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*Article*

# Finding the Mole and Choosing the Apple: Executive Function Challenges in Children with Developmental Language Disorder (DLD)

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**Abstract: Background:** Children with Developmental Language Disorder (DLD) frequently experience deficits in cognitive skills such as working memory (WM) and sustained attention (SA), which are closely related to language development. Yet, these cognitive deficits remain underexplored in early childhood, particularly during the preschool years. **Objective:** This study explores WM and SA in Chilean preschoolers with DLD compared to their typically developing (TD) peers, using the non-verbal tasks "Torpo the Clumsy Mole" for WM and the Continuous Performance Task (CPT) "Duno and the Worms" for SA, both from the Child Neuropsychological Evaluation Test (TENI in Spanish). **Method:** Thirty DLD and 30 TLD peers (aged 4 to 4 years 11 months) participated. Accuracy and reaction times in both tasks were assessed. **Results:** DLD children demonstrated significant deficits in working memory accuracy and poorer sustained attention accuracy despite exhibiting shorter reaction times in the sustained attention task compared to TLD children. **Conclusion:** The findings highlight the multifaceted nature of DLD, particularly in relation to cognitive dimensions beyond language, such as working memory and sustained attention. Early identification of these differences emphasizes the important role of executive functions in DLD.

**Keywords:** Developmental Language Disorder (DLD); sustained attention; working memory; executive functions; preschool children

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## 1. Introduction

Developmental Language Disorder (DLD) is a common condition observed during the school years, characterized by deficiencies in acquiring and utilizing morphosyntax, semantics, vocabulary, phonology, and complex syntax [1]. Since its initial diagnosis, research efforts have been undertaken to better delineate this population and understand the underlying causes of their language difficulties. Notably, these investigations have highlighted cognitive aspects that influenced the nomenclature of the diagnosis. Previously referred to as Specific Language Impairment (SLI), the condition was viewed as limited to the linguistic domain. However, contemporary evidence suggests that non-linguistic areas, such as learning, attention, and memory, are also affected [2].

The cognitive and linguistic challenges associated with DLD pose a significant barrier, especially during the early school years, a critical developmental phase when acquired skills can have lasting consequences [3]. Substantial evidence supports the critical role of cognitive abilities in language performance [4,5]. This underscores the importance of characterizing these cognitive abilities to enhance the prognosis for individuals with DLD.

Among the various cognitive domains investigated, executive functions (EF) have garnered particular attention. EF encompass the cognitive abilities required for planning, organizing, and executing goal-oriented actions [6]. These functions exhibit a sequential developmental pattern,

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intensifying during childhood and plateauing in adolescence. However, their manifestation can vary significantly, especially among pediatric populations [7]. While some studies suggest that all EF components distinctly manifest at an early age, others propose that a single component better explains the variance in EF measures [8,9].

Working memory, one of the components of EF, has received considerable scrutiny. Its development has been observed during early childhood [10,11] playing a vital role in updating information while performing complex tasks [6,12]. Impairments in working memory in children with DLD can result in syntactic and semantic challenges, difficulties in speech planning, and disruptions in phonological development [13]. The deficits in working memory among these children have been confirmed in both verbal and non-verbal tasks [14-16]. Furthermore, an association has been established between non-verbal working memory and the severity of language impairment [17]. Although there is a consensus about the implication of working memory in linguistic performance, recent research suggests that sustained attention, another critical cognitive skill, may serve as a mediating factor in the relationship between non-verbal working memory and language skills in children with DLD [18].

Sustained attention, which encompasses the ability to maintain alertness and select stimuli for extended periods, plays a critical role in information processing, working memory, and other EF [12,19]. This function is evident during the early stages of language acquisition, where children must focus on relevant linguistic input while filtering out irrelevant information. Sustained attention has been significantly linked to sentence comprehension, grammatical skills, and narrative abilities in children with DLD [15,20].

Research on sustained attention in the DLD population has revealed significantly poorer performance in measures of auditory sustained attention [21,22]. Nevertheless, the question has been raised as to whether these differences primarily stem from auditory processing difficulties rather than sustained attention deficits [18]. Results regarding visual-spatial sustained attention in children with DLD have been mixed, with some studies indicating significant differences between groups, and others not [23,24]. Nevertheless, a meta-analysis conducted by Ebert & Kohnert [25] analyzed sustained attention studies in individuals with DLD, including those employing variations of the Continuous Performance Task (CPT) behavioral task [26]. This widely used measure of sustained attention involves pressing a button when presented with a recurring target and withholding responses to non-target stimuli, either verbal or visual. In tasks of this nature, subjects with sustained attention deficits struggle to select target stimuli consistently over time, leading to missed targets, incorrect responses to distractors, or both.

