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# Vocabulary and verbal comprehension of students with Attention Deficit Hyperactivity Disorder

## *Vocabulário e compreensão verbal de escolares com Transtorno do Déficit de Atenção e Hiperatividade*

### ABSTRACT

**Purpose:** To compare the receptive vocabulary and the verbal comprehension of schoolchildren with and without Attention Deficit Hyperactivity Disorder (ADHD), as well as to confront their performance with the normative scores from applied tests. **Methods:** 40 students, with and without ADHD, were submitted to two receptive language tests, TVfusp and Token Test. Descriptive analysis was made, obtaining the average, median, minimum and maximum values. For the comparative assessment between groups, the *t* Student test was employed. For the comparison of performance scores obtained by the schoolchildren with the normative values from the tests applied, the Mann-Whitney test ( $p < 0.05$ ) was employed. **Results:** On all measures assessed, the performance of the children with ADHD was inferior to those without the disorder, which occurred both on TVfusp and Token Test. The comparison between groups showed considerable differences, with 50% and 5% of the ADHD schoolchildren presenting average scores, respectively, on TVfusp and Token Test, in comparison to the normative values of the tests. **Conclusion:** Schoolchildren with ADHD presented more restricted vocabulary and more limited verbal comprehension when compared to their pairs without the disorder. The comparison of the performance obtained by groups with the normative values of the TVfusp and Token Test demonstrates that a portion of the children with ADHD presented performance within the average of the applied tests. This study calls attention to the importance of the language evaluation in children with suspicion of ADHD, going beyond evaluating the presence or absence of nuclear symptoms and their relations with the low academic performance.

### RESUMO

**Objetivo:** Comparar o vocabulário receptivo e a compreensão verbal de escolares com e sem Transtorno do Déficit de Atenção e Hiperatividade (TDAH) e, ainda, confrontar o desempenho deles com os valores normativos dos testes aplicados. **Métodos:** 40 crianças em idade escolar com e sem TDAH foram submetidas a dois testes de linguagem receptiva, TVfusp e Token Test. Análise descritiva foi realizada, obtendo-se os valores de média, mediana, mínimo, máximo e quartis. Para uma análise comparativa entre os grupos foi realizado o teste *t* de Student. Para a comparação dos desempenhos obtidos pelos escolares com os valores de referência dos testes aplicados foi utilizado o Teste de Mann-Whitney ( $p < 0,05$ ). **Resultados:** Em todas as medidas estudadas, o desempenho das crianças com TDAH foi inferior ao das sem o transtorno, no TVfusp e no Token Test. A comparação demonstrou diferença significativa, sendo que 50% e 5% das crianças com TDAH apresentaram pontuação na média, respectivamente, no TVfusp e no Token Test, considerando os valores normativos dos testes. **Conclusão:** Escolares com TDAH apresentaram vocabulário mais restrito e mais dificuldades de compreensão verbal quando comparados aos seus pares sem o transtorno. O confronto do desempenho obtido pelos grupos com os valores normativos do TVfusp e do Token Test indicou que uma parcela das crianças com TDAH apresenta desempenho dentro da média nos testes aplicados. Este estudo chama a atenção para a importância de investigações mais abrangentes em crianças com suspeita de TDAH, indo além da verificação da presença ou ausência dos sintomas nucleares e suas relações com baixo desempenho acadêmico.

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## INTRODUCTION

The Attention Deficit Hyperactivity Disorder (ADHD) is a neurobiological disorder that occurs in childhood, whose core symptoms are inattention, hyperactivity, and impulsivity<sup>(1)</sup>. Population surveys suggest that in most cultures this condition occurs in around 5% children and 2.5% adults<sup>(2)</sup>.

The diagnosis of ADHD is clinical, based on well-defined operational criteria, established by classification systems such as the Diagnostic and Statistical Manual of Mental Disorders (DSM). The symptoms of inattention and/or hyperactivity-impulsivity must be present for at least 6 months with interference in at least two social contexts<sup>(2)</sup>. The definition of ADHD has been updated in the Fifth Edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-V) to characterize more precisely the experience of affected adults. The DSM-V<sup>(2)</sup> maintained the DSM-IV criteria<sup>(3)</sup>, and added examples to illustrate the types of behavior of children, adolescents, and adults with the disorder, helping professionals to better identify the typical symptoms of ADHD in each stage of life.

According to the DSM-V<sup>(2)</sup>, many of the symptoms of individuals with ADHD must be present before the age of 12, compared to the 7 years appointed by the DSM-IV<sup>(3)</sup>. This change is due to investigations that found no clinical differences between children identified at age 7 or later in terms of development, severity, outcome, or response to treatment.

