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STRATEGIES OF MEMORIZATION AND THEIR INFLUENCE ON THE LEARNING PROCESS AMONG INDIVIDUALS WITH BORDERLINE INTELLECTUAL FUNCTIONING

Anna Jankowska^{1(A,B,D,E,F)},
Marta Bogdanowicz^{2(A,B,D,E,F)},
Steven Shaw^{3(A,B,D,E,F)}

¹ Department of Psychology, University of Warmia and Mazury, Olsztyn, Poland

² Institute of Psychology, University of Gdansk, Gdansk, Poland

³ Department of Educational and Counselling Psychology, McGill University, Montreal, Canada

SUMMARY

Borderline Intellectual Functioning (BIF), or borderline intelligence, is defined as an intelligence quotient from 1.01 to 2.00 standard deviations below average, that is, a level between average intelligence and intellectual impairment. This level of mental functioning may still belong to a broadly understood norm. The purpose of the present study is to present the current state of knowledge on the subject of memory-related processes in persons with BIF, and in particular schoolchildren. Children with borderline intelligence are at risk for chronic educational failure, absence from school, repetition of grades, and dropout or expulsion from school. We have concentrated primarily on discussing the relationship between memory-related processes and the characteristic thought processes of these individuals, including a preference for operating with concrete material, rigid and insufficiently critical thinking, and difficulties in organizing and generalizing knowledge, all of which cause serious deficits in academic achievement and effective learning. The article begins with an introduction to the problems of borderline intelligence, including the differential diagnosis, classification, and cognitive functioning of these persons. Then, based on the results of national and international research, we discuss the deficits of short-term and working memory that cause difficulties in processing and organizing, impair the effectiveness of long term memory, and thus cause specific learning strategies to be adopted. Pupils with BIF most often master their school knowledge by using rote memory, the functioning of which is discussed at the end of the article.

Key words: cognitive impairment, intellectual impairment, intellectual disability, working memory, long-term memory

INTRODUCTION

Borderline Intellectual Functioning (BIF), or borderline intelligence, is defined as an intelligence quotient from 1.01 to 2.00 standard deviations below average. Borderline Intellectual Functioning is a categorization of intelligence higher than intellectual impairment, but below average cognitive abilities (APA, 2000). This is not, however, a clinical category, since, as shown by clinical experience and research conducted since the last century (Spionek, 1973; Kostrzewski, 1981; Shaw, 2008b; Bogdanowicz, 2008; Jankowska, 2011; Jankowska & Bogdanowicz, 2008), many clinical groups can be distinguished within it, differing in their symptoms and the pathomechanisms underlying the disturbances of cognitive processes. Since 1980, along with the introduction of the ninth revision of the *International Classification of Diseases, Injuries and Causes of Death* (ICD-9), BIF has been classified as belonging “to a broadly understood norm, and not to the category of intellectual impairment” (Kostrzewski, 1981, p. 118). This population has significantly higher general mental abilities and adaptive functions than do persons with a diagnosis of intellectual disability.

In the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV-TR) published by the American Psychiatric Association, this level of intellectual ability has been encoded under Axis II V62.89 (Borderline Intellectual Functioning) (APA, 2000). Axis II is used to mark disturbances of development and personality. The code V refers to problems that require clinical help, but are not intellectual impairment.

BIF is diagnosed primarily on the basis of a global result obtained in an intelligence test. In the Wechsler intelligence scales the level corresponding to BIF is 70-84 ($\delta=15$); in the previously used Stanford-Binet it was 69-83 ($\delta=16$). According to the recommendations of the DSM-IV-TR, we should be extremely careful in diagnosing BIF in the case of persons who obtained a composite IQ between 71 and 75. In the case of some individuals with this IQ, it is possible to diagnose mild intellectual impairment, if a significant degree of maladaptation is also diagnosed (APA, 2000). Moreover, children with mild intellectual impairment who are raised in a supportive family environment can obtain relatively good results in tests of verbal intelligence, which may raise the composite IQ to the BIF level (Kostrzewski, 1981). However, in tests measuring the level of fluid intelligence, the true level of intellectual ability is revealed to be more than 2.01 standard deviations below the norm, that is, at the level of mild intellectual impairment (Gindrych, 2002; Pąchalska et al., 2012). A diagnosis of BIF, then, requires a careful analysis of the results obtained in psychometric diagnosis, along with all available information regarding the individual's adaptive capabilities.

Students with borderline intelligence have been called invisible children, slow learners, shadow children, grey area kids, and crack kids (because they fall between the cracks of educational support systems), because they rarely meet eligibility criteria for special education as a student with intellectual disabilities or learning disabilities, but have remarkably high failure rates in the general education setting (Shaw, 2008a).

Persons with borderline intellectual functioning constitute a large population; they face many obstacles across the lifespan that increase the risk for educational, mental health and societal problems (Gottfredson, 2005; Shaw, 2008a; 2010). According to the Gaussian curve, children with BIF constitute 14.1% of the population, more than all children in all disability classifications (Shaw, 2008b). In an average primary school class, then, it can be anticipated that there will be 3-4 pupils with BIF (Cooter & Cooter, 2004).

Due to the reduced intellectual abilities of children with BIF, they are not able to meet the school's program demands, especially when they are deprived of appropriate psychological and educational support. Most pupils with BIF experience long history of failures at school, often repeating grades, and as a result they drop out and achieve a very low level of education (Kasen et al., 1998; Jimerson et al., 2000; Cooter & Cooter, 2004; Gottfredson, 2004a); they experience unemployment (Lynn et al., 1984) and underemployment (Lubinski, 2000). Moreover, borderline intelligence has been associated with mental health problems (Masi et al., 1998; Hassiotis et al., 2008), alcohol abuse (Mortensen et al., 2005), illegal drug use, homelessness (Minehan et al., 2000), poor health care (Shore, 2001; Gottfredson, 2004b), hyperactivity and conduct disorder symptoms (van der Meere et al., 2008), social maladaptation (Szymańska & Wyczesany, 1972), gang membership and violent crime (Kasen et al., 1998), increased sexual acting out and sexual aggression (Loeber et al., 2000). Lindsay et al. (2007) state that individuals with BIF may constitute up to 75% of the total number of criminals. This has been confirmed by the preliminary results of research conducted in 2011 at the Institute of Psychology of the University of Gdansk, conducted under the direction of the second author of the present study in a center for socially maladjusted youth.

The difficulties associated with borderline intellectual functioning represent some of the most pervasive and troublesome problems in society. Persons with borderline intellectual functioning are a large and high-risk population that currently receives little, if any, formal educational, social or mental health support (Rourke & Quinlan, 1973; Mink et al., 1984; Bogdanowicz, 1985; Wilson, 1991). Persons with borderline intellectual functioning present challenges that cannot be ignored. Improved understanding and modeling of the cognitive abilities of this population present opportunities that are both theoretically important for the understanding of memory and learning, and socially important for addressing the educational and social needs of a large segment of society.

