

LANGUAGE SKILLS IN CHILDREN WITH ADHD AND DEVELOPMENTAL DYSLEXIA

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SUMMARY

Background. Attention-Deficit Hyperactivity Disorder (ADHD) and specific learning difficulties (dyslexia) belong to the most frequently diagnosed developmental disorders in school-age children, and not infrequently co-occur. Linguistic functioning is one of the aspects of cognitive functioning in the cases of ADHA, dyslexia, or both disorders that presents a very diverse symptomatology. The aim of our interdisciplinary research, conducted on 259 children, was to determine whether or not children diagnosed with ADHD and developmental dyslexia differ in the level of linguistic functioning from their peers who are only hyperactive or have isolated developmental dyslexia.

Material and methods. The experimental group consisted of 62 children diagnosed with both ADHD and dyslexia. This group was compared with two other clinical groups: children with ADHD and children with dyslexia, and to a control group of pupils without any diagnosed deficits, matched to the experimental group in terms of age. We used the Controlled Oral Word Association Test (COWAT), the Phonological-Semantic Interference Test, and the Token Test – 36, in order to analyze cognitive functioning.

Results. Our results indicated that children from all three clinical groups showed a lower level of linguistic competence than the control group. ADHD children had the most difficulties with tasks measuring verbal fluency and comprehension of complex linguistic utterances. The dyslexic group had difficulties mainly with the phonological aspect of language. In the case of co-occurrence of both disorders, cognitive functions deficits are deeper, which must affect school performance.

INTRODUCTION

Attention Deficit and Hyperactivity Disorder (ADHD) and specific learning difficulties (dyslexia) are the most frequently diagnosed developmental disorders in school-age children. Data concerning the frequency of prevalence of the two disturbances indicate that over 10% of school age children suffer from at least one of these. The occurrence of developmental dyslexia in Poland is estimated at 10%, of pure dysgraphia, at 4% (Bogdanowicz, 2003b); European data fluctuate around 10-15% of the population. It is emphasized, however, that deeper symptoms can be found in approximately 4% of children with specific learning difficulties (WHO, 1992). Similarly as in the case of dyslexia, there is no unambiguous information concerning the occurrence of ADHD. Moreover, it would appear that the discrepancies between the data obtained from different countries are even more conspicuous. In the United States, 3-7% of children are believed to have ADHD (APA, 2000), while in England less than 1%, in China from 2% to 13% (Mann et al., 1992), in Poland 6,6% (Kołakowski et al., 2007).

It was in the 1990s – when researchers first began to realize that the co-existence of developmental dyslexia and ADHD is so frequent that it cannot be purely accidental. As early as 1991, Dykman and Ackerman indicated that 25-40% of persons with ADHD also have symptoms of dyslexia, while 15-40% of persons with developmental dyslexia manifest behaviors diagnostic for ADHD. The frequency of the co-existence of both disorders and the cognitive deficits characteristic of them induced researchers to seek their genetic basis. Population studies and DNA analysis, using the mapping method, provided data suggesting that both dyslexia and ADHD are conditioned polygenetically (Pennington & Olson, 2004). The genetic basis of complex disturbances, such as dyslexia and ADHD, is associated with atypical brain development. This is the result of the influence of numerous genes, which slightly modify the development of the brain, including also its functioning as far as reading skills are concerned – from normal reading to intensified difficulties, and also intensified excitability and attention deficit. The locus connected with vulnerability to the occurrence of a continuous trait is called the Quantitative Trait Locus (QTL). The search for a common basis of dyslexia and ADHD revealed such a QTL on chromosome 6p21, characterized by specific reading disturbances, and also by the probability of the occurrence of hyperactivity disorder (Willcutt et al., 2000). What is more, recent studies indicate that the regions on chromosome 16p and 17q may include genes that aggravate the risk of occurrence of both disorders (Del'Homme et al., 2007).

