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NEUROPSYCHOLOGICAL APPROACH TO ASSESSMENT OF NARRATIVE SKILLS IN 5 YEARS-OLD CHILDREN

ENFOQUE NEUROPSICOLÓGICO PARA LA EVALUACIÓN DE LAS HABILIDADES NARRATIVAS EN NIÑOS DE 5 AÑOS

ABORDAGEM NEUROPSICOLÓGICA PARA A AVALIAÇÃO DAS HABILIDADES NARRATIVAS EM CRIANÇAS DE 5 ANOS

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Palavras-chave: funções executivas, idade pré-escolar, narrativas, MAIN, CSBSP

R E S U M O

The study aims to precise the correlations between executive functions development in children with their narrative production. Based on literature review the main hypothesis of the study was that statistical correlations between executive functions and narrative skills depend on assessment measures. To verify the hypothesis 297 preschoolers (150 boys and 147 girls, mean age 5.9±9=0.4 years old) were tested on executive functions (verbal working memory, visual working memory, cognitive flexibility and inhibition) and were asked to create a story (narrative) based on a series of pictures. The narratives were assessed with two assessment tools: Multilingual Assessment Instrument for Narratives (MAIN) and Creating a story based on the Series of Pictures (CSBSP). The data was analyzed with Spearman pairwise correlations. The results showed that neuropsychological approach (CSBSP) permitted to clarify the particularities of relationships between narratives' aspects and executive functions measures.

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A B S T R A C T

El estudio tiene como objetivo precisar las correlaciones entre el desarrollo de las funciones ejecutivas en niños y su producción narrativa. Basado en la revisión de literatura, la hipótesis principal del estudio fue que las correlaciones estadísticas entre funciones ejecutivas y habilidades narrativas dependen de las medidas de evaluación. Para verificar la hipótesis, se evaluó a 297 niños en edad preescolar (150 niños y 147 niñas, edad media de 5.9±9=0.4 años) en funciones ejecutivas (memoria de trabajo verbal, memoria de trabajo visual, flexibilidad cognitiva e inhibición) y se les pidió que crearan una historia (narrativa) basada en una serie de imágenes. Las narrativas fueron evaluadas con dos herramientas de evaluación: Instrumento de Evaluación Multilingüe para Narrativas (MAIN) y Creación de una Historia basada en la Serie de Imágenes (CSBSP). Los datos fueron analizados con correlaciones pareadas de Spearman. Los resultados mostraron que el enfoque neuropsicológico (CSBSP) permitió esclarecer las particularidades de las relaciones entre los aspectos narrativos y las medidas de funciones ejecutivas.

R E S U M E N

O estudo visa precisar as correlações entre o desenvolvimento das funções executivas em crianças e sua produção narrativa. Com base na revisão de literatura, a hipótese principal do estudo foi que as correlações estatísticas entre funções executivas e habilidades narrativas dependem das medidas de avaliação. Para verificar a hipótese, 297 crianças em idade pré-escolar (150 meninos e 147 meninas, idade média de 5.9±9=0.4 anos) foram testadas em funções executivas (memória de trabalho verbal, memória de trabalho visual, flexibilidade cognitiva e inibição) e solicitadas a criar uma história (narrativa) baseada em uma série de imagens. As narrativas foram avaliadas com duas ferramentas de avaliação: Instrumento de Avaliação Multilíngue para Narrativas (MAIN) e Criação de uma História baseada na Série de Imagens (CSBSP). Os dados foram analisados com correlações pareadas de Spearman. Os resultados mostraram que a abordagem neuropsicológica (CSBSP) permitiu esclarecer as particularidades das relações entre os aspectos narrativos e as medidas de funções executivas.

Language development as well as executive functions (EF) grow significantly in preschool age and are crucial factors for further academic achievements (Spiegel et al., 2021; Tikhomirova et al., 2021).

The inter-correlations between these phenomena are studied intensively and there is already meta-analysis of how they are interrelated and what is the directions of this relation (Kaushanskaya et al., 2017; Shokrkon & Nicoladis, 2022). Most of them find significant positive correlation between verbal working memory and linguistic skills

In the majority of studies language development is assessed as linguistic skills (vocabulary, phonetics and grammar competence) (Shokrkon & Nicoladis, 2022). At the same time, the interrelations between executive functions and narrative skills are much less studied, and the results need to be clarified (Baixauli et al., 2016).

NARRATIVES' ASSESSMENT

Narratives are an important tool to measure children language development (Pavlenko, 2008). They permit to assess not only language competence, as do vocabulary or grammar tests (Marini et al., 2020), but language performance in general (Scionti et al., 2023).

Narratives are at wide use in psychological studies to analyze the interrelations between language development and cognitive and emotional functions (Scionti et al., 2023), for example, executive functions and emotion comprehension (Veraksa et al., 2019; Veraksa et al., 2020).

