Available online at www.rajournals.in

RA JOURNAL OF APPLIED RESEARCH
ISSN: 2394-6709
DOI:10.47191/rajar/v8i3.01
Volume: 08 Issue: 03 March-2022

International Open Access

Impact Factor- 7.036

Page no.- 166-180

Perceptive-Cognitive Evolution in Students with Autism Spectrum Disorder from Inter-Conceptual-Nodes Learning

Manuel Ojea Rúa
University of Vigo
Orcid ID: https://orcid.org/0000-0002-9787-2520

ARTICLE INFO

Published Online:
01 March 2022

Corresponding Author:
Manuel Ojea Rúa

ABSTRACT

People with ASD present deficits to perceptual-cognitive neural relationships, which affect into perceptive- cognitive generalization processes, creativity, imagination, symbology, induction-deduction and conceptual-categorical understanding. However, DSM-5 classification basic diagnostic process just focus on behavioral symptoms criterial. For this reason, this research try answer following general aims: 1) verify Semantic Integration Scale (SIS) effectiveness to semantic perceptual-cognitive items measurement, 2) analyze hypothetical improvement along concepts and conceptual-categories understanding through relational link-nodes construction.

Results were found by multivariate comparative test of repeated measures and estimate-comparative post-hoc analysis. Pillai's Trace multivariate comparative specific test of repeated measures to Group* Program interaction indicates a significant critical level (Sig= .00), which allows conclude there´re significant differences between study groups (3), in which experimental group students that neural link-nodes learning get substantial improvement relating control groups (Sig= .00, Adjusted R squared= .316).

KEYWORDS: Autism Spectrum Disorder, Conceptual-Categorical, Perceptive-Cognitive, Semantic-Memory.

INTRODUCTION

According to American Psychiatric Association International Classification [APA] [1], people with Autism Spectrum Disorder (ASD) keep perceptual-cognitive limitations, which influence along perceptive- cognitive processing, specified regarding to deficits in two interactive dimensions and sub-dimensions according three different intensity levels:

I) Interaction and social communication dimension: 1) social relations, 2) joint reference abilities, 3) intersubjective and mentalist capacities, and 4) expressive and receptive communicative dimensions disorders.

II) Restricted behavior dimension: 1) anticipation, 2) flexibility, 3) activity meaning, 4) fiction and imagination, 5) imitation, and 5) suspension of activity initiated.

But, Mazurek, Lu, Macklin and Handen [2] analyze dimensional coding of this disorder symptoms classified to help along subsequent educational planning process pursuant to cognitive specifics needs, however the symptoms different levels categorized on DSM-5 international classification wasn´t empirically validated, therefore just with these criteria there´s short guidance to adjusting psycho- educational interventions.

Hence, inter-relational analysis between symptomatic levels, both perceptive-cognitive ability and information executive processing level could be one high predictor to determine the discriminant validity of symptoms regarding general deficits and, from these analysis, it´s possible can adopt specific right educational interventions to people with ASD [3]. In this sense, limitations indicated into DSM-5 diagnosis classification join interrelated way all basic psychological parameters, whose structure deficits is based conceptual description of ASD diagnosis, which settled about the understanding, encoding and information semantic recovery process levels, influencing along cognitive system as a whole. [4].

Also, Constable, Ring, Gaigg and Bowler [5] assess highly specific and differential study of ASD and Intellectual Disabilities (ID) diagnostic process and conclude that people with ASD show few difficulties in conceptual induction-deduction processes and the perceptual-conceptual categorization processes when content dimension include just one stimulus of learning context, unlike people with ID [6]. However, when different stimuli happen along learning

process, that need criterion cognitive hierarchical organization according, people with ASD show significant needs, which hard interfere over inter-relational analysis and over executive codification- prioritization of cognitive processing. These data also differs from specific needs of people with ID [7]. In synthesis, it´s possible conclude the perceptual-cognitive neural relationships are heavily limited deficits in people with ASD, which right affect to cognitive generalization processes, as well as creativity, imagination, symbology, induction-deduction and conceptual-categorical comprehension, which shape the activity of perceptive-cognitive neural processing.

