in dyslexia, after detecting deficits in novel spatial updating tasks in adults with dyslexia. The SAS is one of two mechanisms involved in the control of action, as proposed in Norman and Shallice (1986) attentional control of action model. Contention scheduling is responsible for the control of relatively simple actions, while the SAS is concerned with controlling higher level, novel actions and it requires attentional control to modulate behaviour.

Analyses performed on the three individual components of the Everyday Attention Questionnaire (Easy, Difficult, and Pairs) indicated that scores on the Adult Reading Questionnaire significantly predicted scores on the Everyday Attention Questionnaire-Easy and Everyday Attention Questionnaire-Pairs components but not on the Everyday Attention Questionnaire-Difficult component, although, as expected, negative relationships were found between the Adult Reading Questionnaire and each of the three components. Therefore, dyslexia symptomatology significantly predicted deficits when performing a combination of tasks and isolated tasks while inhibiting competing stimuli (i.e., music from the radio) but only when the isolated task at hand was not deemed to be cognitively demanding. The significant findings from the Easy component and the non-significant finding from the Difficult component are consistent with Lavie (1995, 2005) perceptual load theory, which suggests that easy tasks are more prone to interference from distracting stimuli, compared with difficult tasks. She proposed that low cognitively demanding tasks (i.e., easy tasks) do not exceed perceptual capacity and, therefore, distractors are able to be processed. On the other hand, when the cognitive demands of a task are high (i.e., difficult tasks), there is no spare perceptual capacity for distractors to be processed. Therefore, the presence of distracting

stimuli while completing a given task would have a greater and more adverse effect when carrying out easy tasks, in comparison with difficult tasks. It is important to note, however, that Remington et al., (2009) argued that task difficulty is not synonymous with perceptual load. They found that adults with Autism Spectrum Disorder (ASD) processed distractors at higher levels of perceptual load without a reduction in task performance. This suggests the potential presence of different perceptual capacities in individuals, with adults with ASD having larger perceptual capacities compared to adults without ASD. While individuals with ASD were excluded from the current study, the extent to which these findings apply to dyslexia or co-occurring dyslexia and ASD warrants further investigation. The significant results from the Pairs component are consistent with the argument of Nicolson and Fawcett (1990) who used evidence from dual-task performance to argue for automatization deficits in children with dyslexia. In their work, children with dyslexia were able to perform at a similar level to children without dyslexia when tasks were performed on their own but showed significantly greater declines when these tasks needed to be carried out simultaneously. The negative association between dyslexia symptomatology and scores on these Everyday Attention Questionnaire components suggests that effects similar to those observed by Nicolson and Fawcett (in children under controlled laboratory conditions) are experienced in everyday situations in adulthood. However, it should be noted that the statistically non-significant findings from the Everyday Attention Questionnaire-Difficult component are not consistent with this argument. In the present study, ADHD-related traits were significant predictors of Everyday Attention Questionnaire-Difficult scores, possibly suggesting that the inhibition of distractors during cognitively demanding tasks is impaired in individuals with ADHD but not in individuals with dyslexia.

The findings from the Daydreaming Frequency Subscale (Singer & Antrobus, 1970) failed to provide further support for the impact of dyslexia on everyday attentional lapses. Although the expected positive relationship between scores on the Adult Reading Questionnaire (Snowling et al., 2012) and the Daydreaming Frequency Subscale was found, indicating that dyslexia symptomatology is related to a higher propensity to daydream and mind-wander, this relationship was not statistically significant. Everyday failures of attention related to daydreaming and mind-wandering might, therefore, not be a result of dyslexia. Mind-wandering occurs when unrelated thoughts interfere with an intended task and it is considered to be a general form of absentmindedness (Schooler et al., 2011). Thus, the findings of this study are not consistent with previous research reporting cognitive failures relating to absentmindedness and internal distractibility in individuals with dyslexia (e.g., Brosnan et al., 2002; Smith-Spark et al., 2004). However, previous research has examined responses to external distractions, which are distinct from mind-wandering (Robison & Unsworth, 2015) and proneness to distraction from internal stimuli. Nevertheless, the predictive power of the model in Block 2 was still found to be significant, as ADHD Self-Report Scale scores (Kessler et al., 2005) were highly significant in predicting more problems with mind-wandering on the Daydreaming Frequency Subscale. This finding suggests that individuals with ADHD, unlike individuals with dyslexia, find it difficult to cope with resisting internally generated distractions, which is what the Daydreaming Frequency Subscale essentially measures. However, the Daydreaming Frequency Subscale does not account for coping with external sources of distraction, which may be a more prominent issue in dyslexia. Indeed, the findings of Brosnan et al. (2002) support this notion, as they used environmental (external) distractors (i.e., background voices) and found that such distractors negatively impacted the performance of individuals with dyslexia on experimental tasks. Although they did not control for ADHD symptomatology (rendering it more difficult to conclude definitively that it is the presence of dyslexia that makes coping with information from the external environment difficult), these findings have been replicated in other studies that have excluded individuals with ADHD (e.g., Peng et al., 2013).

