DOI: https://doi.org/10.4322/aletheia.012.en

Attentional deficits in adolescents diagnosed with Autism Spectrum Disorder

Tiara Terezinha Matte Borges Machado
Ana Paula Almeida de Pereira

***Abstract*:** Autism Spectrum Disorder/ASD is a neurodevelopmental disorder and its symptoms are associated with restricted, repetitive behaviors, and deficits in social communication. In order to establish the relationship between attentional functioning and ASD symptoms, the study adopted a descriptive correlational method performing neuropsychological assessment of 31 adolescents, aged between 10 and 16 years, diagnosed with ASD, recruited from a public hospital in southern Brazil. The assessment protocol included: Autistic Traits Assessment Scale/ATA, Attention Deficit Hyperactivity Disorder Symptom Assessment/SNAP IV, Wechsler Intelligence Scale/WISC-IV; Psychological Battery of Attention/BPA; and Trail Testing/TMT. Results showed that adolescents with ASD can be successful in simple tasks, but present attentional difficulty in complex tasks that require mental control. Conclusion: Attentional problems alter executive functioning.
***Keywords*:** ASD. Attentional Deficit. Neuropsychological assessment.

Déficits atencionais em adolescentes com diagnóstico do Transtorno do Espectro Autista

Resumo: O Transtorno do Espectro Autista/TEA é um transtorno do neurodesenvolvimento e seus sintomas estão associados aos comportamentos restritos, repetitivos, e déficits na comunicação social. Com o objetivo de estabelecer a relação entre o funcionamento atencional e os sintomas do TEA o estudo adotou método descritivo correlacional realizando avaliação neuropsicológica de 31 adolescentes, entre 10 e 16 anos, diagnosticados com TEA, recrutados de um hospital público do sul do Brasil. O protocolo de avaliação incluiu: Escala de Avaliação de Traços Autísticos/ATA, Avaliação de Sintomas de Transtorno do Déficit de Atenção e Hiperatividade/SNAP IV, Escala de Inteligência Wechsler/WISC-IV; Bateria Psicológica da Atenção/BPA; e Teste de Trilhas/TMT. Os Resultados evidenciaram que adolescentes com TEA podem ser bem sucedidos em tarefas simples, mas apresentam dificuldade atencional em tarefas complexas que exigem controle mental. Conclusão: Problemas atencionais alteram o funcionamento executivo.
Palavras-chave: TEA. Déficit Atencional. Avaliação Neuropsicológica.

Introduction

The term Autism Spectrum Disorder (ASD) refers to a condition characterized by developmental problems with persistent impairment in communication and social interaction as core symptoms, as well as restricted and repetitive patterns of behavior (American Psychiatric Association/APA, 2014).

Research shows that the more severe the restricted and repetitive behaviors of ASD in childhood, the greater the severity of inattention symptoms, and the more severe the attention deficit symptoms in children diagnosed with ASD in childhood, the lower the cognitive and adaptive skill level (Zachor & Ben-Itzchak, 2019).

Individuals diagnosed with ASD with attentional deficits may be at greater risk of social and adaptive impairment and may be less responsive to intervention for skills such as problem solving (Ashwood et al., 2015). The study of attentional processes in people diagnosed with ASD is of great theoretical and clinical importance, considering that the development of attentional processes throughout childhood and adolescence underpins the development of other cognitive functions and, in particular, executive functions (EF).

Executive functions are a set of cognitive processes related to self-control that support various abilities for learning and the development of behaviors adapted to the demands of the environment. They are responsible for self-regulation of behavior and attention to achieving goals (Carvalho, Quintas, Assis, & Seabra, 2020; Lezak, 1982). Therefore, they are essential for active adaptation to the sociocultural demands of the adult world.

Attention refers to the capabilities or processes of how the organism becomes receptive to stimuli and how it processes the excitation received or attended to, whether internal or external (Lezak, Howieson, Bigler, & Tranel, 2012). According to the author and their collaborators, the definitions of attention vary widely, from the view of attentional processes as part of a broader category of information processing, to the understanding that the attention system works independently of information processing.

Silva (2012) defines attention as the ability to select and maintain control over the input of external information (sensations and perceptions) at a given moment, and also to control information generated internally, such as our thoughts, memories, concerns or even mental calculations. Without this capacity for selection, the amount of external and/or internal information would be enormous, to the point of making any mental activity unfeasible.

Attentional processes are part of a complex system composed of subcomponents that can be observed according to the demands required by the task (Strauss et al., 2006). It is important to distinguish between these different mechanisms of attention. Understanding that attention-sustaining skills, or concentration, are different from the ability to filter, select or inhibit stimuli, is an example of the necessary distinction to identify which attention deficits the individual has. Another example is the difference between the ability to focus now on one stimulus and now another, alternating attention, and the ability to focus on stimuli simultaneously, divided attention. Attention cannot be reduced to a single aspect and must be understood through its component subsystems evidenced in terms of these demands.

In this sense, in recent years, instruments for assessing attention have been intensively studied in order to validate the clinical investigation and understanding of the individual's attention deficits. Tasks that require different types of attention, such as concentrated, divided, and alternating attention, offer objective measures that support the analysis of this cognitive function.

In addition, clinical research must consider that the attention subsystems work integrated with other cognitive domains and may overlap with components of other cognitive processes (Seabra & Dias, 2012). The functioning of attention integrated with other cognitive processes, such as executive functions, has led some theorists to study attention as part of executive functions.

