


Reading and listening comprehension in the narrative of students with ADHD comorbid with dyslexia

Pilar Vieiro-Iglesias 
Universidade da Coruña, Spain
pilar.vieiro@udc.es

M^a Dolores González-Fernández 
Universidade da Coruña, Spain
m.d.gonzalez@udc.es

Abstract

The aim of this study was to test the possible impact of the form information in presented (reading vs. listening situation) on the comprehension of narrative texts in students with ADHD comorbid with dyslexia. An experimental group with a mean age of 8.5 years and a control group with a mean age of 8.9 years participated. Three measures were used to analyse comprehension: lexical diversity, cohesive resources and episodic structure. The results showed no significant differences in the control group on all the measures under study, but there were significant differences in some measures in the experimental group, so that the use of cohesive resources and lexical diversity were favoured by the reading situation. Measures of episodic structure were not significantly affected by presentation modality.

Keywords: ADHD; dyslexia; listening; reading comprehension; lexical diversity; narrative texts.

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Comprensión lectora y auditiva en la narrativa de estudiantes con TDAH comórbidos con dislexia

Pilar Vieiro-Iglesias 
Universidade da Coruña, Spain
pilar.vieiro@udc.es

M^a Dolores González-Fernández 
Universidade da Coruña, Spain
m.d.gonzalez@udc.es

Resumen

El objetivo de este trabajo es comprobar la posible influencia del formato de presentación de la información (situación de lectura vs escucha) en la comprensión de textos narrativos en alumnado con TDAH comórbido con dislexia. Participaron un grupo experimental con media de edad de 8.5 años y un grupo control con media de edad de 8.9 años. Se utilizaron tres medidas para el análisis de la comprensión: la diversidad léxica, los recursos cohesivos y la estructura episódica. Los resultados mostraron ausencia de diferencias significativas en el grupo control en todas las medidas objeto de estudio, pero sí en algunas en el grupo experimental, de tal modo que el uso de recursos cohesivos y diversidad léxica fueron favorecidos por la situación de lectura. Las medidas de estructura episódica no se vieron significativamente afectadas por la modalidad de presentación.

Palabras clave: TDAH; dislexia; escucha; comprensión lectora; diversidad léxica; textos narrativos.

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INTRODUCTION

Dyslexia and attention deficit hyperactivity disorder (ADHD) are two disorders that are widely diagnosed in childhood, with more than 80% of children with ADHD and 60% of children with dyslexia meeting the criteria for at least one additional diagnosis (Willcutt & Pennington, 2000; Willcutt et al., 2000; Willcutt and Petril, 2023).

Dyslexia, in the DSM-5, is described as a specific learning disorder within the neurodevelopmental disorders. People with dyslexia have persistent reading difficulty that cannot be explained by sensory deficits, cognitive difficulties, lack of motivation or lack of reading instruction. It is an unexpected, specific and persistent failure to acquire efficient reading skills despite conventional instruction, adequate intelligence and sociocultural opportunity (APA, 2013).

ADHD is one of the most prevalent developmental disorders, characterized by excessive activity accompanied by low attention span and impulsivity, and is considered a psychiatric pathology that has a continuum from childhood to adulthood. ADHD occurs in most cultures in approximately 5% of children and 2.5% of adults (APA, 2013).

ADHD affects reading, which becomes difficult when intense activity is required for long periods of time.

Attention and learning problems are generally considered to be interrelated and present a developmental continuum (Mayes and Calhoun, 2007; Mayes et al., 2000) and bidirectional, with comorbidity being very high, as is the case for children with dyslexia for ADHD (Daucourt et al., 2020; Willcutt and Pennington, 2000) or children with ADHD for dyslexia (Ramos-Puca, 2024; Sánchez-Carmona et al., 2020; Willcutt and Pennington, 2000) or children with ADHD for dyslexia (Ramos-Puca, 2024; Sánchez-Carmona et al., 2023; Sanson et al., 1996; Moraleda-Sepúlveda, 2020). Reading difficulties seem to be strongly related to the predominantly inattentive type of ADHD and less so to cases of hyperactivity or impulsivity (Gooch et al., 2011; Mayes & Calhoun, 2007; Re & Cornoldi, 2015).

