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Research Paper

Predictive hypotheses of the conceptual category of Autism Spectrum Disorder

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Abstract
People with Autism Spectrum Disorder (ASD) are characterized by presenting a neurodevelopmental disorder of fundamentally genetic etiology with consequences in the global cognitive process, affecting the psycho-neurological processing of interrelational information processing as a systemic whole. For this reason, the International Classification DSM-5 (American Psychiatric Association (APA), 2013), which includes only behavioral criteria, is very reduced in the face of a disorder that affects the global developmental system, both in the perceptual-cognitive area, as well as in the motor area and other clinical components related to health.
In this study, the following general objectives are set out: 1) to analyze the most important predictor variables that make up the explanatory hypotheses for the diagnosis of autism, 2) to analyze whether these predictor variables differ according to the type of ASD group, age and sex of the participants in the sample, and 3) to elaborate the implications of the predictive analysis for the application of adapted programs.
A total of 262 children belonging to the three ASD groups (ASD-1: 124, ASD-2: 83, and ASD-3: 84) participated in this study, which have been distributed according to five age intervals and two groups according to the sex of the participants. The results found using linear stepwise regression analysis indicate that there are four predictor variables that accumulate to explain the hypotheses explaining the disorder: 1) Social-Communication, which represents an explanatory R for autism of .477 (47.7%), R2: .228 (22.8%), adjusted: .225 (22.5%), 2) in the second phase of the model, the Cognition variable is incorporated, whose interaction explains an R: .520, R2: .270, adjusted: .265, 3) the third step is configured sum of the Visual-Motor variable, which justifies an R: .53, R2: .284, adjusted: .275, and 4) the fourth and last step is collected the Rigidity-Motor variable, with a total explanatory sum of R: .54, R2: 29.7% (adjusted: 28.6%).

Lay abstract
People with ASD are characterized by presenting a neurodevelopmental disorder of basically genetic etiology with consequences in the global cognitive process, which affects the psycho-neurological processing of interrelational information processing, influencing the global set of the neurocognitive system, both in the perceptual-cognitive, motor, and/or clinical level.
This global systemic position requires the application of programs based on the development of processing modes, which can generate holistic development and reduce the cognitive consequences derived from the exposure to stimuli perceived as negative by people with ASD, as they would increase the types and levels of associated comorbidities. For this reason, programs have to design learning contexts that provide for positive responses, elaborated according to previously acquired competencies, which will progressively increase the level of difficulty according to the skills of elaboration of relationships between previous learning and new acquisitions. The subsequent presentation of a wide range of variety of learning contexts will facilitate the processes of generalization of the learned contents to new situations.
Keywords:
Autism Spectrum Disorder, Perception- Cognition, Semantic- Encoding, Visual- Motor, Behaviour.

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I. Introduction

Individuals with ASD form a symptomatic group based on a neurodevelopmental disorder of predominantly genetic etiology with evident consequences in the global cognitive coding process affecting the psycho-neurological processing of interrelational information processing. These basic nuclear deficits explain the limitations in objectifiable behavioral processes observed in the DSM-5 classification, but these criteria are not the only ones affected; Rather, their consequences are mainly expressed in the limitations in the perceptual-cognitive processes in the elaboration of networks or identifying neural nodes of the information encoded with semantic criteria, which severely hinders the use of this information in a spontaneous and adapted way in the different contexts in which it is demanded (Bertone, Hanck, Kogan, Chaudhuri & Cornish, 2010; Courchesne et al., 2005; Zikopoulos&Barbas, 2010).

Indeed, many scientific precursors of the conceptual hypothesis of ASD focused on functional deficits of the central type, which emphasize the analysis of dynamic processes related to interneuronal connectivity for receiving and processing information (Barttfeld et al., 212). Because of these limitations, severe deficits are observed in the development of relationships between analyses, making it difficult during the functional dynamics of the brain networks responsible for the encoding and retrieval of information in semantic terms is largely limited.

These studies were already initiated by Alexander et al. (2007), Barnea-Goraly et al. (2010), and Fletcher et al. (2008), which were later empirically refuted by Tang, Rothbart & Posner (2012), and show that information interconnectivity oppositely takes place in people with ASD, relative to the control group of neurotypical people. The authors state that in people with ASD, inter-informational nodal connectivity increases in the interoceptive state and decreases in the exteroceptive state, but, in addition, in the interoceptive state, functional networks and neural nodes show shorter connections (relationships) than in their neurotypical counterparts, which is observed throughout all cognitive states of psychoneurological systemic information processing.

These explanatory hypotheses allow us to conclude that in addition to the behavioral consequences observed in APA Classification (2013), related to limitations in social interaction and communication and in stereotypical and restrictive behaviors, other symptomatic groups occur that make up the entire diagnosis, especially influencing the active-executive system of the psychological-cognitive processing of information and the clinical consequences that derive from this (Carmo, Duarte, Souza, Pinho& Filipe, 2017).

Likewise, Thomas, Davis, Karmiloff-Smith, Knowland&Charman (2016) show, using neurocomputational models, deficits related to the presence of a deficient processual mechanism of synaptic connections, which are characterized, first, by an excessive development in early childhood and, subsequently, a severe regression occurs in this relational development, giving rise to the hypotheses of regression processes. These regression indicators have been collected and analyzed by Thomas, Knowland& Karmiloff- Smith (2011) analyze and conclude that regression, which constitutes the loss of previously established behaviors, normally, usually occurs towards the second year of life, with language being the most clearly manifest indicator, but these regressions are also observed in cognitive and, above all, motor skills.

In this sense, the different genotypic genetic groups indicate the presence of very specific endophenotypic types that delimit high correlations of ASD with multiple associated symptomatic groups, with greater or lesser prevalence and/or correlational intensity as indicated below.

Among these correlations, the presence of hyperactive behaviors or attention deficit hyperactivity disorder (ADHD), whose relationship is determined by the T allele (marker rs1843809) of the tryptophan hydroxylase gene, expressed in the brain (TPH2), which is a rate-limiting enzyme in the regulation of serotonin synthesis, stands out (Sheehan et al., 2005; Sizoo et al., 2010; Sizoo, van der Gaag& van den Brink, 2015).