There is no consensus in the scientific literature about the boundaries between attentional subsystems and EF. Attentional subcomponents can be understood as components of EF. An example of this is selective attention, responsible for filtering information and suppressing distracting stimuli, which can be understood as inhibitory control, a component of EF. Another example is alternating attention, responsible for the individual's ability to stop focusing on a stimulus and direct it to another, considered a necessary skill for cognitive flexibility, a component of EF.

Understanding and delimiting the different mechanisms of attention and their interconnection with the EF is fundamental in the investigation of attention deficits in the context of ASD. Although the apparent overlapping of attentional components with EF components contributes to the lack of consensus in the scientific literature on the limits between the attentional and executive systems, the present research adopted the model of attention that is based on Modular Theories (Seabra & Dias, 2012), which explain the mechanism of attention as a distinct and separate system from EF but interconnected with executive functioning and other cognitive domains. Based on this theoretical model, it is understood that when the attentional mechanisms cannot fully function, they impact the entire neuropsychological processing.

Given the importance of understanding the impact of attention deficits on executive functioning, particularly in the study of individuals with ASD, and also considering the relevance of EF for self-regulation of behavior, a characteristic difficulty of this group, the present study aims to establish the relationship between attentional functioning and symptoms of Autism Spectrum Disorder.

Method

This is a study with a correlational descriptive design that sought to test the hypothesis that adolescents diagnosed with ASD have a higher prevalence of deficits in attentional processes, when compared to normative groups. Thus, this research design aims to relate the attentional functioning variable to the ASD symptoms variable, to enable the verification of the hypothesis. In order to meet the purposes of this study, adolescents between 10 and 16 years of age attended at a neuropediatrics service at a public hospital in southern Brazil were evaluated.

This research project was reviewed and approved by the Research Ethics Committee of the Health Sector of the supervising University, with opinion No. 3,271,932. All parents or guardians signed the Parental Consent Form (PCF), and adolescents over 12 years old signed the Informed Consent Form (ICF).

Participants

The present study recruited a total of 31 adolescents. Between 2017 and 2019, adolescents receiving care at the Autism clinic of a public university hospital who complained of attention deficits were invited. The inclusion criteria adopted were: (1) being an adolescent of both sexes, (2) aged between 10 and 16 years old, (3) diagnosed with ASD, and (4) verbal communication ability to respond to the evaluation protocol.

Exclusion criteria were: (1) participant with ASD classified as severe, level III, in view of the ASD severity specifiers (APA, 2014), which describe them as people who "require very substantial support" (p. 52 , 2014), which may, therefore, present difficulties in engaging in research procedures, in addition to exposure to the evaluation situation causing suffering to the participant; and (2) adolescents who had traumatic brain injury in their clinical history, diagnosis of epilepsy and pervasive developmental disorder.

Procedures

Phase 1 – Recruitment, carried out in 3 steps: first, the patients' medical records were evaluated and those that met the inclusion criteria were selected. In the second stage, the parents and/or guardians were invited by the resident doctor responsible for the care, at the time of the consultation at the outpatient clinic, one by one, to participate in the research, so that they felt autonomous to decide whether or not to participate in the research. In the third stage, a meeting was held with the parents and the teenager who

joined the research, with the aim of clarifying the parents and guardians about the objectives, research procedures, its phases and presenting the Parental Consent Form (PCF) and the Informed Consent Form (ICF).

Phase 2 – Neuropsychological assessment of recruited participants. Adolescents and their parents/guardians were called to the outpatient clinic in 2 (two) sessions, for anamnesis interview and administration of data collection instruments.

Instruments

The instruments used in this phase of the research aimed at investigating intellectual functioning and surveying the neuropsychological profile, with emphasis on attentional processes, enabling verification of the relationship between attentional functioning and ASD symptoms.

For this purpose, data collection began with an anamnesis interview investigating the history of development; medical history; Social development; School Records; family history; current profile (level of independence in daily life), as well as clarifying the aspects in which attentional complaints impact the participant's adaptation to the demands of the environment.

Questionnaires answered by parents or caregivers were also used, such as the Autistic Traits Scale/ATA (Assumpção, Kuczynski, Gabriel, & Rocca, 1999), to identify behaviors characteristic of autism and the SNAP-IV Questionnaire (Mattos, Serra-Pinheiro, Rohde, & Pinto, 2006), used to identify behaviors suggestive of attention deficit hyperactivity disorder.

The Wechsler Intelligence Scale for Children - 4th Edition/WISC-IV (Wechsler, 2013) was used to assess children's intellectual capacity and problem-solving process. The Trails/TMT Test (Mitrushina, Boone, Razani, & D'Elia, 2005) was administered to assess visual sustained attention, divided attention, and Executive Function components: working memory and cognitive flexibility (Seabra & Dias, 2012) and the Psychological Battery of Attention/BPA (Rueda, 2013) was applied to assess general attention capacity, as well as specific types of attention: concentrated attention, divided attention, and alternating attention. These are tasks that require visual attention and visual-motor coordination from the examinee.

Data analysis

The data collected for characterizing the sample were presented using means, standard deviations, and percentages of demographic data. The scores obtained by the sample in the instruments used in the neuropsychological assessment were also described using the means, standard deviations and percentage of the sample that is in the clinical range, when compared with the normative group.