Both behavioural and molecular genetic studies support a partially shared genetic aetiology between ADHD and dyslexia and draw the comorbid phenotype as a result of overlapping risk factors leading to a high rate of co-occurrence of these disorders. It appears that children with ADHD and dyslexia have difficulty with different aspects of information processing and in particular with memory-related functions. Dhar et al., (2008) argue that comorbid subjects differ from ADHD in information processing characteristics, although they are very close to dyslexics in the sense that they show deficits in the word decoding process. Such difficulty seems to occur, especially in identifying unfamiliar words (Ehm et al., 2016; Dittman, 2016). These encoding problems can interfere with reading comprehension, making it difficult to determine whether comprehension problems are due to decoding difficulties, comprehension difficulties, or both (Swanson et al., 2018). At the comprehension level, there are deficits in the identification of topics or main ideas, in the ability to make inferences, identification of textual inconsistencies, ability to order fragments, and in planning and self-regulation skills (Erickson et al., 2015; Hlas et al., 2019; Miranda-Casas et al., 2011; Shalev et al., 2016).

Due to the close relationship between lexical access and reading comprehension processes, some studies have used the listening versus reading situation to explore comprehension deficits associated with ADHD (Bellani et al., 2011; Kim, 2016; Lorch et al., 2020; Nilsen et al., 2013). Auditory comprehension studies show that people with ADHD also have difficulties in higher-order language processes, such as understanding figurative language (Bignell and Cain, 2007) and answering inferential questions (McInnes et al., 2003). In addition, they show deficits in organization, identification of main ideas and coherence after listening to a text (Miller et al., 2013; Purvis and Tannock, 1997; Swanson et al., 2018).

If we think about how ADHD might affect comprehension processes, it seems that it may strain the pool of cognitive resources available to form connections between text ideas. Even when children with ADHD do not have comorbid word decoding problems, it could be that their reduced attentional resources may affect the formation of text connections, so that central information may not emerge in

their text representation to the same degree as it does for those without ADHD comprehension, leading to a centrality deficit (Herrera-Gutiérrez, 2021). In terms of comprehension of texts that had been heard, it was found that, compared to controls, children with ADHD showed a greater centrality deficit, even though they recalled more central than peripheral information (Flake et al., 2007). ADHD population appears to deplete the cognitive resources available to form connections between text ideas, even when children with ADHD do not have comorbid word decoding problems, Lorch et al., (2000) have provided data supporting this idea in auditory comprehension tasks. Children who had already retold passages they had heard or told about television programmes they had seen showed this pattern.

In this context, it is interesting to know whether centrality deficits are also obtained for reading comprehension. Thus, the purposes of this paper are (1) to know the influence of the message reception modality (listening-reading) on the comprehension of narrative texts (2) to examine the cognitive skills involved in this process such as episodic organisation, cohesion and lexical diversity of text summaries.

We assume that there will be significant differences only in the measures of organisation (episodic organization and cohesion), which will be favoured by the reading situation, attributing to these a facilitating context for the retrieval of information as opposed to the measures of lexical diversity more related to the level of previous vocabulary.

METHOD

Participants

This study initially consisted of 42 participants diagnosed with ADHD comorbid and dyslexia, 21 girls and 21 boys. Once the Reading Delay Assessment test (Maldonado et al., 1992) was administered, which allowed us to match the sample at the level of Reading Age, the sample consisted of 36 participants (16 girls and 20 boys). A further 36 subjects, selected from a total of 40, formed the control group, half of whom were boys and half girls, none of whom had learning difficulties or developmental disorders.

The sample presented a mental reading age corresponding to the same level of schooling and trimester as established by the test, being in all cases between the 50th and 80th percentiles. The mean age of subjects with ADHD comorbid with dyslexia was 8.5 (SD = 1.02), with 60th percentile on the reading task, 75th percentile on vocabulary and 75th percentile on the Raven intellectual development test. The subjects who acted as controls had a mean age of 8.82 (SD = 1.59), with 75th percentile on the reading task, 75th percentile on vocabulary and 80th percentile on the Raven intellectual development test.

According to DSM-5 criteria, participants in the experimental group were classified as ADHD only if symptoms were present before the age of seven and if these symptoms caused significant functional impairment in two or more settings. All participants met six or more symptoms on both dimensions (inattention and hyperactivity) which resulted in them being identified as comorbid. Controls did not meet DSM-5 criteria for either ADHD and/or dyslexia.

Since the selection of individuals was accidental and not random, in addition to ensuring that the two groups were of the same size, special care was taken to ensure that their composition was similar in terms of variables such as Age ($F = 0.23$; $p = 0.79$) and Gender ($c^2 = 0.99$; $p = 0.71$) so that the results could be contaminated as little as possible.

Instruments and materials

- Maldonado et al. (1992) Reading Retardation Assessment Test_PEREL_ allowed us to match the sample in mental reading age.