Also noteworthy are the relationships between ASD and deficits in visual-motor coordination and motor rigidity (Oliver, 2013). This correlational component is fundamental, since these sensory limitations have a decisive influence on the mode of coding and cognitive processing and its immediate consequences in academic tasks, even when individuals with ASD present good cognitive abilities, since, when sensory processes related to visual-motor integration are affected, they influence the set of subsequent actions (Kulp, 1999; McHale & Cermak, 1992; Sanghavi& Kelkar, 2005).

Cohen (1994; 1998) and Simmons et al. (2007) further assert that difficulties in elaborating nodal relationships between neuropsychological information processes are associated with the excessive allocation of neural resources and excessively conjunctive neural codes in individuals with ASD, which are well localized, supporting the explanatory hypotheses of the disorder from the perspective of weak central cognitive coherence, characterized by partial and excessively localized processing of stimuli.

In summary, Tanaka & Sung (2016) establish three basic hypotheses to specify the diagnostic group of the disorder: 1) a holistic hypothetical approach, 2) the hypothesis of weak central cognitive coherence, characterized by a perceptual bias, which is of a localist type, and 3) the hypothesis of direct reaction avoidance towards the interlocutor. Well, most observational evidence focuses on the perceptual-cognitive process characterized by a bias of local type, focused on specific aspects of the stimulus, due to the interconnectional constraints between the neurocognitive networks-nodes along all phases of the processing system.

Marchena, Eigsti, Worek, Ono & Snedeker (2011) develop the mutual exclusivity hypothesis, also based on the presence of a weak or local cognitive type. Markman's mutual exclusivity theory (Markman, 1990; Markman & Wachtel, 1988) points out that, in effect, people with ASD attribute a categorical label to a previously learned conceptual set, such that each object is related to that categorical label, and it is thereafter that a significant bias or constraint occurs to attribute a new identifying label to that concept or conceptual category This hypothesis explains the pragmatism that is evident during the learning process in people with ASD and the rigidity to facilitate the development from functional facts to the association of concepts and conceptual categories, which, according to this same theory, is achieved through the elaboration of associative networks, with a tendency to elaborations of simple maps of the concept, which arises because learning is processed in the form of mapping between different levels of representation of the concept and, therefore, if a problem or functional context is not present again during the presentation of the concept, then its retrieval and attribution becomes difficult (Ojea, 2018).

Objectives

In this study, therefore, the following general objectives are set out: 1) to analyze the most important predictor variables that make up the explanatory hypotheses for the diagnosis of autism, 2) to analyze whether these predictor variables differ according to the type of ASD group, age and sex of the participants in the sample, and 3) to extract the most important consequences for the involvement of programs adapted to people with ASD.

II. Method

Research design

The design is based on an experimental analysis related to the collection of data found in an ad hoc construction questionnaire. The data analysis base used was the SPSS statistical package, through the tests related to the research objectives, which were found using linear regression analysis by successive steps, the values found on the homogeneity of the sample and the post hoc comparative multivariate analyses for the fixed variables: group, age, and sex.

Participants

A total of 262 young people belonging to the three ASD groups (ASD-1: 124, ASD-2: 83) and ASD-3: 84), distributed according to five age intervals and two groups referring to the sex of the participants, participated in the study (see Table 1).

Table 1. Participants.

Sex	Group		Age					Total
			2-5.9	6- 9.9	10-13.9	14-17.9	>18	
Men	Group	ASD-1	36	30	18	12	13	109
		ASD-2	20	19	13	7	10	69
		ASD-3	16	14	4	2	7	43
	Total		72	63	35	21	30	221
Women	Group	ASD-1	0	1	5	2	7	15
		ASD-2	6	3	2	2	1	14
		ASD-3	2	4	0	1	5	12
	Total		8	8	7	5	13	41

Variables

According to recent studies, ASD is conceptualized both in terms of conduct and behavioral variables, which include values related to communication-social interaction and restricted and stereotyped behaviors, and concerning perceptual-cognitive assumptions, which include the type of information processing. In this sense, the most recent analyses of these hypotheses are characterized by the presence of deficits found in the neurocognitive nodal relationships between information inputs and outputs in people with ASD Likewise, as a consequence of the nodal relational deficits, a high incidence of symptoms associated with recurrent comorbidity with the nuclear disorder is shown.

For this reason, in this study, the variables of continuous values selected are the following: 1) Attent-Perception, which combines all the perceptual-attentional type components of information, 2) Coding- Memory, which collects the particularities of cognitive processing from outside to inside and vice versa, analyzing the mode of information retrieval, 3) Cognition (general cognitive level), related to the ability to encode information, its analysis and synthesis and the application and generalization of learning in contexts, 4) Social-Communication, which encompasses symptoms related to social interaction and communication, 5) Setereotyped- Language (peculiar characteristics of language: Repetitive- Restrictive- Echolalic language), which refers to reiterative expressions of language, tone of voice, volume or any other particular expression, 6) Dyslalia- Dysarthria, (oral language disturbances), referring to the presence of deficits in the articulation and construction of language, 7) Behavior (stereotyped behaviors and other behavioral disturbances), 8) Development (global development), referring to delays or the presence of evident developmental setbacks in previously made acquisitions, 9) Rigidity-Motor related to structural rigidity of movement and verbal and socio-emotional expressions, 10) Visual-Motor corresponding to the levels of visual-motor coordination and criteria related to fine and gross motor skills, 11) Hyperactivity (attention deficit with overt hyperactivity), related to the levels of associated severe hyperactivity, 12) Anxiety, referring to the comorbid anxiety levels associated with ASD, 13) Depression, referring to severe levels of depression as an associated comorbid element, 14) Schizotype, related to the comorbid presence of permanent schizotypal traits, 15) Epilepsy, referring to the frequency of epilepsy as a comorbidity factor highly associated with the disorder.

The fixed or dependent variables used (DV) are three: 16) Group (type of group) referring to the three analysis groups: level 1, 2, and 3 DSA, 17) Age (age of the participants), which have been distributed in five age intervals, and 18) Sex (sex of the participants).

Procedure

Based on the analysis of the most updated studies, concerning the hypothetical explanations of the conceptual category of ASD, the variables that are expected to best respond to the different studies analyzed and experimentally corroborated have been selected. These studies have facilitated the design of the questionnaire of quantitative continuous value questions, applied through the online drive response system. The questions are made up of values on a scale from 0: no deficit to 4: severe deficit, for each selected dynamic variable. Once the answers were found, we proceeded to the consequent statistical analysis.

