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Interrelations between Perceptive-Cognitive Factors and Behavioural Variables to Level Diagnosis of People with Autism Spectrum Disorder

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ABSTRACT

Relationships analysis between perceptual-cognitive factors and behavioural variables it makes up autism spectrum disorder (ASD) differential specific diagnosis, constitute a fundamental recurrent of currently research, then found data allow the construction of integrated evaluation scales to validate more complete and reliable diagnosis of people with ASD.

The interdimensional diagnostic Scale has been applied and coded for 10 dimensions: 1) conceptual units, 2) signifiers, 3) hierarchy, 4) nodal relationships, 5) categorical relationships, 6) Recovery, 7) social interaction, 8) social communication, 9) stereotypical behaviours, and 10) restrictive behaviours.

A total of 75 participants with ASD have participated in this study of three ASD´ intensity levels and different age intervals, from 3 years old.

Data analyses focused along study the *factorial analysis determinant* (*KMO and Bartlett's test*) statistic, as well as, *bivariate correlations analysis* for three dimensions calculated statistically: "processing", "social" and "behaviours", show significant critical inter-relational levels (sig: .00), which allows conclude to existence of highly relationships between both variables group and their practical applications for consequent, reliable and valid diagnosis process.

Finally, the statistical data of your application to perform the level diagnostic analysis is completed, through corresponding statistical percentage, means and standard deviations, to facilitate the ASD level 1-2-3 diagnostic way.

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KEYWORDS: Autism Spectrum Disorder, Processing, Cognitive- Perceptive, Diagnostic.

INTRODUCTION

Conceptual revision of 5th International Classification (DSM-5) of American Psychiatric Association [APA] (2013) categorizes diagnostic group of people with ASD as multilevel disorder, adjusted to strictly behavioural clinical symptoms set, regarding presence of deficits into social interaction, social communication and stereotyped and restrictive behaviours, which are specified along three levels or degrees of intensity of needs or types of needy human and/or technological help, from mild needs (level 1) to specific very highly needs help (level 3).

The attendance of these limitations, considered conceptually as specific permanent needs and mediated human and/or technological supports required, don´t develop unilaterally, but rather, successively, interrelate with other set of basic psychological-neurological parameters it make up perceptual-cognitive processing regarding to skills of perception, comprehension, coding and recovery of information over social context; hence, both restrictive and stereotyped behavioural consequences and perceptual-cognitive processing special model relate highly and influence over criteria specific clinical set of ASD (Cain & Oakhill, 2007; Stothers & Cardy, 2012).

This particularity extends throughout psycho-neurological processing, in relation to perceptual processing characteristics, regarding three levels or degrees of ASD´ intensity, whose basic perceptive- cognitive specific processes aspects are:

1) Partial or local bias about cognitive attribution of perceived concepts and categories.
2) Severe limitations about development of nodes and interrelated relationships between currently perceived information and previously learned concepts along socio-personal learning context.

Thereby, cognitive specificities affect from same perceptive-receptive process of contextual stimuli to information recovery from permanent memory or long-term memory. Throughout information processing, creation of links

between concepts and categories is especially particular functioning.

Nodes or links creation depends cognitive attributions made, which are greatly determined by attribution explicit system, external stimuli attribution and basic assumptions of Theory of Mind attributions, regarding thoughts of other (Eigsti & Irvine, 2021), as well as limitations in imagination or fiction tasks to establish a simile with reality that facilitates symbolic understanding and local processing bias, which prioritizes particular concepts over global information processing (Lawrence, Collyer & Poulson, 2021; Nyström, Jones, Darki, Bölte & Falck-Ytter, 2021), that are more susceptible to interference of applied distractors during the perceptual processing owing tendency of weak-type central coherence cognition (Baisa, Mevorach & Shalev, 2021; Mottron, Dawson, Soulieres, Hubert, & Burack, 2006).

The most recently research related suggests, then, that information processing cognitive network includes three partially independent cerebral subsystems:

1) Subsystem formed by temporal lobe, which is involved in links creation for memory recovery of previously learned concepts.
2) Dorsal medial prefrontal cortex subsystem, involved in social area tasks and social communication.
3) Anterior medial prefrontal cortex subsystem, which relates and joins the other two subsystems.