- Peabody Test, 3rd ed. (PPVT - III - Form A; [Dunn et al., 2006](#)) to assess vocabulary level.
- For the assessment of IQ the [Raven test \(1990\)](#) was used, using reasoning by analogies, comparison of shapes and reasoning ability based on figurative stimuli.
- The analysis of episodic structure, cohesive resources and lexical diversity was carried out through an analysis of the summaries of two narrative texts.

Design

The design included the comparison of groups in order to analyse whether there were differences in the implementation of comprehension strategies related to the modality of presentation of the text on which the measures were analysed (episodic structure, cohesive resources and lexical diversity). In both experimental situations, the subjects had to produce a written summary of what they had read.

Episodic structure was measured by the percentage of propositions present in each part of the text's superstructure (Frame, Theme, Plot and Resolution) according to Story Grammar ([Thorndyke, 1977](#)).

Cohesive resources (grammatical and lexical elements whose function is to unify the different premises that make up a text) were assessed through the percentage of temporal, causal, adversative, consecutive and conditional connectors present in the summaries.

Lexical diversity was measured through the use of different words in their summaries, analysing the percentage of content words (nouns, verbs, adjectives and adverbs) and function words present in the summaries.

Procedure

Once the consent of the families for the participation of the subjects in the study was obtained, data collection was carried out at the educational centre attended by the participants. This process was based on the practice of listening to and reading narrative texts, with their subsequent comprehension in written form. The first text is read by the researcher, and the participants then summarise it in writing, and the second text is read by the participants, and they then summarise it in writing.

For the analysis of the summaries, an inter-judge agreement was made. Two experts in reading comprehension analysed the superstructure of the summaries following the methodology of [Thorndyke's Story Grammar \(1977\)](#). The total number of words and the number of different words were also counted in order to measure lexical diversity, as well as the number and type of cohesive resources. Cohen's kappa was used to measure the agreement of the two raters. Two trials per rater were used and the kappa value was .80.

RESULTS

The data obtained were analysed with IBM SPSS, v. 26.0. First, a descriptive analysis was made of the results of the scores obtained in averages, maximums, minimums and deviation in successes in the different measures in the control and experimental groups ([tables 1 to 6](#) and [figure 1](#)), where the differences between the control and experimental groups can be clearly seen, with a higher level of effectiveness for the former in all the measures analysed: lexical diversity, episodic structure, cohesive resources and identification of main ideas. Likewise, no differences were found between the two experimental situations in the control group, but there were differences in the experimental group.

Table 1

Descriptive analysis of the experimental group on cohesive resources

	Reading				Listen to			
	M	Max	Min	DT	M	Max	Min	Desvest
Temporary	46	56	32	7.53	54	60.00	43.00	5.28
Causes	32	35	23	6.61	45	68.00	41.00	6.42
Adversatives	5	7	3	1.93	0	0	0	0
Consecutive	2	6	1	1.87	0	0	0	0
Conditional	15	18	12	1.87	1	1	0	0.89

Table 2

Descriptive analysis of the control group on cohesive resources

	Reading				Listen to			
	M	Max	Min	DT	M	Max	Min	Desvest
Temporary	36	43	29	5.53	38	40	23	8.28
Causes	32	43	26	4.61	28	33	17	6.42
Adversatives	15	19	10	7.83	12	19	9	6.77
Consecutive	10	11	6	8.87	10	25	16	7.66
Conditional	17	19	8	3.87	12	29	8	8.77

The descriptive data showed that the control group used the greatest variety of cohesive resources regardless of the experimental listening/reading situation. In both situations, the highest percentage of resources used were temporal and causal, followed by conditionals, adversatives and consecutives, which were in a lower range of use.

The experimental group used mostly temporal and causal connectors in both situations (listening and reading).

The contrast of means analysing each of the measures of cohesive resources through the Student's t-test showed that the differences between the ADHD-dyslexia group and the control were statistically significant on all measures in the listening situation in favour of the latter (Temporal: $t = 4.61$, $p = .001$; Causal: $t = 3.04$, $p < .003$; Adversative: $t = 3.65$, $p = .004$; Consecutive: $t = 7.98$, $p = .005$; Conditional: $t = 8.71$, $p = .009$ one-sided).

In the reading situation, significant differences were only found in favour of the control group in the use of Temporal ($t = 4.01$, $p = .009$), Adversative ($t = 1.047$, $p = .03$ and Consecutive ($t = 3.66$, $p = .01$; one-sided). In the ADHD-dyslexia group, reading favoured conditional connectors, the differences with respect to the listening situation reached statistical significance ($t = 9.11$, $p = .041$).

