Working Memory and Syntactic Processing in ADHD: Evidence from Relative Clauses

Larissa V. A. de Pádua Chiodetto (larissa.chiodetto@gmail.com)[1] & Thiago Oliveira da Motta Sampaio[2]
[1]Instituto de Estudos da Linguagem, Universidade Estadual de Campinas (UNICAMP)
[2]Instituto de Estudos da Linguagem, Universidade Estadual de Campinas (UNICAMP)

Abstract

Individual differences in executive control, including working memory capacity (WMC), are known to modulate sentence processing, but their role in neurodiverse populations remains unclear. This study examined how WMC relates to the processing of subject- and object-relative clauses in Brazilian Portuguese speakers with and without ADHD, using a WMC task and a self-paced reading paradigm with comprehension questions. Online measures showed that WMC modulated reading times differently across groups at the onset of the relative clause in object-extracted structures. This pattern suggests that both expectation-based and memory-based factors contribute to processing difficulty, consistent with locality accounts. Offline measures showed that accuracy was reduced in the OR condition and modulated differently by WMC across groups, with WMC predicting higher accuracy in the control group but not in the ADHD group. These findings suggest that reading times may reflect different processing strategies across cognitive profiles.

Keywords: working memory; sentence processing; syntactic processing; ADHD; relative clauses

Introduction

Models of sentence processing often assume that faster processing reflects greater cognitive efficiency, whereas longer reading times are taken as evidence of increased processing cost (Staub et al., 2017; Parker et al., 2017; Gibson, 2001). However, this interpretation becomes less straightforward when individual differences in executive control influence how cognitive resources are allocated over time relative to typical peers. In such cases, reading speed may reflect adaptive or compensatory strategies rather than inherent processing difficulty (Nicenboim et al., 2016; Lustig et al., 2009; Van Dyke & McElree, 2006).

Attention-Deficit/Hyperactivity Disorder (ADHD) is defined as a neurodevelopmental disorder involving a long-standing pattern of inattentive and/or hyperactive–impulsive behaviors that leads to marked difficulties in academic, occupational, or social functioning across development (American Psychiatric Association, 2014). The symptoms of ADHD are associated in the scientific literature with cognitive deficits in executive functions, including working memory (Kofler et al., 2018; Posner et al., 2020; Dias & Seabra, 2013; American Psychiatric Association, 2014).

Working memory capacity (WMC) is consistently referred to as impaired in ADHD relative to neurotypical individuals, persisting from childhood into adulthood (Cortese & Coghill, 2018; Duan et al., 2021). Baddeley (2000) conceptualized a WMC model that supports the simultaneous storage and processing of information during complex cognitive tasks, including language comprehension. The WMC impairment has direct implications for syntactic processing, particularly in structures with high WMC demands, such as relative clauses. Subject-relative (SR) and object-relative (OR) clauses differ markedly in processing cost: ORs require resolving long-distance dependencies between the filler and gap, taxing WM resources and eliciting longer reading times than SRs (Staub et al., 2017; Gibson et al., 2013; Traxler et al., 2002). Two competing accounts explain this SR/OR asymmetry: memory-based theories versus expectation-based accounts (Staub et al., 2017; Gibson et al., 2013; Traxler et al., 2002). Memory-based theories propose that OR clause processing difficulty arises during filler-gap integration at the relative clause verb (King & Just, 1991; Gordon et al., 2001). According to this view, individual WMC directly determines the ability to resolve these dependencies, as working memory must simultaneously store and process linguistic elements for successful sentence comprehension. In contrast, expectation-based theories argue that OR clause difficulty stems from low transitional probabilities: OR constructions are less frequent than SRs in natural language, generating greater surprise at clause onset, reflected in higher reading times (RT) at that region than at the verb within the relative clause (Hale, 2001; Levy, 2008). Thus, this model predicts the relative clause onset as the primary locus of processing difficulty.