Indeed, Kasirer and Mashal [8] relate information cognitive processing difficulties in people with ASD with problem-solving processes depending on perceptive-cognitive-executive planning and flexibility cognitive processes, which are cause of contents internalization, social understanding, cognitive mediation and conceptual- categorical relation ability. These cognitive hypotheses cause a substantially lower performance, both regarding concepts acquisition, as categories construction, likewise into subsequent recovery of information or permanent memory recovery capacity regarding, that shape another essential diagnostic difference, both normal-typical people, as well people with ID. For this reason, Lin, Ni, Tseng and Gau [9] conclude the cognitive processing needs are central symptoms of people with AS, regarding cognitive self-regulation actions and executive tasks develop, which differentially influence both emotional lability and anguish- anxiety levels, as well as impulsiveness, hyperactivity, frustration and tolerance of stimuli, which mostly interfere over educational and psychosocial development.

indeed, Eycke and Müller [10] point out the executive dysfunction theory is sharply disturbed in people with ASD and, hence, owing this processing particular way, all human basic psychological processes also are affected, above all regarding basic psychological processes of attention, imagination, creativity and induction-deduction, but, mostly, the relational links structure and conceptual- categorical significant relationships are highly affected [11].

Kim et al. [12] even carry out electrophysiological analysis of perceptive- cognitive executive functions processing relating error control in students with ASD in order predict conceptual academic performance, owing there´s empirical relationship between error control and academic skills development. In this study, traditional electrophysiological methods and have been used advanced timings combined with principal component analysis to get neural activity related to error control and prove its relationships with perceptive- cognitive performance. Mostly important conclusion allow deduce that, when error relating with negativity (ERN) is increased likewise if theta power of fronto-central error trials and error positivity (Pe) are enhanced, thus basic academic skill outcomes improvement are observed and, consequently, a positive Pe becomes a highly predictive statistical element of academic development. Authors show that perceptive-cognitive processing conforms an interactive whole of human neuro- psychological components.

Thereby, interactions complexity between ASD different levels progressively gets its influence on functionality of daily responses and actions, altering all interactive domains, both conceptual domain it´s related to perceptual-comprehensive processes, social domain which influences social interactions and perceptive- cognitive attribution, as practical- functional domain that´s shapes previously acquired autonomous skills. For this reason, it´s high necessary implement an exhaustive empirical measurement of perceptual-cognitive process regarding conceptual semantic understand processing it´s developed from information encoded inside long-term memory (LTM) or semantic information coding.

For this reason, Ojea and Tellado [13] develop Semantic Integration Scale (SIS) in order to get on processing of encoding and retrieval level on students with ASD and survey perceptual-cognitive processing level. Scale is structured along six sub-dimensions, according to perceptive-cognitive processing theories, whose empirical evidence was highly analysed (see Annex I). Kelley, Paul, Fein and Naigles [14] also carry out an investigation about the linguistic- semantic particularities in individuals with ASD compared to control group of normo-typical students and conclude that comparative data found in grammatical structure are imperceptible, but in pragmatic-semantic language are highly significant, in which students with ASD show severe limitations. Cronin [15], likewise, through a study carried out with children with high-functioning ASD show that relationship weren´t observed between oral phonological processes and conceptual information decoding, however, relationships between semantic comprehension , decoding processes and conceptual- categorical understanding processes were significant and concluding that semantic process constitutes an cognitive basic aspect to specific academic development of children with ASD. Botting and Adams [16] regarding comparative study realyzed, children with ASD got significantly lower performance in pragmatic semantic tasks related other two control clinical groups, both typical development group and communication disorders group. Bennet et al. [17] suggest the pragmatic- semantic domains are functionally associated to diagnostic process in preschool children with ASD and from this specific need analysis, personal development was improved significantly. Brignell, Williams, Jachno, Prior, Reilly and Morgan [18] also confirm that although oral-linguistic evolution doesn´t present significant differences, however development of conceptual decoding items and semantic-pragmatic-linguistic criteria did differ significantly within experimental and control groups.