Neurobiological assumptions of currently research data shows greater modulation of network locally owing reduced connection between the previous subnetworks (Bathelt & Geurts, 2021), which concludes with deficits and particularities in brain networks or neural nodes interconnected creation, with basic goal facilitate information flow effectively. Therefore, focus over information local details of people with ASD may not be cause, a consequence of these connective limitations found (Buckner & DiNicola, 2019; Padmanabhan, Lynch, Schaer, & Menon, 2017).

Consequently, perceptual-cognitive processing is based on semantic understanding of information (Ojea & Tellado, 2018), which is developed from conceptual information encoded and stored in long-term memory or semantic permanent memory (Bennet et al., 2015; Botting & Adams, 2005; Brignell, Williams, Jachno, Prior, Reilly & Morgan, 2018; Cronin, 2014; Kelley, Paul, Fein & Naigles; 2006); as well as, specific consequences important atypical way along perceptual perceptive- sensory processing in people with ASD. This symptomatic criteria set is specified in restrictive behaviors hierarchized in DSM-5 classification it have been studied and related with sensorial restrictive processing (Robertson y Baron-Cohén, 2017; Falck-Ytter, Nyström, Gredebäck, Gliga, & Bölte, 2018; Nyström, Jones, Darki, Bölte, & Falck-Ytter, 2018).

These theoretical principles should allow conclude the criterial dimensions of current diagnostic process of ASD included in DSM-5 classification should be corrected and revised, with general aim to incorporating the perceptual-cognitive factorial semantic elements, which underlie to ASD´ considerations diagnoses, but nor remove restrictive and stereotyped behaviours criteria currently included in diagnostic whole.

Agreement with theoretical hypotheses, in this study has designed two basic main aims: 1) to analyse the relationships between perceptual-cognitive factors and the behavioural criterial dimensions specified in DSM-5 classification, regarding dimensions of social interaction and communication reciprocal social and restrictive and stereotyped behaviours, and 2) to delimit the ASD' level diagnosis, according processing and behavioural dimensions.

METHOD

Research design.

Research design constitutes an experimental study based on perceptual-cognitive and behavioural variables analysis, through psychometric tests, analysed according to SPSS statistics, v. 23.

Likewise, the statistical data of your application to perform the level diagnostic analysis is completed.

Participants.

A total of 75 participants with ASD´ previous diagnosis get involved in this study, from three levels or degrees of disorder and also from different age intervals (see Table 1).

Table 1: Participants (N: 75).

y-o	3-6.9	7-10.9	11-13.9	14-17.9	>18	Total
ASD-1	5	19	8	4	2	38
ASD-2	6	8	4	4	2	24
ASD-3	4	2	5	2	0	13
TOTAL	15	29	17	10	4	**75**

As indicated, data found to people with three levels of ASD, from 3 y-o, of which, 15 are between 3 and 6.9 y-o, 29 between 7 and 10.9 y-o, 17 between 11 and 13.9 y-o, 10 between 14 and 17.9 y-o and 4 participants over 18 y-o.

There´re 38 participants with ASD´ level- 1, 24 with ASD´ level- 2 and 13 participants have diagnosis of ASD´ level- 3.

Variables

Study made up the analysis of ten dynamic quantitative variables and two fixed variables, which, two fixed variables are: 1) "group" (ASD´ level), and 2) "age" (different age intervals), and ten dynamic variables operationalized according to perceptual-cognitive and behavioural specificities, as predictors of ASD people diagnosis specificity:

1. "Comprehension": Understanding of conceptual-categorical units and attribution of fiction and imagination abilities.
2. "Meaning": Reconstruction of significant and cognitive attribution of fiction and imagination abilities.
3. "Hierarchization": Hierarchization ability of concepts units and their conceptual categories.
4. "Inter-concepts": Development of relationships-nodes between concepts units.
5. "Nodes": Development of relationships-nodes between conceptual and their categories and between categories.
6. "Recovery": Information recovery of semantic permanent memory.
7. "Interaction": Reciprocal social interaction abilities.
8. "Communication": Communication and language verbal- nonverbal abilities.
9. "Stereotypes": Stereotyped behaviours.
10. "Restrictive": Restrictive and sensory behaviours.

General data of means (μ) and standard typical deviations (σ) are observed to ten dynamic variables can be seen in Table 2.

Table 2: Variables and factors.