Importantly, although working memory is a capacity-limited resource, its role in sentence processing cannot be reduced to storage demands alone. In line with this broader view, WMC has been shown to be associated with reading times and sentence comprehension accuracy on complex syntactic tasks, such as OR's reading tasks (Staub et al., 2017; Gibson et al., 2001; King & Just, 1991). More recent work suggests that WMC is tightly intertwined with executive control mechanisms, including inhibition and the maintenance of attention (Kofler et al., 2024; Alderson et al., 2010). Accordingly, individual differences in WMC may reflect not only storage capacity but also variation in the control strategies engaged during online processing. Reading times are often treated as representative of processing cost; however, this assumption may be challenged when executive control differs across individuals. In this study, we investigate whether individual differences in WMC influence syntactic processing similarly across cognitive profiles. Using a verbal WMC task and a

In G. Boleda, I. Dautriche, M. Maldonado, C. Saldana and T. Torrent (Eds.), *Proceedings of the 48th Annual Conference of the Cognitive Science Society*

self-paced reading paradigm with comprehension questions, we examine how WMC relates to the processing of subject and object clauses and whether the observed processing costs are better accounted for by expectation-based or memory-based explanations of the SR/OR asymmetry. Additionally, we assess whether reading times consistently index processing difficulty, or whether they instead reflect differences in strategic allocation of cognitive resources when executive control varies across individuals.

Methods

Participants

Fifty native Brazilian Portuguese speakers participated in this study. The experimental group consisted of twenty participants diagnosed with ADHD according to DSM-5 criteria (12 female; age range: 19-39 years, mean = 30.15, SD = 5.57). The control group consisted of thirty neurotypical participants who did not report any history or suspicion of reading or language disorders (20 female; age range: 18-39 years; mean = 29.47, SD = 5.31). Participants with comorbid neurodevelopmental disorders associated with ADHD were excluded from the experimental group, and participants with any neurodevelopmental disorders were excluded from the control group. Individuals from both groups with a history of brain injury, such as trauma or epilepsy, were also excluded.

Materials

The experimental tasks included a verbal memory capacity task (WMCT) and a self-paced reading task (SPR). Both were built in PsychoPy version 2024.2.4 and presented on a computer to the participants.

The verbal memory capacity task (WMCT) was adapted from the Reading Span task (Stone & Towse, 2015). Brazilian Portuguese sentences used in this task were adapted from Fonseca (2020). The test consisted of trials formed by interspersed sentences and numbers. The sentences and numbers were programmed to appear in a random order and not to be repeated for the same participant.

A self-paced reading task (SRT) that manipulated OR and SR clauses in Brazilian Portuguese was used to collect both online and offline syntactic processing data. The experimental materials consisted of 32 experimental clauses (16 SR and 16 OR) and 32 fillers. The experimental clauses were distributed across two lists, so that SR and OR clauses appeared in equal proportions across items, using a Latin-square design. Thus, each participant was presented with 16 experimental clauses (8 SR and 8 OR) and 32 fillers (16 SR and 16 OR). Both sentence types were presented in six segments, as illustrated in (1a) for SR clauses and (1b) for OR clauses.

(1a) O fotógrafo | que atacou | o presidente | esqueceu | a reunião | do trabalho

The photographer | that attacked | the president | forgot | the work | meeting

(1b) O fotógrafo | que o presidente | atacou | esqueceu | a reunião | do trabalho

The photographer | that the president | attacked | forgot | the work | meeting

Sentences were presented in six segments, as illustrated in (1a) and (1b). Segment 2 corresponds to the onset of the relative clause, in the SR (1a) to *that attacked,* whereas in the OR corresponds to *that the president*. Segment 3 contains the embedded verb *attacked* in OR clauses (1b) and contains the Noun Phrase (NP) *the president,* in SR (1a). Thus, the critical segments were 2 and 3 in the OR condition, serving as the reference for complex-sentence analysis relative to the SR condition.

A Latin Square design ensured that no participant read the same sentence twice. Sentences such as (1a) were in one version of the self-paced experiment, and the alternative version contained the same lexical items arranged in the other condition, like (1b). The sentences were controlled for the number of syllables and for potential memory interference factors that could affect sentence processing difficulty. Therefore, the semantic content of the noun phrases (NPs) in the experimental sentences was controlled to refer to professions in the masculine form in Brazilian Portuguese, since the language requires gender agreement with nouns.

Procedure

Participants were first administered the WMCT, followed by the self-paced reading task. The WMC task consisted of a series of trials where the participants were instructed to memorize numbers while reading and comprehending sentences. In each trial, participants were first presented with a number to remember. On the subsequent screen, a sentence was displayed, and participants were required to judge whether it made sense (Figure 1).