CHARACTERISTICS OF COGNITIVE FUNCTIONS AND THEIR IMPLICATIONS FOR ACADEMIC SKILLS IN PERSONS WITH BIF

From educational and clinical studies it can be inferred that children with borderline intelligence have several characteristics that make learning and memo-

rizing academic information more difficult. Their thought processes are characterized by a high degree of concreteness, limited independence, and a low level of criticism, along with limited creativity and little ability to search for new and original ways of solving a problem (rigid and unproductive thinking) (Włodarski, 1966; Bogdanowicz, 1985). Language development is typically delayed (Lipowska, 2008). The tempo of thinking and working of these persons is slow, and they commit a significant number of mistakes even in comparison to their contemporaries with specific difficulties in learning to read and write (Bonifacci & Snowling, 2008).

The third author of the present study (Shaw, 2008b) has divided the specific intellectual difficulties of these individuals into five categories, differentiated by the characteristics of the cognitive processes:

1. Children with BIF perform at a higher level in information that is presented in a concrete fashion. The more abstract a concept or teaching technique, the more difficult it is to learn;
2. They do not transfer or generalize skills, knowledge, and strategies as well as their age peers. Children with BIF tend to learn what is taught quite well, but have difficulty transferring and applying the concepts taught to new situations;
3. Children with BIF have difficulty cognitively organizing new material and assimilating incoming information into previously acquired information;
4. Children with BIF benefit from increasing academic engaged time. This population often requires extra practice and more time on task to develop the same level of academic skills as their typically developing peers;
5. Students with borderline intelligence nearly always develop academic motivation deficits.

Low general cognitive ability (i.e. the g-factor) is a common and important explanation for learning and academic difficulties (Deary et al., 2007; Rohde & Thompson, 2007). Advances in models of intelligence and statistical modeling have created a new specificity in identifying the aspects of general mental ability that are the best predictors of learning and academic skill acquisition (Braden & Shaw, 2009).

Based on educational studies and other models of the relationships between mental abilities and school achievement (e.g., Howe et al., 1989; Benson, 2008), the control processes (Campione & Brown, 1980) of the information processing system are the most important constructs in understanding academic learning. These control processes are defined as including algorithms, strategies, rules, methods of organization, reasoning, divergent thinking, previous knowledge, and other learned characteristics that appear to be most important. These control processes are all loaded highly on the g-factor (Campione et al., 1985; Carroll, 1993). The close relationship between control processes and g leads to the widely supported idea that general mental ability accounts for nearly all sources of predictable variance in academic achievement (Neisser et al., 1996).

The foundation of the control process is referred to as the architecture of knowledge storage systems. The architecture includes the capacity, durability, and efficiency of memory systems. Capacity refers to the storage space available

in a knowledge store (Campione & Brown, 1980; Colom et al., 2004). Durability refers to the relative permanence of information in the store when unprocessed before the information is completely lost. Efficiency is defined as the temporal features of the knowledge storing system (e.g., speed of memory research, tracking and searching speed, speed of moving information from short-term to long term memory stores). Campione and Brown (1980) proposed that there were few individual differences in the features of capacity and duration. However, efficiency of processing is considered to be a major architectural feature that predicts the development of control process and what is typically thought of as general mental ability (Ackerman et al., 2005).

Subsequent studies and complex models have confirmed the role of mental speed in explaining the variance in academic achievement (Beauducel & Kersting, 2002; Alloway et al., 2006; Taub et al., 2008; Vock et al., 2011). For purposes of learning new information, this is an intuitive finding. To illustrate, information is transferred from a sensory channel to a short-term memory store of limited capacity and durability. To be permanently stored, the information needs to be efficiently processed to a permanent long-term memory store. The more efficient the transfer of information, the less likely the limited capacity and durability store is to be overwhelmed with incoming information, which would result in lost information (Martinez et al., 2011). For example, previous knowledge or an existing schema on related subject matter serves to increase efficiency of processing information. Efficiency of processing is not only important for new information entering via a sensory channel, but also important in rapid recall and active use of previously learned information existing in a long-term storage system. Efficiency of processing mediates the development of control process and is clearly a major factor in the development of academic skills.

In the case of children with BIF, below average efficiency of information processing results in challenges in recalling and applying information, thus leading to difficulties applying and generalizing what has previously been learned (Kuncel et al., 2010). Improving models of understanding the relationships among general mental ability, memory, and academic functioning is especially important for the portion of the population labeled Borderline Intellectual Functioning (APA, 2000).

SHORT-TERM MEMORY AND WORKING MEMORY IN PUPILS WITH BIF

There is a relationship between the overall intellectual abilities of a person, especially thinking and learning, and the course of memory related processes. The results of research indicate that both short-term memory (Miller & Vernon, 1992) and working memory (Ackerman et al., 2002, 2005; Colom & Shih, 2004) are associated with the level of intelligence. Most of the tasks in intelligence tests require the ability to encode, store, and process information in short-term and working memory, and to recall information previously stored in long-term memory (Miller & Vernon, 1996).

In order to fully understand the nature of the difficulties in cognitive functioning encountered by persons with BIF and the school failures it entails, it is necessary to look carefully at the functioning of short-term and working memory in these persons. Current opinion holds that short-term memory and working memory are separate cognitive processes. The nature of the relationships between them has not yet been clearly established. Nevertheless, the operation of short term memory is to a large extent independent of working memory. Most studies on the role of short-term memory find weak relationships between passive short-term memory storage and academic achievement (Colom et al., 2006; Cowan & Alloway, 2008). It is working memory that is more strongly correlated with learning and educational achievements (Hornung et al., 2011). Working memory serves not only to store temporarily a limited amount of information necessary for cognitive operations currently in progress, but also and primarily for the active and conscious processing of information (Daneman & Carpenter 1980; Baddeley & Logie 1999; Bayliss et al., 2005). Working memory is currently regarded as a central cognitive system, and its basic functions, that is, the temporary storage and processing of current information, are thought to be decisive for a person's cognitive effectiveness.

Working memory constitutes part of the executive functions, whose task is to initiate action, formulate and realize goals, and plan and control activity (Pennington & Ozonoff, 1996). Working memory is largely mediated by control processes, such as previous knowledge, strategies, reasoning, and divergent thinking (Hutton & Towse, 2011). The convergence of multiple aspects of the information processing model logically makes working memory highly correlated with both g and academic achievement (Colom et al., 2010). In the case of children with BIF, the same inefficiency also leads to problems in storing, recalling, and applying complex control processes. Finally, weaknesses in working memory lead to success with tasks that are simple or concrete, and difficulty with complex and abstract tasks (Shaw, 2008b).

Working memory processes visuo-spatial and verbal information derived from different sensory modalities and from long-term memory. Its functioning, then, is strictly dependent on the activity of various sub-systems of long-term and short-term memory. All four components involved in the processing of information in working memory (short-term storage: verbal and visuospatial as well as verbal and visuospatial executive processes) are associated with the course of intellectual processes (Tillman et al., 2008), which means that working memory is involved in the performance of many complex cognitive activities, such as comprehension, deduction, and learning (Baddeley, 1986; Burgess et al., 2011). Recently, some especially important research was conducted by Alloway and Alloway (2010). One of the main goals of their research was to test the hypothesis that deficits occur in working memory in both the verbal and visuo-spatial domains. The research involved 39 pupils with BIF (average age 9;8, 28 boys and 11 girls), whose results were compared with those of a control group (average age 9;8). According to their results, the pupils with BIF achieved lower scores in all tests measuring verbal and visuo-spatial short-term memory and verbal and visuo-spatial working memory. They differed from their contemporaries with normal IQs primarily in

tasks measuring visuo-spatial working memory. Deficits were also observed in the domain of other executive functions. This research proved that pupils with BIF have a significantly different profile of working memory and executive functions when compared to pupils of average intelligence.