Data analysis

The parametric experimental data of the analysis were: 1) Cronbach's Alpha to analyze the validity and reliability of the sample, 2) linear regression analysis using the method of successive steps, to test the predictor variables of the study, 3) analysis of the values of the homogeneity of the sampling distribution, performed using the statistic of value analysis, due to the presence of extreme values, 4) post hoc comparative multivariate analysis for the type of group and age intervals, for the variables selected by the regression analysis, and 5) the comparative t-test for 2 independent samples concerning the sex variable for the predictor variables of the regression analysis.

III. Results

Level of sample reliability

The reliability of the sample was found using Cronbach's Alpha statistic, which allowed to conclude that the validity-reliability of the sample for the 18 items of the study and N: 262 participants, is appreciably high: α: .820 (82.9%), which allows to carry out a priori analysis of the data with certain guarantees of effectiveness and experimental validity.

Selection of predictor variables

This section constitutes the main objective of this study, in which the predictor variables that best contribute to explaining the ASD configuration are selected. This data was obtained using stepwise linear regression analysis. The output of the data taking the variable Group as DV allows the following predictor model to be deduced, which is made up of the average progressive weighting of four variables, for a reliability level < .05.

The selected variables accumulate progressively in this order: 1) Social-Communication variable, 2) Cognition variable, 3) Visual-Motor variable and 4) Rigidity-Motor variable. Indeed, the synthesis of the regression model and its explanatory data R, R^2, and R^2 adjusted, can be observed in Table 2.

Table 2.Model Summary.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.477(a)	.228	.225	.69
2	.520(b)	.270	.265	.67
3	.53(c)	.284	.275	.66
4	.54(d)	.297	.286	.66

a) Predictors: (Constant), Social- Communication.
b) Predictors: (Constant), Social- Communication, Cognition.
c) Predictors: (Constant), Social- Communication, Cognition, Visual- Motor.
d) Predictors: (Constant), Social- Communication, Cognition, Visual- Motor, Rigidity- Motor.
e) Dependent Variable: Group.

As can be seen, the first variable selected by the model is Social- Communication, which presents an explanatory R for ASD: .477 (47.7%), R2: .228 (22.8%), adjusted: .225 (22.5%), in the second phase of the model, the Cognition variable is incorporated to the previous variable, whose interaction already explains an R: .520, R2: .270, adjusted: .265. The third step is configured by the interaction of the two previous variables + the Visual-Motor variable, which explains an R: .53, R2: .284, adjusted: .275, and, finally, in the fourth phase, the Rigidity-Motor variable is incorporated, which gives rise to a total explanatory sum of R: .54, R2: 29.7% (adjusted: 28.6%).

The value of the F-statistic found for the R^2 for each step, analyzed using the critical levels of the Anova Table for the DV Group, shown in Table 3, shows that the levels are significantly different from zero for each step selected by the regression analysis.

Table 3: Anova.

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	36.61	1	36.61	76.63	.00(a)
	Residual	124.21	260	.47		
	Total	160.82	261			
2	Regression	43.46	2	21.73	47.96	.00(b)
	Residual	117.36	259	.45		
	Total	160.82	261			
3	Regression	45.64	3	15.21	34.07	.00(c)
	Residual	115.18	258	.44		
	Total	160.82	261			
4	Regression	47.77	4	11.94	27.15	.00(d)
	Residual	113.05	257	.44		
	Total	160.82	261			

a) Predictors: (Constant), Social- Communication.
b) Predictors: (Constant), Social- Communication, Cognition.
c) Predictors: (Constant), Social- Communication, Cognition, Visual- Motor.
d) Predictors: (Constant), Social- Communication, Cognition, Visual- Motor, Rigidity- Motor.
e) Dependent Variable: Group.

Indeed, as can be seen, the first step presents a significant critical level (sig: .00, for an F: 76.63), which is therefore different from zero. Thus, it is to be expected that the other steps collected are also significantly different from zero; thus, the second step presents a sig: .00 (F: 47.96), and in the third step a significant critical level is found: .00 (F: 34.07) and, finally, the fourth step also presents a significantly differential level (sig: .00, F: 27.15). The partial regression coefficients corresponding to each variable included in the regression equation model allow us to obtain the constant value and the importance given to each variable within the regression analysis equation (Beta), considered for the dependent variable: Group (see Table 4).

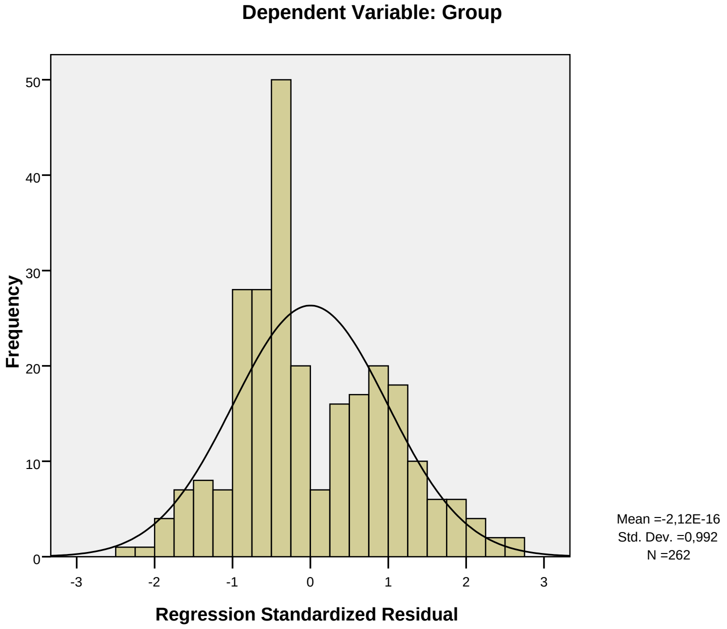
Table 4: Regression coefficients.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.00	.09		10.78	.00
	Social- Communication	.23	.02	.47	8.75	.00
2	(Constant)	.86	.09		8.84	.00
	Social- Communication	.18	.03	.36	6.11	.00
	Cognition	.14	.03	.23	3.89	.00
3	(Constant)	1.01	.11		8.62	.00
	Social- Communication	.18	.02	.37	6.22	.00

