

Syntactic awareness and phonological working memory in trisomy 21: performances compared before and after speech-language-hearing intervention

Consciência sintática e memória de trabalho fonológica na trissomia do 21: comparação entre desempenho pré- e pós intervenção fonoaudiológica

Conciencia sintatica y memoria de trabajo fonologica em trisomia 21: comparación entre el desempeño pre y post intervención de terapia del habla

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Abstract

This study aimed to verify whether syntactic awareness and phonological working memory performance in adolescents and young adults with trisomy 21 (T21) differed before and after speech-language-hearing intervention and analyze the relationship between these skills. This is an intervention, quantitative, exploratory study, developed through case reports. A group of 7 individuals, aged 13 to 23 years, participated in this study, which is part of an extension project at a higher education institution. The methodological procedures involved assessment through the syntactic awareness and phonological working memory tests – nonwords and digits. Data were initially collected in 4 sessions, applying the pre-intervention assessment protocols. After these procedures, 15 weekly intervention sessions lasting 40 minutes were carried out based on the assessment information to stimulate linguistic and metalinguistic skills. Then they were reassessed in 4 sessions. The data indicated a positive relationship between the syntactic awareness tests and phonological working memory, before and after the intervention. The therapy focused on linguistic and metalinguistic stimulation benefitted the group, increasing their scores in these skills. The data indicate relevant aspects to be addressed in speech-language-hearing intervention, considering the correlations identified between syntactic awareness skills and phonological working memory. Since this is a case report and there is no control group, these results cannot be generalized, which represents a limitation of the study.

Keywords: Down Syndrome; Memory, Short-Term; Phrases; Evaluation; Intervention Study; Speech, Language and Hearing Sciences.

Resumo

O objetivo do estudo é verificar se há diferença entre desempenho de consciência sintática e de memória de trabalho fonológica em adolescentes e jovens adultos com trissomia do 21 (T21) pré e pós intervenção fonoaudiológica, bem como analisar a relação entre essas habilidades. É uma pesquisa de intervenção, de natureza quantitativa, exploratória, desenvolvida por meio do relato de casos. Um conjunto de 7 indivíduos, com idades entre 13 e 23 anos, foram os participantes deste estudo, realizado em um projeto de extensão, em uma instituição de nível superior. Os procedimentos metodológicos envolvem a avaliação por meio da prova de consciência sintática e da prova de memória de trabalho fonológica – não palavras e dígitos. A coleta de dados inicial foi realizada em 4 sessões, onde foram aplicados os protocolos de avaliação pré-intervenção. Após esses procedimentos, considerando as informações obtidas nas avaliações, foram realizadas 15 sessões de intervenção, baseadas na estimulação de habilidades linguísticas e metalinguísticas, com duração de 40 minutos e frequência semanal. Em seguida, foi realizada a reavaliação, em 4 sessões. Os dados apontam para uma relação positiva entre as provas de consciência sintática com memória de trabalho fonológica, antes e após a intervenção. A terapia voltada para estimulação linguística e metalinguística realizada com o grupo foi benéfica, apresentando aumento dos escores nas habilidades apresentadas. Esses dados indicam aspectos relevantes a serem abordados na intervenção fonoaudiológica, tendo em vista as correlações identificadas entre as habilidades de consciência sintática e memória de trabalho fonológica. Por tratar-se de um relato de casos e por não haver grupo controle, não é possível generalizar tais resultados, o que representa uma limitação do estudo.

Palavras-chave: Síndrome de Down; Memória de curto prazo; Frases; Avaliação; Estudos de intervenção; Fonoaudiologia.