Variables	μ	σ
Group		
Age		
Comprehension	3.38	1.99
Meaning	3.41	1.79
Hierarchization	3.46	1.81
Inter-concepts	3.57	1.71
Nodes	3.89	2.05
Recovery	3.89	1.99
Interaction	3.57	1.77
Communication	3.49	1.94
Stereotypes	3.44	1.84
Restrictive	3.20	1.85

Also, to facilitate this analysis, variables were reduced to three basic general dimensions, which have been calculated statistically:

I. Dimension: "PROCESSING", which formed by following perceptual-cognitive variables: *Comprehension*, *meanings*, *hierarchy*, *inter-concepts*, *nodes* and *recovery*.
II. Dimension: "SOCIAL", formed by following variables: *Interaction* and *communication*.
III. Dimension: "BEHAVIOUR", formed by stereotyped and restrictive behaviours: *Stereotypies* and *restrictive*.

Data codification

The Scale has been applied and coded for 10 dimensions: 1) conceptual units, 2) signifiers, 3) hierarchy, 4) nodal relationships, 5) categorical relationships, 6) Recovery, 7) social interaction, 8) social communication, 9) stereotypical behaviours, and 10) restrictive behaviours (Ojea, 2023).

The dimensions have been coded with five values, from 0- 4, being 0 (no deficit) and 4 (severe deficit).

The direct data are converted into averages, the means of which decide the ASD´ level diagnosis according group way.

Procedure

Evaluation process of variables elaborated, as well as, subsequent coding process. Later, data resulting from diagnoses calculated allowed obtaining results of interrelationships analysis between variables group reduced in three dimensions: "processing" (perceptive- cognitive processing), "social" (interaction and communication social) and "behaviour" (restrictive and stereotyped behaviours).

Finally, the average statistical regarding to the diagnostic conclusion of the ASD level is indicated.

RESULTS

Data reliability

All variables have been subjected to reliability analysis to check empirical reliability and statistical validity.

Results allow observe significantly high levels of reliability in all study analysis items, calculated throughout means of *Cronbach´s Alpha (α)* (see Table 3).

Table 3: Cronbach´s Alpha for variables.

VARIABLES	***μ***	***σ²***	***α***
Group	65.52	960.62	**.92**
Age	64.74	1013.01	**.93**
Comprehension	62.80	890.11	**.91**
Meaning	62.78	900.98	**.91**
Hierarchization	62.72	900.09	**.91**
Inter-concepts	62.62	903.63	**.91**
Nodes	62.30	884.61	**.91**
Recovery	62.30	884.79	**.91**
Interaction	62.62	897.79	**.91**
Communication	62.70	888.84	**.91**
Stereotypes	62.75	906.72	**.91**
Restrictive	62.99	929.23	**.92**

In effect, mean global of reliability find out *Cronbach´s Alpha*: .92, standardized level (*α*): .97, which indicates the data respond significantly to valid analysis and intrinsically reliable, which advantages empirical study results.

Similarly, reliability analysis for calculated dimensions *Cronbach´s Alpha* shows significant mean level (*α*): .93, which allows deducing a statistically significant study whole validity (see Table 4).

Table 4: Cronbach´s Alpha for dimensions.

DIMENSIONS	***μ***	***σ²***	***α****
PROCESSING	47.81	512.69	**.96**
SOCIAL	60.87	842.67	**.91**
BEHAVIOR	61.15	871.16	**.91**

Factor analysis: Determinant statistical.

The correlation level and statistical sphericity interdimensional have been found, through a *factorial analysis* is carried out. *Determinant* statistic of *factorial analysis* shows significant level near zero: .03, which implies that dimensions analysed are significantly well interrelated: processing, social and behaviour.

Bartlett's sphericity test also corroborates that magnitudes of partial correlation coefficients found are highly significant relationships inter three dimensions calculated (Sig: .00) (see Table 5).

Table 5: Factor analysis

KMO and Barlett´s test		
Kaiser-Meyer-Olkin.		.66
Bartlett sphericity	Chi^2	249.96
	Df.	3
	Sig.	.00