Ebert and Kohnert [25] revealed significant deficits in sustained attention in both auditory and visual-spatial modalities, where the DLD population exhibited low accuracy compared to their typically language developing (TLD) peers. Notably, this difference was not observed in response times. Subsequent studies have reported similar results in the pediatric population, employing the CPT task in both verbal and nonverbal modalities[11,20,27].

Despite evidence suggesting that children with DLD often exhibit lower performance in executive function measures compared to their TLD peers [16,28], it is essential to emphasize that these group-level differences do not always mirror individual characteristics. Kapa and Erikson [24] conducted an analysis of 11 scientific studies reporting performance in sustained attention, working memory, inhibition, and flexibility in individuals with DLD and their TLD peers. While mean comparisons indicate a general trend of subjects with DLD scoring lower than their TLD counterparts, both groups displayed wide standard deviations, suggesting that some subjects with DLD obtained scores similar to TLD children.

In light of the reported findings, it is evident that deficiencies in cognitive mechanisms in children with DLD are diverse, yet there is a consensus that a significant number of individuals experience these difficulties. This poses a challenge, as revealed by a survey conducted in educational settings in the United States, which considered a total of 2961 speech and language pathologists. The findings indicated that only half of the specialists reported implementing cognitive-level interventions in preschoolers [29].

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Given this scenario, there is a growing interest in investigating how skills that have been shown to be impaired, such as sustained attention and working memory, influence language development. In this context, our aim is to compare the performance of sustained attention and working memory in preschool children with DLD, native Spanish speakers, and their TLD peers; we hypothesize that the children with DLD will demonstrate lower performance in both sustained attention and working memory compared to their TLD peers. This analysis will provide essential information to evaluate the incorporation of these EF into the school-based therapeutic approach in the Spanish context.

## 2. Materials and Methods

This is a cuasi-experimental study. Two neuropsychological tests were used to assess performance in working memory and sustained attention.

### *2.1. Participants*

The group of participants in this study consisted of 30 children with DLD in the experimental group and 30 TLD children in the control group. For the estimation of the minimum required sample size, the following parameters were considered: a) Effect size (f) = .25, b) Statistical power (1 - $\beta$) = .95; c) Significance level ($\alpha$) = .05; d) Number of measurements = 2. According to these variables, a minimum of 27 individuals per group is needed, as calculated by the G*Power program version 3.1.7. [30].

The inclusion criteria stipulated participants falling within the age range of 4 years to 4 years and 11 months during the assessment and actively attending preschool level. Additionally, it was required that their vision be either normal or corrected. Those classified within the DLD group attended a special language school where they were evaluated upon admission according to Chilean ministerial regulations, specifically through the use of the Teprosif-R, Tecal, and STSG tests, which together diagnose DLD [31]; this evaluation was conducted by different speech-language pathologists.

Due to the impracticality of reproducing the evaluation instruments mandated by educational regulations within a 6-month period, we opted to employ the Test of Initial Language Development (TELD-3: S) by Ramos et al. [32] to validate the linguistic diagnosis of the participants. This test was selected because it has been validated in Chile for diagnosing DLD, with high reliability indicated by Cronbach's Alpha coefficients of .931 in the receptive subtest, .947 in the expressive subtest, and .969 for the total test score. It was administered by a single speech-language pathologist. The TELD-3:S evaluates the ability to follow instructions using concrete materials. Semantically, the test assesses vocabulary identification through visual stimuli with distractors, while grammatically, it assesses sentence identification also with distractors.

Expressively, the test requires participants to name visually presented elements and respond to direct informational questions, all of which are crucial abilities for diagnosing DLD [1]. Subjects in the DLD group had to have a total test score below or within the 10th percentile for their age, while subjects in the TLD group had scores above the 25th percentile. As indicated in Table 1, significant differences in TELD-3:S scores were observed between DLD and TLD participants.