The co-existence of both these disturbances is an interesting phenomenon, due, for instance, to the fact that they belong to separate groups of developmental deficits. Developmental dyslexia is included in a broader diagnostic category of specific difficulties in learning or acquiring school-related skills (ICD-10). According to a definition widely used in Poland, dyslexia is:

a syndrome of disturbances of higher mental activities, manifesting themselves in the form of specific learning difficulties in reading and writing. They are conditioned by partial disturbances of the psychomotor development of the functions involved in reading and writing and their integration. Among the developmental deficits of cognitive functions, linguistic function disturbances are of paramount importance. These disturbances include the phonological aspect of language and are prerequisite for the possibility of linguistic communication (Bogdanowicz, 2003b:495). A significantly lower level of reading, which usually appears in connection with spelling difficulties, is an essential condition for the diagnosis of dyslexia. These difficulties take place despite additional exercises, while simultaneously a conspicuous discrepancy can be observed between the level of reading achieved by the child and the level expected at the given level of intellectual development and schooling, with no history of educational negligence. The European Classification ICD-10 (WHO, 1992) places dyslexia within the category disorders of psychological development (F80-F89) under the name of specific developmental disorders of scholastic skills. Simultaneously, it is emphasized that these difficulties do not constitute a homogenous symptom, but rather refer to a group of disturbances related to diverse, significant problems in speech, writing and arithmetic. Attention-Deficit Hyperactivity Disorder is described, by contrast, as a hyperkinetic disorder (HKD) and is not included in the group of broadly conceived learning difficulties, but is treated as a behavioral and emotional disorder with onset usually occurring in childhood and adolescence (F90-F98). A more popular term, however, is ADHD, taken from the American Psychiatric Association classification – DSM-IV-TR (APA, 2000). Despite some differences in the two medical classification schemes, the terms HKD and ADHD will be used interchangeably in this paper.

ADHD manifests itself in attention and concentration difficulties, hyperactivity and impulsivity to a degree that impairs the child's functioning, or to a degree unexpected in relation to the child's development (WHO, 1992; APA, 2000). Behaviors characteristic of ADHD, however, may be a basis for non-specific learning difficulties. Especially inattention may affect negatively the process of learning (Borkowska & Tomaszewski, 2008). Moreover, it is not rare for impulsive reactions and incautious utterances to result in children with ADHD becoming socially isolated and feeling lonely in the peer group, as well as having problems finding a place for themselves in their class. Regrettably, motor restlessness often evokes the reactions of disapproval and impatience in parents, teachers and peers, clearly influencing the effectiveness of learning (Lipowska, 2003).

Large-scale research on the cognitive functioning of children with Attention-Deficit Hyperactivity Disorder from around the world (Willcutt et al., 2005) and Poland (Borkowska, 2008) has described their specific ways of functioning. In the neuropsychological diagnosis of ADHD it is vital to assess executive functions, memory and, of course, attention. In the case of developmental

dyslexia, research has focused on the analysis of linguistic competencies, mostly phonological (Bishop & Snowling, 2004; Bogdanowicz, 2003a). For dyslexic children, however, problems with memory (Ram-Tsur et al., 2008), attention (Facoetti et al., 2004) and visual functions (Wilmer et al., 2004) are also characteristic.

Although linguistic deficit is not an axial symptom of ADHD, there is much evidence to indicate its occurrence in children with ADHD. The analysis of the path of development in a group of children with ADHD in comparison with their peers without ADHD symptoms indicates a more frequent occurrence of abnormal development, or even intellectual impairment in early childhood (Cohen et al., 2000). A child with ADHD may display not only articulation problems (Barkley, 2006), but also difficulties in organizing the utterance, mainly errors of a morphological-syntactical nature, e. g. agramatisms, incomprehensible compound or complex sentences of improper structure (Kim & Kaiser, 2000). In addition to vocabulary difficulties, there is a significant connection between impulsivity and problems with pragmatics (Camarata & Gibson, 1999). Due to planning, editing and self-control deficits, children with ADHD have difficulties in planning their utterances, in both a lexical and semantic aspect. The decrease in tempo of this process decelerates substantially the course of linguistic communication, and makes it more prone to disruptions. A majority of scholars have emphasized that the difficulties of children with ADHD in the linguistic sphere concern the expression, not the perception of speech, and the problems seem to be connected to inattention or impulsivity (Barkley, 2006). Much research on linguistic functioning concerns children with ADHD in whom there may co-appear other disturbances that may intensify or even cause difficulties of linguistic nature. In our research, then, we wished to provide an answer to the question as to whether or not children diagnosed with ADHD and developmental dyslexia differ in the level of linguistic functions from peers who are only hyperactive or have isolated developmental dyslexia. We also wanted to find out what constitutes the core of these differences.