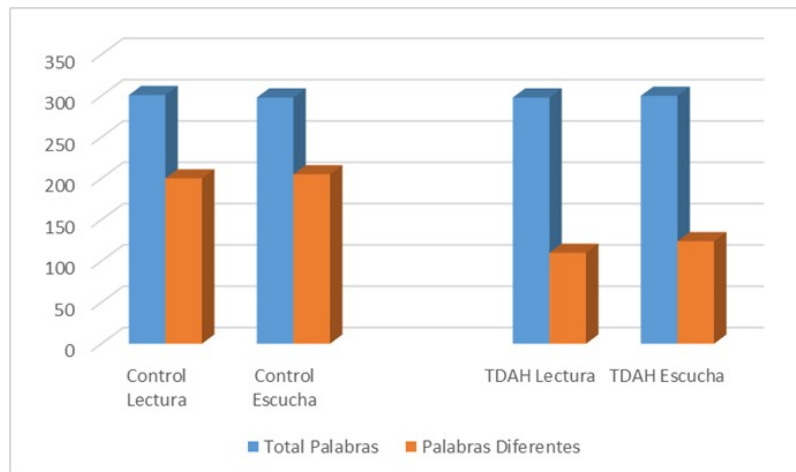
As for the analysis of lexical diversity, we first counted the use of different words in the different summaries using the type-token ratio (TTR) technique. TTR is the ratio obtained by dividing the types (the total number of different words) occurring in a text or utterance by its tokens (the total number of words).

Figure 1 shows the mean number of same words (textual) and different words present in the different experimental situations. It can be seen that the total number of words present in each situation

and group is similar, with no significant differences being found either between the groups or comparing each of the situations (reading vs. listening). However, the experimental group (ADHD-dyslexia) used a lower number of different words in both situations than the control group, and these differences were significant (Reading: $t = 2.65$; $p = .001$; Listening: $t = 5.87$, $p = .003$).

Figure 1

Mean number of textual words and non-textual words in the different experimental situations.



The proportion of content words (nouns, verbs, adjectives and adverbs) and function words present was also analysed.

Table 3

Descriptive analysis of the experimental group on lexical diversity

	Reading				Listen to			
	M	Max	Min	DT	M	Max	Min	DT
P. Function	40	46	32	7.83	33	43	32	9.58
Nouns	32	35	13	9.67	33	36	13	6.69
Verbs	19	28	9	7.77	20	28	10	7.60
Adjectives	8	11	6	8.98	10	11	5	8.97
Adverbs	1	3	0	0.72	2	6	0	4.76

Table 4

Descriptive analysis of the control group in lexical diversity

	Reading				Listen to			
	M	Max	Min	DT	M	Max	Min	DT
P. Function	29	36	22	8.76	29	20	13	5.58
Nouns	28	25	19	6.67	27	33	26	6.66
Verbs	27	31	25	7.88	28	31	21	6.60
Adjectives	10	14	6	8.97	9	14	4	9.97

	Reading				Listen to			
	M	Max	Min	DT	M	Max	Min	DT
Adverbs	6	10	3	4.77	7	9	6	1.76

The experimental group used a greater number of function words and nouns than the control group. These differences reached statistical significance in the function word measures ($t = 11.56, p = .0001$ and $t = 12.65; p = .001$ in reading and listening respectively). The control group used more verbs, adjectives and adverbs in both situations, reaching statistical significance in the measures of verbs in the reading situation ($t = 12.76; p = .001$) and adverbs in both situations ($t = 1.24, p = .003$ one-sided).

The post-tests only showed significant differences in favour of the reading situation in the use of function words in the ADHD-dyslexia group ($t = 12.88; p = .033$).

As for the episodic structure analysed through the narrative superstructure, we observe that the score pertaining to the percentage of recall of the different propositions of each of the parts of the text is not significantly affected by the modality of presentation in the experimental and control groups.

Table 5

Descriptive analysis of the experimental group in episodic structure

	Reading				Listening			
	M	Max	Min	DT	M	Max	Min	SD
Framework	30	46	19	7.83	35	43	32	9.58
Theme	5	9	1	9.67	3	6	1	6.69
Plot	40	48	29	7.77	42	48	38	7.60
Resolution	25	31	16	8.98	21	11	5	8.97

Table 6

Descriptive analysis of the control group in episodic structure

	Reading				Listening			
	M	Max	Min	DT	M	Max	Min	SD
Framework	21	26	.18	7.83	22	33	19	9.58
Theme	10	15	6	3.67	11	18	7	6.69
Plot	37	43	29	7.77	40	47	34	7.60
Resolution	32	41	26	8.98	27	31	22	8.97

DISCUSSION AND CONCLUSIONS

Children with associated disorders have more difficulties at the beginning of their development, in terms of the learning process. In dyslexia, language acquisition may be affected depending on the level of impairment.