Resumen

El objetivo de este estudio es comprobar si existe una diferencia entre el rendimiento de la conciencia sintáctica y la memoria de trabajo fonológica en adolescentes y adultos jóvenes con trisomía 21 (T21) antes y después de la intervención de patología logopédica, así como analizar la relación entre estas habilidades. Se trata de una investigación de intervención, de carácter cuantitativo, exploratorio, desarrollada a través de reportes de casos. Un grupo de 7 individuos, con edades comprendidas entre los 13 y los 23 años, fueron los participantes de este estudio, realizado en un proyecto de extensión en

una institución de educación superior. Los procedimientos metodológicos implican la evaluación por medio de la prueba de conciencia sintáctica y la prueba de memoria de trabajo fonológica, no palabras y dígitos. La recolección inicial de datos se realizó en 4 sesiones, donde se aplicaron los protocolos de evaluación pre-intervención. Luego de estos procedimientos, considerando la información obtenida en las evaluaciones, se realizaron 15 sesiones de intervención, basadas en la estimulación de las habilidades lingüísticas y metalingüísticas, con una duración de 40 minutos y en horarios semanales. Luego, la reevaluación se llevó a cabo en 4 sesiones. Los datos apuntan a una relación positiva entre las pruebas de conciencia sintáctica y la memoria fonológica de trabajo, antes y después de la intervención. La terapia centrada en la estimulación lingüística y metalingüística realizada con el grupo fue beneficiosa, con un aumento de las puntuaciones en las habilidades presentadas. Estos datos indican aspectos relevantes a ser abordados en la intervención de patología logopédica, en vista de las correlaciones identificadas entre las habilidades de conciencia sintáctica y la memoria de trabajo fonológica. Debido a que se trata de un reporte de caso y no existe un grupo control, no es posible generalizar estos resultados, lo que representa una limitación del estudio.

Palabras clave: Síndrome de Down; Memoria a corto plazo; Frases; Evaluación; Estudios de intervención; Terapia de lenguaje.

Introduction

Down Syndrome, also named Trisomy 21 (T21), is characterized by a third copy of chromosome 21 or part of it¹, resulting in structural and functional changes in the body's systems^{1,2}. Cognitive impairment is characteristic of individuals with this condition and is considered the most common cause of genetic intellectual disability¹.

The linguistic profile of people with T21 is heterogeneous and variable throughout life^{3,4}. There is evidence of delayed development of language skills, which are rarely complete¹. For most individuals with T21, expressive language acquisition continues through adolescence⁵, but signs of language decline in the population begin in young adulthood¹.

Morphosyntax in T21

Difficulties in T21 are more pronounced in the structural aspects of language – morphology and syntax – than in other components of language¹. Hence, these people's impairments in morphosyntactic development could be explained by changes in short-term auditory memory and auditory discrimination, which may cause them to be less focused when oral information is presented⁴.

Furthermore, morphosyntactic development may be influenced by nonverbal cognitive skills (visual-spatial processing and inductive reasoning skills), which are characteristically abnormal and limited in individuals with T21².

Some morphosyntactic difficulties identified in T21 refer to the inability to produce appropriate inflections for nominal agreement and indicate person, number, and tense. The plural form is considered an area of weakness in T21, and grammatical morphemes are used inconsistently. They learn verb and auxiliary patterns later than typically developing individuals, and these patterns tend to be unstable in those with T21¹.

There are also changes in concatenation and non-concatenation¹. Broad symptoms characterize the difficulties, specifically syntactic ones, in T21. In syntax, the difficulties permeate word order and grammatical/agreement rules¹. Many individuals may have difficulties in understanding sentences, limiting the comprehension of non-canonical and syntactically simple sentences. Sentence production may be limited to short statements, whereas longer ones may be incoherent and fragmented. There are difficulties in producing syntactically complex sentences².

The delay in syntax production becomes more evident in these individuals as the number of two-word combinations increases⁵. A longitudinal study with people with T21 indicated that the greatest development of receptive and expressive grammatical skills may end in the last years of childhood².

The results of a cross-sectional study with adults with T21 indicate that they reach and maintain a plateau in grammatical comprehension. Inspection of a wide range of grammatical structures revealed several limitations in their receptive syntactic skills. Difficulties increased with sentence



length and grammatical complexity but were also apparent in simple sentences⁶.