**Table 1.** Participant characteristics.

| Variable | DLD (n=30) | | | TD (n=30) | | | Comparison |
|---|---|---|---|---|---|---|---|
| | M | SD | Min-Max | M | SD | Min-Max | |
| Age (months) | 55.03 | 3.85 | 48-60 | 56.17 | 2.52 | 49-60 | t = -1.35 p = 0.18 |
| TELD3-S rec | 82.06 | 5.36 | 68-91 | 100.8 | 5.59 | 91-112 | t = -13.24 p = <0.001 |
| TELD3-S exp | 82.47 | 5.85 | 67-93 | 96.3 | 5.97 | 82-109 | t = -9.06 p = <0.001 |
| TELD3-S total | 164.53 | 3.48 | 156-169 | 197.1 | 5.42 | 185-204 | t = -27.682 p = <0.001 |

Note: Group mean values (M), standard deviation (SD) and score from TELD3-S

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Regarding exclusion criteria, none of the individuals included in the sample exhibited any identified sensory or developmental disorders, such as autism, cognitive impairments, or cerebral palsy. Furthermore, none of the participants had a documented history of trauma necessitating medical intervention. Specifically, this information was obtained through anamnesis responses provided by parents or guardians.

Written consent was obtained from parents and/or legal guardians, and participants also gave verbal consent before participating in the research. This study received ethical approval from the Ethics, Bioethics and Biosafety Committee (Protocol No. CEBB 731-2020) of the University of Concepción (Chile).

### *2.2. Instruments*

#### 2.2.1. Linguistic Assessment

The linguistic diagnosis of the participants was validated using the TELD-3: S, developed by Ramos et al. [32], this tool evaluates the receptive and expressive language abilities of individuals aged 2 to 7 years and 11 months. The receptive subtest comprises 37 items (24 semantic and 13 grammatical) designed to assess a child's comprehension of spoken language. Early items involve basic questions, such as *Show me the car* or *Show me the ball*, progressing in complexity to tasks such as *Show me the boy next to the house*. Towards the end of the test, participants tackle questions like *Which word is unrelated to the others: bicycle, kite, cat, ball?*.

The expressive subtest comprises 21 semantic and 18 grammatical items, including tasks like repeating sentences and responding to inquiries such as *Who are the members of your family?*. In the later stages of the test, participants engage with more intricate questions like *Look at the dog, cat, bear, and horse. They are all...* and *Examine this picture (of a fireman). What can you tell me about him?*

Using the outcomes from the TELD-3: S, we categorized the participants into two study groups. Those with DLD achieved scores at or below the 10th percentile, whereas TLD children obtained scores at or above the 25th percentile (refer to Table 1 for individual participant scores).

#### 2.2.2. Working Memory Assessment

The evaluation of working memory utilized the nonverbal task "*Torpo el topo torpe/Torpo the clumsy mole*" from the Childhood Neuropsychological Assessment Test (original Spanish version: Test de Evaluación Neuropsicológica Infantil, TENI [33]). Originating and validated in Chile, this instrument gauges working memory, boasting a Cronbach's reliability index of .8. This nonverbal task entails recalling a visual sequence and taps into the participant's ability to temporarily hold and manipulate visual information in their working memory [34]. It has been successfully used in Chile to measure working memory functioning in 5-year-old subjects [35].

Participants observe a mole emerging in various holes within a 3x3 grid on a tablet screen. They are informed that the mole is lost and is probing the holes to find an exit. The mole materializes in a sequence of two holes and then disappears, following a bell sound, the child must replicate the order of appearance. The sequence progressively expands to eight positions. Practice trials are administered and reiterated until the child comprehends the instructions entirely before advancing to the test. The task concludes when the child fails two consecutive trials, and the analysis is founded on the accuracy of the responses.

#### 2.2.3. Sustained Attention Assessment

Sustained attention was assessed using the nonverbal task "*Duno y los gusanos/Duno and the worms*" from the TENI [33]. Originating and validated in Chile, this instrument gauges sustained attention, boasting a Cronbach's reliability index of .8 This visuospatial task is based on the CPT, a widely used model of sustained attention developed by Haldor Rosvold in 1956 [25,26]. In TENI's version, the child observes a conveyor belt of apples for 6 minutes, and is required to touch the screen each time one of these apples has a worm, and to refrain from touching when the apple lacks the worm. The task is presented in a tablet screen format and includes practice trials before the test. Two measures of analysis are obtained: response time (RT), which is the average time from the presentation of the target stimulus until the child touches the screen. This variable is calculated as the sum of the response times for all correct responses associated with the target stimuli divided by the number of correct responses. The second measure is the accuracy index, which is the number of correct responses divided by the number of errors. The test has been successfully used to measure sustained attention functioning in 6-year-old subjects [36].