The results of the WISC and BPA subtests were converted into z-scores, with the aim of performing data analysis from the comparison of the sample's performances in relation to the mean of the normative group. The z-score calculation converted the raw BPA values, weighted and composite WISC values, into scales that indicated how many standard deviations the subject was away from the mean. The following scores were adopted as a cut-off point: equal to or less than -1.0 to -1.49, as alerts for a deficit; and, equal to or less than -1.5, as a suggestion of deficit (Zimmermann, Kochhann, Gonçalves, & Fonseca, 2016). These indices were used as parameters to indicate the clinical range of the sample.

In the case of the trails test, which does not have data on the normative group in the age range of the research sample, the clinical range was identified by calculating the TMT B/A index, considering results lower than 2 or higher than 3 as indicators of low performance in parts A and B of the test, respectively. The clinical range of the SNAP questionnaire was identified by the number of symptoms raised by parents and teachers, according to the DSM-V criteria (APA, 2014).

The inferential analysis of the study started with the use of the Shapiro Wilk Test to verify the distribution of all collected data. The identification of correlations between attention deficits and ASD characteristics was performed using the Spearman coefficient probability test. The analysis of correlations was classified according to the level of relationship between the variables, being considered strong when the degree of relationship is between r = 0.7 to r = 0.9 (+ or -), considered moderate when r is situated between r = 0.4 to r = 0.6 (+ or -) and considered a weak correlation when below r = 0.3 (+ or -) (Dancey & Reidy, 2019).

To estimate the probability of finding the pattern of results obtained by the sample group in the studied population, the p value of each correlation established between the variables was calculated. The level of statistical significance set for the analyzes is 0.99, with the critical value set at $p \leq 0.01$.

Results

Sample characterization

Of the 31 research participants, 93.6% are male and 6.4% are female. The average age of the sample is 12 years (M=148 months, SD=23.8). The mean schooling among 30 participants is 6 years (SD=2). Of the total number of adolescents in the sample, more than half, 58.1%, have complaints of learning difficulties and 48.4% have behavioral complaints.

Table 1 describes the demographic data of the sample along with the complaints presented by the families in the anamnesis interview, classified into behavioral and/or learning complaints.

Table 1

Demographic data and family complaints

	N	%	Mean	SD
Sex:				
Male	29	93.6		
Female	2	6.4		
Age (months)	31		148.0	23.8
Participant's education	30*		6.2	2.0
Learning complaint	18	58.1		
Behavioral complaint	15	48.4		

* *One participant did not have their schooling accounted because they studied in special class.*

Clinical features

Regarding the ASD level, 80.6% of the sample had mild ASD, according to the severity specifiers described in the DSM-V (APA, 2014), which classify the ASD level considering the level of support required by the child. 51.6% of participants in the sample group have other comorbid disorders, such as ADHD (41.9%), and other comorbidities such as anxiety, depression, and specific learning disorders (9.7%).

As for the use of medications, 51.6% use one medication per day and 22.6% of the sample need 2 medications per day. Among the most frequent drugs are Risperidone,

used by 38.7% of the sample and Methylphenidate, used by 32.3%. Table 2 presents the clinical characteristics of the sample group.

Table 2

Clinical features

	N	%
ASD level:		
I - Light	25	80.6
II - Moderate	6	19.4
Comorbidities:		
ASD+TDAH	13	41.9
ASD+Others	3	9.7
ASD without Comorbidity	15	48.4
Number of medications:		
Doesn't use	8	25.8
1 medication	16	51.6
2 medications	7	22.6
Medications:		
Risperidone	12	38.7
Methylphenidate	10	32.3
Fluoxetine	3	9.7
Sertraline	2	6.5
Others	3	9.7

Source: Survey data (2017-2019)

Attentional profile of the sample

The scores obtained by the sample group in the neuropsychological assessment tests are presented below, in Table 3, as well as the percentages of the group that are in the clinical range.

Table 3

Attentional profile, intellectual level and academic performance

Instruments	N Total	Mean	(SD)	Range	Clinic
				N	%
BPA:					
Concentrated	31	62.1	(20.3)	4	12.9
Divided Attention	31	59.6	(24.8)	0	0
Alternating Attention	31	69.7	(27.6)	3	9.7
General Attention	31	191.5	(65.7)	5	16.1
Total Errors	31	3.5	(14.4)		
Omissions	31	3.8	(16.2)		
WISC- IV					
QIT	30	85.0	(18.3)	17	56.7
WISC- IV / subtests:					
Codes	31	7.3	(2.6)	17	54.8
Q. Symbols	30	8.4	(2.8)	13	43.3
Cancellation	23	7.6	(3.2)	15	65.2
Seq. Numb. and Let.	27	7.4	(3.3)	14	51.9
Digits	31	6.0	(2.8)	19	61.3
TMT:					
TB/TA index	25	2.7	(0.8)	(reason <2)	16.0
				(reason>3)	40.0
SNAP Family:					
Inattention	29	4.0	(2.9)	8	27.6
Agitation	29	3.4	(2.5)	5	17.2
SNAP School:					
Inattention	27	2.7	(2.8)	6	22.2
Agitation	27	1.4	(1.7)	1	3.7

Note. BPA/ Psychological Battery for Attention Assessment, WISC-IV/ Wechsler Intelligence Scale for Children; IQ/Coefficient Full intellectual; TMT/Test tracks (parts A and B), TB/Time part B, TA/ Time part A; SNAP-IV questionnaire.