Phonological working memory in T21

T21 is associated with significant memory impairments, which is challenging for this population^{8,9}. Their poor performance in comprehension and syntactic expression tasks is related to the limited amount of linguistic information they can retain, due to their restricted short-term verbal memory capacity. Such impairments in the development of verbal memory have a negative impact on the acquisition of vocabulary and grammatical morphemes in the early stages of language development, impairing syntactic expression⁷.

Short-term memory must be adequate to understand full sentences, enabling information retention and processing. Thus, the population with T21 has difficulty with this skill due to memory impairments⁷.

Working memory is a predictor of language skills⁵. Difficulties in this system affect language development. Deficits in phonological processing can be observed when considering phonological memory⁴.

Working memory is a type of short-term memory that involves the temporary information storage and manipulation, necessary for a wide range of complex cognitive activities such as understanding, learning, and reasoning^{10,11}.

Working memory is multicomponent and can be divided into four subsystems: phonological loop, visuospatial sketchpad, central executive, and episodic buffer¹¹.

The phonological loop, probably the best-developed component of the working memory model, plays an important role in long-term phonological learning and short-term storage. It is associated with vocabulary development in children and with the speed of foreign language vocabulary acquisition in adults. It is particularly suited for the retention of an acoustic sequence¹².

The visuospatial sketchpad comprises visual and spatial information and possibly kinesthetic components¹². The central executive is considered an attentional control system; it has no storage capacity and integrates visual, phonological, and possibly other types of information¹².

In turn, the episodic buffer can store information in a multidimensional code. It plays a role in feeding information and retrieving information from long-term episodic memory¹².

The multicomponent model of Baddeley et al.¹¹ shows that the phonological loop contributes significantly to linguistic processes. It allows the individual to extract relevant morphosyntactic information from the speech signal during processing, a prerequisite for language comprehension and grammatical development. Short-term verbal memory skills play a significant role in the typical and atypical acquisition of morphosyntax².

A study, based on the assumption that phonological working memory influences sentence comprehension performance, found that the number of correct responses decreased as sentence length increased. It can be stated that the longer the sentence, the longer it must be kept in the phonological loop to extract all relevant information. Data analysis, however, also indicated that comprehension is influenced not only by sentence length but also by grammatical factors⁸.

A longitudinal study on the development of short-term verbal memory capacity – measured through the repetition of pseudowords in children and adolescents with T21 – indicated that growth in this domain stabilizes early, around the chronological age of 10 years².

This information reminds us of the importance of intervention in these skills since improving vocabulary and speech are often prioritized in therapy to the detriment of grammar, especially in childhood².

The importance of metalinguistic integrality for linguistic development and learning in educational and social contexts is well known. However, few studies approach phonological working memory and syntactic awareness skills in individuals with developmental disorders, intellectual disability, and a specific linguistic profile. Thus, this study mainly aimed to verify whether the performance in syntactic awareness and phonological working memory in adolescents and young adults with T21 differed before and after speech-language-hearing (SLH) intervention and analyze the relationship between the performance of these skills.

Description

This is an intervention, quantitative, exploratory study, developed through case reports. All ethical criteria were considered. Approval for data collection was obtained from the Human Research Ethics Committee of a Higher Education Institu-



tion, having been assessed and approved under opinion number 6.196.860.

An informed consent form was presented to all participants' parents/guardians in writing, and they authorized their participation. The individuals with T21 signed an informed assent form.

Participants

The research included adolescents and young adults with T21 who on their initiative sought care in the outreach project named "T21 Phono: SLH assistance for people with T21", at a public university.

The eligibility criteria were being a participant in the said outreach project; being aged 13 years to 23 years and 11 months; having a confirmed diagnosis of Down syndrome; being a speaker of Brazilian Portuguese; having authorization and consent from the participants or guardians; understanding commands during the application of the instruments; and being able to communicate intelligibly with the interlocutor. The exclusion criteria were having hearing loss and a report of severe visual or intellectual disability.