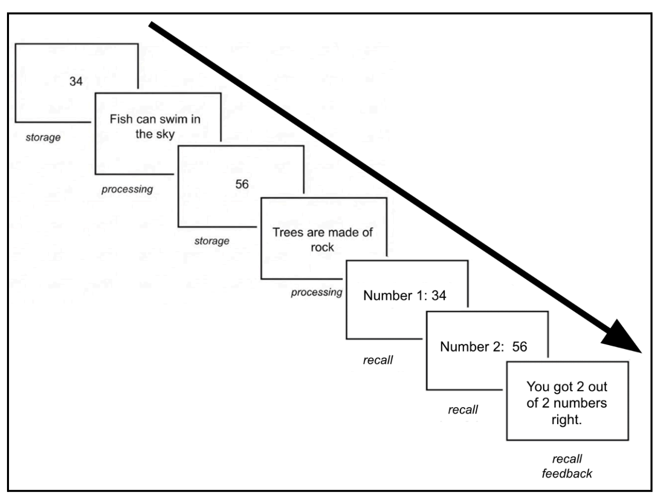

Figure 1: illustration of the verbal memory capacity task (WMCT)

The WMCT is designed to increase in difficulty progressively. It comprises five sets, each containing three trials. Sets differ in the number of numeric and verbal sequences that participants must read and, consequently, the number of numbers they are required to recall at the end of each trial.

After completing the WMCT, participants proceeded to the self-paced reading task. Sentences were presented in a non-cumulative paradigm, and participants advanced through the sentence by pressing the [spacebar] key. Reading times for each sentence segment were measured as the times between key presses. Each trial was followed by a comprehension question to which participants responded via key press. Participants took a one-minute break every third of the experiment to minimize fatigue.

Before both tasks, a practice phase was administered to control for learning effects and related to task familiarization.

Analysis

The analysis investigated whether reading times at critical regions and comprehension accuracy varied as a function of working memory capacity and sentence condition, and whether these effects differed across participant groups.

Working memory capacity was indexed by WMCT scores, computed using partial-credit unit scoring (PCU) following the guidelines of Conway et al. (2005), with each correctly recalled item contributing to the participant's overall score. The individual WMCT score was considered for further SPR-related analysis. For the self-paced experiment (SPR), segment reading time (RT) and comprehension accuracy were analyzed. Once the literature on the difficulty of locality in relative clauses is referenced to the onset of the relative clause or the verb within the relative clause in the OR compared to the SR, we considered segments 2 and 3 (Figure 2) critical for analysis.

Linear mixed-effects models were fitted to log-transformed reading times, whereas logistic mixed-effects models were used to examine the regression probability of comprehension accuracy. Fixed effects included centered WMCT scores, sentence type, participant group, and their interactions. Given the variability within and across participants and items, each model included participants and items as random effects. For inferential analysis, a 95% confidence level ($\alpha = 0.05$) was considered.

Online measures refer to reading times recorded during incremental sentence processing, whereas offline measures correspond to response time and accuracy on the comprehension questions following sentence presentation.

Results

The WMCT and SPR data were tabulated in an Excel sheet, and the analysis was conducted in RStudio version 4.4.1.

Working Memory Capacity Results

ADHD participants scored between 0.24 and 0.85 on the WMCT (mean = 0.53; SD = 0.179). Control participants scored between 0.31 and 0.90 (mean = 0.64; SD = 0.145). A Wilcoxon rank-sum test was used to compare the distributions of scores across groups (Figure 2), revealing a significant difference in WMCT scores (W = 193.5, p-value = 0.0357), with higher scores in the control group.

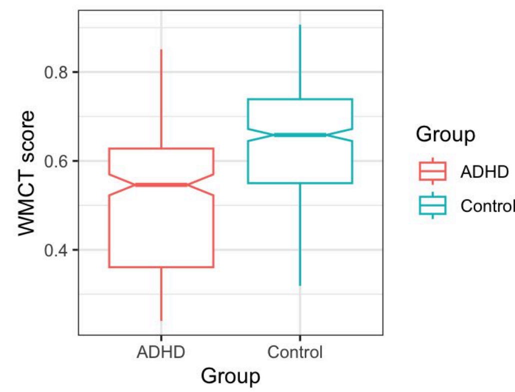

Figure 2: Boxplot of the distribution of WCMT score by group

Self-paced Reading: Online Results

Across groups, ADHD and control participants showed increased RTs for critical segments (2 and 3) in OR conditions compared to SR (Figure 3).

