

EXECUTIVE FUNCTIONS & LEARNING DISABILITIES –
CORRELATIONS IN DIAGNOSTICS AND PREVENTION OF FASD

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ABSTRACT: *This study is based on an unauthorized translation of Diagnostic Guide for Fetal Alcohol Spectrum Disorders: The 4-Digit Diagnostic Code, Third Edition, 2004 written by Susan J. Astley, Professor of Epidemiology. The research further includes additional scholarly sources, studies conducted by authors of this article as well as their own research in Centre for Diagnostics, Therapy and Prevention of FAS. Our purpose was to explore selected correlations between executive functions and writing and reading tests in selected target groups (elementary school students between the age of 9 and 11). The research project partially corresponds to diagnostics criteria for selected domains “executive functions” and “learning disabilities” in the original Guide - The 4-Digit Diagnostic Code. An outcome of this study, which was conducted within the project Context of Selected Diagnoses in Students with Fetal Alcohol Syndrome Spectrum and Students’ Inclusion in Selected Daycares and Elementary Schools, reveals positive correlations between selected domains and a significance in FASD prevention within Slovakia.*

KEY WORDS: *Fetal Alcohol Syndrome, Fetal Alcohol Spectrum Disorder, Diagnosis, Prevention in Slovakia, Correlation, Executive Functions, Learning Disability*

INTRODUCTION

Main purpose of this study is to expose distinctive limitations in prevention and diagnostics of FASD in Slovakia. We have developed our research method from selected diagnostic procedures formulated in *Diagnostic Guide for FASD. Diagnostic Guide for Fetal Alcohol Spectrum Disorders: The 4-Digit Diagnostic Code* (Astley, 2004), which we consider to be a highly effective tool for defining limitations in conventional approach to diagnostics of prenatally exposed individuals. The author, Susan Astley, thoroughly established the outcomes of her research in the Diagnostic Guide (Astley, 2004, p. 10). For the purpose of this study, we selected those which were relevant for Slovakia and which had to be placed within the context of the local policy situation:

- *There are no normalized functional definitions for any diagnosis that would fall under FASD in Slovakia.*
- *There is a lack of objective quantitative systems which would measure and record the range of symptoms in key diagnostic functions (features).*
- *Congenital defects and neurodevelopmental disorders resulting from alcohol exposure (Stratton et al. 1996) indicate a causal connection between alcohol exposure and the outcome in an individual that currently cannot be medically supported.*
- *In medical reports, FASD diagnoses too often lack a proper documentation method that was implemented in the diagnostic process of FASD. There is usually negligible or no data documentation that would support a relevant diagnosis.*

The lack of such documentation diminishes quality of the research that might otherwise help in a formulation of causes leading to individual behavior. This results in legislative or system criteria being not met, and consequently, in a failure of health care providers and educators to provide suitable intervention for affected individuals. Some individuals have low IQ, while others have normal IQ. Some suffer from an attention deficit disorder, while others may be afflicted with memory or speech disorders. From the perspective of health care system, an inability to provide such comprehensive medical reports mitigates an attempt to precisely and correctly monitor the prevalence of FASD diagnoses within a population. *Supportive data are critical for verification and confirmation of a diagnosis. Within the healthcare system, careful monitoring is necessary*

for suitable policy formulation and is fundamental for evaluation of its efficiency in a primary prevention. Comprehensive data collecting for the 4-Digit Diagnostic Code has important implications not only in the process of correct diagnostics but also in an efficient prevention. The 4-Digit Diagnostic Code provides a comprehensive diagnostic system that records all supportive data as well as supplies numerical classification structure which is included in clinical, research and monitoring databases (Astley, 2004, p. 12).

“4-Digit Diagnostic Code” helped us to reduce existing limitations. The four codes describe a manifestation magnitude of four main diagnostic symptoms of FASD in the following order:

- lower growth,
- FAS facial phenotype,
- CNS abnormality, and
- prenatal alcohol exposure.

The 4-Digit diagnostic method was born in the Centre of Diagnostics and Prevention of FAS at University of Washington in Seattle (FAS DPN) as a result of comprehensive reports of more than 2000 patients diagnosed in FAS DPN (from birth to the age of 53)(Clarren, Astley, 1997; Clarren et al., 2000; in: Astley, 2004). Currently, the 4-Digit Diagnostic Code is an infrastructure for fully integrated and highly successful screening and for diagnostic, preventive and control policy in the state of Washington (Astley et al., 2002; Astley, 2004).