Initially, 10 adolescents and young adults with T21 were included in the study. However, three participants were excluded during the study – one for not being able to understand and respond to the research instruments; one patient for being absent; and the last one for lacking interest in continuing. At the end of the study, seven participants formed the total sample.

Each pathologist was initially responsible for treating five participants. After some of them discontinued the treatment, the remaining seven volunteers were distributed among those professionals.

Assessments

Parents were initially interviewed, obtaining pregnancy, childbirth, development, education, therapy, and medical information. Data from the initial assessments were collected in four 40-minute weekly sessions. The assessments were carried out by two SLH pathologists, both master's students in the SLH postgraduate program, in the research line entitled Language Development and Rehabilitation, collaborators of the T21 Phono outreach project.

Participants were examined with the following instruments to obtain a better understanding of language skills: phonological working memory test – nonwords and digits¹³ and syntactic awareness test (PCS, in Portuguese)¹⁴.

The phonological working memory test – nonwords and digits includes the pseudoword repetition task (in which participants are asked to repeat words that are not in the dictionary) and the forward and backward digit repetition task. The ABFW – child language test¹⁵ verified the phonetic inventory and surveyed the phonological rules used by the participants, identifying changes in working memory or phonological rules.

Syntactic awareness was assessed through oral language, using the PCS, whose 55 questions are divided into four subtests: 1) Grammatical judgment: participants were asked to judge the grammar of 20 sentences, half of them grammatically correct and the other half ungrammatical – with morphemic anomalies or inverted order. 2) Grammatical correction: this subtest required the correction of 10 ungrammatical sentences. 3) Grammatical correction of sentences with grammatical and semantic errors: in this item, the participant is exposed to 10 sentences with both semantic and grammatical errors and must correct the grammatical error without altering the semantic error. 4) Word categorization: the participant classifies words into parts of speech: nouns, adjectives, and verbs. The total score is the sum of all correct answers, reaching a maximum of 55 points.

At the end of the intervention sessions, another four were carried out for reassessment, by the same researchers, with the same sequence and instruments as the initial assessment.

Intervention

After these procedures and data analysis from the initial assessments, fifteen 40-minute intervention sessions were carried out per week, following the plan developed by Santos et al.¹⁶ for adolescents and young adults with T21. The therapeutic sessions were conducted by the same researchers responsible for the assessments, who applied the intervention plan individually with each participant.

The therapeutic objectives included structured stimulation of vocabulary, working memory, and predictive and essential linguistic skills for the development of the metalinguistic skill of syntactic awareness (Table 1).

It should be clarified that the research reported in this article is part of a broader research project, which also intervenes in receptive and expressive vocabulary skills in adolescents and adults with T21, which is why this skill was stimulated.

Table 1. Linguistic and metalinguistic intervention plan

SESSIONS	OBJECTIVES
1 st to 5 th	To stimulate expressive and receptive vocabulary, through improvement of receptive vocabulary; expansion of expressive vocabulary; semantic categorization; and understanding of simple words and sentences in oral form.
6 th to 10 th	To expand the capacity to store and handle short-term information.
11 th to 15 th	To stimulate syntactic awareness, exploring parts of speech in semantic categories, expanding the categorization of words into nouns, adjectives, and verbs; maximizing the perception and agreement of elements in syntactic organization; identifying and correcting ungrammatical sentences; dissociating grammatical and semantic errors in sentences.

Source: Santos et al., 2024.

The activities included physical and digital games, drawings, stories, associating concepts, understanding sentences and instructions, drama, logical sequences, puzzles, imitation, music, riddles, treasure hunts, and so forth.

Data analysis procedures

The data were organized in spreadsheets and analyzed with the R software. Initially, descriptive statistical analysis was performed by presenting position and dispersion measures. Then, it was verified whether the syntactic awareness and working memory tests differed before and after the SLH intervention, using the Wilcoxon test with a 5% significance level. Finally, the correlation between PCS score and working memory variables was analyzed before and after the intervention, using Pearson's correlation coefficient with a 5% significance level.