The main difficulty that stands with narratives is their transcription and assessment. (The problem of narratives' transcription conventions is not the topic of the current study). The assessment of narratives differs from study to study (Cook, 2020; Gagarina et al., 2019). Word length, mean length of utterance (MLU), number of clauses per narrative number of different words are mostly measured (Pavlenko, 2008). Lexical correctness is also an important aspect, that is used in assessing narratives (Kyuchukov, & Ushakova, 2021; Marini et al., 2021). Later on the narratives' measures were presented as

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macrostructural and microstructural (Baixauli et al., 2016). Macrostructural measures include coherence, cohesion and internal state language (Kaderavek et al., 2004). Microstructural measures include productivity (in words, clauses) and syntactic complexity (Baixauli et al., 2016).

There are not many complete methods for narratives' elicitation and assessment that are widely used.

We can cite 1) *Test of Narrative Language* (Gillam & Pearson, 2004); 2) One of subtests included in the Batteria per la Valutazione del Linguaggio in bambini dai 4 ai 12 anni (Batteria per la Valutazione del Linguaggio; BVL_4-12); 3) Multilingual Assessment Instrument for Narratives (Main) (Gagarina et al., 2019); 4) Creating a story based on the Series of Pictures (CSBSP, Akhutina et al., 2016).

As methods 3 and 4 are accessible for use, we shall compare their measures and shall study the difference in correlations with EF of both of them.

INTERRELATIONS BETWEEN EXECUTIVE FUNCTIONS AND NARRATIVE SKILLS

Executive functions are mental processes that regulate attention, memory, planning and controlling (Diamond, 2020). In the Myake's approach they include verbal and visual working memory, inhibitory control and cognitive flexibility. They are assessed with different tools (Korneev et al., 2021; Korneev et al., 2022; Rivera Valdez, & López Cortés, 2024; Zakharova, & Machinskaya, 2023), but the tool NEPSY-II is mostly widely used (Veraksa et al., 2022).

EF proved to be a key-factor for numerous psychological phenomena in children: music training (Bayanova et al., 2024), dance classes (Chichinina et al., 2022), joint media engagement (Bukhalenkova et al., 2023), play types in children (Veraksa et al., 2022) etc.

The relationships between EF and language development were examined thoroughly. It was found that there were found strong correlations between executive functions and linguistics skills (Kovyazina et al., 2021; Marini et al., 2020).

The correlations between executive functions and narrative skills were also studied. The results fall into three groups:

1) There are no significant correlations between EF and narrative skills, or correlation is negative (Marini et al., 2020; Rivera Valdez, & López Cortés, 2024).
2) There are significant correlations (Baixauli et al., 2016).
3) Significant correlations are found, but not for all the aspects of narratives. For example, cognitive flexibility is significantly correlated with narratives' comprehension (Oshchepkova et al., 2021), verbal working memory with lexical and grammatical correctness of narratives (Veraksa et al., 2020). The impact of EF on language development was also shown (Oshchepkova & Shatskaya, 2023). The longitudinal analysis revealed that verbal working memory and inhibitory control in preschool age (at the age of 6) predicted narrative skills at the age of 8 y.o.

Based on these findings, the hypothesis of the current study supposes that the results of the correlations between EF and narrative skills depend on the measures. The instrument that was elaborated from neuropsychological approach would better show the particularities of relationships between EF and narrative skills in children more precisely.

To verify this hypothesis, we assess the same children's narratives by two measure methods: MAIN and CSBSP and compared the results of correlations.

SAMPLE

297 preschoolers participate in the study (150 boys and 147 girls, mean age 5.9±9=0.4 years old). The children attended preschool organizations in Moscow (Russia). Their parents signed informed consent.

The diagnostics took place personally with every child, in a quiet room, familiar to children.

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METHODS AND PROCEDURE

NARRATIVE ELICITATION AND ASSESSMENT

For narrative elicitation children were offered series of pictures "Nest" from the tool Multilingual Assessment Instrument for Narratives (Main) (Gagarina et al., 2019). This method offers 4 series of 6 pictures. We have chosen the series "Nest". The pictures are cut and glued into an accordion book, that children are encouraged to look through and to tell a story what had happened. The stories were recorded, then transcribed and assessed with two methods:

1) Multilingual Assessment Instrument for Narratives (Main) (Gagarina et al., 2019). The narrative measures assess: a) story structure (SS) (1 point for 10 elements of 3 episodes. The general score varies from 0 to 10 points, b) structural complexity (SC) (the number of complete episodes "goal – attempt – outcome" (GAO) and not complete (GO, GA, AO), c) number of internal state terms (IST) (including metalinguistic verbs (*shout, say*), metacognitive verbs (*think, suppose*) and words expressing emotions (*feel, angry, happy*). This method stands that microstructure comprises such linguistic aspects as narrative length, lexis, morphosyntax, discourse and bilingual phenomena. Microstructure is language-specific, so there are no common measures for this aspect.
2) Creating a story based on the Series of Pictures (CSBSP) (Akhutina et al., 2016). The measures assess: 1) Text length (in words); 2) Semantic completeness. 3 points are given for every correct episode. The general score varies from 0 to 45 points. 3) Semantic adequacy (text coherence) - consistency of narrative with images. Score varies from 0 (narrative is absolutely adequate to images) to 3 penalty points (the narrative has nothing in common with images). 4) Programming (cohesion). Local and global links between parts of a narrative. Score varies from 0 (links are presented on local and global level without gaps) to 3 penalty points (the absence of narrative). 5) Syntactic organization. Score varies from 0 (there are no mistakes in constructing phrases from the point of view syntax) to 3 penalty points (verbs are absent, there no links between parts of sentence); 6) lexical organization. Score varies from 0 (there are no mistakes in lexical use) to 3 penalty points (in narrative there are only pronouns or incorrect words).

EXECUTIVE FUNCTIONS ASSESSMENT:

EF were assessed with Russian version of NEPSY-II, tested on a sample of Russian preschoolers (Korkman et al., 2007; Veraksa et al., 2020a,b).

Four aspects of EF were evaluated:

1) Cognitive flexibility. It was measured by the "Dimensional Change Card Sort" test (DCCS) Dimensional Change Card Sort" test (DCCS) (Zelazo, 2006). There are three card-sorting tasks. The total score for all of them varies from 0 to 24 points.
2) Inhibition was measured by the subtest "Inhibition" (NEPSY-II) (Korkman et al., 2007). This subtest includes two parameters: 1) the sum of self-corrected and not-corrected mistakes) and 2) the time a child spends on completing the task. The score can achieve 240 points.
3) Visual working memory was measured by the subtest "Memory for Designs" (NEPSY-II) (Korkman et al., 2007). A child is supposed to remember content and space of four grids. He receives max. 46 points for remembering the content, max. 24 points for remembering the space of pictures and max. 46 bonus points for remembering the both simultaneously. Total score is max. 120 points.
4) Verbal memory was measured by the subtest "Sentences Repetition" (NEPSY-II) (Korkman et al., 2007). A child is supposed to repeat 17 sentences of increasing length, syntactical and semantical complexity. For a correct answer a child is awarded with 2 points. Total score max. is 34 points.

Then the data were analyzed with jamovi. (Version 2.2) tool (The jamovi project, 2021).

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RESULTS

DESCRIPTIVE STATISTICS.

Descriptives statistics for scales of MAIN, CSBSP and cognitive measures are presented in Tables 1, 2, and 3 respectively.

Table 1.

Descriptives of MAIN

Scale	Mean (std. dev.)	Minimum	Maximum	Skewness	Sig. of Shapiro-Wilk's test
SS	6.339 (1.691)	1	11	-0.120	<.001
SC	2.102 (0.87)	0	4	-0.454	<.001
IST	2.567 (2.079)	0	16	1.607	<.001

Table 2.

Descriptives of CSBSP

Scale	Mean (std. dev.)	Minimum	Maximum	Skewness	Sig. of Shapiro-Wilk's test
text length	46.864 (20.166)	9	164	1.554	<.001
semantic completeness	28.128 (6.634)	9	45	-0.245	<.001
semantic adequacy	1.042 (0.946)	0	3	0.542	<.001
text programming	1.529 (0.672)	0	3	-0.134	<.001
syntactic organization	1.600 (0.770)	0	3	-0.146	<.001
lexical organization	0.960 (0.816)	0	3	0.617	<.001

Table 3.

Descriptives of Cognitive measures

Parameter	Mean (std. dev.)	Min.	Max.	Skewness	Sig. of Shapiro -Wilk's test
Cognitive flexibility	11.158 (3.109)	2	19	-0.089	<.001
Inhibition	201.25 (27.61)	120	240	-0.413	<.001
Visuospatial memory	70.486 (19.879)	29	120	0.684	<.001
Verbal memory	18.332 (3.505)	8	31	0.175	0.004

CORRELATION ANALYSIS

Spearman pairwise correlations were calculated to assess the correspondence between the scores of the narrative scales and EF measures. The correlations between MAIN and CSBSP scales and EF measures are shown in Tables 4 and 5, respectively.

Table 4.

Spearman correlation between MAIN scales and cognitive measures

	Cognitive flexibility	Inhibition	Visual work memory	Verbal work memory
SS	0.11	0.1	0.2***	0.12
SC	0.079	0.05	0.17**	0.11
IST	-0.064	-0.079	-0.045	-0.058

** - p < .01, *** - p < 0.001

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Table 5.