A lower capacity can be observed in the working memory of persons of reduced intellectual ability: a shorter time for storing elements and a limited capacity (Kyllonen & Christal, 1990; Kyllonen, 1993; Bosca, 2003). Capacity is an important characteristic of working memory. The capacity of working memory can be understood as the number of elements of information that can be stored at one time or as the time before the information expires (Baddeley & Logie 1999; Cowan, 2001). The capacity of working memory is limited and differentiated among individuals (Cowan & Alloway, 2008). Research has shown that the more advanced the processing of information in working memory, the more its capacity is reduced (Daneman & Carpenter, 1980). When the task is complex and requires the analysis of many elements (for example a mathematical task), working memory can be overloaded, the result of which may be the loss of some of the information, failure to complete the task, or retardation of information processing. The research by Engle et al. (1999) demonstrated that the processing of complex information in working memory slows down the process and reduces the memory span of short-term memory. In that situation only very simple tasks can be processed and performed (Artigas-Pallarés, 2003), the solution of which does not require the engagement of complex cognitive operations. This phenomenon can be explained by the preference observed among pupils with BIF for performing tasks involving concrete material, especially in the case of learning (Singh, 2004). Children with BIF are significantly delayed in reaching Piaget's stage of formal operations, directly connected with the capacity for abstract thinking and operations with abstract material (Masi et al., 1998). A preponderance of concrete and pictorial thinking can be observed over verbal and conceptual thinking, a proportion that is characteristic for earlier phases of development (Spionek, 1970). These children have considerable difficulty with comprehending and manipulating abstract material, and do not understand the meaning of symbols (Maurer, 1975). They achieve decidedly better results when solving problems that involve manual operations on concrete objects (Haughton, 1980). This means that in all likelihood tasks that require the storage and processing of abstract information – which is often incomprehensible for these children, due to its significant degree of difficulty – seriously overload the efficiency and processing speed of working memory, which causes partial loss of information, and thus the individual performs the task incorrectly, or stops and abandons it before it is complete.

When considering the specific nature of the functioning of working memory, the model proposed by Baddeley (1986) is still authoritative. He distinguished three components of working memory: two memory stores (the phonological loop and the visuo-spatial sketchbook) and a central executive system that controls the resources of attention and the work of these stores. Among the tasks belonging to the central executive are:

- the coordination of information derived from different sensory modalities;
- the exploitation of knowledge derived from long-term memory;
- planning and the choice of strategies;
- the coordination of tasks being performed simultaneously;
- the integration of tasks into more complex sequences;
- the monitoring of mental operations (Baddeley, 1996).

The phonological loop has been divided into a passive store, responsible for the storage of memory traces, and an active articulatory loop, whose role is to rehearse verbal and auditory information temporarily stored in the phonological store. The visuo-spatial sketchpad stores information regarding the shapes, colors, sizes or spatial position of objects. Another subsystem is the episodic buffer, which enables communication with long-term memory (Baddeley, 2000). The performance of complex cognitive functions, such as learning and problem-solving, requires the engagement of all the components of working memory mentioned in the model. Moreover, since speech and language abilities are needed not only for communication and comprehension, but also for thinking, the phonological loop, which is responsible for processing verbal information, is the basis for verbal comprehension and thinking (Artigas-Pallarés et al., 2007). St. Clair-Thompson and Gathercole (2006) have shown that working memory, especially the phonological loop, plays an essential role in the development of various kinds of knowledge and language skills, associated with the acquisition of new words and the development of the mental lexicon (Gathercole et al., 2004).

Comparative research between children with cognitive deficits (intellectual impairment) and their contemporaries with at least average cognitive capabilities has shown that the former group displays serious deficits in the functioning of the three components of working memory distinguished by Baddeley; these differences concern primarily the phonological loop (Henry, 2001; Pickering & Gathercole 2004; van der Molen et al., 2007; Mähler & Schuchardt, 2009). In their research, Schuchardt, Gebhardt, and Mähler (2010) compared the functioning of working memory and its components among pupils with intellectual impairment, borderline intelligence, and average intelligence. The comparison was done on the basis of the biological age of the children in the various groups and their intellectual age. The results basically confirmed the results of previous research, in which pupils with intellectual deficits, in comparison to pupils with at least average intelligence, were characterized by deficits mainly in the phonological loop and retardation in the development of the remaining two components. It was also shown that the deficits in the functioning of these components of working memory become worse proportionally to the degree of intellectual impairment. The children with mild intellectual impairment achieved lower scores than did the children with BIF, while the latter had lower scores than the children of average intelligence. It was also shown that children of the same intellectual age with deficits in cognitive functioning achieved lower scores in the phonological loop than did the children of average IQ at the same intellectual age, and also at the same biological age. The deficits in processing information in the

phonological loop affected both pupils with intellectual impairment and those with BIF. No variation was observed in the patterns of these deficits that would serve for differential diagnosis between children with intellectual impairment and children with BIF. These results indicate that deficits in the processing of phonological information appear to be associated with the lower level of cognitive functioning of these persons. Working memory and the level of language development are associated with fluid intelligence and the g factor (Gray & Braver, 2003). The degree of retardation in the development of the components of working memory correspond to the retardation in the development of general cognitive abilities. Significant deficits and delays in the development of the phonological loop may explain the BIF children's characteristic difficulties in understanding and remembering the teacher's instructions explaining how school tasks are to be performed (Gathercole et al., 2006; Alloway et al., 2009b).

There is a connection between working memory and the ability to learn (Cowan & Alloway, 2008). Research indicates that working memory is a better predictor of academic achievements than IQ. Deficits in the functioning of working memory are a more decisive factor than IQ for failure in school (Alloway & Alloway, 2010). Improvement in the efficiency of working memory brings about improved grades in school (Minear & Shah 2006; van der Molen et al., 2010). Educational failures that are associated with the level of functioning of working memory mainly involve:

- difficulties in learning to read (Gathercole et al., 2006b);
- specific language impairment (Alloway & Archibald, 2008);
- difficulty in understanding written text;
- problems with mathematics (Gathercole & Baddeley, 1993; Logie et al., 1994; Pickering & Gathercole, 2004).

According to Maehler and Schuchart (2009), pupils with learning difficulties show an especially low level of working memory in tasks measuring verbal and visuo-spatial short-term memory.

Research indicates that pupils with difficulties in reading and mathematics display deficits in visuo-spatial and verbal working memory, while their verbal and visuo-spatial short-term memory was developed appropriately for their age (Alloway et al., 2006a; Gathercole et al., 2006b). It has been demonstrated that deficits in verbal working memory are especially characteristic for children with difficulties in mastering the skills of reading (e.g., Swanson, 1994; De Jong, 1998), arithmetic (e.g., Bull & Scerif, 2001; Passolunghi & Siegel, 2001), and verbal comprehension (e.g., Nation et al., 1999; Seigneuric et al., 2000).

These difficulties are also characteristic for children with BIF, who display major deficits and delays in acquiring basic school skills, such as reading (with comprehension), writing, and arithmetic (Kaznowski, 2004). Especially difficult for these pupils are tasks which require the involvement of auditory short-term memory (Henry 2001; van der Molen et al., 2007), which to a certain extent explains their failures in learning to write from dictation (Bocsa, 2003). Initial problems with mastering basic school skills, such as reading and writing, cause

almost immediate failures in school and successively worsening difficulties in learning over the next years of education (Shaw, 2000).