The current study is not without limitations. Although efforts have been made to exclude participants with other neurodevelopmental disorders from the sample and to statistically control for highly co-occurring ADHD, the lack of a measure of IQ means that it cannot be confirmed definitively that the everyday cognitive problems reported by the participants were indeed due to dyslexia symptomatology, rather than a broader cognitive impairment. However, the current findings are consistent with previous research that has utilised IQ-matched participants (e.g., Smith-Spark et al., 2004; Smith-Spark, Henry et al., 2016). It should also be noted that only subjective, self-report measures were utilised, therefore the validity of the results relied on the truthfulness of the answers provided by the participants. The validity might have been compromised due to demand characteristics, if the participants provided the answers that they thought that the experimenter was expecting, instead of honest and candid self-reports. However, set against this, the questionnaires were all well-established instruments with good pedigrees. Moreover, the findings were generally consistent with those obtained in previous studies, some of which took proxy-ratings to corroborate the self-reports of respondents (Smith-Spark & Zięcik, 2016; Smith-Spark et al., 2004) or had items to check for unduly negative self-concept (Smith-Spark, Henry et al., 2016). In these studies involving proxy ratings, close associates of the questionnaire respondents also rated the participants with dyslexia as experiencing more everyday cognitive problems, while Smith-Spark, Henry et al. found that more frequently reported everyday executive functioning difficulties were not the result of an unduly negative self-concept.

Despite these methodological limitations (which can be levelled at most work relying on self-reports), the present study has enhanced the current knowledge of the implication of everyday cognitive processes in dyslexia and shed greater light on some of the specific areas of everyday cognition that are impaired. The findings also have theoretical and practical implications. Although, traditionally, dyslexia has been linked with phonological deficits (e.g., Snowling, 1987; Stanovich, 1988; Vellutino et al., 2004), the current study has added to the literature indicating that deficits in dyslexia are not limited to reading and spelling difficulties and that broader cognitive impairments are experienced in adulthood. On the basis of these findings, there is a need for dyslexia theories to do more to incorporate broader cognitive deficits into their frameworks, as current theories do not explain adequately why individuals with the condition present with cognitive impairments beyond the obvious difficulties in phonological processing. The present study has demonstrated that, while everyday cognitive impairments are not considered to be a primary feature of dyslexia, identifying such deficits is vital in order to improve interventions and design ‘‘dyslexia-friendly’’ classrooms and workplaces. For example, individuals having concerns over a heightened incidence of attentional lapses related to absentmindedness might benefit from mindfulness training, which would teach them to fully focus their attention on the present, in an attempt to reduce their propensity towards

absentmindedness (Johannes et al., 2018). Similarly, individuals with dyslexia who present with working memory problems could benefit from working memory training, as there is some evidence to suggest that it can expand the working memory capacity and reduce word reading errors (Horowitz-Kraus & Breznitz, 2009). However, it should be noted that a meta-analytic review conducted by Melby-Lervåg and Hulme (2013) only found evidence of short-term gains in working memory and little evidence of far-transfer to other cognitive skills. Employers could utilise the current findings to provide a more supportive and accepting environment in the workplace (Sanderson, 2011) and to better understand the impact that dyslexia can have on employees' performance beyond its widely recognized detrimental effects on reading and writing processes. By acknowledging that employees with dyslexia might be more distracted or might need to be reminded of upcoming deadlines, misunderstandings and unnecessary confrontations can be avoided (Nalavany et al., 2018) and resultant impedances to career progression and success removed.

The present study has also identified a potential distinction between the role of distractibility in dyslexia and its role in ADHD, that should be investigated further. In particular, future research should aim to add clarity to whether there is a difference between the type of distractors that can negatively affect individuals with dyslexia in comparison with individuals with ADHD. To the best of the authors' knowledge, this distinction has not yet been explored in the literature and warrants further empirical investigation.

5. Conclusion

Adults with dyslexia-related traits self-reported having more memory failures and attentional lapses in their everyday lives, thus demonstrating both the persistence of the effects of dyslexia into adulthood and their impact beyond the literacy domain and beyond the university-age samples used in previous research. The findings have important implications, not only for dyslexia theory but also for adopting "dyslexia-friendly" practices and developing interventions to enhance resilience and confidence in individuals with dyslexia, which they can carry with them through their lives.

CRediT authorship contribution statement

Christina Protopapa: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Writing – original draft, Writing – review & editing. **James H. Smith-Spark:** Conceptualization, Formal analysis, Methodology, Resources, Supervision, Writing – original draft, Writing – review & editing.

Declarations of interest

None.

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