For the purpose of this study, we have selected two subdomains of CNS abnormality (the third digit of a diagnostic code) that helped us indicate relevant selection and classification description of people who manifested all possible combinations and spectrums of alcohol exposure - executive functions and learning disabilities, particularly, reading and writing.

Influence of alcohol on brain development had been described in several articles by Susan Astley. The studies form a basis for CNS abnormality definition in individuals with FASD. According to the author *...the ability to reveal structural, neurological and functional abnormalities of CNS depends on sensitivity of modern measuring devices and procedures which are constantly advancing. Not all structural or neurological abnormalities develop from measurable dysfunction and not all function abnormalities are caused by a hidden brain damage...*(Astley et al.,

2002; Astley, 2004, p. 47). *The 4- Digit scale for CNS stems from the following assumptions:*

- individuals with prenatal alcohol exposure may manifest structural, neurological and/or functional abnormalities of CNS;
- these CNS abnormalities manifest along the continuity of severity;
- not all functional abnormalities are caused by brain damage.

It is important to realize that CNS scale consists of two scales in one. The first subscale (from 1 to 4) documents higher “probability” of CNS damage that is based on structural, neurological and/or functional proof. *The higher the value from 1 to 4, the stronger the proof or higher probability that CNS is damaged.* In the second subscale, the scale (between 1 to 3) also records higher severity of brain dysfunction. *The higher the value from 1 to 3, the more severe the global dysfunction.*

Descriptive labels with ranks 1 to 4 reflect a higher probability of CNS damage. This fact is confirmed by data from FAS DPN at University of Washington. Among the first 1500 diagnosed patients were those who were rated with 2 or 3-degree dysfunction. These patient were in 5.8 and 10.8 higher risk of structural/neurological damage and that in comparison to patients who did not have any evidence of dysfunction (Rank 1). The medical institute reported that “FAS may be defined by behavioral or cognitive problems which are considered to result from *structural brain damage*; it is not possible to define these as a result of genetic disorder or environmental influence and they do not improve with traditional effective intervention techniques” (Stratton et al., 1996). All monitored individuals who receive Rank 1 (no brain dysfunctions), 2 or 3 may have a brain dysfunction. The patients who manifested considerable structural and/or neurological symptoms of CNS damage were given Rank 4. For this reason, all individuals with structural/neurological symptoms of CNS damage had two CNS evaluations; one, which documents structural/neurological damage (Rank 4); and second, which records the level of dysfunction (Rank 1, 2, or 3).

RESEARCH FOCUS

According to Astley’s Guide (2004), we have adopted the following ranking relevant for Slovakia:

- **A) CNS Rank 4:** (structural/neurological abnormalities) “Definite” evidence of CNS damage

This Rank is selected in case of a clear evidence of CNS damage which is confirmed by traditional medical procedures: present microcephaly, considerable brain abnormalities of supposed prenatal origin supported by imaging devices such as CT or MRI. The abnormalities may include hydrocephaly, heterotopy, epilepsy, change in the shape and/or size of brain parts, seizures which are not caused by postnatal damage or other postnatal events, or other severe neurologic symptoms of supposed prenatal origin.

- **B) CNS Rank 3:** (moderate dysfunction) “possible” evidence of CNS damage

These patients are dysfunctional in the following domains: executive functions, memory, cognition, social/adaptive skills, academic success, speech, motor skill level and attention level, or activities. Rank 3 is based on evidence generated from standardized and valid psychometric tests, such as WISC-III, Rey-Osterrieth, Benton Visual Retention Test, Bender-Gestalt Test, Stanford - Binet or Woodcock Johnson, BRIEF, Mikulajova’s Tests etc. The results derived from our testing of individuals or from other reliable sources are then determined by qualified professionals such as psychologists, psychiatrists, special education professionals, physiotherapists, speech therapists etc. When the testing reveals “significant” impairment in three or more areas of brain function with a deviation of 2 SD, or more, in the standardized test, Rank 3 is given. In Slovak tests, however, it is difficult to define SD deviations because they are not part of standard norms. On the other hand, global delay with more impaired areas may provide an evidence for Rank 3. In every clinical testing, the domains are defined by a team of experienced clinical professionals who take part in the ranking of an affected individual. In the end, evidence that supports Rank 3 must come from standardized psychometric tests.