Pupils with working memory deficits are also characterized by difficulties in concentrating (Martinussen & Tannock, 2006). These deficits manifest themselves not only by a short time of focusing on one task but also increased distractibility and reduced resistance to the influence of distractors. These problems in concentrating affect pupils with BIF to a significant degree. In the research conducted by Karende et al. (2008), which involved 55 children with a diagnosis of BIF (35 boys and 22 girls, average age 11;9), significant difficulties were observed not only in concentrating during lessons, but also strongly intensified hyperactivity while solving problems.

These pupils are easily distracted; focusing on a task requires a major mental effort, which is why they are quickly fatigued. An important question, then, is this: are their difficulties in concentrating the result of below-average cognitive functioning, or is it rather the deficits of attention and executive functions that reduce the individual's intellectual ability (Artigas-Pallares, 2007)?

The deficits in the sphere of working memory also cause a reduced ability to monitor actions in the course of performance and to notice mistakes. Bonifacci and Snowling (2008) conducted research in which they compared a group of dyslexic pupils to a group of pupils with BIF in terms of the speed of processing information and the number of mistakes (111 pupils ranging in age from 6;5 to 15;4). Before beginning their research, the authors assumed that a higher level of intelligence would be accompanied by greater speed of processing information. The speed and correctness of processing information is associated with the level of intellectual ability (Anderson, 1992). This assumption was confirmed by the results: the pupils with BIF, when compared to the children with developmental dyslexia, performed the tasks more slowly, while committing more mistakes. The results obtained by Bonifacci and Snowling (2008) are consistent with the results from a great deal of previous research (Larson & Alderton, 1990; Kranzler, 1992; Coyle, 2001).

Polish research on the efficiency of short-term memory in pupils with BIF was conducted by Kostańska et al. (1995). A previous research project carried out by Gaj (1987, cited by Kostańska, 1995) dealt with the level of development of auditory short-term memory among pupils with BIF. The research involved 60 children from grades 1 to 3 in public primary schools. The children were divided into two groups: an experimental group of 30 pupils with BIF, and a control group of a like number of pupils of average intelligence. Rey's 15-Word Test was used for this research. According to the results, the children with BIF obtained markedly lower scores in the tasks requiring the repetition and recognition of remembered verbal material, which pointed to a lower level of auditory short-term memory. It should be pointed out that teaching in Polish schools is largely based on the processing of auditory information, which means the perception and memorization of verbal information received from the teacher and performing operations on it using working memory.

Further research was conducted by Wierzchowska (1990, cited by Kostańska, 1995), which involved 60 pupils ranging in age from 7 to 11 years attending special schools. Group I consisted of 30 children with BIF, while group II consisted of 30 children with mild intellectual impairment. The author compared the two groups in respect to their scores on Rey's 15-Word Test and Kostrzewski's "Chinese writing" test of visual and auditory learning. The results indicated that the pupils with BIF differed from the pupils with mild intellectual impairment, not in terms of their ability to memorize and recall presented material, but by the tempo of their visual and auditory learning. In each successive trial in the battery of tests being used, the children with BIF achieved progressively higher scores, so that the differences between the two groups increased with each measurement.

To sum up, the research described above proved that pupils with BIF are characterized by poorer performance in auditory short-term memory tasks in comparison to children with average intelligence. These differences are not observed in comparison to pupils with mild intellectual impairment. However, in comparison to pupils with mild intellectual impairment, children with BIF learn more quickly. According to Kostrzewski (1981) it is precisely "teachability" that differentiates between intellectual disability and BIF.

Ostojewska (1990) and Pietrzyk (1990, cited by Kostańska, 1995) conducted research on learning and memory among pupils with BIF, of whom 30 (average age 13;8) were attending special schools, while the remaining 30 (average age 13;7) were attending special education classes in a public primary school. According to the results obtained by Pietrzyk (1990), all of the pupils, regardless of the type of school which they were attending, displayed disturbances of auditory perception and memory, as well as a slow pace of visual and auditory learning. At the same time, the level of auditory analysis and synthesis, auditory direct memory, and the tempo of learning were better developed in the pupils who were attending a public school. The research by Ostojewska (1990, cited by Kostańska, 1995) dealt with the development of visual functions in pupils with BIF. The children with BIF who were attending special education classes in a general school showed a higher level of visual perception, direct visual memory, and tempo of visual and auditory learning than did those who were attending a special school.

To summarize the research by Kostańska, pupils with BIF are characterized by a low level of the development of visual and auditory functions, while much greater deficits in this domain occur in children attending special schools. These results may suggest that the program of a special school is not adapted to the needs and possibilities of pupils with BIF, which could have a negative impact on the cognitive functions of these pupils. Nevertheless, this statement could be questioned, due to the lack of complete information regarding the reasons for referring these particular children to special education.

Similar results were also obtained by Wojnarska (2003) in research on the academic competencies of pupils with BIF. The experimental group consisted of 30 pupils with BIF, while the control group consisted of 30 pupils with average IQs. The pupils from both groups were attending grades 2 to 4 in public primary

schools. The research covered several domains of cognitive functioning: short-term memory (auditory and visual), reading and writing, and language development. In Rey's 15-Word Test the pupils with BIF repeated a significantly lower number of words than did the children in the control group. According to the author's observations, the BIF pupils displayed a tendency to rote memorization (a well developed rote memory), as indicated by a tendency to name first the words at the beginning and end of the list, and a desire to preserve the correct order of the words. The pupils with BIF also repeated a smaller number of non-words in the Zetotest than did the children from the control group, which resulted from deficits in phonological memory. Similar results were obtained in the Digit Recall subtest from the WISC-R: the children from the experimental group in two trials repeated fewer digits than did the children from the control group. The level of performance (number of errors) committed by the children with BIF in Stambak's Rhythm Trial corresponded to the level of children at the age of six. These results point up the low level of development of auditory perception and sequential auditory short-term memory. No statistically significant differences between groups were observed in the level of visual memory (Rey's Complex Figure Test); moreover, in Kostrzewski's "Chinese writing" test the children with BIF showed a faster tempo of visual and auditory learning than did the pupils in the control group. The pupils in the experimental group also more often used immature reading strategies. Nearly half of them read out loud (decoding), while less than 30% were reading fluently at a level expected from pupils at this stage of primary school education. Despite their average performance in reading, these children displayed a slow tempo of reading and difficulties in comprehending the text. In the case of writing trials, the pupils with BIF experienced the greatest difficulties in writing from dictation, and committed phonetic errors. The level of reading and writing was assessed using Straburzyńska and Śliwińska's series of tests of reading and writing, along with Grzywak-Kaczyńska's reading test.

LONG-TERM MEMORY IN INDIVIDUALS WITH BORDERLINE INTELLECTUAL FUNCTIONING

Working memory has a connection with long-term memory. Working memory processes information derived from sensory modalities and memory traces activated from long-term memory (Engle, 1996), which makes it possible to understand the given problem (Kyllonen & Christal, 1990). Long-term memory "constitutes the long-term storage of encoded memory traces with an unlimited capacity and storage time" (Kurcz 1992, p. 39). The effective and permanent acquisition of knowledge requires above all understanding the essence of the given material, the discovery of connections between the elements, an appropriate organization, and the imposition of a structure; for the performance of these activities it is necessary to activate the knowledge already possessed and accumulated in long-term memory. Learning also consists in the permanent mastery of new information by incorporating it into the structure of the information already possessed. Thus

the memorization of information in long-term memory requires a significant cognitive effort, in order to actively organized the material to be coded and integrated with the knowledge already possessed.

