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Characteristics of cognitive deficits and writing skills of Polish adults with developmental dyslexia

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ABSTRACT

The present study was aimed at analysing cognitive deficits of dyslexic adults, and examining their written language skills in comparison with their peers. Our results confirm the presence of a certain profile of symptoms in adult dyslexics. We noticed deficits in: phonological (verbal) short-term memory, phonological awareness, rapid automatised naming (speed, self-corrections), visual perception and control, and visual-motor coordination. Moreover, the dyslexic participants, as compared with their nondyslexic peers, produced more word structure errors whilst writing an essay. However, there were no significant differences between the two groups in the length of the essay, the number of linguistic and punctuation errors, the number of adjectives, and stylistic devices.

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1. Introduction

Literature often reports contradictory information about the symptomatology of dyslexia. However, language and visuospatial functions, and time processing deficits have been listed amongst the most characteristic symptoms by the majority of scholars (Lyon et al., 2003; Nicolson and Fawcett, 2008; Reid et al., 2007; Wolf and Bowers, 1999). People with dyslexia are also believed to suffer from impaired working, short-term and long-term memory for the three modalities involved (visual, auditory, and kinaesthetic) (Bogdanowicz, 2009; Di Betta and Romani, 2006; Hatcher et al., 2002; Lundberg and Høien, 2001; Smith-Spark et al., 2003; Smythe, 2007; Swanson and Sáez, 2003).

The relevant research, however, has been conducted primarily with children. The current knowledge, the observations of experienced clinicians, as well as few scientific studies indicate that dyslexia is not limited to a specific period of development, namely academic education, but remains a problem which affects one's entire life (Pollak, 2012). Clearly, dyslexic symptoms are also present after an individual has completed the formal education stage (Cook Moats, 1995; Reid et al., 2007). Yet, some scholars suggest that the cognitive profile characteristic of adults with dyslexia is different from the profile typical of children with the same disability (Bogdanowicz, 2009; Everatt, 1997; Krasowicz-Kupis,

2008). They argue that some problems occurring in childhood do not necessarily resolve with cognitive maturation, and that their quantity and quality may change. Therefore, the aim of our study was to determine specific cognitive deficits which characterise the population of adults with dyslexia.

1.1. Cognitive deficits

Reports on dyslexia in adults indicate that the phonological deficit persists into adulthood (even in persons with compensated dyslexia) (Bogdanowicz, 2009; Di Betta and Romani, 2006; Reid et al., 2007; Rice and Brooks, 2004). Hatcher et al. (2002) suggest spelling, reading nonwords, digit span, and writing speed tasks as diagnostic measures of dyslexia in adults. These skills and abilities are directly related to phonological processing. In line with these studies, the need for applying more difficult tests for adults is emphasised (Nicolson and Fawcett, 2008).

Some researchers claim that phonological deficit manifests in retrieving words from mental lexicon (specifically, in the impaired verbal fluency and slow pace of naming) (Krasowicz-Kupis, 2008; Reid et al., 2007). Alternatively, according to Wolf and Bowers' "double-deficit hypothesis" (1999), phonological deficit and rapid naming deficit represent two separate causes of reading disorder. Indeed, *Rapid Automatised Naming* (RAN) seems to be one of the most diagnostic indices of dyslexia at the cognitive level (Felton et al., 1990; Jones et al., 2009; Reid et al., 2007; Wolff et al., 1990). However, dyslexic adults' performance usually does not differ from the performance of nondyslexics on all RAN tasks.

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Moreover, the results of Everatt's studies (1997) suggest that the difference in RAN between dyslexic and nondyslexic people may disappear with age.

The literature does not provide a clear answer to the question as to whether a working memory deficit can be regarded as a symptom of dyslexia in adults. There is some controversy as to what the short-term memory tests actually examine, mainly because researchers use different cognitive models and incompatible terminology. Indisputably, adults with dyslexia have problems with working and/or short-term phonological memory (Fawcett and Nicolson, 1997; Łockiewicz et al., 2012; Smith-Spark et al., 2003; Smythe, 2007; Swanson and Sáez, 2003). However, according to Snowling et al. (1991), separating phonological working memory from other phonological processes is extremely difficult, even in a best-designed experiment. In addition, the issue of visuospatial working memory in adults with dyslexia has not been clarified. Some reports argued no significant differences between adults with dyslexia and their peers without the disorder (Di Betta and Romani, 2006; Jeffries and Everatt, 2004; Łockiewicz et al., 2012; Smith-Spark et al., 2003), whilst other studies undermined those findings (Swanson and Sáez, 2003). According to Smith-Spark et al. (2003), dyslexic adults' performance in tests measuring their visuospatial memory depends largely on the level of cognitive demands. Consequently, only more difficult tasks differentiate dyslexic from nondyslexic persons.

The research on visuospatial abilities (excluding memory processes) in adults with dyslexia indicates that persons with dyslexia in comparison with their peers perform worse in visuospatial tasks (Bogdanowicz, 2009; Winner et al., 2001).