	Cognition	.15	.03	.25	4,.04	.00
	Visual- Motor	-.07	.03	-.11	-2.20	.02
4	(Constant)	.93	.12		7.70	.00
	Social- Communication	.18	.02	.36	6.19	.00
	Cognition	.14	.03	.24	4.01	.00
	Visual- Motor	-.10	.03	-.17	-2.98	.00
	Rigidity- Motor	.13	.06	.13	2.20	.02

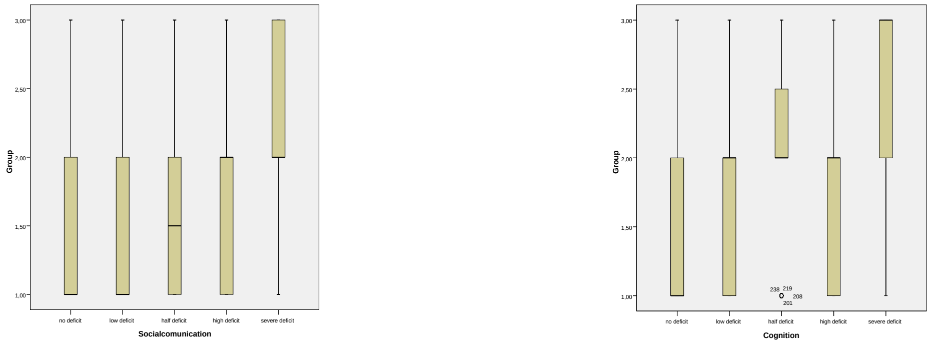
As indicated, the statistical significance value for the explanatory contribution of DSA to the proportion of variance explained for each variable included in the model is highly significant in all selected steps. The first step (Social- Communication) indicates a level sig: .00 (t constant: 10.78), the second step (Social-Communication + Cognition) (sig: .00, t constant: 8.84), the third step, formed by Social- Communication + Cognition + Visual- Motor (sig: .00, t constant: 8.62), and, finally, the fourth step, which collects Social-Communication + Cognition + Visual- Motor + Rigidity- Motor, indicates a critical level sig: .00, t constant: 7.70.
However, the histogram of typed residuals from the regression analysis allows a corresponding visual observation with the indicated data from the equation, which is slightly asymmetric (see Figure 1).

Figure 1. Histogram of the regression equation.



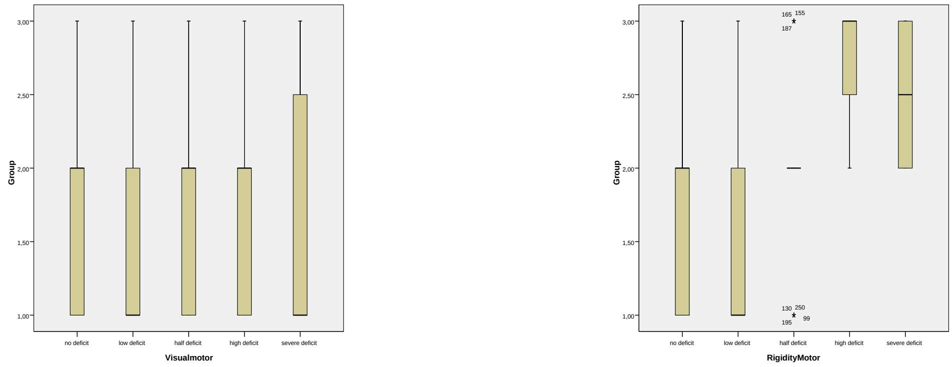
As the Histogram above shows, the central part of the distribution is not very homogeneous, but presents some asymmetry, due to the existence of several extreme values in the negative tail of the scale, where the residuals accumulate, especially about the value -1. This position is explained in terms of the outliers found in the data so that the distribution is not associated with a distribution fitted to a normal probability model so the results should be interpreted with some caution. However, a more detailed analysis of the heterogeneity of the data, analyzed using box plots of the descriptive values, performed for the type of group, justifies the dispersion and asymmetry of the distribution found. Indeed, the outliers are explained by the values found in the ASD-3 group, which places the median of the Social-Communication variable at very extreme values (see Figure 2), as well as the values found for the Cognition variable, whose distribution presents slightly asymmetric data for the ASD-2 group and highly extreme for the ASD-3 group (see Figure 2).

Figure 2. Distribution of data for the variables: Social-Communication and Cognition.



The levels of dispersion are reduced in the Visual-Motor variable and again increase considerably in the Rigidity-Motor variable for the ASD-2 and ASD-3 groups, which justifies the proportion of accumulated residuals at the extremes observed in the normal distribution of the histogram of the regression analysis (see Figure 3).

Figure 3. Distribution of the data for the variables: Visual-Motor and Rigidity-Motor.



Comparative analysis of the predictor variables for DV: Group

The comparative analysis for the group variable has been found using the post hoc multivariate statistical test for the variables collected by the regression analysis. According to Levene's index, it is calculated with the Tukey test for the Social- Communication (sig: .00), Cognition (sig: .00), and Rigidity-Motor (sig: .00) variables, while it is calculated with the Games-Howell test for the Visual-Motor variable (Levene: sig: .98).

Table 5. Multiple Comparisons to Group variable.

DV		(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.
Social-Communication	Tukey HSD	ASD-1	ASD-2	-.96	.19	.00
			ASD-3	-1.94	.22	.00
		ASD-2	ASD-1	.96	.19	.00
			ASD-3	-.97	.24	.00
		ASD-3	ASD-1	1.94	.22	.00
			ASD-2	.97	.24	.00
Cognition	Tukey HSD	ASD-1	ASD-2	-.86	.16	.00
			ASD-3	-1.29	.19	.00
		ASD-2	ASD-1	.86	.16	.00
			ASD-3	-.42	.20	.10
		ASD-3	ASD-1	1.29	.19	.00
			ASD-2	.42	.20	.10
Vusual-Motor	Games-Howell	ASD-1	ASD-2	.05	.18	.95
			ASD-3	.10	.21	.88
		ASD-2	ASD-1	-.05	.18	.95
			ASD-3	.04	.22	.97
		ASD-3	ASD-1	-.10	.21	.88
			ASD-2	-.04	.22	.97
Rigidity-Motor	Tukey HSD	ASD-1	ASD-2	-.19	.10	.18
			ASD-3	-.25	.12	.10
		ASD-2	ASD-1	.19	.10	.18

			ASD-3	-.06	.13	.88
		ASD-3	ASD-1	.25	.12	.10
			ASD-2	.06	.13	.88

As can be seen, the data found indicates, in general, scattered data in the predictor variables analyzed for the three ASD-1-2-3 groups. In the Social- Communication variable (sig: .00), and in the Cognition variable, significant differences were also found between the groups, except between the ASD-2 and ASD-3 groups (sig: .10). In the other two predictor variables: Visual-Motor and Rigidity-Motor, no significant differences were found according to the type of group to which the participants belonged.