Engle (1996) observed differences among people in the amount of information derived from long-term memory that can be processed in working memory under conscious control (mental effort). Thus it is highly likely that in the case of persons with BIF, who characteristically tire easily and have difficulty dealing with abstract material, the analysis of complex information from long-term memory in the active system of working memory is an extraordinarily difficult task. As a result, the active process of organizing and integrating knowledge in working memory is largely ineffective. This explains why pupils with BIF have so many difficulties in perceiving and understanding the relationship between the knowledge already possessed and the information which they are learning (Verguts & DeBoeck, 2001), and difficulties in the logical organization of knowledge (Campione & Brown, 1978; Shaw, 2008).

The active organization and integration of the knowledge already possessed and the knowledge newly acquired also make it possible to generalize knowledge and skills. Pupils with BIF, due to the difficulties described above, usually display very little aptitude for generalizing knowledge. This capability requires the transfer of information from long-term memory to working-memory, which, when used in a flexible and creative way, can serve to create new strategies for problem-solving (Pachalska et al., 2007).

THE APPLICATION OF ROTE MEMORY AS A LEARNING STRATEGY BY STUDENTS WITH BIF

Rote memory has been observed to be relatively well developed in pupils with BIF (Maurer, 1975; Rodden-Nord & Shinn, 1991; Czajowska & Herda, 2001). This type of memory allows information to be remembered in a literal and very precise manner without logical understanding (Kim et al., 2006). Some authors emphasize that the rote memorization of information observed among children with BIF is one of the strategies they employ most often in school (Bocsa, 2003). The contents remembered in this way, however, quickly decay. As a rule they are used only in a rigid manner, basically only in the context in which learning took place, which contributes to the lack of skill in applying the knowledge in concrete, practical situations (Kostańska, 1995).

Since they acquire information in a rote manner, these pupils display a generalized difficulty that consists in a limited ability to understand and master learned material over a longer period of time. This results from the difficulties – typical for persons with BIF – in organizing knowledge and creating a logical connection between the knowledge already possessed and newly acquired information. This underlies the difficulties in generalizing knowledge and the limited ability to make use of skills acquired in one sphere in other spheres that differ from the original one. This means that in new situations these persons seldom take advantage of prior experience or knowledge (Alessi, 1987). That is why, de-

spite the fact that they know the rules and strategies of operations (e.g. mathematics), they are unable to apply them effectively (Veenman & Verhej, 2001). Most often these pupils are unable to decide where, how, and when to make use of the knowledge they possess. One of the consequences of their poor organizational abilities and major difficulties in generalizing and transferring information from one sphere to another is the small number of problem-solving strategies they possess. Typically these are rather simple strategies corresponding to earlier stages of the child's development, and involve concrete thinking (Shaw & Gouwens, 2002; Lowenstein, 2003). Difficulties of this sort slow down the pace at which these persons learn and work. Accordingly, effective teaching of children with BIF is possible when strategies are applied to integrate new and previous knowledge (Cooter & Cooter, 2004). In order to create a connection between pre-existing and newly acquired knowledge, a large number of exercises is necessary, thanks to which the pupil learns to use logical associations and connections in the process of memorizing, and the given material is made sensible. That is why the mastery of knowledge and the way it is used in a manner that is fully and permanently comprehensible for children with BIF requires more time and cognitive effort than in the case of children with average intelligence (Shaw, 2008b).

CONCLUSION

Pupils with BIF are characterized by reduced efficiency of short-term, working, and long-term memory systems (Verguts & DeBoeck, 2001; Kostańska, 1995). Rote memory, however, is well developed, which is why one of the most commonly used learning strategies is the mastery of knowledge without any logical understanding of the remembered contents. In addition, the high susceptibility to distractors, manifesting itself as difficulties in concentrating, which are characteristic for persons with BIF, affects the process of manipulating information in memory. This becomes particularly obvious in situations where the operations are being performed on material that is difficult, not understood, abstract. Effective and long-lasting learning requires not only the ability to recognize and understand the problem to be solved, but also the requisite planning and control of this process, in accordance with a previously accepted goal. This requires constant monitoring of the process of learning. One of the important aspects of the process of memorization is self-awareness and knowledge of one's own strong and weak points in the course of cognitive functions (Becker, 1975; Bobrow, 1975; Bobrow & Norman, 1975). Knowledge about when to use, how to coordinate, and in what way to monitor the various kinds of abilities involved in solving a given problem is the basis for metacognition (Mayer, 1998; Pressley, 2006). It is executive functions that are responsible for the realization of these tasks.

The differences in the level of intelligence are closely associated, as shown in this article, with the functioning of short-term, long-term, and working memory, the level of self-awareness possessed by the individual (Brown & Lawton, 1977), and the efficiency of executive functions (Campione & Brown, 1980).