Therefore, this research get two general **aims**: 1) prove SIS Scale effectiveness regarding the measures of semantic perceptual-cognitive integration processes, and 2) according

previously analysis, verify hypothetical improvement to construction of concepts and conceptual categories from inter-concepts relational nodes learning.

METHOD

Design

Research design is based on experimental study of students with ASD integrated on 3 groups according to programs applied: 1) concepts-categories construction without reinforcement (ORDINARY CONCEPT), 2) concepts-categories construction with adapted reinforcement (ADAPTED CONCEPT WITHOUT NODES), and 3) concepts-categories construction complemented with concept inter-relational (links- nodes) (ADAPTED CONCEPT WITH NODES). Groups were subjected to 3 measurements (programs: Understanding, Recovery and Relating) along 3 different times (total= 9 measures).

Participants

A total of 28 participants have participated in this study, whose general characteristics can be seen in Table 1, crossing Group variables with ASD way, Age, Sex and program´ measurement.

Table 1. ASD* Group* Age* Sex distribution (N= 28).

Sex	Age years	GROUPS	PROGRAMS	ASD			Total
				ASD1	ASD2	ASD3	
Guy	6-8	GROUP	ORDINARY CONCEPT	1	1	0	2
			ADAPTED CONCEPT WITHOUT NODES	3	0	0	3
			ADAPTED CONCEPT WITH NODES	4	0	1	5
	9-11	GROUP	ORDINARY CONCEPT	3	0		3
			ADAPTED CONCEPT WITHOUT NODES	3	0		3
			ADAPTED CONCEPTO WITH NODES	1	1		2
	12-14	GROUP	ORDINARY CONCEPT	2	0		2
			ADAPTED CONCEPT WITHOUT NODES	1	1		2
			ADAPTED CONCEPTO WITH NODES	1	0		1
	15- 18	GROUP	ORDINARY CONCEPT			1	1
			ADAPTED CONCEPT WITHOUT NODES			1	1
Girl	6-8	GROUP	ORDINARY CONCEPT	1			1
	9-11	GROUP	ADAPTED CONCEPTO WITH NODES	1			1
	15- 18	GROUP	ADAPTED CONCEPTO WITH NODES	1			1

As can be seen, ordinary program is made up of one group of 9 students with ASD, adapted program without relationships is made up of second group of 9 students with ASD and adapted program complemented with the learning of nodes or relations is formed by a third group of 10 students with ASD.

Variables

The study variables are the following, which corresponding values and codes can see on Table 2.

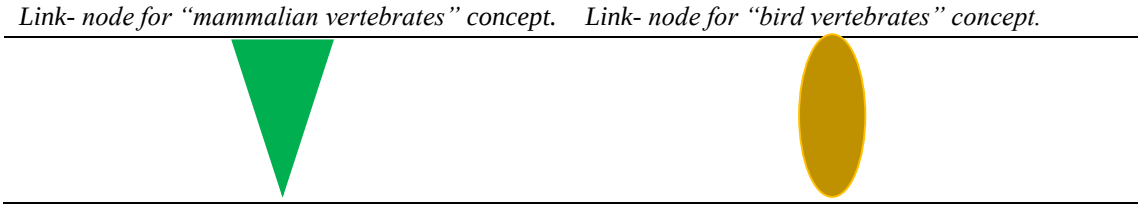
Table 2. Variables, values and codes.

Variables	Values	Codes
Group (3)	Ordinary Concept	0
	Adapted concept without nodes	1
	Adapted concepts with nodes	2
Program (3 times)	Understanding I-II-II	0-4
	RecoveryI-II-III	0-4
	Relating I-II-III	0-4
ASD	ASD-1	0
	ASD-2	1
	ASD-3	2
Age	6-8 years	0
	9-11	1
	12-14	2
	15-18	3
Sex	Guy	0
	Girl	1

Measurement variables: Understanding, Recovery and Relating, which have been evaluated along three measures throughout SIS Scale analysis processes. Likewise, third program regarding neural- nodes and relationships between concepts construction has structured according Ojea' categorical conceptual semantic integration program [19]. (see Annex II). Relationship program follows a structural process facilitating link creation of concept-categorical along intrinsic learning process. In this example, link-node is represented by green triangle associated with vertebrate mammal concept, while brown circular link-node is associated with vertebrate bird concept. Both nodes are codified to facilitate conceptual information recovery and, likewise, inter-concept and inter-categories relationships formation within semantic memory (see Figure 1). Activity way is adapted to curricular demands, age and competences of students.