In addition to the core symptoms, patients with ADHD often present other cognitive and behavioral disorders, including language. Students with ADHD have a high prevalence of language alterations in relation to those without the disorder<sup>(4)</sup>. Studies<sup>(4-8)</sup> suggested that significant levels of language alterations can occur in up to 60% cases. These changes may be: delayed language acquisition, receptive and expressive language disorders, and lag in communication skills, the latter (pragmatic difficulties) being the most representative of the language disorders.

There is no consensus about the nature of language difficulties in cases of ADHD. They are often pointed as secondary to behavioral complex of impulsivity, hyperactivity, and inattention, or to executive function deficit, which would limit the development of self-regulatory skills and lead these children to respond questions quickly and impulsively, talk excessively or inappropriately for the context<sup>(5,9)</sup>. It also raises the hypothesis that limited language skills can be a risk factor for the phenotype of ADHD<sup>(10)</sup>, and also that the overlap of language disorders and attention reflects common biological etiology<sup>(4)</sup>. The fact is that language difficulties occur in greater proportion in children with ADHD than in the general population and are not restricted to the difficulties related to communication skills<sup>(11)</sup>.

Although there is considerable evidence that language difficulties are associated with ADHD, they have not been sufficiently explored in the national scenario<sup>(12,13)</sup> or even international<sup>(14)</sup>. Given the above, this study aimed to compare the receptive vocabulary and verbal comprehension of schoolchildren with and without ADHD, and to compare their performance with the normative values of the tests applied.

## METHODS

This work was approved by the research ethics committee of the School of Dentistry of Bauru at Universidade de São Paulo, under number 14112913.2.0000.5417. All parents and/or guardians authorized the participation of their child in the study by signing the informed consent, according to Resolution 466/CNS, from December 12, 2012.

The study included 40 schoolchildren aged between 7 and 10 years, of both sexes, being 20 of them diagnosed with ADHD (experimental group, EG) and 20 without learning, attention, and language disorders (control group, CG). Children were matched for chronological age, sex, and educational level (Chart 1).

The subjects of EG were selected from those who were diagnosed with ADHD combined type in two centers with neurology clinics: School of Medicine of Ribeirão Preto of Universidade de São Paulo (USP) and School of Medicine of Botucatu of Universidade Estadual Paulista (UNESP). The criteria used by the team for the diagnosis was the DSM-IV<sup>(3)</sup>, and there were no changes in the DSM-V<sup>(2)</sup>. All children of EG were making use of medication, and the most widely used was methylphenidate. The drugs were not suspended for conducting evaluations.

The subjects of the CG were selected in an elementary school, and inclusion criteria were the following: not having flunked any school year; not presenting records of any disability (intellectual, visual, hearing, or physical) in school or historical records of changes in development language; presenting compatible performance with average (or higher) with the series (year) in the School Performance Test (Teste de Desempenho Escolar - TDE)<sup>(15)</sup>; and also score below six items marked as

**Chart 1.** Sample characterization

School year	Gender	EG	CG
		Age	Age
2 <sup>nd</sup> year	M	7;4	7;3
	M	7;7	7;6
	M	7;7	7;8
	M	7;8	7;9
	M	7;11	7;10
	M	8;1	8;0
	M	8;4	8;3
	F	8;4	8;5
	M	8;6	8;5
3 <sup>rd</sup> year	M	8;8	8;9
	M	9;4	9;3
	M	9;6	9;5
	M	9;10	9;9
	M	9;10	9;9
	M	9;11	9;11
	M	10;2	10;1
4 <sup>th</sup> year	M	10;3	10;4
	M	10;7	10;8
	F	10;10	10;9
	M	10;10	10;9

**Caption:** M = male; F = female; CG = control group; EG = experimental group

“quite” or “too much” for symptoms of inattention and six items marked as “quite” or “too much” for symptoms of hyperactivity and impulsivity in Swanson, Nolan, and Pelham questionnaire, called SNAP-IV<sup>(16)</sup>. The questionnaire was applied with the teachers. The 40 subjects selected to participate in the study were evaluated by a speech language pathologist, trained in language. The instruments were applied in children of the EG and CG in the neurology clinic and in school, respectively. Regardless of the group, the application environment was booked and suitable for cognitive-linguistic evaluation.

For the assessment of receptive vocabulary, the Vocabulary Test by Figures, TVfusp, was used and standardized to evaluate the reception of words among 7- to 10-year-old children<sup>(17)</sup>. The test was validated and standardized considering the socioeconomic level and type of school — public and private. In this work, all 40 children were from public schools and with low socioeconomic status (SES). These data were checked in medical records of the neurology clinic (EG) and schools (CG).