MATERIAL AND METHODS

The research was conducted in Poland in the years 2006-2008 among 259 persons. The experimental group consisted of 62 pupils from 4th to 6th grade, diagnosed with both ADHD and dyslexia (30 girls and 32 boys). There were also two comparison groups: pupils with ADHD only (32 girls and 31 boys) and pupils with dyslexia only (31 girls and 36 boys). The control group consisted of pupils with no such deficits diagnosed (37 girls and 30 boys), matched to the three clinical groups in terms of age ($M = 11.4$; $SD = 0.7$). The study was carried out individually with each child. An interdisciplinary diagnosis was formulated by psychologists, teachers and physicians in clinics, mental health clinics and neurological clinics.

In order to analyze linguistic functioning, we used the following instruments:

- the Controlled Oral Word Association Test (COWAT, Pačhalska, 2007),
- Pačhalska and Lipowska's Phonological-Semantic Interference Test (2006);
- the Token Test – 36 as developed by Kościeszka and Krasowicz-Kupis (1995).

The intensity of the axial symptoms for ADHD was specified using the ADHD and behaviour disturbances diagnosis questionnaire of Wolańczyk and Kołakowski (2005).

RESULTS AND DISCUSSION

We started our analysis with an assessment of the intensity of axial symptoms for ADHD in all the groups we studied (Fig. 1).

As expected, only children with the diagnosis of ADHD fulfilled the criteria indicated in the medical classifications, which confirms that the subjects had been properly selected. It should not be overlooked, though, that in the group of children with developmental dyslexia the intensity of behaviors indicating attention disturbances is substantially higher than in the control group ($t = 4.3$; $p = 0.000$). It is true that inattention is not included in the diagnostic criteria for specific learning difficulties; however, numerous authors report that problems with focusing attention intensify the symptoms of developmental dyslexia (Facoetti et al., 2000). Recent research using functional magnetic resonance imaging (fMRI) even indicates that attention dysfunctions underlie problems with learning, reading, and writing. This becomes particularly conspicuous during the later period of education, when the skill of fluent, automatized reading is attained by some dyslexic students, namely those in whom inattention difficulties were not very intense (Shaywitz & Shaywitz, 2008). In the group of children with isolated dyslexia we examined, as many as 17 subjects out of 67 (25% of the group) manifested an intensity of inattention problems on the level characteristic of ADHD. Moreover, almost the same amount

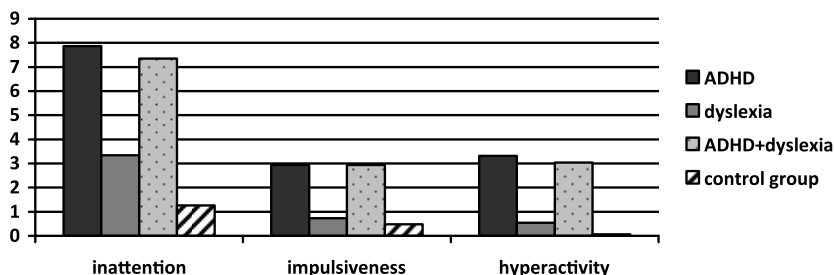


Fig. 1. Intensity of behaviors characteristic for ADHD

of children, i.e. 16 subjects, showed no difficulties in this area. The difference between boys and girls failed to reach significance.

As far as the linguistic functioning of children with ADHD is concerned, the thesis of lowered verbal fluency is one the best experimentally proven (Schecklmann et al., 2008). Thus, it was very appropriate to measure eventual differences between students with ADHD and dyslexia and the group with no cognitive deficits on the COWAT (Fig. 2).

The obtained results confirm previous data showing that linguistic fluency is lowered in both children with ADHD and with developmental dyslexia (Marzocchi et al., 2008). The semantic category task (number of names of animals in one minute) was found to be the least difficult for the subjects. Despite the low level of difficulty, the results of children with ADHD ($t = 2.1$; $p = 0.044$), as well as of those with both ADHD and dyslexia ($t = 3.1$; $p = 0.003$) proved to be significantly different. Interestingly, dyslexic children achieved similar results to those in the control group. The analysis of the data suggests that specific learning difficulties intensify problems with verbal fluency mainly in the case of phonological category (words beginning with K), where the greatest difficulties were experienced by children with both dyslexia and ADHD. The task that required listing "objects that can be bought in a supermarket beginning with the letter M," involving both semantic and phonological categories, proved to be so difficult for 11 year old children that no statistically significant differences between groups were found.