2.2.4. Procedure and Statistical Analysis

A descriptive analysis was conducted to summarize the performance measures of Torpo the clumsy mole's accuracy, Duno and worms' reaction time (RT), and Duno and worms' accuracy within each group (DLD and TDL). Additionally, an inferential analysis was performed, mediated by the results of the Kolmogorov-Smirnov test assessing sample normality and size (N =60), to compare the means of these variables between the two groups. The outcome of the Kolmogorov-Smirnov test determined whether parametric or non-parametric tests were employed. The statistical analyses were conducted using SPSS 22 [37].

## 3. Results

Smirnov test results suggest that only sustained attention reaction times followed a normal distribution ($D(60) = .107$, $p = .082$). Both working memory and sustained attention accuracy variables exhibited significant deviations from normal distribution ($D(60) = .183$, $p < .001$ and $D(60) = .171$, $p < .001$, respectively). Due to the sample size and non-normal distribution of data, nonparametric tests were employed for the statistical analysis of working memory and sustained attention accuracy variables.

We first present the results of the Student's t-test for the variable with normal distribution and then the Mann-Whitney U test for variables with non-normal distribution.

Regarding sustained attention reaction times, the results indicated that participants with DLD achieved significantly shorter reaction times compared to the control group ($t(58) = -6.15$; $p < .005$), consistent with previous findings [25]. The effect size, as indicated by G*Power analysis, was $d = 1.59$, and the power was $1 - \beta = .99$. In the accuracy index of sustained attention, the DLD subjects exhibited significantly lower performance than the TLD group ($U = 96$, $z = -5.27$, $p < .005$). The effect size, as indicated by G*Power analysis, was $d = 1.88$, and the power was $1 - \beta = .99$ (see Table 2), aligning with previous research [11,20,22,27]

The analysis of working memory measures revealed a significantly lower average of correct responses in the "*Torpo the clumsy mole/Torpo el topo torpe*" task in the DLD group compared to their TLD peers ($U = 142.5$, $z = -4,61$, $p < .005$). The effect size, as indicated by G*Power analysis, was $d = 1.47$, and the power was $1 - \beta = .98$. (see Table 2). This suggests that the DLD group retains short visual information sequences to a lesser extent than the control group, consistent with findings from previous studies [14,17].

**Table 2.** Means and Standard Deviations of Working Memory and Sustained Attention Test for DLD and TLD Participants.

| | DLD (n=30) | | | TLD (n=30) | | |
|---|---|---|---|---|---|---|
| **Dependent Variable** | **M** | **SD** | **Min-Max** | **M** | **SD** | **Min-Max** |
| Accuracy Torpo the clumsy mole* | 6.03 | 1.75 | 4-10 | 9.33 | 2.64 | 5-13 |
| Reaction time Duno and the worms* | 6.8 | 2.37 | 3-15 | 10.6 | 2.42 | 5-15 |
| Accuracy index Duno and the worms* | 7.167 | 1.88 | 5-12 | 11.07 | 2.26 | 6-14 |

*=Indicates significant differences.

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To investigate potential correlations between the variables, Spearman's rho correlation coefficient (ϱ) was employed. Correlations were found among all three variables, as shown in Table 3. These findings suggest a significant linear relationship between working memory performance and sustained attention, both for accuracy and reaction times.

**Table 3.** Spearman´s rho Correlations Between Executive Functions.

| | DLD | | | TLD | | |
|---|---|---|---|---|---|---|
| **Variable** | **ACC WM** | **ACC SA** | **RT SA** | ACC WM | ACC SA | RT SA |
| ACC WM | 1 | 564** | .624** | 1 | .463** | .603** |
| ACC SA | | 1 | .630** | | 1 | .463* |
| RT SA | | | 1 | | | 1 |

Note: ACC WM =accuracy working memory (Torpo the Clumsy Mole); ACC SA=accuracy sustained attention (Duno and the worms); RT SA=reaction time sustained attention (Duno and the worms RT). *= Indicates significant differences at .05, **= Indicates significant differences at .01.