- **C) CNS Rank 2** “Possible” evidence for CNS damage

Rank 2 should be given to two groups of individuals whose records report impaired behavioral, cognitive, and/or developmental areas.

The first affected group, if positive, was not yet tested and given Rank 3. One of the reasons may be that at the time of testing, an individual was too young to be tested (younger than 6 years). The child should then be retested and evidence for Rank 3 reassessed when he/she is older. Term “*neurobehavioral damage*” applies to Rank 2. *If the Rank is given to a young child, based on data about child’s development, the clinical team may decide not to employ the term “neurobehavioral damage”.*

In the second group, there is no persuasive evidence for Rank 3 or, according to a clinical team, the possibility of likely CNS damage cannot be fully excluded. In this case, behavior of these individuals cannot be formulated such as normal variants or temporary emotional reactions to environment. There should be an option of alternate testing or a procedure of alternate diagnostic assessment. Yet, if the suitable testing had been performed and there was no clear evidence of dysfunction or developmental delay, it is improbable that Rank 2 would be given.

– D) CNS, Rank 1 “No” present evidence of CNS damage

If there are no functional or developmental problems which would reflect CNS damage, Rank 1 is given. Evidence for Rank 1 may come from standardized psychometric tests, observational data, and/or from an interview with a caregiver/parent. Even though Rank 1 is rare in FASD Diagnostic Clinic, it may help us to discuss such result within a context of a healthy child assessment which was given in general pediatric clinic where most of the kids would be given Rank 1.

DESCRIPTION OF SELECTED SUBDOMAINS

If we want to assess capacity and strength of CNS within a context of FASD diagnostics, it is necessary to narrow down our research to selected subdomains which also reflect the demands of professional pedagogic intervention practice: executive functions and academic skills (these we have further narrowed down to processes of reading and writing). According to *Encyclopedia of Mental Disorders*, the term “executive functions” denotes the part of cognitive functions which regulate other functions and behavior of an individual (Barry, 2007; in: Krchníková, 2009). Halford explained simultaneous understanding and in his

work proved that a limitation of understanding in respect to working memory reduced the ability of grasping statistical interactions between variables. “According to him, three variables represent maximum which a subject can simultaneously grasp. This limitation does not disclose memory limitation; subjects are able to process all relevant information, but not continually. A number of units which we are able to process simultaneously is limited. According to Lehl and Fisher, it is possible to express our working memory capacity in mathematical terms: $C(\text{bit}) = C_k(\text{bit/s}) \times D(\text{s})$ (Krchníková, 2009).

C is the capacity of working memory which is defined by reciprocal relationship between individual mental speed of information processing, described as C_k , expressed in bit/s, and measured by speed of reading and time during which given information rests in working memory, expressed in seconds (Krchníková, 2009).

The author includes KAI test (which includes the subtest, Letter Reading, showing maximum speed of information transfer to short-term memory that in adults also measures in detail an actual level of general intelligence, speed of information processing, duration of presence momentum; and the subtest, - Sign Repetition, consisting of two parts: sign reading and letter reproduction). Relevant IQ values are then assigned to results of subtests in KAI. These results reflect an extent of general fluid intelligence. Test norms include population between 17-65 years. Nevertheless, the authors claim that there is no test limitation in respect to the age of individuals; the only condition is proband’s ability to read fluently.

In his study *Executive Functions and Text Comprehension in Primary Education*, Klimovic (2014) does not recommend an isolated learning of cognitive strategies. He suggests learning within a context of curriculum. Two levels of interventions in two basic domains - at the level of environment and the level of a learner - describe the presence of executive functions in models of selective attention, planning, impulsivity check, cognitive flexibility, working memory, inhibition, strategic behavior leading to a goal, self-regulation, activity monitoring, metacognition etc. In his study, the author introduces modern research of relationship between executive functioning and text comprehension. He also discloses Jensen’s model and McCloskey’s model. *In Jensen’s model of cognitive functions, it is possible to reveal which intellectual, non-intellectual and*

performance components are present in learning situations requiring a comprehensive approach in everyday solutions. Relationship analysis between intellectual knowledge construction functions and reading (Jensen, 2009; in: Klimovic, 2014, p. 3) delivered an overview of cognitive processes in reading in the areas of phonemic awareness, process of analysis and synthesis of word meanings and their recognition, reading fluency and comprehension (Klimovic, 2014, p. 4). Jensen’s model answers the question, which mental activities are performed by a reader while reading, and it also suggests how is it possible to develop components of cognitive education.