Comparative analysis of predictor variables for the age variable

The comparative data for the age variable, found using the Tukey test for the Social- Communication (sig: .00) and Rigidity- Motor (sig: .00) variables, and the Games-Howell test for Cognition (sig: .25) and Visual- Motor (sig: .86), are shown in Table 6.

Table 6. Multiple Comparisons to Age.

DV		(I) Age	(J) Age	Difference (I-J)	Std. Error	Sig.
Social-Communication	Tukey HSD	2-5.9	6- 9.9	.40	.22	.35
			10-13.9	1.29	.25	.00
			14-17.9	1.05	.30	.00
			>18	.93	.25	.00
		6- 9.9	2-5.9	-.40	.22	.35
			10-13.9	.88	.26	.00
			14-17.9	.65	.31	.22
			>18	.52	.26	.27
		10-13.9	2-5.9	-1.29	.25	.00
			6- 9.9	-.88	.26	.00
			14-17.9	-.23	.33	.95
			>18	-.36	.29	.73
		14-17.9	2-5.9	-1.05	.30	.00
			6- 9.9	-.65	.31	.22
			10-13.9	.23	.33	.95
			>18	-.12	.33	.99
		>18	2-5.9	-.93	.25	.00
			6- 9.9	-.52	.26	.27
			10-13.9	.36	.29	.73
			14-17.9	.12	.33	.99
Cognition	Games-Howell	2-5.9	6- 9.9	-.23	.20	.78
			10-13.9	.07	.22	.99
			14-17.9	-.02	.27	1.00
			>18	-.57	.28	.25
		6- 9.9	2-5.9	.23	.20	.78
			10-13.9	.30	.23	.69
			14-17.9	.20	.27	.94
			>18	-.34	.28	.75
		10-13.9	2-5.9	-.07	.22	.99
			6- 9.9	-.30	.23	.69
			14-17.9	-.10	.29	.99
			>18	-.65	.30	.22
		14-17.9	2-5.9	.02	.27	1.00
			6- 9.9	-.20	.27	.94
			10-13.9	.10	.29	.99
			>18	-.55	.34	.49
		>18	2-5.9	.57	.28	.25
			6- 9.9	.34	.28	.75
			10-13.9	.65	.30	.22
Visual Motor	Games-Howell	2-5.9	6- 9.9	-.17	.21	.93
			10-13.9	-.15	.24	.97
			14-17.9	-.38	.30	.71
			>18	-.02	.23	1.00
		6- 9.9	2-5.9	.17	.21	.93
			10-13.9	.02	.25	1.00
			14-17.9	-.20	.30	.95
			>18	.14	.24	.97
		10-13.9	2-5.9	.15	.24	.97
			6- 9.9	-.02	.25	1.00
			14-17.9	-.23	.33	.95
			>18	.12	.27	.99

		14-17.9	2-5.9	.38	.30	.71
			6- 9.9	.20	.30	.95
			10-13.9	.23	.33	.95
			>18	.35	.32	.80
		>18	2-5.9	.02	.23	1.00
			6- 9.9	-.14	.24	.97
			10-13.9	-.12	.27	.99
			14-17.9	-.35	.32	.80
Rigidity-Motor	Tukey HSD	2-5.9	6- 9.9	.11	.12	.89
			10-13.9	-.19	.14	.64
			14-17.9	-,15	.16	.90
			>18	-.23	.14	.48
		6- 9.9	2-5.9	-.11	.12	.89
			10-13.9	-.30	.14	.22
			14-17.9	-.26	.17	.55
			>18	-.34	.14	.13
		10-13.9	2-5.9	.19	.14	.64
			6- 9.9	.30	.14	.22
			14-17.9	.04	.18	.99
			>18	-.03	.16	1.00
		14-17.9	2-5.9	.15	.16	.90
			6- 9.9	.26	.17	.55
			10-13.9	-.04	.18	.99
			>18	-.08	.18	.99
		>18	2-5.9	.23	.14	.48
			6- 9.9	.34	.14	.13
			10-13.9	.03	.16	1.00
			14-17.9	.08	.18	.99

As can be seen, significant differences are only found for the variable that makes up the first step of the regression equation: Social- Communication, between the group of the interval 2- 5.9 yoin relation to the age intervals: 10- 13.9 yo (sig: .00), 14- 17.9 (sig: .00) and the age interval: >18 yo (sig: .00). Likewise, significant differences were found between the age interval between 6- 9.9 yo and 10- 13.9 yo (sig: .00).

Comparative analysis of predictor variables according to the sex variable

The sex variable is composed of two values (0: male, 1: female), so the comparative analysis was performed using the t-test for independent samples, which, according to Levene's test, is calculated considering equality of variances for the variables Social- Communication (sig: .32), Cognition (sig: .69) and Rigidity- Motor (sig: .63), while not assuming this equality for the variable Visual- Motor (sig: .03) (see Table 7).

Table 7. Independent samples test to sex variable.

		Levene's Test		t-test for Equality of Means				
		F	*Sig.*	*t*	*df*	*Sig. 2-Tail*	*Mean Difference*	*Std. Error Difference*
Social-Communication	Equal variances assumed	.96	.32	-1.16	260	.24	-.31	.27
Cognition	Equal variances assumed	.16	.69	-2.07	26	.03	-.45	.22
Visual- Motor	**Equal variances not assumed**	4.37	.03	.81	51,19	.42	.20	.24
Rigidity- Motor	Equal variances assumed	.23	.63	-.09	26	.92	-.01	.13

Indeed, as can be seen, the sig. 2- Tail level for the variables is significantly different only for the variable Cognition (sig: .03), while for all the other predictor variables, the data obtained are independent of the type of sex of the participants: Social- Communication (sig: .24), Visual- Motor (sig: .42) and Rigidity- Motor (sig: .92).