## 4. Discussion

This study investigates the performance on working memory and sustained attention tasks of Spanish-speaking preschool children with DLD compared to their TLD peers. Our results reveal significant deficits in both working memory and sustained attention in DLD participants, providing valuable insight into the multifaceted nature of DLD during the early school years. Originally conceptualized as specific language impairment (SLI), the evolving definition of DLD now encompasses not only linguistic challenges but also broader cognitive dimensions [2].

In line with previous research [14,15], our results support the existence of working memory deficits in children with DLD. The compromised ability to retain and manipulate short sequences of visual information distinguishes the DLD group from their TLD counterparts. Comparable evidence in different languages supports our findings: Ralli et al. [38] found limited working memory capacity in 8- to 9-year-old Greek-speaking children; Marini et al. [39] reported that measures of executive function, particularly updating working memory and inhibition, correlated with linguistic and narrative measures in Italian preschoolers with DLD; Acosta et al. [40] found working memory deficits in Spanish-speaking children aged 5-11 years with DLD. In addition, a longitudinal study by Blom and Boerma [41] found severe and persistent visuospatial working memory deficits in 5-year-old children with DLD. Gillam et al. [42] results further support the persistence of these deficits by demonstrating differences in children between the ages of 7 and 11.

Our research is consistent with the findings of working memory deficits in the DLD population and provides new evidence within a Spanish-speaking population under the age of 5. In a previous study conducted in Spanish [35] with children aged 5 to 6 years, a task utilizing an experimental paradigm revealed higher accuracy scores for regular verbs compared to irregular verbs, across both present and past tenses. These findings were further influenced by visual working memory, with the DLD group showing modulated reaction times. This measure was assessed using the same TENI task utilized in our research (Torpo the clumsy mole). Collectively, these experiments underscore the significance of working memory in early developmental processes, particularly in children with DLD.

In terms of sustained attention, we observed a distinct pattern in DLD children compared to their TLD counterparts, characterized by shorter reaction times. This reverse situation is consistent with previous studies that also reported an absence of reaction time deficits in the DLD group [25]. A possible explanation for this discrepancy could be that the TLD group took more time to visualize and confirm the target before pressing, whereas the DLD group anticipated in their response, resulting in faster reaction times but a higher proportion of errors, as reflected in their accuracy performance. This is consistent with previous studies showing deficits in sustained attention in individuals with DLD [18, 23,25]

Our results, which to our knowledge are the first to study sustained attention performance in individuals with DLD under the age of 5, provide important clues for the assessment and diagnosis

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of this population. A previous study conducted with Spanish-speaking 6- to 7-year-old children [36] using a dual-task experimental paradigm found that the sustained attention covariate, obtained with "Duno and the worms" task from TENI, modulated linguistic outcomes associated with reading past and future sentences. This implies that the introduction of the attention covariate led to interactions with verbal tense and direction of movement in the representation of a conceptual metaphor, especially in children with DLD. These results demonstrate the evolutionary nature of sustained attention and highlight the fact that the effect of attention can be observed at such an early age, according to the results of the present investigation.

The importance of determining the performance of these two variables lies in the consistent relationship between working memory and language development in DLD. Recent research also links sustained attention to morphosyntactic skills, vocabulary comprehension, and picture naming latency [20,21,43]. In addition, sustained attention has been directly related to working memory performance [18] or, according to the joint mechanism deficit hypothesis, as a possible cause of working memory limitations [44].

The correlation analysis conducted in our study revealed significant relationships among the variables of working memory performance and sustained attention accuracy for both DLD and TLD groups. Specifically, we found a positive correlation between working memory performance and sustained attention accuracy in both groups, indicating that individuals with better working memory abilities tend to exhibit higher levels of sustained attention accuracy. This finding suggests that the ability to retain and manipulate information in working memory may contribute to the sustained attention required for tasks such as Torpo the clumsy mole. Additionally, a positive correlation was observed between working memory performance and sustained attention accuracy in both groups, suggesting that individuals with better working memory abilities tend to respond more quickly during sustained attention tasks. These correlations highlight the interconnected nature of cognitive processes such as working memory and sustained attention and underscore their collective influence on cognitive functioning in individuals with language disorders.