Chart 1. Overview of knowledge construction functions that are present in reading comprehension according to Jensen (Jensen, 2009; in: Klimovic, 2014, p. 3)

Reading component	Intellective knowledge construction functions present in reading comprehension
phonemic awareness	attention (ability of not being easily distracted), accuracy and precision in reception, ability to preliminary establish a suitable approach in reading, comparative behaviour, detection of linguistic norms and reading rules
analytical-synthetic processes	understanding the letters, punctuation marks, ability to use his/her former reading experience, monitoring of individual letters decoding
words and their meaning recognition	ability to use vocabulary in reception and production
reading fluency	adequate reading speed, attention, persistence, automation, self-regulation, autonomy
comprehension	symbol and sign comprehension, verbal tools (vocabulary), collection of information in the reception phase, creating a mental representation of the text, deliberate evocation of knowledge from memory, ability to organize objects and events (by order, classification, grouping , categorization), inferential thinking

There are several important self-regulating executive functions in fluent reading according to McCloskey’s (2009) model of executive functions (Klimovic, 2014). “Ineffective reading is caused by low level of executive functions resulting

in non-recognition of known words, low level of word decoding, lower reading speed and weak comprehension” (Klimovic, 2014). According to the author, the most complex process is text comprehension that can be achieved by integration of:

- underlying partial reading processes (word recognition, word decoding, reading speed) and their executive functions (such as attention, inhibition, monitoring),
- additional cognitive abilities (such as justification, visual-space orientation, dictionary) with respective executive functions,
- executive functions responsible for current timeframe expansion (for example by working memory utilization)
- executive functions responsible for simultaneous coordination of multiple processes in extracting meaning from the text (McCloskey, 2009, p. 144, in: Klimovic, 2014, p. 4).

There are multiple tests of executive functions available but there are controversies in individual tests measuring partial executive functions. *Correlation coefficients between tests of executive functions in Wisconsin Test of Card Sorting and the Test of Towers are a good example of such controversies. These tests measure different non-executive cognitive functions that can influence test results. Another example is an analysis of TMT Test (often used in psychiatry in executive function assessment) because there is a lack of congruity of respective processes as well as their part in a good result* (Chylova, Slavkovska, 2014, p. 56).

The authors reiterate the claim of Sanchez - Cubillo that ...in final analysis of 24 studies using TMT, in part A, the terms, visual browsing, perceptual-motoric speed, processing speed, working memory and general intelligence were interconnected. In part B (used as a test of executive functions), the most mentioned terms- with more time available- were cognitive flexibility, inhibition/interference check, working memory, mental browsing, focused attention and attention distribution (Sanchez - Cubillo et al., in: Chylova, Slavkovska, 2014, p. 56).

Other testing possibilities are presented in Chart 1. According to Nikolai, Stepankova and Bezdicek (2014, p. 275), diagnostics of executive functions in clients with mild cognitive disorder (MCI) should reflect the fact that the most used screening test in medical practice, MMSE, is not very sensitive in its capacity

to discover executive functions disorders. However, analysis of executive functions is necessary for diagnostics of subtypes MCI, mostly non-amnesic MCI and multidomain MCI. Every neuropsychological examination should include executive function analysis. Problems in areas of decision making, problem solving, planning and abstract thinking are typical for executive functions disorders.

The following are the recommendations for diagnostics of specific reading and writing disorders (Mikulajova et al, 2012; Mikulajova, Velecka, 2012; Zelinkova, 1994; in: Varhlikova, 2014):

- Intellect level, in at least the border zone ($IQ \geq 70$).
- Reading ability (RQ) reaches maximum of 85 / 90 points in a standardized test.
- There is a significant discrepancy (IQ is at least 20 points higher than RQ) in comparison of intellect subtests and reading performance.
- Reading difficulties have been visibly present from the start of primary education. The reading level does not exceed the limit of social readability (which children usually reach in the fourth grade).

For our research we have used Mikulajova’s test from 2012.