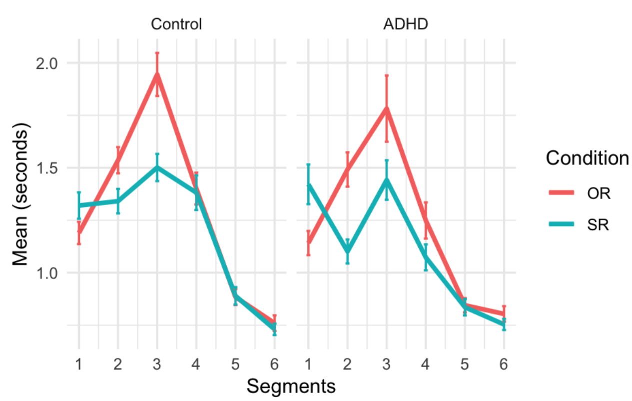

Figure 3: Graphic line of the reading pattern by condition and group (error bars represent within-subject standard error).

Linear mixed-effects model results showed that, at the onset of the embedded clause (segment 2), there was no main effect of condition ($\beta = 0.098$; SE = 0.154; t-value = 0.64; p = 0.525) or WMCT ($\beta = 0.817$; SE = 0.481; t-value = 1.70; p = 0.095). In the OR condition, control participants showed higher reading times at the onset of the relative clause than the ADHD participants ($\beta = 1.152$; SE = 0.413;

t-value = 2.79; p = 0.0072). There was an interaction between WMC, syntactic structure, and group (β = 1.031; SE = 0.389; t-value = 2.64; p = 0.0082), suggesting that the association between WMC and RTs may differ across groups (i.e., in the control group, higher WMC tended to be associated with faster RTs, whereas in the ADHD group, higher WMC tended to be associated with slower RTs, particularly in OR clauses). Interaction effects are shown in Figure 4.

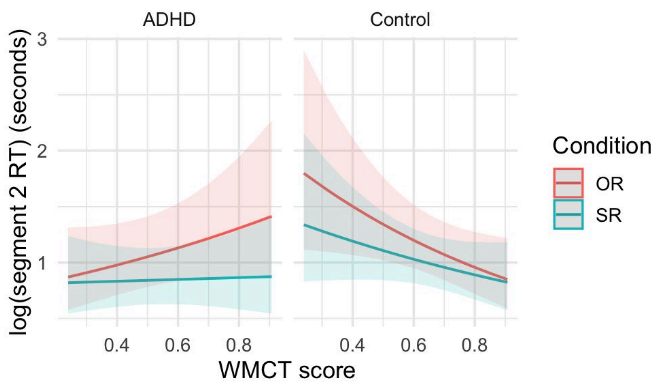

Figure 4: Effect of the interaction between score, condition, and segment 2 reading time across the ADHD and control groups

At the following segment (segment 3), ORs continued to elicit longer reading times than SRs (main effect of condition: β = -0.151, SE = 0.039, t-value = -3.876, p = 0.0001). No group (main effect of group: β = 0.726, SE = 0.128, t-value = 0.726, p = 0.471) differences were observed. There was no WMCT effect (β = 0.243, SE = 0.384, t-value = 0.634, p = 0.529) and no group-by-complexity interaction (β = -0.065, SE = 0.079, t-value = -0.823, p = 0.410). To verify whether the increase in reaction time observed in segment 3 was a spillover effect from segment 2, a comparison of models was conducted with and without segment 2 RT (reaction time) as a predictor of segment 3.

In the model without spillover control, subject-relative (SR) clauses were read significantly faster than object-relative (OR) clauses at segment 3. When reading time (RT) at segment 2 (β = 0.267, SE = 0.0439, t-value = 6.101, p < 0.000001) was included as a covariate, spillover from the preceding segment emerged as a strong positive predictor of RT at segment 3. Notably, the syntactic structure effect remained significant (β = -0.103, SE = 0.039, t-value = -2.612, p = 0.009), indicating that SR clauses still elicited shorter RTs than OR clauses after accounting for spillover. This suggests an independent contribution of relative-clause type to processing in this region, beyond spillover effects.

Self-paced Reading: Offline Results

Mean accuracy was calculated for each group and condition. Accuracy was higher for subject-relative than object-relative clauses in both groups. In the ADHD group, accuracy was 84.4% (SE = 3.0) for object-relative clauses and 92.5% (SE = 2.1) for subject-relative clauses. In the control group, accuracy was 85.8% (SE = 3.2) and 95.8% (SE = 1.7), respectively. Overall, both groups showed similar levels of comprehension accuracy, with higher performance for subject-relative clauses across groups.