Limitations of the study

Indeed, the results should be interpreted with some caution, since outliers are found, so the distribution does not resemble a distribution adjusted to a normal probability model, due to the presence of very extreme values, which are explained by the significant differences found for the ASD-3 analysis group, especially concerning the median found in the Social-Communication variable, which is the highest R-value of the prediction analysis. It would also be necessary to corroborate this data with larger samples.

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IV. Discussion

Mazefsky, Collier, Golt&Siegle (2020) establish a link between the findings that relate the limitations of autism with deficits in the creation of neurocognitive nexus-node-relationships, which affects the entire human developmental system. Their research shows that the perceptual and stimulus coding abilities or capacities in people with ASD depend on the nature of those same stimuli. Thus, in the face of physical stimuli, of simple objectifiable actions, which demand a linear response, there are no differences between the group of people with ASD and the neurotypical group, but when these stimuli carry an overload of emotional-cognitive interpretation, then, evident differences are observed between the groups. In this case, people with ASD indicate significant limitations in processing the understanding of the stimulus and show selective difficulties in its correct interpretation or semantic integration of the learning target. This finding is consistent with the results obtained by Moore et al. (1997) and also Hubert et al. (2007) who also show significant selective deficits in understanding and responding to stimuli in people with ASD when the stimuli carry an added cognitive-emotional value, which was independent of the IQ or intellectual ability of people with ASD. These data are very important since they indicate that the deficits in the nodal-cognitive relationships, which hinder the learning process and the response to the contexts in people with ASD, are independent of their IQ or intellectual capacity, but are an intrinsic part of the symptomatic core that makes up the particular mode of psycho-neurological processing of information.

Therefore, the integrated deficits in the levels of perceptual-cognitive processing and the ability to establish relationships between information contents are the principles that characterize the basic differences between the experimental group of people with ASD in relation to the control group. These deductions allow us to affirm that there is no single variable affected in ASD, but rather a set of altered symptoms, which affect global development to a greater or lesser extent, depending on the level of ASD and the recurrent comorbid clinical associations with the disorder. In this sense, different developmental variables may be affected, such as motor development, visual-motor development, kinesthetic development, motor rhythm, behavioral disturbances, attention deficits, hyperactivity, the presence of schizotypal traits, anxiety or depressive processes, eating and/or sleep problems and/or the presence of other severe clinical disturbances, such as epilepsy.

Thus, intervention programs must be adjusted to these particular characteristics. If this persistent correlation of some or several of these symptoms with the core disorder of ASD is true, then the specific reactions of people with ASD will also be particular, analogous to the limitations of the interpretation and coding they perform on the stimuli. Indeed, Carole, da Fonseca, Santos, Moore, Monfardini&Deruelle, C. (2008) show that people with ASD significantly increase their susceptibility to perseveration of situations perceived as negative or distressing or entailing negative consequences as a consequence of interaction in the context of people with ASD. Indeed, Gotham et al. (2015), Keenan et al. (2018), Mazefsky, Pelphrey& Dahl (2012), and Tottenham et al. (2014) suggest that people with ASD evidence a considerable increase in neural reactions to perceived negative stimuli in the contextual environment with which they interact, compared to the neurotypical control group, which, in turn, may have severe consequences on their mental health, with an increase in severe depressive symptomatology. In fact, empirical evidence suggests that people with ASD experience increased neural reactions precisely because specific brain regions in people with ASD are more susceptible than in the control group, observed by amygdala neural activity, through MRI measures (Gotham et al., 2018; Keenan et al., 2018; Siegle et al., 2015; Siegle, Steinhauer, Thase, Stenger & Carter, 2015).

In summary, this symptomatic process is largely related to the particular mode of cognitive information processing, which requires a highly specific programmed intervention that facilitates gradual development and can reduce the perverse effects of an inadequate programmatic application.

For this, it is necessary to obtain positive reinforcement in the context of the learning activities, to reduce the consequences of the global perseverance affected in individuals with ASD, so that learning must design contexts per the potentialities and previous capacities of students with ASD, to facilitate a positive response, which becomes the best reinforcement of their learning. Subsequently, this process is repeated in different contexts with an increase in the level of difficulty, according to the particular development of prior knowledge and the capacity for the establishment of relationships between new knowledge and previously learned knowledge.

V. Conclusion

The recurrent conceptual hypotheses on the ASD category are confirmed in this study. Indeed, ASD is related to the presence of the criteria symptomatic groups collected by APA (2013, ob. cit.), related to the presence of deficits in communication and social interaction, but, in addition, the presence of alterations compatible with perceptual-cognitive processing is confirmed, which constitutes the second step of the predictive model, which is related to the particular ability to perceive, encode, analyze, relate and retrieve the target information for learning. In people with ASD, there are severe limitations in the development of nodal-synaptic relationships between the information stored in the semantic memory (permanent memory) and the new incoming information, which hinders the spontaneous retrieval of information when it is demanded in different contexts, as well as determines deficits in the ability to make inductions and deductions and/or apply the processes of generalization of learned processes to new situations.

The third and fourth steps of the regression equation are shaped by the evidence of associated comorbid processes in people with ASD, which are related to visual-motor coordination and global motor rigidity. Indeed, the current DSM-5 Diagnostic Classification makes explicit the presence of stereotyped and restrictive behaviors in people with ASD but does not accredit the presence of a global structure related to motor rigidity, which so significantly affects the global psychomotor system. For this reason, this finding is very novel for the symptomatological consideration of autism. And, possibly, it is the presence of this structural rigidity that justifies the presence of the criterion stereotyped behaviors objectified in the DSM-5; however, the presence of symptoms related to stereotyped behaviors varies greatly depending on the level of diagnosis of ASD, while global motor rigidity is a basic predictor par excellence, collected in this study, and should therefore be incorporated into the explanatory hypotheses of the disorder.