Chart 1. Selection of neuropsychological methods in psychiatry measuring cognitive deficit in related areas, with added tests of personality, affectivity, and subjective survival (Chylova, Slavkovska, 2014, p. 57)

Intellect level, formation of concepts, and judgment	Perception	Visual-motor skills	Attention	Memory
WAIS-R	TMT test	Kohs Block Test	Observation	WMS-R
WAIS-III	Visual object and space perception battery test (VOSP)	Bender-Gestalt Test	Numeric square	WMS-III

Raven PM		Symbols and Block from WAIS-III	Bourdon Test	Rey-Osterrieth Complex Figure
	Dichotic Listening Test	Draw-a-Person Test	Subtests from WAIS-R and WMS-R (figures, symbols, number repetitions, mental control)	Benton Visual Retention Test
	Speech Discrimination Test	Benton Visual Retention Test		Test of Memory and Learning
	Albert's Test, Bells Test (neglect syndrome)	The Clock-Drawing Test	Stroop Test	Test of Memory LGT-3
		Luria-Nebraska Neuropsychological Battery - motor skills/praxia		
		Grassi Test		
Speech	Executive functions	Screening through Personality and Relationship	Premorbid Functioning	Screening to rule out dementia

		Attachment Test		
Observation	TMT Test	Rorschach Test	Anamnesis - education, employment etc	Adenbrooke's Cognitive Examination ACE-R
Luria-Nebraska Neuropsychological Battery	Stroop Test	Hand Test Draw-a-Person Test	Dictionary from WAIS-R	Montreal Cognitive Screening Test MoCA
Selected subtests	Kohs Block Test Verbal Fluency Test	Luscher Color Test		Cognitive function Screening MMSE
Token Test	Card Sorting Test WCST	Association Experiment		
	Porteus Maze Test	Thematic Apperception Test TAT		
	Tower Test (TOH, TOL, TOT)	the scale of depression, anxiety HAMA, HAMD, BDI, GDI, STAI, MAS, etc.		
	Selected subtests WMS, WAIS-R, WAIS-III			

PROBLEM OF RESEARCH

In order to be able to prove the importance of assessments within CNS context for the 4-Digit Code Diagnostics in the subdomain of “executive functions” with the subdomain “academic skills” that belong under the category

of F80-F89 disorders (F81 - Specific developmental disorders of learning abilities), it is necessary to conduct the research. This study delivers the part based on Church's and Kaltenbach's (1997) verified claim that *craniofacial and ocular anomalies in kids are related to hearing disorders due to common embryonic foundation in the first and second pharyngeal arch. Toxic effect of substances such as alcohol causes malformations of pharyngeal arches and often leads to language comprehension problems. Hearing disorders in FASD children are manifested by sensory deprivation. If present since birth, the children may suffer from permanent hearing loss, speech impairment and consequently, they fail in academic skills which are based on communication. Therefore, an early identification and treatment improves prognosis in children with FASD* (Church & Kaltenbach 1997). The study delivered the following result: Number and types of impaired or damaged domains in children with FASD and a comparison with diagnostic conclusions of Special Education Centres and prevention in subdomains "academic skills" and "executive functions" show defects mostly in kids between 5, 9-16 years (Okalova, Jablonsky, 2017).

Our research revealed severe impairment of perception area among the children diagnosed with FASD in groups: A, C, F, K, L. In addition, the children's verbal processing ability was also severely damaged (Okalova, Jablonsky, 2017). According to Mikulajova (2012) and scientists from the *Research Institute of Child Psychology and Pathopsychology (VUDPaP)*, the speech research in learning disabilities in an area of dyslexia is necessary. Until 2012, Set T-239, Diagnostics of Specific Learning Disabilities, (Novak, 2002) has been used in counseling clinics. The Set focused on sense-perception. Only after ten years, the perspective of disorder in reading and writing skills is shifting. New battery of Mikulajova's tests includes screening tools for pre-primary education level. These, however, do not diagnose dyslexia in years when the reading and writing are developing. If we want to diagnose learning disabilities by comparing perceptions and speech disorders, we should also adjust other diagnostic tools related to development of speech to a diagnosis of dyslexia based on perception and speech (Okalova, Jablonsky, 2017).

Speech Therapy tests are necessary for correct diagnostics of selected disturbed domains in executive functions and learning disabilities. The Department of Speech Therapy at Comenius University in Bratislava

summarized the research which brings in new tests with narrative design. Thank to dissertations and theses, it is now possible to use a new standardized test “ Slovak Intelligibility in Context Scale (ICS): Slovak (McLeod, Harrison, McCormack, 2012), translated by: Dana Buntova. This test can diagnose the kids between the ages of 3-5 years. It is advisable to use the scale in combination with the Communication Test: Words and Gestures for kids 8 to 16 month old and with Communication Test: Words and Sentences for kids between 17-36 months created by a team: Svetlana Kapalkova, Daniela Slancova, Iveta Bonova, Jana Kesselova, Marina Mikulajova. Communication Test is an authorized adaptation of MacArthur-Bates Communicative Development Inventories (Fenson, Marchman, Thal, Dale, Reznick, Bates, 2007). These tests may be used with TEKOS - Communication Test, Heidelberg Test of Speech Development (H-S-E-T) (Okalova, Jablonsky, 2017).