REFERENCES

- Ackerman, P.L., Beier, M.E. & Boyle, M.O. (2002). Individual differences in working memory within a nomological network of cognitive and perceptual speed abilities. *Journal of Experimental Psychology-General*, 131, 567-589.
- Ackerman, P.L., Beier, M.E. & Boyle, M.O. (2005). Working memory and intelligence: the same or different constructs? *Psychological Bulletin*, 131, 30-60.
- Alessi, G. (1987). Generative strategies and teaching for generalization. *Analysis of Verbal Behavior*, 5, 15-27.
- Alloway, T.P., Gathercole, S.E. & Pickering, S.J. (2006). Verbal and visuo-spatial short-term and working memory in children: are they separable? *Child Development*, 77, 1698-1716.
- Alloway, T.P. & Archibald, L.M. (2008). Working memory and learning in children with developmental coordination disorder and specific language impairment. *Journal of Learning Disabilities*, 41, 251-62.
- Alloway, T.P., Gathercole, S.E., Kirkwood, H.J. & Elliott, J.E. (2009b). The cognitive and behavioural characteristics of children with low working memory. *Child Development*, 80, 606-621.
- Alloway T.P. & Alloway R.G. (2010). Investigating the predictive roles of working memory and IQ in academic attainment. *Journal of Experimental Child Psychology*, 106, 20-29.
- American Psychiatric Association (2000). *Diagnostic and Statistical Manual of Mental Disorders*, 4th ed. Washington, DC.
- Anderson, M. (1992). *Intelligence and development: a cognitive theory*. Oxford: Blackwell.
- Artigas-Pallarés, J. (2003). Perfiles cognitivos de la inteligencia límite. *Fronteras del retraso mental. Revista Neurológica*, 36, 161-167.
- Artigas-Pallarés, J., Rigau-Ratera, E. & García-Nonell, E. (2007). Capacidad de inteligencia límite y disfunción ejecutiva. *Revista Neurológica*, 44, 67-69.
- Baddeley, A.D. (1986). *Working memory*. New York: Oxford University Press.
- Baddeley, A.D. (1996). Exploring the central executive. *Quarterly Journal of Experimental Psychology*, 49A, 5-28.
- Baddeley, A.D. & Logie, R.H. (1999). Working memory: the multiple-component model. In: A. Miyake & P. Shah (Eds.), *Models of working memory: mechanisms of active maintenance and executive control*. Cambridge: Cambridge University Press.
- Baddeley A.D. (2000) The episodic buffer: a new component of working memory? *Trends in Cognitive Sciences*, 4(11), 417-423.
- Bayliss, D.M., Jarrold, C., Baddeley, A.D., Gunn, D.M. & Leigh, E. (2005). Mapping the developmental constraints on WM span performance. *Developmental Psychology*, 41, 579-597.
- Beauducel, A. & Kersting, M. (2002). Fluid and crystallized intelligence and the Berlin Model of Intelligence Structure (BIS). *European Journal of Psychological Assessment*, 18, 97-112.
- Becker, J.D. (1975). Reflections on the formal description of behavior. In: D.G. Bobrow & A. Collins (eds.), *Representation and understanding: studies in cognitive science*. New York: Academic Press.
- Benson, N. (2008). Cattell Horn Carroll cognitive abilities and reading achievement. *Journal of Psychoeducational Assessment*, 26, 27-41.
- Bobrow, D.G. (1975). Dimensions of representation. In D.G. Bobrow & A. Collins (eds.), *Representation and understanding: studies in cognitive science*. New York: Academic Press.
- Bobrow, D.G. & Norman, D.A. (1975). Some principles of memory schemata. In: D.G. Bobrow & A. Collins (Eds.). *Representation and understanding: studies in cognitive science*. New York: Academic Press.
- Bocsa, E. (2003). School adjustment of borderline intelligence pupils. Summary of doctoral thesis. Babeş-Bolyai University in Cluj-Napoca, Romania. Department of Psychology and Education. Available on-line at: <http://www.inap.no/artikler/bosca01summarydoctorthesis.pdf>
- Bogdanowicz, M. (1985). *Psychologia kliniczna dziecka w wieku przedszkolnym*. Warsaw: WSiP.
- Bogdanowicz, M. (2008). *Portrety nie tylko znanych osób z dysleksją*. Gdańsk: Harmonia.
- Bonifacci, P. & Snowling, M.J. (2008). Speed of processing and reading disability: a cross-linguistic investigation of dyslexia and borderline intellectual functioning. *Cognition*, 107(3), 999-1017.

- Braden, J.P. & Shaw, S.R. (2009). Intervention validity of cognitive assessment: knowns, unknowns, and unknowables. *Assessment for Effective Intervention*, 34, 106-115.
- Brown, A.I. & Lawton, S.C. (1977). The feeling of knowing experience in educable retarded children. *Developmental Psychology*, 13, 364-370.
- Bull, R. & Scerif, G. (2001). Executive functioning as a predictor of children's mathematics ability: shifting, inhibition and working memory. *Developmental Neuropsychology*, 19, 273-292.
- Burgess, G.C., Braver, T.S., Conway, A.R.A. & Gray, J.R. (2011). Neural mechanisms of interference control underline the relationship between fluid intelligence and working memory span. *Journal of Experimental Psychology: General*, 140, 674-692.
- Campione, J.C. & Brown, A.L. (1980). Toward a theory of intelligence: contributions from research with retarded children. *Intelligence*, 2, 279-304.
- Campione, J.C., Brown, A.L., Ferrara, R.A., Jones, R.S. & Steinberg, E. (1985). Breakdowns in flexible use of information: intelligence-related differences in transfer following equivalent learning performance. *Intelligence*, 9, 297-315.
- Carroll, J.B. (1993). *Human cognitive abilities: a survey of factor-analytic studies*. Cambridge, MA: Cambridge University Press.
- Colom, R. & Shih, P.C. (2004). Is working memory fractionated onto different components of intelligence? *Intelligence*, 32, 431-444.
- Colom, R., Rebollo, I., Palacios, A. Juan-Espinoza, M. & Kyllonen, P.C. (2004). Working memory is (almost) perfectly predicted by g. *Intelligence*, 32, 277-296.
- Colom, R., Shih, P.C., Flores-Mendoza, C. & Quiroga, M.A. (2006). The real relationship between short-term memory and working memory. *Memory*, 14, 804-813.
- Conway, A.R.A. & Engle, R.W. (1996). Individual differences in working memory capacity: more evidence for a general capacity theory. *Memory*, 4, 577-590.
- Cooter, K.S. & Cooter, R.B. (2004). One size doesn't fit all: slow learners in the reading classroom. *The Reading Teacher*, 57(7), 680-684.
- Coyle, T.R. (2001). IQ is related to the worst performance rule in a memory task involving children. *Intelligence*, 29(2), 117-129.
- Cowan, N. (2001). The magical number 4 in short-term memory: a reconsideration of mental storage capacity. *Behavioral & Brain Sciences*, 24, 87-114.
- Cowan, N. & Alloway, T.P. (2008). The development of working memory in childhood. In: M. Courage & N. Cowan (eds.), *Development of memory in infancy and childhood*, 2nd ed. Hove: Psychology Press.
- Czajkowska, I. & Herda, K. (2001). *Zajęcia korekcyjno-kompensacyjne*. Warsaw: WSiP.
- Daneman, M. & Carpenter, P.A. (1980). Individual differences in working memory and reading. *Journal of Verbal Learning and Verbal Behavior*, 19, 450-466.
- De Jong, P.F. (1998). Working memory deficits of reading disabled children. *Journal of Experimental Child Psychology*, 70, 75-96.
- Deary, I.J., Strand, S., Smith, P. & Fernandes, C. (2007). Intelligence and educational achievement. *Intelligence*, 35, 13-21.
- Engle, R.E., Kane, M.J. & Tuholski, S.W. (1999). Individual differences in working memory capacity and what they tell us about controlled attention, general fluid intelligence, and functions of the prefrontal cortex. In: A. Miyake & P. Shah (eds.), *Models of working memory: mechanisms of active maintenance and executive control*. Cambridge: Cambridge University Press.
- Fuster, J.M. (2005). The cortical substrate of general intelligence. *Cortex*, 41, 228-237.
- Gathercole, S. & Baddeley, A.D. (1993). *Working memory and language*. Hove: Erlbaum.
- Gathercole, S.E., Pickering, S.J., Knight, C. & Stegmann, Z. (2004). Working memory skills and educational attainment: evidence from national curriculum assessments at 7 and 14 years of age. *Applied Cognitive Psychology*, 18, 1-16.
- Gathercole S.E., Alloway T.P., Willis C.S. & Adams A.M. (2006a). Working memory in children with reading disabilities. *Journal of Experimental Child Psychology*, 93, 265-81.
- Gathercole, S.E., Lamont, E. & Alloway, T.P. (2006b). Working memory in the classroom. In: S. Pickering (ed.), *Working memory and education*. Amsterdam: Elsevier Press.