A mixed-effects logistic regression was conducted with accuracy (correct vs. incorrect) as the dependent variable and log-transformed reading times (RT) at critical segments, WMCT, condition, group, and log-transformed RT comprehension question as predictors of sentence comprehension.

Accuracy increased as reading time at segment 3 decreased, such that log-transformed RT at segment 3 was a significant negative predictor of correct responses (β = −0.693, SE = 0.220, z = −3.154, p = 0.002). Log-transformed question RT was a significant positive predictor (β = 0.676, SE = 0.241, z = 2.807, p = 0.005), indicating that longer decision times were associated with lower accuracy. Log-transformed RT at segment 2 were no significant predictor for comprehension accuracy (β = -0.4755, SE = 0.2835, z = -1.677, p =0.09350). Being in the control group significantly increased the log-odds of an incorrect response (β = 3.043, SE = 1.132, z = 2.689, p = 0.007). The SR condition (β = -2.3148, SE = 0.5306, z = -4.362, p = 0.000013) decreased the error log-odds by a statistically significant amount. In contrast, the WMC did not show a significant main effect on accuracy (β = -1.039, SE = 1.316, z = -0.790, p = 0.429), although it corresponded to the WMC coefficient in the reference group (ADHD). Finally, a significant negative interaction was found between WMC and the control group (β = −5.2316, SE = 1.9889, z = −2.630, p = 0.0085), indicating that the relationship between WMC and accuracy differed between groups, with a significant association in the control group and not in the ADHD group. Figure 5 shows the interaction between predictors of error probability, providing a clearer understanding of the effects of WMCT and group on comprehension accuracy.

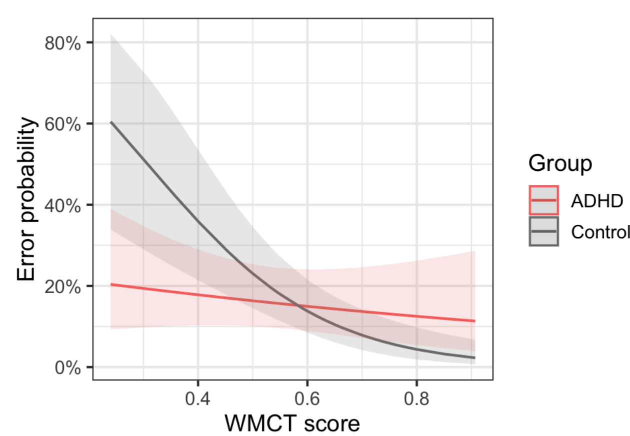

Figure 5: Error probability considering WMCT score across groups.

The control group showed higher accuracy at high working memory capacity task (WMCT) scores. This score effect was no longer significant in the ADHD group. Notably, controls had higher error rates than ADHD participants at low WMC scores, an effect absent at high WMC levels.

A mixed-effects linear regression on RT question ($n = 50$) revealed a significant positive effect of log-transformed RT at segment 3 ($\beta = 0.088$, $SE = 0.0350$, t-value = 2.523, $p = 0.011$), indicating higher RT at question comprehension with higher reading times at segment 3. The SR condition (relative to OR) showed a significant negative effect on RT question ($\beta = -0.144$, $SE = 0.033$, t-value = −4.27, $p = 0.00002$), in which the SR condition was a predictor for faster response of the comprehension question. There was no log-transformed RT at the segment 2 effect ($\beta = 0.004$, $SE = 0.037$, t-value = 0.124, $p = 0.901$) or WMCT effect ($\beta = -0.442$, $SE = 0.288$, t-value = -1.538, $p = 0.1307$) on the RT question.

Discussion

Our findings indicate that working memory capacity (WMC) did not have a consistent effect on sentence processing across participants. Instead, its influence depended on the group. Offline, WMC predicted higher accuracy in the control group, but it was not related to accuracy in the ADHD group. A similar dissociation across groups was observed in online measures: at the onset of the object-relative clause, higher WMC was associated with faster reading times in the control group, but with slower reading times in the ADHD group. Previous work in sentence processing has proposed that WMC modulates the difficulty of object-relative (OR) clauses relative to subject-relative (SR) clauses, primarily based on increased reading times at the verb within the relative clause, reflecting integration costs during argument structure processing (King & Just, 1991; Grodner & Gibson, 2005; Gordon et al., 2006). Under these accounts, higher WMC is expected to mitigate integration costs in OR structures.