For each type of school and SES, there are tables with normative data. The reference values for 811 students from 1<sup>st</sup> to 4<sup>th</sup> grade (2<sup>nd</sup> to 5<sup>th</sup> year) of public school and low SES are shown in Chart 2. For the application of children from public schools, 139 sequences with four figures each are used, and the child must point 1 figure among 4 based on the word spoken by the examiner.

**Chart 2.** Normative values presented on the TVfusp<sup>(17)</sup> for students of public school and low socioeconomic level

Grade/school year	Minimum	Average	Maximum	Standard deviation
1st grade (2nd year)	51	98.50	128	12.82
2nd grade (3rd year)	83	109.58	131	9.88
3rd grade (4th year)	82	116.65	133	7.80
4th grade (5th year)	68	120.73	135	8.87

To check the auditory-verbal understanding, we used the reduced version of the Token Test<sup>(18)</sup>, described in a study that presents preliminary results for the standardization of a language test battery, including the Token Test<sup>(19)</sup>. The test consists of a set of 20 different pieces from the combination of 2 geometric shapes (circle and square), 2 different sizes (small and large), and 5 different colors (white, black, green, yellow, and red). The short version implies 36 commands (1 point for each correct answer and 0 for error) divided into 6 parts. Commands are classified as of low complexity when they involve a single order (e.g., “touch the yellow circle”) and of high complexity when they involve two orders and domain of adverbs, prepositions, and conjunctions (e.g., “beyond the yellow circle, touch the black circle;” “place the red circle between the yellow square and the green square”).

The reference values<sup>(19)</sup> obtained with 109 children aged 7 to 10 years are shown in Chart 3.

Direct scores of each of the applied procedures were adopted. Descriptive analysis was performed to obtain the values of mean, median, minimum, maximum, and quartiles. For comparative analysis between groups, the Student *t*-test was used.

**Chart 3.** Preliminary results for the normative data of the Token Test<sup>(19)</sup>

Year	Average	Standard deviation	Percentile				
			10	25	50	75	90
7	30	2.6	26	28	31	33	34
8	31	3.1	26	28	32	34	35
9	32	2.3	29	32	33	34	34
10	33	2.1	30	31	35	35	36

To compare the performance obtained by students with the reference values of tests of vocabulary and verbal comprehension, the Mann-Whitney test was used. A significance level of 5% ( $p < 0.05$ ) was adopted.

**RESULTS**

A descriptive analysis of the performance of subjects of the experimental and control groups was performed. Table 1 presents the descriptive statistics with mean, median, minimum, maximum, lower quartile, upper quartile, and standard deviation in receptive vocabulary tests (TVfusp) and verbal comprehension (Token Test).

Table 2 shows the *p*-values obtained with statistical significance when comparing the groups regarding the performance of the subjects in receptive vocabulary and verbal comprehension tests.

Figure 1 shows the percentages of the EG and CG in relation to the reference values (minimum, maximum, and average) presented in TVfusp for children from 1<sup>st</sup> to 4<sup>th</sup> grade of public school and low SES. The *p*-value was significant ( $< 0.001$ ).

Of the 20 children from the EG, 10 had scores equal or above the average for the TVfusp. The children of the CG obtained scores close to the maximum.

**Table 1.** Descriptive measures of scores of the experimental group and control group on the TVfusp and Token Test

	Mean (SD)	Median (Min–Max)	Lower quartile	Upper quartile
TvFusp (n=20)				
CG	115.55 (9.34)	116.5 (100–133)	107,5	121,5
EG	78 (5.05)	78.5 (67–84)	77,5	81,5
Token Test (n=20)				
CG	33.55 (1.53)	34 (30–36)	33	34,5
EG	27.7 (4.18)	29 (20–34)	24	31

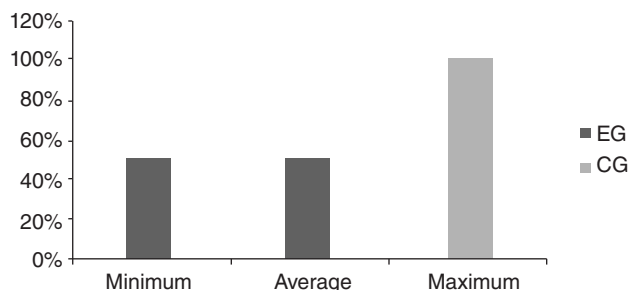
**Legenda:** GE = grupo experimento; GC = grupo controle; DP = desvio padrão; min = mínimo; max = máximo