In this case, we have worked with a group of ADHD comorbid with dyslexia in order to test whether the format of presentation of oral/written information, i.e. reading vs. listening situation, can influence the comprehension of narrative texts (a genre with a familiar and clearly differentiated superstructure). We refer with to the importance of the use of mechanisms such as causal, temporal or spatial connectors as linguistic features which help the reader or listener to understand. In addition, the different grammatical units and the variety of words (nouns, mental verbs, relative clauses, adjectives and adverbs) present in the texts also justified our choice.

We used three measures to analyse narrative texts: lexical diversity, cohesive resources and episodic structure. This analysis is based on the input-output of listening-writing and reading-writing. The results showed that there were no significant differences in the control group in all the measures under study, but there were significant differences in the performance of the experimental group, from which it can be deduced that reading comprehension difficulties do not characterise all the processes of this skill in schoolchildren with ADHD-dyslexia, but that they are particularly evident in the use of cohesive resources, as well as in lexical diversity.

The reading situation facilitated the use of cohesive resources and brought the experimental group closer to the control group in the use of causal and conditional connectors.

Lexical diversity was similar in both groups, however, the control group made significantly more use of content words than the experimental group. Also, the scores for the use of verbs, adjectives and adverbs were significantly higher for the control group.

The experimental reading situation significantly benefited the use of function words in the ADHD-dyslexia group.

Finding reduced competence in the use of textual coherence in listening situations in subjects with ADHD-dyslexia adds to other work highlighting the convergence of failures in listening comprehension (Catts et al., 2003). Deficits in listening comprehension in ADHD subjects are interpreted as being more likely to be due to failures in inhibition or poor task involvement (Leonard et al., 2009). These data lead us once again to the confirmation that the processing and comprehension of auditory information by this group is deficient (Beitchman et al., 1989; Haghshenas et al., 2014; Kim, 2016; Tinius, 2003).

In the reading and listening situations, the ADHD-dyslexia group performed at the same level as the control group on measures of episodic structure. In this sense, the percentage of remembered propositions, as well as the presence of the different elements of the narrative superstructure did not discriminate the subjects according to the experimental situation.

These results should be interpreted in the light of the demands of the text comprehension task. Text comprehension involves a construction resulting from the representation of the overall meaning of discourse. This process is relatively complex and interactive in nature. In it, the individual brings into play different knowledge that engages the limited storage and processing resources of working memory (Loh et al., 2011; Jarrett et al., 2015), which is why we could interpret the cognitive overload involved in the listening situation, as shown in the work of Bellani et al., 2011; Lightbody (2002) or McInnes et al., 2003) who maintain that although the reading comprehension problems of children with attention difficulties are related to poor word reading, listening comprehension is particularly vulnerable in this type of population.

Along the same lines, Cain and Bignell (2014) maintain that reading favours comprehension over listening, as the visual presentation of the text allows one to go back when something is unclear or when the thread of the discourse is simply lost.

Once the results have been analysed in the light of the objectives set out, an open line of research would involve the macro-structural analysis of the texts since, according to Miranda-Casas (1988), although the subject may have a complete literal understanding of the text, and therefore complete its structure, ADHD subjects with dyslexia present difficulties in interpretative comprehension, that is, the subject does not make inferences or draw conclusions and also presents difficulties in critical reading, due to the fact that they do not contribute any type of prior knowledge or add any assessment to the text.

It can be concluded that the results of this research provide empirical evidence for the hypothesis that there is a benefit of the reading situation among ADHD-dyslexia profiles in measures of cohesive resources (mainly in the use of conditional connectors) as well as a significantly higher use of function words, giving greater complexity to the syntactic structure of the sentence, the latter aspect not analysed in previous scientific literature.

However, the explanatory complexity underlying listening comprehension in ADHD will need to be explored in depth in future work.

CONTRIBUTION OF THE AUTHORS

Pilar Vieiro-Iglesias: Project administration; Formal analysis; Conceptualization; Data curation; Writing - original draft; Writing - review & editing; Research; Methodology; Resources; Supervision; Validation; Visualisation.

M^a Dolores González-Fernández: Formal analysis; Writing-review & editing; Resources; Supervision; Validation; Visualisation.

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