Although the comparison of WMCT scores confirmed that the ADHD group exhibited lower working memory capacity than the control group, WMC alone did not account for differences in syntactic processing. Crucially, however, we observed a significant interaction between WMC, group, and reading time at the onset of the object-relative clause (segment 2), a region typically associated with expectation-driven processing (Hale, 2001). This interaction revealed qualitatively different patterns across groups: in adults with ADHD, higher WMC was associated with longer reading times at this segment, whereas in the control group, higher WMC was associated with faster reading times.

This finding contrasts with traditional assumptions that higher WMC uniformly facilitates sentence comprehension (Grodner & Gibson, 2005; King & Just, 1991; Gordon et al., 2006). Instead, our data support a more complex interpretation of how working memory and other cognitive features shape online processing in ADHD. According to Baddeley's (2000) model, working memory is integrally linked to executive function. This set of cognitive functions is defined as formed by working memory, inhibitory control, organization, and planning (Kofler et al., 2018; Posner, Polanczyk, Sonuga-Barke, 2020; Dias, Seabra, 2013).

Importantly, this interaction does not license strong causal claims about underlying mechanisms. Rather, it indicates that the functional role of WMC during early syntactic processing differs across cognitive profiles. One interpretation consistent with the data is that, in adults with ADHD, higher WMC supports a more controlled allocation of attention at the onset of complex structures, leading to longer reading times that need not reflect increased processing difficulty. Because inhibitory control and sustained attention were not independently measured, this interpretation remains speculative.

Consistent with prior evidence (Nicenboim et al., 2016), longer RTs among participants with higher WMC should not be straightforwardly interpreted as a marker of difficulty but rather as indexing more controlled, resource-intensive processing. Adults with ADHD often develop compensatory strategies to manage executive function deficits (Canela et al., 2017), which may manifest as longer reading times or increased reanalysis effort when processing syntactically complex input. In our data, this compensatory use of time did not yield higher comprehension accuracy, suggesting that although attentional allocation patterns differ, final interpretation outcomes remain comparable across groups.

More broadly, these findings highlight the importance of considering executive function differences when interpreting reading time measures in self-paced reading paradigms. For ADHD readers, faster reading may sometimes indicate strategic acceleration to reduce working memory decay (Lustig et al., 2009; Van Dyke & McElree, 2006), while slower reading may reflect compensatory attention recruitment. These findings caution against treating reading time as a direct proxy for processing difficulty in neurodiverse populations, where similar comprehension outcomes may be achieved through qualitatively different reading time allocation strategies.

Object-extracted relative clauses showed increased reaction times at clause onset relative to subject relatives, consistent with locality-based accounts of sentence processing (Staub et al., 2017; Gibson et al., 2013; Gordon & Lowder, 2012; Traxler et al., 2002), with both spillover and condition effects contributing to higher RTs into the verb region (segment 3). This suggests that both expectation-based and working-memory-based mechanisms (Staub, 2010; Staub et al., 2017) are active during the comprehension of complex sentences. The absence of a consistent relationship between WMC and comprehension accuracy across groups, however, underscores that syntactic processing in ADHD is modulated by broader cognitive and executive control dynamics rather than memory capacity alone.

Finally, although the WMC was analyzed as an isolated variable, it did not statistically significantly predict comprehension accuracy. Otherwise, the interaction within groups showed that the control group was more sensitive to the paradigm, suggesting that higher working memory capacity increases the likelihood of correct responses in relative clauses relative to the ADHD group. The Brazilian study by Almeida (2021) did not find a statistically significant association between WMCT based on the Daneman & Carpenter (1980) task and comprehension accuracy in the ADHD group. One possible explanation for the interaction effect between WMC and condition across groups is that ADHD participants with higher scores may employ more effective processing strategies supported by executive functions, given that working memory is part of these abilities. In contrast, those with lower scores may exhibit reduced sustained attention across sentence segments, even though this did not affect reading accuracy. Since comprehension involves multiple interacting cognitive components beyond working memory capacity, these nuances may not have been fully captured just by the WMCT applied in this study. Future work should integrate multiple control measures to better model these interactions.

Conclusion

This study examined how working memory capacity (WMC) relates to the processing of relative clauses in adults with and without ADHD, using a verbal working memory task and a self-paced reading paradigm. Although individual differences in WMC did not consistently predict reading times or comprehension accuracy across participants, we observed group-specific modulation of both online and offline processing measures. In particular, higher-WMC adults with ADHD showed longer reading times at the onset of object-relative clauses, whereas higher-WMC controls showed faster reading, indicating that the functional role of WMC during sentence processing differs across cognitive profiles.