**Table 2.** Performance comparison between the experimental group and the control group on the procedures applied

Procedures	Average EG	Average CG	t-value	p-value
Tvfusp	78.00	115.55	-15.79	<0.001*
Token Test	27.70	33.55	-5.87	<0.001*

\*Statistical significance ( $p < 0.05$ ) — Mann-Whitney test

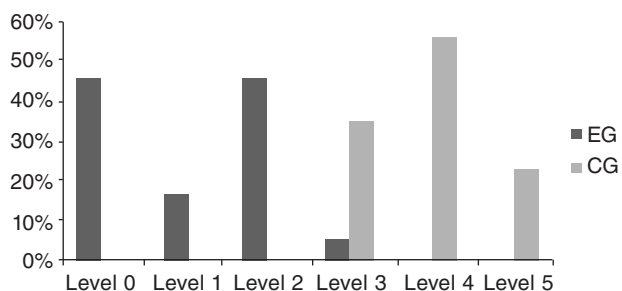
**Caption:** EG = experimental group; CG = control group



**Caption:** EG = experimental group; CG = control group  
**Figure 1.** Percentage of the experimental group and control group on the classification of TVfusp

Application of the Token Test in this study followed the reference values (percentiles) described in the study with preliminary data on regulation of Brazilian children<sup>(19)</sup>. There were cases where the student obtained lower scores than percentile 10 (minimum reference value). The scores had levels to provide greater clarity to the chart reading. Level 0: below the 10<sup>th</sup> percentile; Level 1: 10<sup>th</sup> percentile; Level 2: 25<sup>th</sup> percentile; Level 3: 50<sup>th</sup> percentile; Level 4: 75<sup>th</sup> percentile; and Level 5: 90<sup>th</sup> percentile.

Figure 2 shows the percentages of the EG and CG in each classification obtained according to results and specifications described earlier. The Mann-Whitney test was applied and the p-value was significant (<0.001).



**Caption:** EG = experimental group; CG = control group  
**Figure 2.** Percentage of the experimental group and control group on the classification of the Token Test

In the Token Test, a child of the EG showed a compatible performance with the mean value; the performances of others were inferior.

**DISCUSSION**

This study investigated the receptive language of school-children with and without ADHD, using two procedures: one in vocabulary level and another at the level of sentences with direct orders.

For all measures studied, the performance of children in the EG was lower compared to those in the CG (Table 1) in TVfusp. The minimum value of the CG was higher than the average and the median obtained by children of the EG, and

the maximum value of the EG was inferior to the minimum obtained by the CG, confirming the lower performance of children with ADHD. The comparison between groups was significantly different (Table 2).

Investigations of vocabulary in children with ADHD have shown different results. In a study in which various language measures were applied, among them the Peabody Picture Vocabulary Test — similar instrument to TVfusp — no significant difference was observed between children with and without ADHD<sup>(20)</sup> for receptive vocabulary. The evaluation of development of semantic skills of children with ADHD without reading disabilities also did not show receptive deficit<sup>(21)</sup>. However, verifying the percentage of correct answers for the identification of synonymous words in students with ADHD showed significantly worse results compared to students without the disorder<sup>(22)</sup>. The same difficulty was found by Vaquerizo-Madrid et al.<sup>(23)</sup> in semantic organization tasks.

There are suggestions of explanations for this diversity of performance. Children with ADHD show worse language skills at all levels as compared to those without ADHD. However, not all exhibit the same degree of difficulty; some have apparently normal language, others exhibit obvious language difficulties<sup>(6,20,24)</sup>. The language involves a series of psycholinguistic processes that are manifested in levels, namely, phonological, syntactic, semantic, and pragmatic, both in comprehension as in production. In terms of comprehension, the semantics is related to the recognition of words, phrases, and the evocation of objects, actions, and relationships they represent. Thus, a change in the semantic level can manifest itself in the inability to identify the relationships between words, but not the ability to recognize them. Not always the task required by the language test includes all the skills involved in the semantic representation network.

The study<sup>(22)</sup> described below exemplifies the divergence to be found in the analysis of a vocabulary test. In a procedure involving a number of synonyms, vocabulary hits, and precision, the performance of children with ADHD was significantly worse compared to their peers without the disorder in precision criterion, but not the number.

The relationship between attention deficit and vocabulary has been explained by the loss in more complex cognitive skills, such as executive functions. Executive dysfunctions are present in ADHD, so much that many experts consider them the main origin of the disorder. Executive functions involve a number of mental processes, one of them being the working memory<sup>(9)</sup>. The phonological component of working memory plays an important role in vocabulary acquisition. Thus, flaws in mental processes related to executive functions can affect skills such as lexical storage, leading to a more restricted vocabulary.