1.2. Written language skills

Specific impairments in written language performance continue into adulthood, and they exert negative influence on both the professional and personal life (Cook Moats, 1995; Michelsson et al., 1985; Smythe, 2007). Adults with dyslexia write incorrect texts. As compared with their peers, dyslexics produce more spelling and/or punctuation errors (Bogdanowicz, 2003, 1983; Connelly et al., 2006; Jaklewicz, 1997; Kemp et al., 2009; Li and Hamel, 2003; McLoughlin et al., 2002; Miles, 1993; Reid and Kirk, 2001; Sterling et al., 1997), lexical and morphological errors (Li and Hamel, 2003; Rubin et al., 1991), and use wrong pronouns (Li and Hamel, 2003). Unfortunately, in literature few other manifestations of disorders of written language skills in dyslexic adults have been described.

1.3. The correspondence between cognitive deficits and written language performance

Writing is a complex neuropsychological process, which involves many linguistic and nonlinguistic abilities. According to a "simple view of writing" proposed by Berninger et al. (2002), generating a text within a working memory environment is based on transcription (handwriting and spelling) and executive functions (planning, monitoring, reviewing, revising, organising, and attending). Contemporary cognitive models of written language processing indicate the importance of, in addition to working memory, orthographic and phonological memory representations, semantic system, grapheme-phoneme conversion. Impaired writing skills in dyslexia are caused by certain cognitive deficits. So far little research has focused on examining the correspondence between cognitive abilities and various aspects of the written production of dyslexic adults. Therefore, whilst reviewing the literature we also discuss articles concerning children. According to Cook Moats (1995), individuals with spelling problems usually have relatively greater difficulty with those dimensions of spelling that make heavy demands on both phonological and morphophonological awareness, and the specific recall of letter sequences. The author argues that spelling competence has hardly any relationship to non-symbolic, visuospatial learning abilities. The visual component of spelling is closely linked to other linguistic functions and

involves a special memory system which is used to store and recall images of print. Hanley's study (1997) shows that students with dyslexia have smaller reading vocabularies than their peers. Connelly et al. (2006) argue that dyslexic students' working memory deficits exert negative influence on their ability to cope with lower-order transcription skills (spelling and handwriting fluency). These results are congruent with other research concerning the influence of handwriting speed on adult writing (Peeverly, 2006). To conclude, greater transcription speed increases automaticity of word production, which in turn lessens the burden on working memory and enables writers to use its limited capacity for the metacognitive processes required to produce a good text. Surprisingly, in Connelly et al.'s (2006) study higher order aspects of writing, such as ideas and organisation, were not affected by memory problems. One of the aims of Helland's study (2007) was to examine the extent to which neuro-cognitive deficits' patterns found in dyslexic subjects correlated with their spelling performances. As expected, such correspondence was demonstrated, but only to a limited degree. The author concluded that similar literacy problems may be caused by different cognitive deficits. Pietras (2008), however, failed to establish a link between dyslexic teenagers' cognitive impairments and certain types of errors in their essays and dictations. These results partially confirm previous studies (Bogdanowicz, 1978), which demonstrated that the total number of errors produced is an indication of the extent and scope of developmental disorders of visual and auditory functions involved in writing, but not of the type of dysfunction. The subjects with auditory working memory deficit and poor auditory-motor coordination produced significantly more errors, including errors in word structure than their peers.

Thus, researchers interested in writing skills tend to focus on the correctness of written language performance. There is a lack of research concerning aspects of writing, such as its length and the level of lexical richness. "The Disorder of Written Expression" (315.2) described in DSM-IV-TR (2000), and impaired expressive writing included in ICD-10 (2000) amongst "Other developmental disorders of scholastic skills" (F81.8), together with their complex pathomechanism, remain an unexplored research area.

The aim of our study was to establish cognitive profiles of dyslexic adults. We compared the performance of dyslexic adults with that of their nondyslexic peers in: phonological awareness, RAN, nonverbal visuospatial perception, verbal working memory, and written language performance. We were also interested in the correspondence between the cognitive deficits of dyslexic adults and their writing skills.

2. Materials and methods

2.1. Participants

The initial sample consisted of 318 adults, 18–30 years old. However, due to a considerable amount of missing data, there were 180 participants in the final test group. Our study included 101 females (56.1% of total) and 79 males (43.9% of total). The distribution of students by the type of school or college they attended was as follows: social sciences (32.8%), exact sciences (20%), humanities (17.8%), arts (10%), environmental studies (8, 9%), languages (6.7%), sports (3.9%). There were 93 subjects with developmental dyslexia (51.7%, $M_{age} = 22.29$, $SD = 2.67$), and 87 students without this disorder (48.3%, $M_{age} = 22.36$, $SD = 2.39$), $t(178) = 0.17$, $p = .862$.

The occurrence of developmental dyslexia was assessed on the basis of an independent psychological assessment issued by state psychological and educational counselling centres. This diagnosis was made according to the criteria of the Polish Ministry of National Education, which include at least an average level of intelligence (over 85), the achievement tests scores for reading and writing below average (-1 SD cut-off), and processing deficit symptoms in one or more areas of cognitive or language functioning. The criteria used in the dyslexia assessment are in agreement with the ICD-10. Moreover, the dyslexic group ($M = 52.37$, $SD = 12.08$)

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