Although the sample indeed indicates extreme outliers, which indicates some caution with the interpretation of the data, this dispersion is due to the extreme data found in the participants of the ASD-3 group and also slightly in the ASD-2 group, which disperses the scores significantly in relation to the ASD-1 group, so that the data, although they should be taken with some caution, should be included for future research on the conceptual category and explanatory hypotheses of the diagnosis of people with ASD.

These conclusions have a decisive influence on the type of intervention programs for the development of people with ASD. Indeed, intervention plans should consider the new conceptual category of ASD from a global perspective, which in addition to the guidelines for the development of the criteria contained in the current Classification, it is necessary to promote the integral development in the cognitive area, which encompasses the different psycho-neurological processes of information: 1) perception, 2) encoding, 3) relational processes, 4) semantic storage, and 5) information retrieval, under the perspective of the development of positive learning contexts. In addition, these actions should be complemented with the development of cognitive-motor flexibility, as well as with other associated comorbid relationships, to respond in a systemic way to the set of diagnosed general symptoms.

References

[1]. Alexander, A. L., Lee, J. E., Lazar, M., Boudos, R., DuBray, M. B., Oakes, T. R., ... &Lainhart, J. E. (2007). Diffusion tensor imaging of the corpus callosum in autism. Neuroimage, 34, 61- 73. DOI: 10.1016/j.neuroimage.2006.08.032

[2]. American Psychiatric Association. (2013). Diagnostic and Statistical Manual of Mental Disorders- DSM-5 (5th ed.). American Psychiatric Publishin. https://www.psychiatry.org/psychiatrists/practice/dsm

[3]. Barnea-Goraly, N., Lotspeich, L. J., & Reiss, A. L. (2010). Similar white matter aberrations in children with autism and their unaffected siblings: a diffusion tensor imaging study using tract-based spatial statistics. Archives of General Psychiatry, 67, 1052-1060. DOI: 10.1001/archgenpsychiatry.2010.123

[4]. Barttfeld, P, Wicker, B., Cukier, S., Navarta, S., Lew, S, Leiguarda, R., &Sigman, M. (2012). State-dependent changes of connectivity patterns and functional brain network topology in autism spectrum disorder. Neuropsychologia, 50, 3653-3662. journal homepage: www.elsevier.com/locate/neuropsychologia

[5]. Barttfeld, P., Wicker, B., Cukier, S., Navarta, S., Lew, S., &Sigman, M. (2011). A big-world network in ASD: dynamical connectivity analysis reflects a deficit in long-range connections and an excess of short-range connections. Neuropsychologia, 49, 254-26. DOI: 10.1016/j.neuropsychologia.2010.11.024

[6]. Bertone, A., Hanck, J., Kogan, C., Chaudhuri, A., & Cornish, K. (2010). Associating neural alterations and genotype in Autism and Fragile X Syndrome: incorporating perceptual phenotypes in causal modeling. J Autism Dev Disord, 40, 1541-1548. DOI: 10.1007/s10803-010-1110-z

[7]. Carmo, J. C., Duarte, E., Souza, C., Pinho, S., & Filipe, C. N. (2017). Brief Report: testing the impairment of initiation processes hypothesis in Autism Spectrum Disorder. J Autism Dev Disord, 47, 1256-1260. DOI 10.1007/s10803-017-3031-6

[8]. Carole, P., da Fonseca, D., Santos, A., Moore, D. G., Monfardini, E., &Deruelle, C. (2008). Recognition of biological motion in children with autistic spectrum disorders. Autism, 12(3) 261-274. DOI: 10.1177/1362361307089520

[9]. Cohen, I.L. (1994). An artificial neural network analogue of learning in autism. Biological Psychiatry, 36, 5-20. DOI:10.1016/0006-3223(94)90057-4

[10]. Cohen, I.L. (1998). Neural network analysis of learning in autism. In D.J. Stein & J. Ludik (Eds.), Neural networks and psychopathology (pp. 274-315). New York: Cambridge University Press. DOI: 10.1017/CBO9780511547195.012

[11]. Courchesne, E., Redcay, E., Morgan, J. T., & Kennedy, D. P. (2005). Autism at the beginning: microstructural and growth abnormalities underlying the cognitive and behavioral phenotype of autism. Development and Psychopathology, 17, 577-597. DOI: 10.1017/S0954579405050285

[12]. Fletcher, P. T., Whitaker, R. T., Tao, R., DuBray, M. B., Froehlich, A., Ravichandran, C., … &Lagen, N. (2010). Microstructural connectivity of the arcuate fasciculus in adolescents with high-functioning autism. Neuroimage, 51, 1117-1125. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2966943/

[13]. Gotham, K. O, Marvin, A. R., Taylor, J. L., Warren, Z., Anderson, C. M., Law, P. A., … & Lipkin, P. H. (2015). Characterizing the daily life, needs, and priorities of adults with autism spectrum disorder from interactive autism network data. Autism, 19(7), 794-804. DOI: 10.1177/1362361315583818

[14]. Gotham, K. O., Siegle, G. J., Han, G. T., Tomarken, A. J., Crist, R. N., Simon, D. M., &Bodfish, J. W. (2018). Pupil response to social-emotional material is associated with rumination and depressive symptoms in adults with autism spectrum disorder. PLOS ONE, 13(8). https://doi.org/10.1371/journal.pone.0200340

[15]. Hubert, B., Wicker, B., Moore, D. G., Monfardini, E., Duverger, H., da Fonseca, D., &Deruelle, C. (2007). Recognition of emotional and non-emotional biological motion in individuals with Autistic Spectrum Disorders. Journal of Autism and Developmental Disorders 37, 1386-92. DOI: 10.1007/s10803-006-0275-y

[16]. James W. Tanaka, J. W., & Andrew Sung, A. (2016). The ''Eye Avoidance'' hypothesis of Autism face processing. J Autism Dev Disord, 46, 1538- 1552. DOI: 10.1007/s10803-013-1976-7

[17]. Keenan, E. G., Gotham, K., & Lerner, M. D. (2018). Hooked on a feeling: repetitive cognition and internalizing symptomatology in relation to autism spectrum symptomatology. Depression, 22(7), 814-824. https://doi.org/10. 1177/1362361317709603

[18]. Keenan, E. G., Gotham, K., & Lerner, M. D. (2018). Hooked on a feeling: Repetitive cognition and internalizing symptomatology in relation to Autism Spectrum symptomatology. Depression, 22(7), 814–824. https://doi.org/10. 1177/1362361317709603