Characterization of participants and individual performance

Relevant information characterizing the study participants is presented below, along with their individual results in the phonological working memory and syntactic awareness test, before and after the SLH intervention.

P1 is a 20-year-old literate male adult, attending the 4th grade in high school. He is an environmental control technician at a public institution and is taking a course to stimulate concentration, reasoning, memory, creativity, and self-esteem skills. He is undergoing speech and psycho-pedagogy therapy. His result before the intervention in the phonological working memory test – nonword repetition was below the expected. In the digit test, he was classified as above average. After the intervention process, he increased by 11 points in nonword repetition, with a total of 77 points,

moving in the classification to above the average standardization value. In the digit test, he remained above average, going from 23 to 26 points. In the syntactic awareness test, he had an average classification in the initial evaluation process, increasing the final result by 5 points after the intervention, remaining in the average classification.

P2, female, 13 years old, illiterate, attending the 4th grade in a private elementary school. She is currently only undergoing speech therapy. She had low scores in the working memory test, with results below expectations in nonword and digit repetition. After the intervention sessions, although the score classification was still below average, the total scores increased from 13 to 25 points in nonword repetition. In digit repetition, the increase was slight, by only 1 point. In the syntactic awareness test, the total score increased in the four items from 0 to 18 points. The adolescent understood grammatical judgment and categorization better after the speech therapy stimulation.

P3, female, 17 years old, illiterate, attends the 1st grade in high school. She attends two speech therapy sessions per week. In the phonological working memory test, she increased by 26 points in nonword repetition after the intervention. In the digit test, the score was lower, classified as below average, increasing by only 1 point after the intervention. In the syntactic awareness test, she went from 20 to 27 points in the total score. She was below average in both moments. Before the intervention, she had not obtained a score in grammatical correction and sentence correction, presenting correct answers after the intervention.

P4, female, 21 years old, illiterate. She had attended up to the 4th grade of adult education in a public school but did not complete it. She is undergoing SLH and psycho-pedagogy therapy. She practices swimming and capoeira. Her scores

increased for nonwords (a variation of 8 points in total) and digits (a variation of 3 points in total) after the stimulation sessions. In the syntactic awareness test, the young woman did not perform differently before and after the intervention.

P5, female, 18 years old, illiterate. She attends the 1st grade of high school and Specialized Educational Assistance in a public school. She is part of the autonomy, experience, and leisure group (ANIMA, in Portuguese), is currently undergoing speech and psycho-pedagogy therapy, and had swimming and physical education classes. Her score in the working memory test increased by 20 points in nonword repetition, but decreased by 1 point in digit repetition, from 4 points in the initial assessment to 3 points in the final assessment. In the syntactic awareness test, the grammatical judgment score decreased by 2 points after the intervention, and the categorization score increased by 2 points. The syntactic awareness classification was significantly low before and after the intervention, with no change in the total score.

P6, female, 18 years old, literate, attending the 6th grade in a private middle school. She is currently undergoing speech and psycho-pedagogy therapy, attends the Center for Mediation and School Support, and participates in the ANIMA. Her scores in the working memory test were below the expected average, but the data shows a modest increase between the evaluations, going from 31 to 34 points in

nonwords and from 5 to 8 points in digit repetition. The scores increased in the syntactic awareness test as well. She had not scored in grammatical correction before the intervention but improved after it.

P7, female, 23 years old, literate, attending the 4th semester of gastronomy in a private higher education institution. She is being monitored at the Center for Mediation and School Support and undergoes psycho-pedagogy and speech therapy. She attends horse riding, karate, functional training, and “brain exercises”. Her classification in the initial and final phonological working memory test – nonword repetition was below average, although the total score increased from 62 to 69 points. In digit repetition, the young woman went from below average to above average, from 15 to 23 points. She improved considerably in syntactic awareness. She scored no points in the initial sentence correction assessment but in the final one, she obtained 8 correct answers out of a total of 10 sentences. In total, there was a 14-point increase in the syntactic awareness test scores from before to after the intervention.