Spearman correlation between CSBSP scales and cognitive measures

	Cognitive flexibility	Inhibition	Visual work memory	Verbal work memory
text length	0.067	0.086	0.1	0.015
semantic completeness	0.083	0.15*	0.24****	0.14*
semantic adequacy	-0.0017	-0.19**	-0.08	-0.2***
text programming	-0.12	-0.22***	-0.17**	-0.26****
syntactic organization	-0.0048	-0.12	-0.14*	-0.25****
lexical organization	0.075	-0.038	0.028	-0.14*

* - p <0.05, ** - p < .01, *** - p < 0.001, **** - p < .0001

note. Negative correlations are due to reverse scales

To clarify interrelations between MAIN and CSBSP scales Spearman correlation analysis was calculated and shown in Table 6.

Table 6.

Spearman correlation between CSBSP and MAIN scales

	SS	SC	IST
text length	0.66****	0.5****	0.45****
semantic completeness	0.73****	0.52****	0.33****
semantic adequacy	-0.08	-0.05	0.11
text programming	-0.39****	-0.21***	-0.12*
syntactic organization	-0.1	-0.047	-0.02
lexical organization	0.079	0.037	0.046

* - p <0.05, ** - p < .01, *** - p < 0.001, **** - p < .0001

note. Negative correlations are due to reverse scales

DISCUSSION

The descriptive statistics show the results relevant to other data on preschoolers' EF data (Rudnova et al., 2024; Veraksa et al., 2023), but the results are worse that in several studies (Dolgikh et al., 2022). That might the result of some differences in age and families' SES.

As for narrative assessments for MAIN, it is difficult to compare them with Gagarina's data (Gagarina et al., 2021) because of the difference in children age and bilingual status. The data of narratives' assessment according to CSBSP corresponds with the data obtained earlier on other material (Akhutina, 2016; Korneev et al., 2021).

Correlation analysis between EF and MAIN scores showed positive significant correlation only between story structure and structural complexity and verbal working memory. It is to note that the measure of Internal state language did not show any interrelations with narrative skills. Perhaps, it is characteristic for preschool children and would appear later.

At the same time strong correlations were found between different aspects of CSBSP and EF. Thus, verbal working memory has strong positive correlations with all the narrative measures but text length. Text length or discourse fluency does not always demonstrate good narrative skills, because it might be a symptom of talkativeness (Coplan et al., 2011). Visual working memory has the strongest correlation with semantic completeness: children who better remember pictures and their details reproduce them into narratives. This data confirms the results received in (Smithson & Nicoladis, 2014) about the impact of visuospatial working memory upon narration in children. Less strong but still significant is the correlation

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between visual working memory and text programming and syntactic organization. We can suppose that it is due to the capacity of a child to remember not only details but their consequence in a story. Negative correlations are due to the assessment of text programming and syntactic organization: children receive penalty points for mistakes, so less is the score better are the results.

Inhibition also has significant correlation with text programming and weaker but significant correlations with semantic adequacy and semantic completeness. The results confirmed the data received earlier (Oshchepkova, & Shatskaya, 2023) and can be explained by the fact that inhibitory control permits to a child to inhibit other stimuli and to concentrate only at the goal story.

Cognitive flexibility (CF) showed no significant correlations with narrative production skills. Earlier it was shown that CF is correlated to narrative comprehension (Escobar, & Espinoza, 2024; Oshchepkova et al., 2021) and to better switching between languages in bilinguals (Oshchepkova et al., 2023). But there were not found data about strong correlations between CF and narrative production.

Correlation analysis between MAIN and CSBSP showed that the measures *text length* and *semantic completeness* are strongly inter-correlated with all MAIN measures. It can be explained by text length in general: more words are in a story, more complete it is and more complete episodes are presented. The number of IST also depends on general narrative fluency.

Text programming has strong correlations with story structure and structural complexity, because these measures assess narrative general cohesion – full description of episodes and links between them. Programming has a very weak correlation with IST, because they assess different phenomena.

Syntactic organization and lexical organization have no correlations with MAIN measures, because MAIN's authors underline that lexis and grammar are language specific and are included to narrative microstructure. What is necessary to highlight is the absence of correlations between semantic adequacy and MAIN's measures. Semantic adequacy is a key-measure that assess cohesion of narrative, its accordance with the stimuli and inner logic of a narrative (Akhutina, 2016). Consequently, it is important to take this aspect into consideration when assessing children's narratives.

CONCLUSION

The attempt to analyze how narratives assessment measures influenced the statistics on the correlations between EF and narrative skills in children showed that neuropsychological approach permitted to show more subtle particularities of these relationships. The main advantage of neuropsychological approach is the possibility to assess semantic adequacy, inner logic of children's narratives. The correlations between EF measures and narrative measures in the frame of Luria's approach could be useful for further scientific research as well as for correction programs.

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