For diagnostics of Rank 3 (according to definition of CNS damage in Astley’s Guide 2004; Translation into Slovak language was conducted by The Centre for Diagnostics, Therapy and Prevention of FAS) in domains *academic/education skills* in areas of reading and writing we suggested the following order:

- The Communication Test: Words and Gestures for children between 8-16 months from authors: Svetlana Kapalková, Daniela Slančová, Iveta Bónová, Jana Kesselová, Marína Mikulajová.
- Communication Test: Words and Sentences for children between 17-36 months from authors: Svetlana Kapalková, Daniela Slančová, Iveta Bónová, Jana Kesselová, Marína Mikulajová.
- Slovak Intelligibility in Context Scale (ICS): Slovak (McLeod, Harrison, McCormack, 2012), translation: Dana Buntová.
- Mikulajová (2012) Reading, Writing and Dyslexia;
- T239 Diagnostics of specific learning disabilities (Okálová, Jablonský, 2017).

For the subdomain of executive functions in IQ, we recommend not only standardized verbal tests such as WISC-III, Stanford-Binet or Woodcock Johnson but also non-verbal test due to speech disorders and variable intellect : SON-R. In the domain *Planning and Management*, we recommend to implement the tool BRIEF which defines the child’s profile from the perspective of a parent and a teacher. This will help to define the profile of executive functions

in combination with the test WCST (Wisconsin Card Sorting Test (Okalova, Jablonsky, 2017)).

If we introduced a subscale in everyday diagnostic practice of Rank 3 (CNS): MRI, PAT, EEG, microcephaly, spasms, epilepsy and other neurological techniques or diagnoses, we would not have to use any tests. It would be sufficient to define severity of disability on a scale and we would not have to identify damaged domains.

INSTRUMENT AND PROCEDURES

The research presents correlations of tests BRIEF and Mikulajova's tests - Reading tests and test sets - and evaluation of spelling skills, for subdomains "executive functions" and "academic skills" in Rank 3 CNS 4-Digit Diagnostic Code of FASD diagnostics.

The sample is from 67 elementary school students between the age of 9-11. The research methods were as follows: Mikulajova 2012, BRIEF Test of Executive Functions (version : Parent-Teacher), SPSS Software. The data were processed by researchers from our partner, *The Centre of Diagnostics, Therapy and Prevention of FAS* - Maria Kralova, Katarina Salisova, Barbora Jarinova, Simona Matokarova, Jana Vanikova, Miriama Gerbova and Darina Obusekova.

The main research question that we posed was: Did the students, who were identified through Mikulajova's test 2012 as those with reading and writing disabilities, have their executive functions (measured by BRIEF) impaired?

RESEARCH RESULTS

In interaction between working memory and reading power; working memory and accuracy of reading; working memory and spelling test II; working memory and test IV HS, correlations had value higher than $p > 0,05$. We got similar results in correlations: initiative and reading power; initiative and accuracy of reading; initiative and test IV in HS. In the correlation initiative vs spelling test II, the value was 0.047 which means, that there is a statistical significance.

Chart 2 Correlation, initiative, and spelling test II

		initiative	spelling_test_II
Initiative	Pearson Correlation	1	-,559*
	Sig. (2-tailed)		,047
spelling_test_II	Pearson Correlation	-,559*	1
	Sig. (2-tailed)	,047	

When measuring *attention shift and reading power*, the value was again higher than 0.05. The correlation of $p=0.030$ was taken in values for *attention shift and reading accuracy*.

Chart 2 Correlation, attention shift, and accuracy of reading

		Attention shift	Accuracy of reading
Attention shift	Pearson Correlation	1	-,362*
	Sig. (2-tailed)		,030
Accuracy of reading	Pearson Correlation	-,362*	1
	Sig. (2-tailed)	,030	

The correlations *attention shift vs spelling test II to VII* in HS had a p value above 0.05.