It is important to note that although significant differences were found between the two groups, the data did not represent ranges of normality due to individual differences in some subjects. This highlights the inherent heterogeneity in cognitive function profiles between DLD and TLD children and underscores the need for personalized interventions that go beyond a one-size-fits-all approach and recognize and address the unique cognitive needs of each child. In particular, Kapa and Erikson [24] have emphasized the importance of tailoring interventions to individual strengths and weaknesses in executive functioning. In addition, findings from Smolak et al. [18] and Zapparrata et al. [5] support the notion that a personalized approach may lead to more effective outcomes given the variability in cognitive profiles within the DLD population.

Previous research has demonstrated improvements in executive functions, such as working memory and sustained attention, through computerized cognitive training in clinical settings [45, 46] and educational environments [47]. Game-based training has shown promise in improving outcomes for both DLD populations [48] and typically developing children [49].

*Limitations*

A limitation of our study is the absence of nonverbal IQ measurement in both DLD subjects and TLD peers. However, the use of this variable in our study can be controversial due to several reasons. Firstly, nonverbal IQ has traditionally been primarily utilized to equalize performance between DLD and TDL groups; however, these comparisons have been conducted in studies with populations older than those in our investigation [38,39,50]. Moreover, there is no validated test available in our country to measure IQ in 4-year-old subjects, with the recommended Wechsler Intelligence Scale for Children-Fifth Edition typically administered from the age of 6 [51]. Therefore, the absence of a validated test for younger subjects poses an additional challenge in accurately measuring nonverbal IQ. Secondly, there is no consensus on the most appropriate method for considering this variable. Other approaches, such as that of Larson and Weister [14], have presented significant differences in nonverbal IQ between DLD and TDL groups, potentially categorizing DLD more as a cognitive

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disorder than a language impairment, which can be misleading. Finally, our focus was on language assessment, and we considered that our subjects underwent a rigorous evaluation using instruments that assure linguistic diagnosis and their capacity to respond to tests. There were no indicators of IQ differences, also noted in the interviews with caregivers.

Moving forward, future research should address these methodological challenges and strive to adopt standardized approaches to control for nonverbal IQ while ensuring an accurate depiction of the unique characteristics of DLD. Additionally, we suggest the use of specific linguistic tasks tailored to different language proficiency levels and the conduct of replications across different school levels to provide further insight into the trajectory of cognitive skills and language acquisition in the Spanish language context.

## 5. Conclusions

In conclusion, our study contributes significantly to the knowledge of the role of cognitive functions, especially working memory and sustained attention, in DLD. It highlights that difficulties in these functions are present at an early preschool stage in Spanish-speaking children. The need for personalized interventions tailored to the unique cognitive profiles of children with DLD, even before the preschool stage, becomes apparent. Stimulating cognitive domains not only benefits the clinical population, but also extends the positive effects to TLD peers. The potential use of game-based intervention in both populations highlights a promising avenue for future research.

The need to integrate interventions for cognitive functions particularly working memory and sustained attention, with traditional language interventions becomes apparent, particularly in light of the gap reported by speech-language pathologists in incorporating cognitive-level interventions in educational settings [29]. Our study supports the argument for a holistic and integrated approach that addresses both linguistic and cognitive aspects to support preschool children with DLD more effectively [52].

**Author Contributions:** For research articles with several authors, a short paragraph specifying their individual contributions must be provided. The following statements should be used "Conceptualization, M.U.; methodology, M.U., S.S.; validation, M.U..; formal analysis, M.U, S.S..; investigation, S.S..; resources, M.U.; data curation, M.U.; writing—original draft preparation, S.S. and M.U..; writing—review and editing, H.M..; visualization, S.S..; supervision, M.U., H.M; project administration, M.U..; funding acquisition, M.U. All authors have read and agreed to the published version of the manuscript.

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**Informed Consent Statement:** Written informed consent was obtained from all parents/guardians of the children. Additionally, verbal and written assent was obtained from the children before their participation in the experiment.

**Data Availability Statement:** The data generated and analyzed in this study are available on reasonable request from the corresponding author. The data are not publicly available as they are human data from adults and children in neurotypical and clinical groups.

**Conflicts of Interest:** The authors declare no conflicts of interest

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