Other two programs followed the traditional curriculum, the first doesn´t involve educational reinforcement development, second program is adapted program that implies a specific educational reinforcement to student needs previously assessed.

Figure 1. Relationships- nodes (see Annex II)



Procedure

This study develop along year 2021. First, students selection carried out to different groups in several educational centers, later measuring process began through SIS Scale. Students corresponding to 3 group which program with relational-nodes was applied, it carry out specific way along 1.30 hour time weekly sessions complementary to school.

Data analysis

Resulting data was found through ANOVA test of Repeated-Measures and Post-hoc Multiple-Comparisons for factors: Group and Program.

Interactive comparative data for ASD type, Age and Sex are also indicated.

RESULTS

Multivariate ANOVA test analysis data of repeated measures for 9 measures factor: Understanding (3), Recovery (3) and Relating (3) to Group variable (3) can be seen in Table 3.

Likewise, interactions of 9 measurements with Group * Program found to Age, Sex and ASD type variables can be observed.

Table 3. Multivariate tests.

Effect		Value	F	Hypothesis df	Error df	Sig.
PROGRAM	Pillai's Trace	.90	17.57(a)	8.00	15.00	.00
	Wilks' Lambda	.09	17.57(a)	8.00	15.00	.00
	Hotelling's Trace	9.37	17.57(a)	8.00	15.00	.00
	Roy's Largest Root	9.37	17.57(a)	8.00	15.00	.00
PROGRAM * GROUP	Pillai's Trace	1.28	3.61	16.00	32.00	.00
	Wilks' Lambda	.07	4.85(a)	16.00	30.00	.00
	Hotelling's Trace	7.16	6.27	16.00	28.00	.00
	Roy's Largest Root	6.44	12.87(b)	8.00	16.00	.00
PROGRAM * ASD type	Pillai's Trace	.70	4.39(a)	8.00	15.00	.00
	Wilks' Lambda	.29	4.39(a)	8.00	15.00	.00
	Hotelling's Trace	2.34	4.39(a)	8.00	15.00	.00
	Roy's Largest Root	2.34	4.39(a)	8.00	15.00	.00
PROGRAM * Age	Pillai's Trace	.31	.86(a)	8.00	15.00	.56
	Wilks' Lambda	.68	.86(a)	8.00	15.00	.56
	Hotelling's Trace	.46	.86(a)	8.00	15.00	.56
	Roy's Largest Root	.46	.86(a)	8.00	15.00	.56

PROGRAM * Sex	Pillai's Trace	.54	2.23(a)	8.00	15.00	.08
	Wilks' Lambda	.45	2.23(a)	8.00	15.00	.08
	Hotelling's Trace	1.19	2.23(a)	8.00	15.00	.08
	Roy's Largest Root	1.19	2.23(a)	8.00	15.00	.08

As can be seen, repeated measures model analysis exhibits, first, statistics associated with variances analysis of applied program found a significant critical level (Sig= .00), which indicates the 9 related measures changes have been meaningful along assessment times; secondly, Pillai's Trace data analyzed for Program* Group interactions indicate a significant difference variance data (Sig= .01). Other statistical found also significant level (Wilks´Lambda, Hotelling´s Trace, Roy´s Largest Root) (Sig= .00). These data show that there´re obvious differences between three different groups assigned to tthree programs type along successive measures.

Secondly, it´s observed that model interactions to ASD type indicate significant critical levels (Sig= .00), which allow deduce several programs found different result regarding student´ ASD way.

Finally, thirdly, other statistics of repeated measures in relation to Age and Sex relating Group* Program show non-significant critical values (Sig= .56 and Sig= .08 respectively); hence, programs not found differences owing these fixes variables.