The canonical subject-object asymmetry held, with increased reading times at the relative onset and spillover to the embedded verb, supporting hybrid accounts combining memory retrieval costs and expectation violations (Staub, 2010; Staub, Dillon, & Clifton, 2017). Although adults with ADHD achieved comparable comprehension accuracy to controls overall, group differences in accuracy were modulated by WMC. In the control group, higher WMC predicted higher accuracy, whereas in the ADHD group, WMC was not related to accuracy. Notably, controls showed higher error rates at lower WMC levels, a pattern that diminished at higher WMC levels. The results suggest that similar comprehension outcomes may be achieved through distinct time-allocation patterns across groups, underscoring that WMC alone is insufficient to account for syntactic processing in this population. Our findings highlight the need for models that incorporate broader executive-control mechanisms, integrating working memory with attentional control and compensatory strategies.

References

Alderson, R. M., Rapport, M. D., Hudec, K. L., Sarver, D. E., & Kofler, M. J. (2010). Competing core processes in attention-deficit/hyperactivity disorder (ADHD): Do working memory deficiencies underlie behavioral inhibition deficits? Journal of Abnormal Child Psychology, 38(4), 497–507. https://doi.org/10.1007/s10802-010-9387-0

Almeida, P. de A. (2021). Influência da memória de trabalho na compreensão leitora de estudantes universitários com TDAH [Dissertação de mestrado, Universidade Federal da Paraíba].

American Psychiatric Association. (2014). Manual diagnóstico e estatístico de transtornos mentais: DSM-5 (5ª ed.). Artmed.

Baddeley, A. (2000). The episodic buffer: A new component of working memory? Trends in Cognitive Sciences, 4(11), 417–423. https://doi.org/10.1016/S1364-6613(00)01538-2

Canela, C., Bucci, M. P., Debrabant, J., Bakchine, S., & Karsenti, E. (2017). Skills and compensation strategies in adult ADHD: A qualitative study. PLOS ONE, 12(9), e0184964. https://doi.org/10.1371/journal.pone.0184964

Conway, A. R. A., Kane, M. J., Bunting, M. F., Hambrick, D. Z., Wilhelm, O., & Engle, R. W. (2005). Working memory span tasks: A methodological review and user's guide. Psychonomic Bulletin & Review, 12(5), 769–786. https://doi.org/10.3758/BF03196772

Cortese, S., & Coghill, D. (2018). Twenty years of research on attention-deficit/hyperactivity disorder (ADHD): Looking back, looking forward. Evidence Based Mental Health, 21(4), 173–176. https://doi.org/10.1136/ebmental-2018-300050

Daneman, M., & Carpenter, P. A. (1980). Individual differences in working memory and reading. Journal of Verbal Learning and Verbal Behavior, 19(4), 450–466. https://doi.org/10.1016/S0022-5371(80)90312-6

Dias, N. M., & Seabra, A. G. (2013). Funções executivas: desenvolvimento e intervenção. Temas sobre Desenvolvimento, 206–212.

Duan, K., Fang, W., Su, C., Lin, H., Lin, B., Liu, S., Zang, Y., Zhang, Y., & Zhang, C. (2021). Gray matter networks associated with attention and working memory deficit in ADHD across adolescence and adulthood. Translational Psychiatry, 11(1), 1–12. https://doi.org/10.1038/s41398-021-01311-6

Fonseca, G. R. (2020). Processos de memória no processamento de dependências de longa distância [Dissertação de mestrado, Universidade Estadual de Campinas].

Gibson, E. (2001). The dependency locality theory: A distance-based theory of linguistic complexity. In A. P. Marantz, Y. Miyashita, & W. O'Neil (Eds.), Image, language, brain (pp. 95–126). MIT Press.