The average of the raw scores reached by the sample in the BPA is within the expected average performance, in the subtests of concentrated attention (M=62.1), divided (M=59.6), alternating (M=69.7), and attention overall (M=191.5) when compared with the normative sample regarding the age of participants (Rueda, 2013). Such performance demonstrates that most of the participants in the sample are capable of performing tasks in which it is necessary to sustain and maintain attention on a single stimulus for a certain period of time; maintain attentional focus on more than one stimulus

simultaneously and have the ability to alternate their attentional focus, recruiting attention to focus now on one stimulus, now on another, for a certain period of time.

However, the percentages of participants who were in the clinical range reveal that 12.9% had difficulty in the concentrated attention subtest, obtaining a performance of 1 SD of the average of the normative group, and 9.7% had difficulty in the alternating attention subtest. No participant was in the clinical range on the divided attention subtest.

The average general intellectual level of the sample was 85.0 (SD=18.3), classified according to the norms of the Wechsler Intelligence Scale as a lower average, within the preserved global cognitive level. However, 56.7% of the sample is in the clinical range, with 8 participants being 1 SD from the normative group mean and 9 participants being 2 SD.

In the WISC subtests, in which the participant needs to recruit attentional processes to respond to other demands, the group presented important difficulties. Such subtests were selected, so that their results can be interpreted in the light of neuropsychology and compared both to specific attention tests and to the information collected through questionnaires answered by parents and teachers.

In the Code subtest, which, among other cognitive domains, assesses selective and alternating visual attention, more than half of the participants (54.8%) obtained scores that show alertness to deficits or show deficits, demonstrating the difficulty of participants who are in the clinical range, in alternating attentional focus between different stimuli to select and copy the correct response.

In the Search for Symbols subtest, which requires selective, divided and alternating visual attention, 43.3% of the participants had difficulty in alternating attentional focus, as well as maintaining focus simultaneously to different stimuli, to select the correct answer, suggesting alertness to deficit and/or evidence of deficit.

In the Cancellation Subtest, which in addition to psychomotor processing speed, also demands concentrated and selective visual attention capacity, 65.2% showed alertness for deficit and/or deficit, evidencing attentional difficulties of the sample group.

In the Digits subtest, which requires concentrated auditory attention, 61.3% of the participants had a performance classified in the clinical range, and in the Sequence of Numbers and Letters subtest, which in addition to demanding concentrated auditory attention, requires divided attention, 51.9% of the participants placed up in the clinical range.

In the Trails Test, the mean achieved by the group was 2.7 (SD=0.8). When comparing the times that the group took to perform parts A and B of the test, 40% of the participants had a deficiency in part B, considering that they obtained indices at a ratio greater than 3, demonstrating difficulty in switching attention, now to numeric stimuli, sometimes for letter stimuli. The same index pointed out that 16% of the sample obtained a ratio lower than 2, suggesting slowness in part A of the test and difficulty in initiation, a component of executive functions.

The SNAP-IV was answered by 29 parents and 27 teachers. The questionnaire answered by the families revealed that 27.6% of the parents consider that their children have symptoms of inattention and 17.2% have symptoms of agitation and hyperactivity. In the opinion of the teachers, 22.2% believe that the participants have symptoms of inattention and 3.7% of agitation and hyperactivity.

Behavioral profile of the sample

The detailed survey of behaviors and symptoms characteristic of ASD manifested by the sample was carried out using the Autistic Traits Assessment Scale (ATA) answered by the parents. The mean total score achieved by the sample in the ATA was 26 (SD=0.1).

Among the symptoms most identified by parents, low frustration tolerance stands out, identified in 84.6% of the participants, followed by manipulation of the environment and resistance to change, with 69.2%. Other behaviors identified by more than half of the parents were lack of attention and interest in learning, in 65.4%, and hyper or hypoactivity, in 57.7% of participants.

The behaviors identified as lack of attention, described the participant's difficulties in fixation and concentration, as well as fixation of attention on their own sound or motor productions, giving the feeling that they are absent. Among the attitudes that appear to lack interest in learning, there is a lack of interest in learning, seeking solutions in others. In relation to hyper or hypoactivity, the adolescent can present from agitation, disordered and uncontrolled excitement, to great passivity, with total absence of response.

Below in Table 4, the symptoms investigated in 23 questions by the ATA are presented, as well as the percentage of participants who had 2 or more behaviors identified by their parents, in each question.