[19]. Kulp, M. T. (1999). Relationship between visual motor integration skill and academic performance in kindergarten through third grade. Optometry & Vision Science, 76(3), 159-163. DOI: 10.1097/00006324-199903000-00015

[20]. Marchena, A. de, Eigsti, I. M., Worek, A., Ono, K. E., &SnedekerJ. B. (2011). Mutual exclusivity in autism spectrum disorders: testing the pragmatic hypothesis. Cognition, 119, 96-113. journal homepage: www.elsevier.com/locate/COGNIT

[21]. Markman, E. (1990). Constraints children place on word learning. Cognitive Science, 14, 154- 173. https://doi.org/10.1207/s15516709cog1401_4

[22]. Markman, E. M., & Wachtel, G. F. (1988). Children´s use of mutual exclusivity to constrain the meanings of words. Cognitive Psychology, 20, 121-157. https://doi.org/10.1016/0010-0285(88)90017-5

[23]. Mazefsky, C. A., Collier, A., Golt, J., &Siegle, G. J. (2020). Neural features of sustained emotional information processing in autism spectrum disorder. Autism, 24(4), 941-953. sagepub.com/journals-permissions DOI: 10.1177/1362361320903137

[24]. Mazefsky, C. A., Pelphrey, K. A., & Dahl, R. E. (2012). The need for a broader approach to emotion regulation research in autism. Child Development Perspectives, 6(1), 92-97. https://doi.org/10.1111/j.1750-8606.2011.00229.x

[25]. McHale, K., & Cermak, S. A. (1992). Fine motor activities in elementary school: preliminary findings and provisional implications for children with fine motor problems. American Journal of Occupational Therapy, 46(10), 898-903. DOI: 10.5014/ajot.46.10.898

[26]. Moore, D.G., Hobson, R. P., & Lee, A. (1997). Components of Person Perception: an investigation with Autistic, Non-Autistic retarded and typically developing children and adolescents. British Journal of Developmental Psychology 15, 401-23.https://doi.org/10.1111/j.2044-835X.1997.tb00738.x

[27]. Ojea, M. (2018).Developmentalof conceptual categories in studentswithautismspectrumdisorder (Desarrollo de categorías conceptuales en estudiantes con trastorno del espectro autista). Madrid: Pirámide. PROGRAMA RELATEA. Desarrollo de categorías conceptuales en estudiantes con trastornos del espectro autista | Ediciones Pirámide (edicionespiramide.es)

[28]. Oliver, K. (2013). Visual, motor, and visual- motor integration difficulties in students with Autism Spectrum Disorders. Georgia State University Digital Archive @ GSU. https://scholarworks.gsu.edu/cgi/viewcontent.cgi?article=1095&context=cps_diss

[29]. Sanghavi, R., & Kelkar, R. (2005). Visual-motor integration and learning- disabled children. Journal of Indian Occupational Therapy, 27(2), 33-38. https://aiota.org/temp/ijotpdf/ibat05i2p33.pdf

[30]. Sheehan, K., Lowe, N., Kirley A, Mullins, C., Fitzgerald, M., Gill, M., &Hawi, Z. (2005). Tryptophan hydroxylase 2 (TPH2) gene variants associated with ADHD. Molecular Psychiatry 10, 944-949. DOI: 10.1038/sj.mp.4001698

[31]. Siegle, G. J., D´Andrea, W., Jones, N., Hallquist, M. N., Stepp, S. D., Fortunato, A.,… &Pilkonis, P. A. (2015). Prolonged physiological reactivity and loss: Association of pupillary reactivity with negative thinking and feelings. International Journal of Psychophysiology, 98(2), 310-320. https://doi. org/10.1016/j.ijpsycho.2015.05.009

[32]. Siegle, G. J., Steinhauer, S. R., Thase, M. E., Stenger, V. A., & Carter, C. S. (2002). Can't shake that feeling: Eventrelated fMRI assessment of sustained amygdala activity in response to emotional information in depressed individuals. Biological Psychiatry, 51(9), 693-707. https://doi.org/10.1016/S0006-3223(02)01314-8

[33]. Simmons, D.R., McKay, L., McAleer, P., Toal, E., & Robertson, A., &Pollick, F. E. (2007). Neural noise and autism spectrum disorders [ECVP Abstract]. Perception, 36 (Suppl.), 119-120. http://eprints.gla.ac.uk/29863/

[34]. Sizoo, B. B., van derGaag, R. J., & van den Brink, W. (2025). Temperament and character as endophenotype in adults with autism spectrum disorders or attention deficit/hyperactivity disorder. Autism, 19(4) 400-408. DOI: 10.1177/1362361314522352

[35]. Sizoo, B., van den Brink, W., Franke, B., Arias, A., van Wijngaarden- Cremers, P., & van derGaag, R. J. (2010). Do candidate genes discriminate patients with an autism spectrum disorder from those with attention deficit/hyperactivity disorder and is there an effect of lifetime substance use disorders? The World Journal of Biological Psychiatry, 11, 699-708.DOI: 10.3109/15622975.2010.480985

[36]. Tang, Y. Y., Rothbart, M.., & Posner, M. I. (2012). Neural correlates of establishing, maintaining, and switching brain states. Trends in Cognitive Sciences, 16, 330-337. DOI: 10.1016/j.tics.2012.05.001

[37]. Thomas, M. S. C., Davis, R., Karmiloff-Smith, A. Knowland, V. C. P., & Charman, T. (2016). The over-pruning hypothesis of Autism. Developmental Science, 19(2), 284-305. DOI: 10.1111/desc.12303

[38]. Tottenham, N., Hertzig, M. E., Gillespie-Lynch, K., Gilhooly, T., Millner, A. J., & Casey, B. J. (2014). Elevated amygdala response to faces and gaze aversion in autism spectrum disorder. Social Cognitive and Affective Neuroscience, 9, 106-117. https://doi.org/10.1093/scan/nst050

[39]. Zikopoulos, B., &Barbas, H. (2010). Changes in prefrontal axons may disrupt the network in autism. Journal of Neuroscience, 30, 14595-14609. https://www.jneurosci.org/content/30/44/14595