Gibson, E., Tily, H., & Fedorenko, E. (2013). The processing complexity of English relative clauses. In M. Sanz, I. Laka, M. K. Tanenhaus, & M. Sanz (Eds.), Language down the garden path: The cognitive and biological basis for linguistic structures. Oxford UniversityPress. https://doi.org/10.1093/acprof:oso/9780199677139.001.0001

Gordon, P. C., Hendrick, R., & Johnson, M. (2001). Memory interference during language processing. Journal of Experimental Psychology: Learning, Memory, and Cognition, 27(6), 1411–1423. https://doi.org/10.1037/0278-7393.27.6.1411

Gordon, P. C., Hendrick, R., Johnson, M. R., & Lee, Y. (2006). Similarity-based interference during language comprehension: Evidence from eye tracking during reading. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 32*(6), 1304–1321. https://doi.org/10.1037/0278-7393.32.6.1304

Gordon, P. C., & Lowder, M. W. (2012). Complex Sentence Processing: A Review of Theoretical Perspectives on the Comprehension of Relative Clauses. Language and Linguistics Compass, 6(7), 403–415. https://doi.org/10.1002/lnc3.347

Grodner, D. J., & Gibson, E. A. F. (2005). Consequences of the serial nature of linguistic input for sentential complexity. Cognitive Science, 29(2), 261–291. https://doi.org/10.1207/s15516709cog0000_7

Hale, J. (2001). A probabilistic Earley parser as a psycholinguistic model. In Proceedings of NAACL (Vol. 2, pp. 159–166).

King, J., & Just, M. A. (1991). Individual differences in syntactic processing: The role of working memory. Journal of Memory and Language, 30(5), 580–602. https://doi.org/10.1016/0749-596X(91)90027-H

Kofler, M. J., Irwin, L. N., Soto, E. F., Groves, N. B., Harmon, S. L., & Sarver, D. E. (2018). Working memory and organizational skills problems in ADHD. Journal of Child Psychology and Psychiatry, 59(1), 57–67. https://doi.org/10.1111/jcpp.12773

Kofler, M. J., Delucia, C., Zilioli, M., Irwin, L. N., Wells, E. L., Soto, C. J., & Austin, A. B. (2024). Executive function deficits in attention-deficit/hyperactivity disorder and autism spectrum disorder. *Nature Reviews Psychology, 3*(10), 701–719. https://doi.org/10.1038/s44159-024-00365-8

Levy, R. (2008). Expectation-based syntactic comprehension. Cognition, 106(3), 1126–1177. https://doi.org/10.1016/j.cognition.2007.05.006

Lustig, C., Berman, M. G., Nee, D. E., Lewis, R. L., Sledge Moore, K., & Jonides, J. (2009). Psychological and neural mechanisms of short-term memory. In G. G. Berntson & J. T. Cacioppo (Eds.), Handbook of neuroscience for the behavioral sciences (Vol. 1, pp. 567–585). Wiley.

Nicenboim, B., Vasishth, S., Engelmann, F., & Suckow, K. (2016). When high-capacity readers slow down and low-capacity readers speed up: Working memory and locality effects. Frontiers in Psychology, 7, 280. https://doi.org/10.3389/fpsyg.2016.00280

Parker, D., Shvartsman, M., & Van Dyke, J. A. (2017). The cue-based retrieval theory of sentence comprehension: New findings and new challenges. In L. Escobar, V. Torrens, & T. Parodi (Eds.), Language processing and disorders (pp. 122-143). Cambridge Scholars Publishing. https://cambridgescholars.com/product/978-1-4438-9508-8/

Posner, J., Polanczyk, G. V., & Sonuga-Barke, E. (2020). Attention-deficit hyperactivity disorder. The Lancet, 395(10222), 450–462. https://doi.org/10.1016/S0140-6736(19)33004-1

Staub, A. (2010). Eye movements and processing difficulty in object relative clauses. Cognition, 116(1), 71–86. https://doi.org/10.1016/j.cognition.2010.04.002

Staub, A., Dillon, B., & Clifton, C. (2017). The matrix verb as a source of comprehension difficulty in object relative sentences. Cognitive Science, 41(S6), 1353–1376. https://doi.org/10.1111/cogs.12428

Stone, J. M., & Towse, J. N. (2015). A working memory test battery: Java-based collection of seven working memory tasks. Journal of Open Research Software, 3(1). https://doi.org/10.5334/jors.br

Traxler, M. J., Morris, R. K., & Seely, R. E. (2002). Processing subject and object relative clauses: Evidence from eye movements. Journal of Memory and Language, 47(1), 69–90. https://doi.org/10.1006/jmla.2001.2836

Van Dyke, J. A., & McElree, B. (2006). Retrieval interference in sentence comprehension. Journal of Memory and Language, 55(2), 157–166. https://doi.org/10.1016/j.jml.2006.03.007