Table 4

Behavioral Profile and Characterization of ASD Symptoms

ATA issues	N Total	Mean	(SD)	Participants with 2 or more behaviors identified by investigated symptom	
				N	%
ATA					
1 Social Interaction	26	1.3	(0.8)	13	50.0
2 Ambient manipulations	26	1.6	(0.7)	18	69.2
3 Use people	26	1.2	(0.9)	12	46.2
4 Resistance to change	26	1.7	(0.5)	18	69.2
5 Rigid order	26	1.0	(0.8)	8	30.8
6 Eye contact	26	1.2	(0.9)	12	46.2
7 Expressionless mimes	26	0.7	(0.7)	4	15.4
8 Sleep	26	1.0	(0.9)	10	38.5
9 Food	26	0.9	(0.9)	8	30.8
10 Sphincters	26	0.5	(0.7)	3	11.5
11 Sensory explorations	26	0.9	(0.9)	9	34.6
12 Functional Use of Objects	26	0.8	(0.8)	7	26.9
13 Lack of attention	26	1.5	(0.7)	17	65.4
14 Interest in learning	26	1.5	(0.8)	17	65.4
15 Lack of initiative	26	1.2	(0.9)	12	46.2
16 Language Communication	26	1.2	(0.9)	13	50.0
17 Manifest Skills	26	1.3	(0.8)	14	53.8
18 Frustration	26	1.8	(0.5)	22	84.6
19 Responsibilities	26	1.0	(0.8)	9	34.6
20 Hyper Hypoactivity	26	1.3	(0.8)	15	57.7
21 Stereotypies	26	1.2	(0.8)	11	42.3
22 Danger awareness	26	0.8	(0.9)	7	26.9
23 Symptoms before 36 months	26	0.8	(0.4)	0	0
ATA Total Score	27	26*	(0.1)		

Note. ATA/Autism Trait Assessment Scale
*ATA cut-off line >15;

The correlation between the variables revealed that no statistical significance was found between the ASD characteristics and the attentional profile of the sample raised by the BPA. However, correlations (r) were found between ASD characteristics and participants' performance in some neuropsychological assessment instruments.

Table 5 presents the linear correlation coefficients between the variables studied and the *p* values.

Table 05

Correlation coefficients between variables and p values

	ATA Total
ATA Total	--
BPA AC	*0.40 *(p=0.098)*
BPA AD	*0.48 *(p=0.013)*
BPA AA	0.31 *(p=0.189)*
Omissions AA	*0.48 *(p=0.184)*
BPA A General	*0.45 *(p=0.045)*
WISC IV - CD	*0.56 *(p=0.042)*
WISC IV - SNL	0.08 *(p=0.719)*
WISC IV - PS	0.17 *(p=0.476)*
WISC IV - CA	0.12 *(p=0.752)*
WISC IV - QIT	*-0.36 *(p=0.314)*
TMT – Part A	*-0.41 *(p=0.084)*
TMT – Part B	-0.32 *(p=0.277)*
TMT – TB / TA	-0.10 *(p=0.873)*
SNAP Fam. Inattention	*0.40 *(p=0.063)*
SNAP Fam. Agitation	*0.47 *(p=0.044)*
SNAP Escola Inattention	0.07 *(p=0.962)*
SNAP Escola Agitation	0.21 *(p=0.893)*

Note. * significant correlations

Moderate and positive correlations were found between the total scores of the ATA scale and the scores of the SNAP -IV questionnaire, answered by the families (r =0.40 and r =0.47), revealing that the greater the ASD symptoms identified by the parents, the greater the inattention and agitation behaviors perceived by the family.

Moderate and positive correlations were also found between the total ATA scale score and the BPA test scores. Analyzing the relationship between the scores of total omissions committed by the sample in the subtest of alternating attention and the ATA (r =0.48), it is understood that the greater the number of ASD symptoms identified by the parents, the greater the number of visual stimuli neglected by the group.

However, analyzing the moderate and positive relationship between the total score of the ATA and the BPA subtests, which assess concentrated attention (r=0.40), divided

attention (r =0.48) and general attention (r =0 ,45), it is strangely noticed that the higher the scores in the ATA, that is, the greater the number of ASD characteristic behaviors identified by the parents, the higher the scores of the participants in the attention tests.

Interestingly, the same moderate and positive relationship was found between the total score of the ATA and the subtest Codes of the WISC-IV (r= 0.56), showing that the greater the characteristic behaviors of ASD, the greater the performance of the participants in the test that requires selective and alternating visual attention. However, a weak and negative relationship was found between the ITQ Index and the ATA score (r= - 0.36), indicating that the more ASD behaviors identified by parents, the lower the participant's Total IQ.

A moderate and negative correlation was found between the total score of the ATA and the score of the time spent by the sample in performing part A of the Trails Test (r=-.41), indicating that the more frequent the ASD characteristics, the lower the performance of participants in this portion of the test that requires visual sustained attention and initiation, executive function skill.

Having established the relationships between the characteristic behaviors of ASD and the attentional profile of the participants, the analysis and discussion of the main findings are presented below.

Discussion

The adolescents in the sample predominantly presented learning difficulties (58.1%) and behavioral complaints (48%). The majority (93.6%) of the participants are male, this is probably due to the place where the sample was recruited, which assists more male patients than indicated as prevalent in the literature. The proportion between the number of male and female participants in the sample is greater than that presented in the DSM-V (APA, 2014) which points out that the diagnosis of ASD is four times more frequent in males than in females.

The diagnosis of the sample group identified that 51.6% of the participants had comorbid symptoms, given that it is in accordance with the DSM-V (APA, 2014), about 70% of people with autism spectrum disorder may have a comorbid mental disorder, and 40% may have two or more comorbid mental disorders.

The performance of the participants in the Psychological Attention Battery revealed that a small percentage of the sample group presented a deficit or deficit alert for general

attention, as well as for concentrated and alternating attention. No participant was in the clinical range on the divided attention subtest.