Considerations on group performance before and after intervention

Tables 2 and 3 present the associations between the scores of the group of participants before and after the intervention in the phonological working memory and syntactic awareness tests, respectively.

Table 2. Comparison of the phonological working memory test before and after the intervention

Variable	Before		After		P-value
	Mean	SD	Mean	SD	
Nonwords score	33.57	22.47	46.00	21.69	0.317
Digits score	9.14	7.38	11.71	9.01	0.440

Caption: n (absolute number of observations); % (percentage frequency of observations); SD (standard deviation). Wilcoxon test
Source: Research data, 2023.

Table 3. Comparison of the syntactic awareness test before and after the intervention

Variable	Before		After		P-value
	Mean	SD	Mean	SD	
Grammatical judgment	13.86	6.61	15.71	3.19	0.897
Grammatical correction	2.28	3.09	5.00	4.08	0.284
Sentence correction	1.14	2.60	3.429	4.11	0.229
Classification score	7.28	4.34	7.71	2.28	1.000
PCS score	24.57	14.14	31.86	12.77	0.442

Caption: PCS (syntactic awareness test); n (absolute number of observations); % (percentage frequency of observations); SD (standard deviation). Wilcoxon Test
Source: Research data, 2023.

After analyzing the data individually, some considerations can be made regarding the group's performance. In the assessment of phonological memory – nonwords and digits –, the data were compared with the standardization study¹⁰ that researched typical children and obtained reference values. All participants, who are already adolescents and young adults, obtained scores much lower than expected in nonword repetition. Likewise, the score was very low in digit repetition. Only one participant obtained an above-average classification in the pre-intervention digit scores and, after the intervention, achieved above-average results also in nonword repetition. After the intervention, one young woman went from below average to above average in digit repetition.

It can be verified that phonological working memory is altered in these individuals, agreeing with the literature that states that individuals with T21 have impaired short-term verbal memory skills^{4,5}.

Phonological memory is challenging for those with T21^{17,10}. Auditory sequential memory skills in children and young adults are substantially lower in people with T21 than in peers with other intellectual disabilities. Such impairment reflects unfavorably on vocabulary development and sentence comprehension and expression⁴.

When performing the syntactic awareness test, only one participant had an average performance before the intervention. The other six individuals had very low performance. After the intervention, the participant who had previously been classified as average remained the same, and a young adult improved her performance, going from very low to average performance. These two young adults are literate, have a higher education level, and continue to receive stimulation from multidisciplinary therapies and specialized educational support.

The youngest participant in this research, who performed worse on the syntactic awareness test, may be at a disadvantage due to educational conditions and less access to therapeutic intervention throughout her development.

The judgment of grammatical and ungrammatical sentences was the item that revealed the

least difficulty for most volunteers. Although they sometimes recognize when a sentence is ungrammatical, most participants are unable to correct it to make it grammatical. It is considerably difficult to understand the grammatical correction of sentences with grammatical and semantic errors, which would involve removing the grammatical error without altering the semantic error. In the grammatical categorization of adjectives, nouns, and verbs, most participants had an average and variable performance before and after the intervention. In terms of overall performance, most participants changed the metalinguistic ability of syntactic awareness. The results corroborate data from cross-sectional and longitudinal evidence¹⁸ that suggest that adolescents with T21 have impaired syntax comprehension skills.

Despite the low overall performance in working memory, there was an increase in individual scores before and after the SLH intervention. The performance in the syntactic awareness test also improved after structured stimulation. The two young people who performed best in the pre-intervention tests were the ones who performed best in the post-intervention tests in both skills investigated.

The results of the group of participants demonstrate improvements in the classifications and scores of all the tests after the intervention. However, these results were not statistically significant. This aspect can be justified by the few participants, which can influence the statistical power of the tests and make it difficult to analyze the real effects obtained with the intervention. Furthermore, the individual variability and characteristics of the participants may have interfered, and the few intervention sessions may not have been sufficient to obtain statistically significant results, given their difficulties.