- Gindrych, P. (2002). *Funkcjonowanie psychospołeczne uczniów dyslektycznych*. Lublin: UMCS Press.
- Gottfredson, L.S. (2004a). Schools and the g factor. *The Wilson Quarterly*, 35-45.
- Gottfredson, L.S. (2004b). Intelligence: is it the epidemiologists' elusive "fundamental cause" of social class inequalities in health? *Journal of Personality and Social Psychology*, 86, 174-199.
- Gottfredson, L.S. (2005). Implications of cognitive differences for schooling within diverse societies. In: C.L. Frisby & C.R. Reynolds (eds.), *Comprehensive handbook of multicultural school psychology*. Hoboken, NJ: Wiley & Sons.
- Gray, J.R., Chabris, C.F. & Braver, T.S. (2003). Neural mechanisms of general fluid intelligence. *Nature Neuroscience*, 6, 316-338.
- Gutiérrez-Martínez, F., Melchor, R. & Vila, J.O. (2011). Working memory, reading comprehension, intelligence and school achievement: prevalence of the "fluid" component in working memory measures. *Infancia y Aprendizaje*, 34(4), 465-479.
- Hassiotis, A., Strydom, A., Hall, I., Ali, A., Lawrence-Smith, G., Meltzer, H., Head, J. & Bebbington, P. (2008). Psychiatric morbidity and social functioning among adults with borderline intelligence living in private households. *Journal of Intellectual Disability Research*, 52(2), 95-106.
- Haughton, E.C. (1980). Practicing practices: learning by activity. *Journal of Precision Teaching*, 1, 3-20.
- Henry, L.A. (2001). How does the severity of a learning disability affect working memory performance? *Memory*, 9, 233-47.
- Hornung, C., Brunner, M., Reuter, R.A. P. & Martin, R. (2011). Children's working memory: its structure and relationship to fluid intelligence. *Intelligence*, 39(4), 210-221.
- Howe, M.L., O'Sullivan, J.T., Brainerd, C.J. & Kingma, J. (1989). Localizing the development of ability difference in organized memory. *Contemporary Educational Psychology*, 14, 336-356.
- Jankowska, A., Frankowska, K. & Bogdanowicz, M. (2009). Inteligencja Borderline-rozwód poglądów o inteligencji niższej niż przeciętna. In: C. Kosakowski, A. Krause & M. Wójcik (eds.), *Relacje i doświadczenia społeczne osób z niepełnosprawnością*. Toruń-Olsztyn: Wydawnictwo Edukacyjne Akapit.
- Jensen, A.R. (1998). *The g factor*. Westport, CT: Praeger.
- Jimerson, S., Egeland, B., Sroufe, L.A. & Carlson, B.A. (2000). Prospective longitudinal study of high school dropouts examining multiple predictors across development. *Journal of School Psychology*, 38, 525-549.
- Karende, S., Kanchan, S. & Kulkarni, M. (2008). Clinical and psychoeducational profile of children with borderline intellectual functioning. *Indian Journal of Pediatrics*, 75, 795-800.
- Kasen, S., Cohen, P. & Brook, J. (1998). Adolescent school experiences and dropout, adolescent pregnancy, and young adult deviant behavior. *Journal of Adolescent Research*, 13, 49-72.
- Kaznowski, K. (2004). Slow learners: are educators leaving them behind? *National Association of Secondary School Principals Bulletin*, 88, 31-45.
- Kim, A.H., Woodruff, A.L., Klein, C. & Vaughn, S. (2006). Facilitating co-teaching for literacy in general education through technology: focus on students with learning disabilities. *Reading & Writing Quarterly*, 22, 269-291.
- Kostańska, L. (1995). Procesy intelektualne i poznawcze dzieci o niższym od przeciętnego poziomie inteligencji - próba charakterystyki. In: Z. Gaś (ed.), *Psychologia wychowawcza*. Lublin: Wydawnictwo UMCS.
- Kostrzewski, J. (1981). Osoby o niższym niż przeciętny poziomie sprawności intelektualnych. In: K. Kirejczyk (ed.), *Upośledzenie umysłowe*. Warsaw: PWN.
- Kranzler, J.H. (1992). A test of Larson and Alderton's (1990) worst performance rule of reaction time variability. *Personality & Individual Differences*, 13, 255-261.
- Kuncel, N.R., Ones, D.S. & Sackett, P.R. (2010). Individual differences as predictors of work, educational, and broad life outcomes. *Personality and Individual Differences*, 49, 331-336.
- Kurcz, I. (1992). *Pamięć, uczenie się, język*. Warsaw: PWN.
- Kyllonen, P.C. & Christal, R.E. (1990). Reasoning ability is (little more than) working-memory capacity? *Intelligence*, 14, 389-433.

- Kyllonen, P.C. (1993). Aptitude testing based on information processing: a test of the four-sources model. *Journal of General Psychology*, 120, 375-405.
- Lindsay, W., Hastings, R., Griffiths, D. & Hayes, S. (2007). Trends and challenges in forensic research on offenders with intellectual disabilities. *Journal of Intellectual & Developmental Disability*, 2, 55-61.
- Lipowska, M. (2008). Sprawność fonologiczna dzieci z inteligencją niższą niż przeciętna. In: J. Porayski-Pomsta (ed.). *Diagnoza i terapia w logopedii* (pp. 190-203). Warszawa: Dom Wydawniczy Elipsa.
- Loeber, R. & Farrington, D.P. (2000). Young children who commit crime: epidemiology, developmental origins, risk factors, early interventions, and policy implications. *Development & Psychopathology*, 12, 737-762.
- Logie, R.H., Gilhooly, K.J. & Wynn, V. (1994). Counting on working memory in mental arithmetic. *Memory & Cognition*, 22, 295-410.
- Lowenstein, D. (2003). Understanding and helping the slow learner. Available on-line at: www.clubtheo.com/momdad/html/dslow.html
- Lubinski, D. (2000). Scientific and social significance of assessing individual differences: sinking shafts at a few critical points. *Annual Review of Psychology*, 51, 405-444.
- Lynn, R., Hampson, S. & Magee, M. (1984). Home background, intelligence, and personality and education as predictors of unemployment in young people. *Personality and Individual Differences*, 5, 549-557.
- Martínez, K., Burgaleta, M., Román, F.J., Escorial, S., Shih, P.C., Quiroga, M.A. & Colom, R. (2011). Can fluid intelligence be reduced to 'simple' short-term storage? *Intelligence*, 9, 473-480.
- Masi, G., Marcheschi, M. & Pfanner, P. (1998). Adolescents with borderline intellectual functioning: psychopathological risk. *Adolescence*, 33(130), 425-434.
- Maurer, A. (1975). Właściwości rozwoju psychoruchowego dzieci ociężałych umysłowo jako źródło ich trudności szkolnych. *Ruch Pedagogiczny*, 4, 510-522.
- Mähler, C. & Schuchardt, K. (2009). Working memory functioning in children with learning disabilities: does intelligence make a difference? *Journal of Intellectual Disability Research*, 53, 3-10.
- Martinussen, R. & Tannock, R. (2006). Working memory impairments in children with attention-deficit hyperactivity disorder with and without comorbid language learning disorders. *Journal of Clinical & Experimental Neuropsychology*, 28, 1073-1094.
- Mayer, R.E. (1998). Cognitive, meta-cognitive and motivational components of problem solving. *Instructional Science*, 26, 49-63.
- Miller, L.T. & Vernon, P.A. (1992). The general factor in short-term memory, intelligence and reaction time. *Intelligence*, 16, 5-29.
- Miller, L.T. & Vernon, P.A. (1996). Intelligence, reaction time, and working memory in 4- to 6-year-old children. *Intelligence*, 22, 155-190.
- Minear, M. & Shah, P. (2006). Sources of working memory deficits in children and possibilities for remediation. In: S. Pickering (ed.), *Working memory and education*. London: Academic Press.
- Minehand, J.A., Newcomb, M.D. & Galaif, E.R. (2000). Predictors of adolescent drug use: cognitive abilities, coping strategies, and purpose in life. *Journal of Child & Adolescent Substance Abuse*, 10, 33-52.
- Mink, I.T., Meyers, C.E. & Nihira, K. (1984). Taxonomy of family life styles: II. Homes with slow-learning children. *American Journal of Mental Deficiency*, 89, 111-123.
- Nation, K., Adams, J.W., Bowyer-Crane, C.A. & Snowling, M.J. (1999). Working memory deficits in poor comprehenders reflect underlying language impairments. *Journal of Experimental Child Psychology*, 73, 139-158.
- Neisser, U., Boodoo, G., Bouchard, T., Boykin, A., Brody, N., Ceci, S. & Urbina, S. (1996). Intelligence: knowns and unknowns. *American Psychologist*, 51, 77-101.
- Pąchalska, M., Jastrzębowska, G., Lipowska, M. & Pufal, A. (2007). Specific language impairment: neuropsychological and neurolinguistic aspects. *Acta Neuropsychologica*, 5(3), 131-154.