Correlation comparison of parents' and teachers' sheets in the test BRIEF was consistent. It means that there was no significant variation in respect to an evaluator "parent / teacher".

GEC score vs. reading power with the spelling test II as well as with the test IV in HS reached values $p=0.355$ up to 0.569 . When comparing GEC score vs reading accuracy, the correlation is positive and there is a link ($p=0.036$).

DISCUSSION

Hypothesis defining an expectation that the students with reading and writing disabilities have their executive functions impaired (BRIEF) was confirmed only partially, mainly in the functions - initiative and attention shift (*initiative vs spelling test II $p= 0.047$ and attention shift vs reading accuracy $p= 0.030$*). In these values, there is a statistical significance in relation to the spelling and reading accuracy. Comparisons of parents' and teachers' sheets in the test BRIEF with Mikulajova's tests coincided and therefore, there is no significant variance between the executive function evaluations of a parent and a teacher. *A positive correlation was found in GEC score vs. reading accuracy ($p=0.036$).*

CONCLUSIONS AND RECOMMENDATIONS FOR PRACTICE

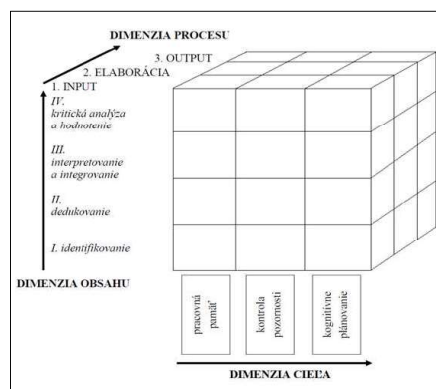
If according to Jensen, (Jensen, 2009; in: Klimovic, 2014) *phonematic awareness* and its *knowledge construction intellect functions (executives)*, *present in text comprehension*, are defined as an attention (*ability of undivided attention*), it is probable (resulting from our findings - *attention shift vs reading accuracy $p=0.030$*) that students with weaker attention will be also weaker in two other subdomains of executive functions and academic skills which are dependent on writing and reading. In agreement with Astley's claim (2004), we believe that the test formulation for individuals with prenatal alcohol exposure, who may manifest structural, neurological and/or functional CNS abnormalities, alongside the severity continuum, will be a challenge, especially if the test should include the imaging technology. If impaired ability to shift attention depends on reading accuracy, it is important to know the range of objective SD deviations in the subdomain of the third digit in the 4-Digit Code Diagnostics of FASD - "*academic skills*" and the subdomain "*cognitive/executive functions*" taking into

account the presence of another subdomain “*behavior/attention/activity*”. We were looking for the results in new Slovak studies which, however, offer only partial answers. When looking at *attention* it is important to assess *focus and persistence* which partially are included within stimulation concept by authors of the project APVV-0281-11- *Executive Functions as a Structural Component of Learning Ability: Diagnostics and Stimulation* (Liptáková, Klimovič, 2016, p. 16). The concept is in more detail presented in the study *Stimulation of Effective Functions in a Student by Text Comprehension Processes*, represented by the scheme 1 (Liptakova, Klimovic, 2016, p. 18).

The correlation with structural changes captured by imaging technologies and their valence in relation to the final 4-Digit code combination in FASD remains a challenge for the researchers. It is necessary to get the values from patients diagnosed by a set of a FAS and pFAS diagnoses. This is also valid in case if other circumstances appear (initiative vs spelling test II $p= 0.047$).

Initiative represents independent task engagement or starting an activity and an ability to create ideas and strategies for problem solving. ”Wolters (Rabin, 2011, in: Schweigerová, 2014, p. 7) pointed out that procrastination correlates with student’s self-efficacy and self-regulation”. If this statement is correct then it is necessary to include inhibition correlates with initiative into the tests. Since executive functions are key in the learning process it is surprising that these functions have not been linked to academic procrastination earlier (Schweigerová – Slavkovská, 2015). Dependent spelling skill measured in the Test II (in the Test of Diacritic - writing of the letters *ď, ť, ň* represents diacritic in relation to grapheme groups (*ďa – de* etc) (30 words)) indicates other possible correlates such as experienced student’s failure.

Scheme 1. Goal, Content, and Process Dimension in Education Model



Process dimension

- Output
- Elaboration
- Input
- Critical Analysis and Evaluation
- Interpretation and Integration
- Deduction
- Identification

Content Dimension

Goal Dimension

- Working Memory
- Attention Control
- Cognitive Planning

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