Correlation between syntactic awareness and phonological working memory before and after SLH intervention

Table 4 shows the correlation results between PCS score and working memory score for nonwords and digits before and after the intervention.

Table 4. Correlation of the syntactic awareness test with non-word and digits phonological working memory before and after the intervention

VARIABLE	CORRELATION VALUE	P-VALUE
PCS score before X WM nonword score before	0.793	0.033
PCS score after X WM nonword score after	0.876	0.009
PCS score before X WM digit score before	0.655	0.11
PCS score after X WM digit score after	0.937	0.001

Caption: PCS (syntactic awareness test); WM (working memory).
Pearson coefficient test
Source: Research data, 2023.

PCS score was significantly correlated with working memory nonword score before and after the intervention. The correlation between the PCS score and the working memory digits score before the intervention was not significant. However, the correlation between the PCS score and the working memory digits score after the intervention was significant. All correlations were positive and strong¹⁹, meaning that high values in one variable are associated with high values in the other.

Thus, the present study is in line with the literature on T21, which relates comprehension or syntactic production skills with performance in verbal memory tasks and highlights the relevant relationships between the two domains².

People who perform satisfactorily in pseudoword repetition have positive results in syntactic development⁷. The literature has also discussed that short-term memory impairments may be the basis of language difficulties in people with T21 who have deficiencies in this aspect, as language input may not be sustained in working memory for long enough, resulting in changes in grammatical morphology²⁰.

Furthermore, the limited amount of linguistic information, due to reduced memory capacity, leads to poor performance in syntactic comprehension and expression tasks⁷. A previous study shows that a considerable number of children and adolescents with T21 have deficits in subject-verb agreement marking and are unable to meet an acquisition criterion. Verbal agreement and short-term phonological memory performances are related in pseudoword repetition²⁰.

The literature shows that syntactic awareness tasks require immediate memory for the retention of verbal information, allowing the sentence to be corrected or completed²¹. Good verbal short-term memory skills produce a larger set of different words, longer expressions, and more complex

grammatical expressions than poor verbal short-term memory skills²².

One can only learn syntactic structures and understand simple and complex sentences adequately with good performance of short-term/working verbal memory²³.

Short-term verbal memory predicts syntactic development. The results of the linguistic and metalinguistic skills tests show how complex and related these domains are. Hence, there is a clear low performance in syntactic awareness and verbal working memory skills in T21, and it should be considered that these skills are correlated, with relevant characteristics for these people's morpho-syntactic linguistic development.

Difficulties in these skills affect these people's communication, as they may have difficulty following conversations and instructions and expressing needs and thoughts. As communication professionals, SLH pathologists have the challenge of offering appropriate opportunities for the development of different levels of cognitive, linguistic, and learning skills at different stages of life.

Therefore, the therapy aimed at linguistic and metalinguistic stimulation with the group of adolescents and young adults with T21 was beneficial, increasing their scores in the skills investigated, even though the literature points to a possible stabilization at the end of adolescence and beginning of adulthood².

Final considerations

The intervention in working memory skills improved individual performance in nonword and digit repetition among adolescents and young adults with T21. In addition, performance in the syntactic awareness test improved among most participants after the intervention sessions.

Thus, the intervention process aimed at stimulating linguistic and metalinguistic skills led adolescents and young adults to improve slightly in the stimulated skills.

Moreover, the study found a significant correlation between syntactic awareness skills and phonological working memory – nonword test before and after the intervention. In the working memory assessment – digit test, the significant correlation only occurred after the intervention, when patients improved their scores.

The conclusions corroborate the data described in the literature but considering that this is a case report with a small sample, the results cannot be generalized – further studies with larger samples are needed.

Another limitation is the absence of a control group with another intellectual disability and with typical development, matched for phonological working memory performance, enabling greater comparability and the analysis of possible variables interfering with the results.

The results highlight relevant aspects to be addressed in SLH intervention, given the correlations identified between syntactic awareness skills and phonological working memory, as well as the possibility of improvements in the performance of individuals in these skills after SLH intervention.

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