Searching for a neurological ground for cognitive dysfunctions with the use of modern neuroimaging methods revealed that in the group of children with ADHD both structural and dynamic changes occur in frontal and temporal areas of the brain, most notably pre-frontal cortex (Castellanos et al., 2002). The results of neuropsychological assessments, together with information obtained through neuroimaging, seem to allow us to state that there is a frontal dysfunction in the group of children with ADHD, which explains, for the most part, the problems with verbal fluency (Dąbkowska & Borkowska, 2000). Verbal fluency is certainly a measure not only of linguistic functioning, but also of executive functions, a deficit in which respect is characteristic of ADHD. In the case of developmental dyslexia, the intensity of the verbal flu-

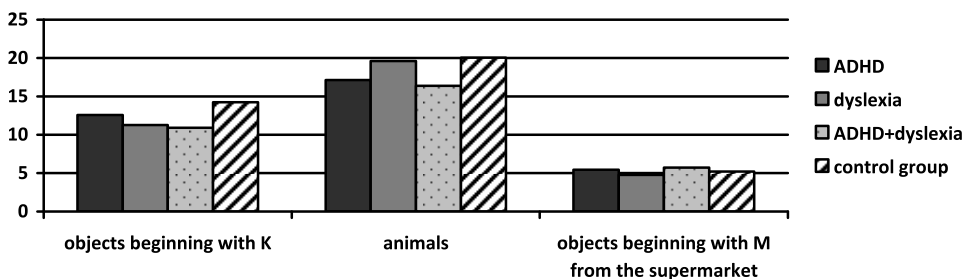


Fig. 2. Level of verbal fluency of examined children

ency deficit is connected with the clinical picture of the disturbance. The studies by Cohen et al. (1999) suggest that the differences in verbal fluency may even be helpful in the differential diagnosis between the Language Disorder/Dysphonetic Dyslexic subgroup and the Visual-Spatial/Dyseidetic Dyslexic subgroup.

Verbal fluency deficits are characteristic for children with ADHD, while problems with the phonological aspect of language as typical for developmental dyslexia (see: Krasowicz-Kupis, 2004). We analyzed the distribution of results achieved by the children we examined in the Phonological-Semantic Interference Test (Pačalska and Lipowska, 2006), which requiring the deletion of a sound or a syllable from a given word or nonword (Fig. 3).

First, it should be noticed that the control group achieved significantly better results in all trials, and children with the co-existence of both deficits performed the tasks on the lowest level; however, here the results were not always significant. The deletion of a sound or a syllable from a word, seen as the easiest tasks, did not discriminate the clinical groups examined. As expected, the most difficult task proved to be deleting elements from nonwords. This ability appears in properly developing children as the last one in the series, and is classified among metalinguistic competencies (Lipowska, 2001; Krasowicz-Kupis, 2004). With progress in the educational process, basic phonological difficulties, thanks to the therapeutic methods used, or perhaps the influence of education itself, are to a high degree compensated, and the phonological deficit seems not to play such an important role at all (Snowling, 2004). Phonological awareness deficit is the core criterion for the diagnosis of dyslexia, which is why it is no surprise that children with this disturbance had the largest number of difficulties. Why, however, did children with ADHD experience problems? It is just in the situation of manipulation performed on nonwords where phonological working memory plays an important role, which then leads to the occurrence of difficulties in the group of children with ADHD (Norrelgen et al., 1999). Not only do the operations on nonwords overload memory stores to the highest degree, but they also engage phonological processes, because there is no possibility of referring to semantic clues. We cannot therefore speak of a phonological deficit in the group of

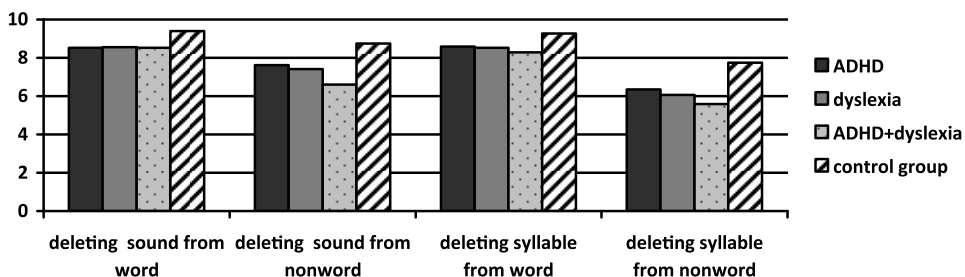


Fig. 3. Phonological awareness of examined children

children with ADHD, but of a connection between the deficits of memory and the performance of complex phonological tasks, which engage cognitive resources to a substantial degree.