Regarding verbal comprehension, investigations in children with ADHD are less divergent. By testing with use of inferences or direct orders, the comprehension of these children has proved to be deficient<sup>(10,22,25-27)</sup>. The descriptive analysis of this study showed decreased performance by the children of the EG compared to those of the CG in all measures studied for the Token Test (Table 1), as well as the

comparison between groups indicated significant difference (Table 2). The Token Test is a procedure that examines the verbal comprehension requiring routine vocabulary (five basic colors, two sizes, and two geometric shapes), and the complexity of the test is shown in the increase in length of questions and the domain of a few conjunctions and adverbs. Thus, poorer performance in this type of procedure could be due to lag in working memory. The verbal comprehension and memory skills were investigated in children with and without language disorders with ADHD<sup>(26)</sup>. They underwent cognitive, language, verbal working memory, and comprehension tests. The children with ADHD who had no co-occurrence with language disorders understood factual information, but had gaps in inferential comprehension, in understanding instructions, and in verbal working memory. The authors concluded that children with ADHD without language disorders can show gaps in comprehension, even if a slight one.

Children with ADHD properly understand superficial details, but show deficits in tasks requiring a high degree of effort and control of language and attention<sup>(10)</sup>. Therefore, the comprehension of long and complex orders that require memory and grammar lexicon domain (adverbs, pronouns, or prepositions) may require high degree of attentional control and linguistic domain that they cannot present. The reason for difficulties in verbal comprehension for children with ADHD may also be related to information processing speed. A study found that the group of children with ADHD aged between 8 and 11 years understood complex sentences, but needed more time to provide accurate responses when compared with the control group<sup>(27)</sup>.

Another objective of this study was to verify the performance of children with and without ADHD when confronted with the normative values of the tests applied.

Regarding the receptive vocabulary test TVfusp, the results obtained by students of the CG were close or equal to the maximum (Figure 1). As for the EG, 50% of them had a performance distributed between the minimum and below average (Figure 1) and 50% had scores equal or above the average, that is, these students would not present lowered receptive vocabulary, from the clinical point of view.

As for the Token Test, all students from the CG obtained performance distributed between percentiles 50 and 90. It was observed that 55% of children from the EG had lagged performance (equal to or below the 10th percentile), 40% had values below average, and 5% compatible with the average (Chart 2). Thus, a child showed no lag in verbal comprehension and eight showed inferior performance than the average but above the 10<sup>th</sup> percentile.

Lags with significant differences were found in a group of children with ADHD in most of the neuropsychological tests applied, including the Token Test. However, in a clinical and individual analysis, many children in the sample showed no lag when compared with the normative test data<sup>(25)</sup>. Thus, children with ADHD can present a significant gap in relation to their control peers, but individually they can show performance within the average. This finding indicates that, from a clinical point of view, any test should be applied with caution and, as part of the diagnostic reasoning, made by a qualified professional.

The findings of this study and others point to the importance of investigating the language through judicious methods and speech language pathologists and language experts, indicating, if applicable, interventions for these difficulties. Reviews of language skills, including communication, should be routine in the care of all children with ADHD. This is the suggestion of recent studies on language difficulties observed in children with the disorder<sup>(4,28)</sup>. It is also important to note if interventions on language are effective for the difficulties encountered in this so vulnerable group.

Future studies still need to establish the type of sample with ADHD, given the possibility of different language profiles in children predominantly impulsive, predominantly hyperactive, or with the combined symptoms. Also, it is indicated that the performance of these children with and without medication is checked. The analysis of the effectiveness of methylphenidate in phonological processing skills has not resulted in so positive effects<sup>(29)</sup>. One argument for the lack of efficacy of the medicine for certain skills such as phonological processing is that it has a facilitating effect on cognitive processing in general areas, but not on specific aspects of information processing.

## CONCLUSION

Students with ADHD presented a more limited vocabulary and more difficulties in verbal comprehension when compared to their peers without the disorder. The comparison of performance obtained by the groups with the normative values of TVfusp and Token Test indicated that a portion of children with ADHD presents performance within the average in the tests applied.

This study draws attention to the importance of more comprehensive investigations in children with suspected ADHD, going beyond the verification of the presence or absence of core symptoms and their relationship to low academic performance. The interdisciplinary evaluation of children with ADHD, including speech language pathology within the language, will enable a thorough investigation of the linguistic aspects at different levels (phonology, syntax, semantics, and pragmatics) and mode (comprehension and production), facilitating the design of a plan of appropriate intervention to treat the condition.

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