Furthermore, the moderate and positive correlations between ASD symptoms and the BPA subtests of focused and divided attention suggest, surprisingly, that the greater the symptoms, the greater the capacity for focused and divided attention. This finding, seen preliminarily, seems to be at odds with other studies found in the literature that relate the most severe restricted and repetitive behaviors of ASD in childhood to the severity of inattention symptoms (Zachor & Ben Itzchak, 2019).

However, the analysis of the participants' performance in each attentional subcomponent in the BPA subtests reveals that the participants had less problems in maintaining attention simultaneously on one or more stimuli. This result is similar to the results of studies by Acevedo and Marrero (2019), who, investigating the cognitive functioning of young people diagnosed with ASD between 12 and 18 years old, describe simultaneous processing, supported by visuospatial skills, and planning processes as cognitive strength, attention and successive processing, such as cognitive weaknesses.

Another finding of this study that is in line with the results of Acevedo and Marrero (2019) is a moderate and positive correlation between ASD symptoms and the number of stimulus omissions in the BPA subtest of alternating attention, revealing that the greater the symptoms of ASD, the greater the number of stimuli neglected by the participant in the test. Although correlations do not determine causality, this finding suggests problems of the participants in the sample in alternating the attentional focus, now for one stimulus, now for another, successively, similarly to researchers who describe successive processing, as cognitive weaknesses. Other findings were found by Zachor and Ben-Itzchak (2019) who researched profiles of individuals with ASD, ADHD, and ASD comorbid with ADHD and concluded that more severe symptoms of ASD support greater attentional difficulties.

The results of the sample in the WISC-IV subtests, Codes, Search for Symbols, Cancellation, Sequence of Numbers and Letters, and Digits, are in accordance with the findings in the literature that found an association between attention deficits and ASD behaviors. An important percentage of the sample presented scores that place the participants in the clinical range in these subtests.

It seems contradictory that participants performed differently on WISC and BPA tasks that require the same attentional skills. In both tests the performance of the sample was compared to the normative group, matched by age. When investigating what may

have caused such a contradiction, we must pay attention to the skills required in each instrument.

The WISC-IV subtests require different cognitive skills and assess more than one domain. As the participant recruits a certain skill to perform the subtest, with the increase in the complexity of the task (characteristic of the subtests of the Wechsler Scales), the demand for the evaluated executive functions increases, even if they are not being evaluated directly (Cardoso et al., 2016).

The administration of the WISC-IV subtests is important due to its multifactorial nature and the possibility of observing underlying cognitive domains. According to the researcher Cardoso and his collaborators (2016, p.457), "attention is the input base of information for cognition, thus, all subtests have a secondary demand of this cognitive functional group..."the observation of how the child manages to "get out of their auto-pilot" (emphasis added by the authors), from easy situations to resolve difficult situations", which require greater mental control, is an irrefutable opportunity for evaluation.

Although no significant correlation was found between the ASD symptoms identified by the parents in the ATA, and the sample scores in the subtests Sequence of Numbers and Letters, Cancellation, Search for Symbols, and WISC Digits, the analysis of the constructs evaluated in these subtests seems to point the direction that can lead us to understand how more than half of the participants presented performance that classified them within the clinical range, in these subtests.

It can be conjectured that the apparent contradiction between the results of the sample in the BPA and WISC-IV subtests may be related to the fact that the BPA subtests do not demand from the subject's other cognitive domains besides the specific attention of each subtest, in view of that the BPA, aims to carry out an assessment of the general attention capacity, as well as an individualized assessment of specific types of attention (Rueda & Monteiro, 2013).

The result of the sample in the Trails Test, in which 40% of the participants obtained indices that show cognitive impairment, is another indication of the attention deficits of people with ASD, when they need to maintain mental control in a given task. In part A of the trails test, the subject is required to pay sustained attention as he is asked to connect the numbers in ascending order. It's a task that can easily be done, as long as the numbers are known and the location of the numbers randomly arranged on the sheet are known.

However, in Part B, the subject needs to control their focus of attention, alternating it now to numerical stimuli, now to letter stimuli, and also follow an ascending and alphabetical order of the stimuli. It is a task that requires other cognitive functions and executive skills that depend on the ability to alternate attention (Mitrushina et al., 2005). The analysis of the constructs evaluated in the TMT leads us to the same considerations regarding the WISC subtests.

They are instruments that allow us to explain attention deficits as difficulties of a distinct system, but interconnected with other cognitive domains, which, because they do not function fully, impact all neuropsychological processing. These findings are in line with the attention model of modular theories, which assumes attentional functioning independent of other cognitive processes. Modularity assumes that the different components that make up the cognitive system function and contribute relatively independently to the functioning of the system, having domain specificity, that is, operating on specific information (Seabra & Dias, 2012).

In addition to the results of the sample in the neuropsychological assessment tests, some of the characteristic behaviors of ASD identified by the parents in the ATA scale also point out the attention deficits that impact the executive functioning of the participants. Behaviors that express the attentional difficulty of the sample, describe the participant's tendency to fix attention for a short time or to be unable to fix it; present increased response latency time; and difficulty understanding instructions.