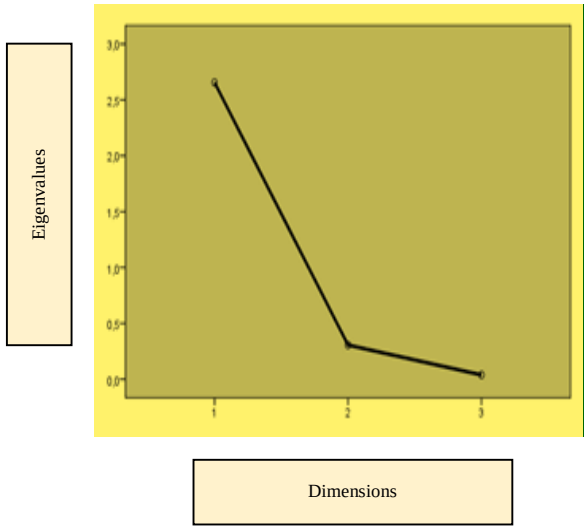
In this sense, variance-covariance correlation matrix, included to three analysis dimensions indicates it only finds one eigenvalue greater at 1, which explains 88.52% of dimensional model variance. Second component gets 98.71% accumulated, and 100% accumulated with third component over initial eigenvalues are observed (see Table 6).

Table 6: Total variance

Component	*Initial eigenvalues*			*Squared saturations sum*		
	Total	*% Variance*	*% Accumulated*	*Total*	*% Variance*	*% Accumulated*
1	2.65	88.52	88.52	2.65	88.52	88.52
2	.30	10.19	98.71			
3	.03	1.28	100.00			

Extraction method: Principal component analysis.
Indeed, covariance matrix results are reflected in sedimentation graph (see Graph 1), in which a significant difference can be seen between first and second component, while, subsequently, there´s certain regularity with third main component.

Graph 1: Eigenvalues sedimentation.



Correlations between semantic and behavioural dimensions.
Bivariate correlations between three dimensions corroborate the *determinant* statistical. Highly significant critical significance levels are found, which substantially improves the inter- relational analysis for study dimensions (see Table 7).

Table 7: Bivariate correlations

DIMENSIONS		**PROCESSING**	**SOCIAL**	**behaviour**
PROCESSING	*r*	1	.95**	.73**
			.00	.00
SOCIAL	*r*		1	.79**
				.00
BEHAVIOR	*r*			1

****Significant correlation to level: .01.**

Indeed, correlations analysis corroborates that, to bilateral significance levels (sig.): .01, significant critical levels, Pearson's *r*: .95 between processing dimension and social dimension, and *r*: .73 to behaviour dimension, as well as, Pearson's *r*: .79 between social and behaviour dimensions.

Transformation of the Scale coding.
The coding of the data corresponding to the 10 dimensions has been able found the following statistical average percentage data, according to the group type (see Tables 8-10)

Table 8: Coding transformation for ASD Level-1.

		PROCESSING	***SOCIAL***	***BEHAVIOUR***	***TOTAL μ***
PERCENTILES	**5**	6.33	2.00	.00	2.77
	10	8.33	2.00	.00	3.44
	15	8.33	2.85	.00	3.72
	20	10.33	3.00	2.60	5.31
	25	10.33	3.00	3.00	5.44
	30	10.33	3.00	3.00	5.44
	35	10.33	3.00	3.00	5.44
	40	10.33	3.00	3.00	5.44

	45	10.33	3.00	3.00	5.44
	50	10.33	3.00	3.00	5.44
	55	10.33	3.00	3.00	5.44
	60	10.33	3.00	3.00	5.44
	65	10.33	3.00	4.00	5.77
	70	10.43	3.00	5.00	6.14
	75	11.08	3.00	5.00	6.36
	80	12.73	3.00	5.20	6.97
	85	15.26	6.00	6,00	9.08
	90	20.66	6.00	6,00	10.88
	95	20.66	6.00	6,00	10.88
μ		11.56	3.34	3,34	6.08
σ^2		14.33	1.47	3,74	6.52
σ		3.78	1.21	1.93	2.31

Table 9: Coding transformation for ASD Level-2.

		PROCESSING	***SOCIAL***	***BEHAVIOUR***	***TOTAL μ***
PERCENTILES	**5**	12.66	3.00	3.00	6.22
	10	13.66	3.50	4.00	7.05
	15	14.66	4.00	5.00	7.88
	20	18.66	6.00	5.00	9.88
	25	19.16	6.00	5.00	10.05
	30	20.66	6.00	5.00	10.55
	35	20.66	6.00	5.00	10.55
	40	20.66	6.00	5.00	10.55
	45	20.66	6.00	6.00	10.88
	50	20.66	6.00	6.00	10.88
	55	20.66	6.00	6.00	10.88
	60	20.66	6.00	6.00	10.88
	65	20.66	6.00	6.00	10.88
	70	20.66	6.00	6.00	10,88
	75	20.66	6.00	6.00	10,88
	80	20.66	6.00	6.00	10,88
	85	25.50	9.00	9.00	14.5
	90	27.00	9.00	9.00	15
	95	30.00	9.00	9.00	16
μ		20.47	6.08	5.91	10.82
σ^2		17.90	2.68	2.68	7.75
σ		4.36	1.63	1.63	2.54

Table 10: Coding transformation for ASD Level-3.