- Pąchalska, M., Ledwoch, B., Moskała, M., Zieniewicz, K., Mańko, G. & Polak, J. (2012). Social intelligence and adequate self expression in patients with orbitofrontal cortex injury in the criminals. *Medical Science Monitor*, 18(10), CR367-373.
- Passolunghi, M.C. & Siegel, L.S. (2001). Short term memory, working memory, and inhibitory control in children with specific arithmetic learning disabilities. *Journal of Experimental Child Psychology*, 80, 44-57.
- Pickering, S.J. & Gathercole, S.E. (2004). Distinctive working memory profiles in children with special educational needs. *Educational Psychology*, 24, 393-408.
- Pressley, M. (2006). Metacognitively competent reading comprehension is constructively responsive reading. *Metacognition & Learning*, 1, 99-113.
- Rodden-Nord, K. & Shinn, M.R. (1991). The range of reading skills within and across general education classrooms: contributions to understanding special education for students with mild handicaps. *Journal of Special Education*, 24, 441-453.
- Rohde, T.E. & Tompson, L.A. (2007). Predicting academic achievement with cognitive ability. *Intelligence*, 32, 573-589.
- Rourke, P.G. & Quinlan, D.M. (1973). Psychological characteristics of problem children at the borderline of mental retardation. *Journal of Consulting & Clinical Psychology*, 40, 59-68.
- Schuchardt, K., Gebhardt, M. & Mäehler, C. (2010). Working memory functions in children with different degrees of intellectual disability. *Journal of Intellectual Disability Research*, 54(4), 346-353.
- Seigneuric, A., Ehrlich, M.-F., Oakhill, J.V. & Yuill, N.M. (2000). Working memory resources and children's reading comprehension. *Reading & Writing*, 13, 81-103.
- Shaw, S.R. & Gouwens, D.A. (2002). Chasing and catching slow learners in changing times. *NASP Communique*, 31, 1-4.
- Shaw, S.R. (2008a). Borderline intellectual functioning: rejecting an outmoded classification or ignoring critical challenges? *Revista Psihologie. Pedagogie specială. Asistentă socială (Journal of Psychology, Special Education, and Social Work)*, 3, 53-78.
- Shaw, S.R. (2008b). An educational programming framework for a subset of students with diverse learning needs: borderline intellectual functioning. *Intervention in School & Clinic*, 43, 291-299.
- Shaw, S.R. (2010). "Slow learners": supporting children at home and school (S2H23). In: A. Canter, L. Paige & S.R. Shaw (eds.), *Helping children at home and at school* (3rd ed.). Bethesda, MD: National Association of School Psychologists.
- Shore, M.F. (2001). Empowering individuals as carers of their own health. *World Hospital Health Services*, 37, 33, 35.
- Singh, V.P. (2004). *Education of the slow learners*. New Delhi: Sarup.
- Spionek, H. (1973). *Zaburzenia rozwoju uczniów a niepowodzenia szkolne*. Warsaw: PWN.
- St. Clair-Thompson, H.L. & Gathercole, S.E. (2006). Executive functions and achievements in school: shifting, updating, inhibition, and working memory. *Quarterly Journal of Experimental Psychology*, 59(4), 745-759.
- Swanson, H.L. (1994). Short-term memory and working memory: do both contribute to our understanding of academic achievement in children and adults with learning disabilities? *Journal of Learning Disabilities*, 27, 34-50.
- Swanson, H.L. & Sachse-Lee, C. (2001). Mathematical problem solving and working memory in children with learning disabilities: both executive and phonological processes are important. *Journal of Experimental Child Psychology*, 79, 294-321.
- Szymańska, J. & Wyczesany, J. (1972). Dziecko ociężałe umysłowo: otwarty problem szkoły podstawowej. *Rocznik Komisji Nauk Pedagogicznych*, vol. XVI.
- Taub, G.E., Floyd, R.G., Keith, T.Z. & McGrew, K.S. (2008). Effects of general and broad cognitive abilities on mathematics achievement. *School Psychology Quarterly*, 23, 187-198.
- Tillman, C.M., Nyberg, L. & Bohlin, G. (2008). Working memory components and intelligence in children. *Intelligence*, 36, 394-402.
- van der Meer, J.J., van der Meer, D.-J., Kunert, H.J., Borger, N. & Pirila, S. (2008). Impulse responses in children with conduct disorder and borderline intellectual functioning. *Child Neuropsychology*, 14, 187-194.

- van der Molen, M.J., Van Luit, J.E.H., Jongmans, M.J. & van der Molen, M.W. (2007). Verbal working memory in children with mild intellectual disabilities. *Journal of Intellectual Disabilities Research*, 51, 162-171.
- van der Molen, M.J. (2010). Working memory structure in 10- and 15-year old children with mild to borderline intellectual disabilities. *Research In Developmental Disabilities*, 31(6), 1258-1263.
- Veenman, M.V.J. & Verheij, J. (2001). Technical students' metacognitive skills: relating general vs. specific metacognitive skills to study. *Learning and Individual Differences*, 13, 259-272.
- Verguts, T. & DeBoeck, P. (2001). On the correlation between working memory capacity and performance on intelligence tests. *Learning & Individual Differences*, 13, 37-56.
- Vock, M., Preckel, F. & Holling, H. (2011). Mental abilities and school achievement: a test of a mediation hypothesis. *Intelligence*, 39, 357-369.
- Wilson, M.S. (1991). Support services professionals' evaluation of current services for students with learning disabilities and low achieving students without learning disabilities: more grist for the reform mill. *School Psychology Review*, 20, 67-80.
- Włodarski, Z. (1966). Niedorozwój umysłowy. In: L. Wołoszynowa (ed.), *Materiały do nauczania psychologii. Psychologia kliniczna i psychopedagogika specjalna*. Series IV, vol. 2. Warsaw: PWN.

Address for Correspondence:

Anna Jankowska

Department of Psychology, University of Warmia and Mazury

ul. Prawocheńskiego 13, 10-744 Olsztyn, Poland

e-mail: amjankowska@hotmail.com