In the SNAP-IV questionnaire, answered by family members, 27.6% of participants met the criteria for inattention and 17.2% for hyperactivity. In the opinion of teachers, 22.2% and 3.7% respectively. It is worth highlighting here the difference in opinions between parents and teachers regarding the behavior of the research participant. There was divergence in the opinion of those who live with him. This finding reveals the importance of investigating the contexts in which the participants are inserted in order to identify whether there are variables influencing the behavior of adolescents, and what they are. Or if the perception of parents and teachers regarding the participant's behavior is influenced by other factors, such as the expectations of the adults who live with the adolescent.

A similar finding was found by Antoniuk (2006) in a survey to identify ADHD symptoms in elementary school children and adolescents, using a brief questionnaire, versions for parents and teachers. The author points out that the low agreement between

teachers, and these in relation to parents, confirmed in the study, should alert clinicians about the care in using scales and questionnaires from different information sources.

A similar warning about the complexity of clinical, behavioral, and neuropsychological assessment was also indicated by researchers Breuillard et al., (2016); Flynn, Colón-Acosta, Zhou, and Bower (2019); Lawson et al., (2015); and Torske et al. (2019); regarding the evaluation of individuals with ASD. The authors emphasize the importance of using objective scales and measures of clinical observation of the behavior of the appraiser, in addition to standardized tests. Such sources of information can help professionals in the investigation that precedes the diagnosis.

Conclusions

The objective of the present study was to describe the attentional functioning of adolescents diagnosed with ASD, related to the symptoms of the condition. The results presented in this study respond to the research objective by correlating the attention deficits of the sample group to the characteristics of ASD.

The survey of the neuropsychological profile of ASD, with emphasis on attentional function, established the relationship between the variables studied, gathering objective evidence that attentional processes are linked to other cognitive domains. This evidence is in line with the attentional profile of ASD found in the literature, in which researchers from various regions of the world point out attentional problems that impact the executive functioning of the individual with ASD.

The findings of this study support that attentional alterations in ASD cannot be explained as failures of a single mechanism. This position is based on the results of the sample that show the attentional difficulty of ASD when the subject is required to use attentional functions for executive functioning.

The investigation clarified that adolescents with ASD may not have attentional deficits and be successful in simple tasks when they only require an attentional mechanism. However, they present attentional deficits in complex tasks that demand more than one attentional mechanism, failing in the mental control necessary for executive functioning.

The study gathered objective evidence that people with ASD have attention deficits that alter executive functions. In this sense, we accept the hypothesis that adolescents diagnosed with ASD have a higher prevalence of deficits in attentional processes, when compared to normative groups.

As a limitation of this study, the number of samples recruited can be pointed out, since the research site offers wide access to the studied population. Further research is recommended, aimed at interventions for the development of the attentional skills necessary for the self-regulation of behavior in adolescents with autism. It is also suggested research on support strategies for parents, such as psychoeducational programs, in order to guide the adolescent's learning processes and their adaptation to the demands of the environment, thus favoring the independence and autonomy of the future young adult throughout life.

References

Acevedo, S. P. & Marrero, E. D. (2019). Perfil Neurocognitivo de Jóvenes Diagnosticados con el Trastorno del Espectro del Autismo Altamente Funcional. *Revista Puertorriqueña de Psicología*, Vol 30(1), 156-168. https://psycnet.apa.org/record/2019-56723-011

American Psychiatric Association — APA (2014). *DSM V — Manual Diagnóstico e Estatístico de Transtornos Mentais*. Porto Alegre: Artmed.

Antoniuk, S. A. (2006). *Desenvolvimento de um Questionário Breve para Identificação do Transtorno de Déficit de Atenção e Hiperatividade Direcionado a Pais e Professores.* [Tese de Doutorado não-publicada]. Curitiba: Universidade Federal do Paraná.

Ashwood, K. L., Tye, C., Azadi, B., Cartwright, S., Asherson, P., & Bolton, P. (2015). Brief Report: Adaptive Functioning in Children with ASD, ADHD and ASD + ADHD. *Journal of Autism and Developmental Disorders*, 45(7), 2235–2242. https://doi.org/10.1007/s10803-014-2352-y

Assumpção, F.B.Jr., Kuczynski, E., Gabriel, M.R., & Rocca, C. C. (1999). Escala de Avaliação de Traços Autísticos (ATA) Validade e Confiabilidade de Uma Escala para a Detecção de Condutas Autísticas. *Arquivos de Neuropsiquiatria*, 57 (1), 23-29. https://doi.org/10.1590/S0004-282X1999000100005

Breuillard, D., Leunen, D., Chemaly, N., Auclair, L., Pinard, J. M., Kaminska, A., Desguerre, I., Ouss, L., & Nabbout, R. (2016). Autism spectrum disorder phenotype and intellectual disability in females with epilepsy and PCDH-19 mutations. *Epilepsy and Behavior*, 60, 75–80. https://doi.org/10.1016/j.yebeh.2016.04.009

Cardoso, C.O., Zimmermann, N., Júlio-Costa, A., Bertola, L., Malloy-Diniz, L., & Fonseca, R.P. (2016). Interpretação quantitativa e qualitativa do WISC – IV na avaliação neuropsicológica: em busca de dissociações cognitivas. Em Weiss, L. G., Saklofske, D. H., Prifitera, A. & Holdnack, J. A., *WISC-IV - Interpretação Clínica Avançada (449 - 478)*. São Paulo: Pearson.