		PROCESSING	***SOCIAL***	***BEHAVIOUR***	***TOTAL μ***
PERCENTILES	**5**	29,33	9.00	6.00	14.77
	10	30,00	9.00	6.00	15
	15	31,00	9.00	6.10	15.36
	20	31,00	9.00	6.80	15.6
	25	31.00	9.00	7.00	15.66
	30	31.00	9.00	7.20	15.73
	35	31.00	9.00	7.90	15.96
	40	32.40	9.00	8.00	16.46
	45	33.33	9.00	8.30	16.87

	50	33.l3	9.00	9.00	17.11
	55	33.33	9.00	9.00	17.11
	60	34.13	9.00	9.00	17.37
	65	35.33	9.00	9.00	17.77
	70	35.33	9.00	9.00	17.77
	75	38.33	10.50	9.00	19.27
	80	41.33	12.00	9.20	20.84
	85	41.33	12.00	9.90	21.07
	90	41.33	12.00	11.20	21.51
	95	41.33	12.00	12.00	21.77
μ		34.46	9.69	8.38	17.52
σ^2		18.4	1.73	2.75	7.64
σ		4.29	1.31	1.66	2.42

Finally, it is possible to conclude with the level of diagnosis of ASD (see Table 11), regarding to systemic interrelation of the dimensions studied.

Table 11: Diagnostic conclusions

APPROXIMATE MEAN SCORE (μ~)	*DIAGNOSTIC CONCLUSION*
(μ~) 6.08	**ASD-1**
(μ~) 10.82	**ASD-2**
(μ~) 17.52	**ASD-3**

CONCLUSIONS

Therefore, from integrated perspective the operationalized variables, conclusive data join perceptive-cognitive factorial parameters of psycho-neurological information processing characteristic of people with ASD with symptom and criterial groups included in specific behavioural responses, related to basic indicators of current international classification DSM-5 (Mayer, 2017; McCormick et al., 2016; Ojea, 2018; Uljarević et al., 2017; Wigham et al., 2015).

Hence, if only one criterial group is selected, many diagnoses, which haven´t specific behavioural symptom set since behavioural perspective, may induce diagnostic errors with clinical and educational consequences to integral development of people with ASD.

For this reason, evaluation analysis should be extended to explanatory factors of disorder, which, although it is no configure observable behavioural elements, make up highly characteristic process of ASD. These factors are related with highly particular perceptual-cognitive processing, and, above all, this consideration is achievable because both factors, perceptual-cognitive and memory processing variable and behavioural factor, complement each other to help explain complementary the specificities of ASD and, consequently, getting with more precisely this diagnosis.

As indicated in correlation levels and determinant analysis of factor analysis, indicated in the Results section, positive significant critical levels are observed between both dimensions, perceptual-cognitive dimensions and the behavioural parameters; thereby, can conclude the interactive goodness of diagnosis adjusts to basic elements that make up this disorder.

Consequently, reliability and statistical validity of disorder diagnosis are improved (Penner, Anagnostou, Andoni & Ungar, 2018), but, it´s necessary resource to using of scales and/or diagnostic tests that interrelate the factorial components that make up this disorder as a whole, both behavioural and intrinsic aspects.

In this sense, as it´s already included over current DSM-5 international classification, also the perceptual-cognitive intrinsic factors make up a highly particular psycho-neurological group within ASD peoples, which, above all, may be basic cause of behavioural criteria consequences of individuals with ASD.

Its main aim s be able to combining both main predictive components of ASD´ diagnosis along same evaluation scale would facilitate its specific evaluation, for which developing highly integrated tests and/or scales, must constitute the fundamental aims to diagnostic evaluation in currently research study relating autism area.

These aims are answered publication of integrated Scale is planned, which is formed by active- dynamic dimensions of this study. Scale is currently in editing process by Barcelona Editions, expected its publication for 2022.

This test includes the dimension of processing, social and behaviour within systemic and integrated perspective regarding **perceptual-cognitive** and behavioural functioning and, hence, facilitate diagnosis processes of people with ASD.

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