Another aspect of linguistic competency of particular interest was the comprehension of instructions. To measure this aspect, we used the Token Test – 36 (Kościeszka & Krasowicz-Kupis, 1995). This method allowed us to examine the level of linguistic comprehension, assessed by the percentage of properly performed instructions, from very high (above 95%) to very low (below 50%) (Fig. 4).

The analysis of the data we obtained suggests a significantly higher level of instruction comprehension in children from the control group. Interestingly, even though the mean results achieved by the clinical groups did not differ significantly, the distribution of scores was clearly dissimilar. Children with isolated dyslexia understood significantly more instructions ($p = 0.000$) than pupils with co-existing dyslexia and ADHD, or with ADHD only. The compared groups were also different in terms of the deficit of linguistic comprehension (a low or very low level of comprehension of instructions), which is connected with the specificity of disturbances, e. g. developmental dyslexia, where linguistic functioning difficulties are a core symptom. The research conducted using this test in a group of children with reading difficulties showed low results, which may be a sign of difficulties in understanding logically and grammatically complex utterances, and troubles with the reception of linguistic texts (Kościeszka & Krasowicz-Kupis, 1995). In its basic version, The Token Test for Children (McGhree et al., 2007) is frequently included in a battery of neuropsychological tests for the diagnosis of cognitive deficits in children with ADHD. Most of the attempts to interpret the low results achieved in this test refer to the connection between comprehension of complex linguistic instructions and attention deficits, as well as difficulties in planning actions (Shallice et al., 2007). The level of comprehension of instructions was the lowest in children who manifested both reading difficulties and ADHD. This is due to the occurrence in these groups of a double deficit: linguistic functions and attention.

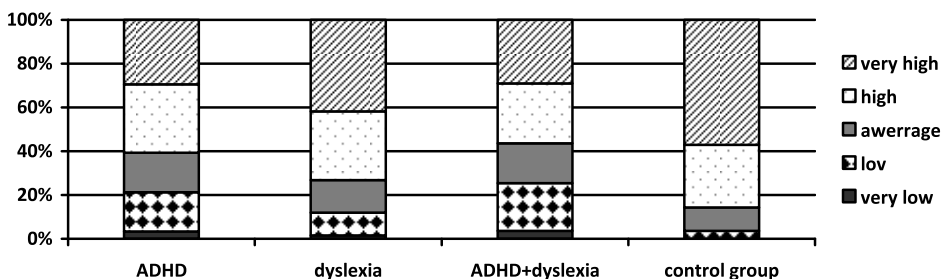


Fig. 4. Level of understanding instructions among the examined children

CONCLUSIONS

The occurrence of similar axial symptoms in several different disorders may lead to a biased diagnosis. It is not at all rare for Attention-Deficit Hyperactivity Disorder to be equated with behavior disturbances, and dyslexia is suspected in many children without specific difficulties. Regrettably, despite work on the standardization of diagnostic methods, there are still no standardized tests in Poland, on the basis of which dyslexia and ADHD are diagnosed in all clinics. Such a tool for third grade children (9 year olds) is currently being prepared by a team of experts in the Diagnostic Tools Laboratory in Warsaw. The research presented here demonstrate the existence of identical deficits of cognitive functions in the compared groups, including linguistic problems:

- lowered verbal fluency (mostly in the task requiring phonological awareness),
- difficulties in eliminating of phonological units (mainly syllables) from non-words, which engages phonological processes, but above all overloads memory resources.

As far as the group of children with ADHD is concerned, it may be stated that our research showed a connection between memory deficits and the performance of complex phonological tasks, engaging cognitive resources to a high degree. The level of comprehension of instructions proved to be the lowest in children who manifested both kinds of disturbances, i.e. both reading difficulties and ADHD. This is due to the occurrence in these groups of a double deficit: linguistic functions and attention. The results of our research allowed us to state that in the case of the occurrence of both disturbances, dyslexia and ADHD, both the learning difficulties and the cognitive deficits causing them are deepened, which may negatively influence school success.

Dyslexic students require the adjustment of methods and teaching conditions, as well as requirements and assessment of their possibilities and limitations specific for this group of children, for their special educational needs (Bogdanowicz, 2003). Although ADHD is not a disturbance classified as a "specific learning difficulty", undoubtedly the impulsivity, restlessness, and especially inattention, may cause serious academic problems.

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