Carvalho, A.C.R. de, Quintas, R.H.R., Assis, S.M.B de, & Seabra, A.G. (2020). Motor performance, intelligence, and executive functions in children with asd. *International Journal of Development Research*, 10(02), 34053-34060. https://www.journalijdr.com/sites/default/files/issue-pdf/18180.pdf

Dancey, C.P. & Reidy, J. (2019). Análise de correlação: o r de Pearson. Em Dancey, C.P. & Reidy, J., *Estatística sem matemática para psicologia*, (169 - 210). Porto Alegre: Penso.

Flynn, R. M., Colón-Acosta, N., Zhou, J., & Bower, J. (2019). A game-based repeated assessment for cognitive monitoring: Initial usability and adherence study in a summer camp setting. *Journal of Autism and Developmental Disorders*, 49(5), 2003-2014. https://doi.org.ez22.periodicos.capes.gov.br/10.1007/s10803-019-03881-w

Lawson, R. A., Papadakis, A. A., Higginson, C. I., Barnett, J. E., Wills, M. C., Strang, J. F., Wallace, G. L., & Kenworthy, L. (2015). Everyday executive function impairments predict comorbid psychopathology in autism spectrum and attention deficit hyperactivity disorders. *Neuropsychology*, 29(3), 445–453. https://doi.org/10.1037/neu0000145

Lezak, M. D. (1982). The problem of assessing executive functions. *International Journal of Psychology, 17*(1-4), 281-297. https://doi.org/10.1080/00207598208247445

Lezak, M. D., Howieson, D.B., Bigler, E. D., & Tranel, D. (2012). *Avaliação neuropsicológica* (5ª ed.). Imprensa da Universidade de Oxford.

Mattos, P., Serra-Pinheiro, M. A., Rohde, L.A., & Pinto, D. (2006). Apresentação de uma versão em português para uso no Brasil do instrumento MTA-SNAP-IV de avaliação de sintomas de transtorno do déficit de atenção/hiperatividade e sintomas de transtorno desafiador e de oposição. *Revista de Psiquiatria*, 28(3), 290-297. https://doi.org/10.1590/S0101-81082006000300008

Mitrushina, M. N., Boone, K. B., Razani, J., & D'Elia, L. F. (2005). *Handbook of Normative Data for Neuropsychological Assessment.* (2ª Ed.). Oxford: Oxford University Press.

Rueda, F. J. M. (2013). *Bateria Psicológica para Avaliação da Atenção.* São Paulo: Vetor.

Rueda, F. J. M., & Monteiro, R. M. (2013). Bateria Psicológica para Avaliação da Atenção (BPA): Desempenho de diferentes faixas etárias. *Psico-USF*, *18*(1), 99-108. http://dx.doi.org/10.1590/S1413-82712013000100011

Seabra, A. G., & Dias, N. M. (Orgs.). (2012). *Avaliação Neuropsicológica Cognitiva: Atenção e funções executivas* (Vol. 1). São Paulo: Memnon.

Silva, L. C. A. M. (2012). Reabilitação neuropsicológica da atenção e seus aspectos. Em Abrisqueta-Gomes, J. e col. (Orgs.), Reabilitação Neuropsicológica: Abordagem Interdisciplinar e Modelos Conceituais na Prática Clínica (pp. 173-180). Porto Alegre: Artmed.

Torske, T., Nærland, T., Bettella, F., Bjella, T., Malt, E., Høyland, A. L., Stenberg, N., Øie, M. G., & Andreassen, O. A. (2019). Autism spectrum disorder polygenic scores are associated with every day executive function in children admitted for clinical assessment. *Autism Research*, 13(2), 207–220. https://doi.org/10.1002/aur.2207

Wechsler, D. (2013). Escala Weschsler de inteligência para crianças: WISC-IV. Manual Técnico. Tradução do manual original Maria de Lourdes Duprat. (4. ed.). São Paulo: Casa do Psicólogo.

Zachor, D. A., & Ben-Itzchak, E. (2019). From Toddlerhood to Adolescence: Which Characteristics Among Toddlers with Autism Spectrum Disorder Predict Adolescent Attention Deficit/Hyperactivity Symptom Severity? A Long-Term Follow-Up Study. *Journal of Autism and Developmental Disorders,* 49(8), 3191–3202. https://doi.org/10.1007/s10803-019-04042-9

Zimmermann, N., Kochhann, R., Gonçalves, H. A., & Fonseca, R. P. (2016). *Como escrever um laudo neuropsicológico?* São Paulo: Casa do Psicólogo.

Recebido em 23 de outubro de 2021

Aprovado em 01 de agosto de 2023

Tiara Terezinha Matte Borges Machado: Psicóloga, Mestranda do Programa de Pós-Graduação em Psicologia, Universidade Federal do Paraná/UFPR, Curitiba, Paraná, Brasil. Praça Santos Andrade, nº 50/sala 106, Curitiba/PR. 80060-000, telefone: (41)9.8409.3642. E-mail: timachado1003@gmail.com.br

Ana Paula Almeida de Pereira: Doutora em Psicologia da Reabilitação, docente do Programa de Pós-Graduação em Psicologia, Universidade Federal do Paraná/UFPR, Curitiba, Paraná, Brasil. Praça Santos Andrade, nº 50/sala 106, Curitiba/PR. 80060-000, Tel.:(41)3310-2625, E-mail: anapaula_depereira@yahoo.com