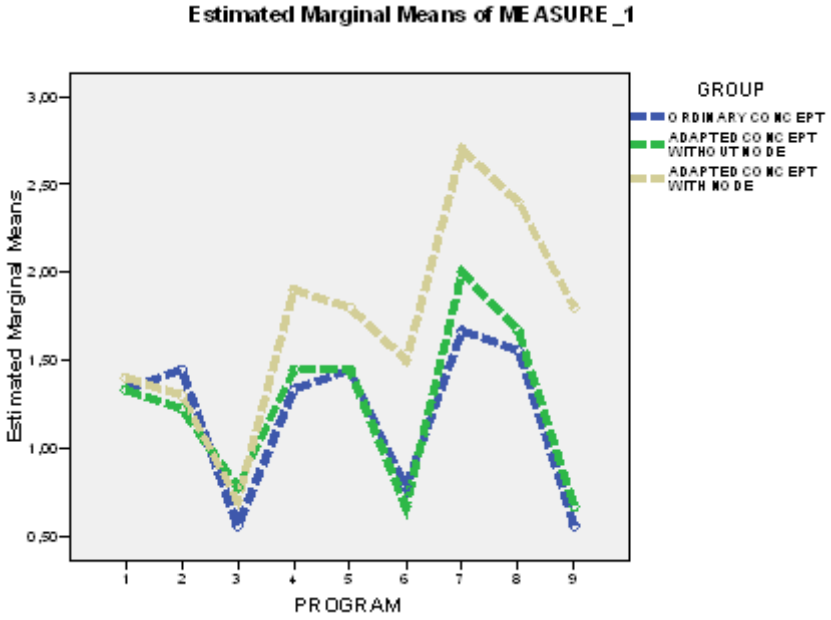
Likewise, Mauchly's sphericity contrast analysis (see Table 4) indicates that associated level is high significant (Sig= .00), Mauchly's W= .02, which allows deduce that variance-covariance matrix doesn´t is spherical, but matrix is susceptible to significant changes along measures evolution for different groups, comparing type of Program* Group.

Table 4. Mauchly's test.

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon(a)		
					Huynh-Feldt	Lower-bound	Greenhouse-Geisser
PROGRAM	.02	68.50	35	.00	.61	.99.	.12.

Likewise, Graph 1 shows 9 measures data evolution throughout relating 3 groups.

Graph 1. Measures evolution.



As can be seen graph, adapted program with node´ learning achieves substantially higher evolution (yellow line), in relation to other two programs. Indeed, from third repeated measurement there´s a rise along link-nodes learning group, notwithstanding during first and second measures are observed similar scores.

Likewise, adapted program (green line) presents a slightly higher evolution than ordinary program (blue line), which

doesn´t any educational reinforcement support.

In effect, for confidence interval calculated at 95%, mean of estimated statistical evolution to factors allows observe that estimate statistical mean to link-nodes program is significantly higher (μ= 1.85) in relation to group without educational reinforcement (μ=1.17) neither with adapted program (μ= 1.11) (see Table 5). These data are interpreted as predictive scores about analyzed variables development.

Table 5. Estimated statistical evolution: predictors.

GROUP	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
ORDINARY CONCEPT	1.17	.22	.70	1.64
ADAPTED CONCEPT WITHOUT NODE	1.11	.23	.63	1.59
ADAPTED CONCEPT WITH NODE	1.85	.22	1.39	2.30

Multiple comparisons post-hoc inter-subject effects and R squared analysis between variables: Program* Group, taking program variable (Understanding. Recovery and Relating I, II, III) as dependent variable can be observed in Table 6.

Table 6. Post-hoc comparative test.

Source	**PROGRAM VARIABLE Dependent Variable**	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Corrected Model	UnderstandingI	.02(a)	2	.01	.01	.98
	RecoveryI	.22(b)	2	.11	.10	.90
	RelatingI	.22(c)	2	.11	.18	.83
	UnderstandingI	1.73(d)	2	.86	.93	.40
	RecoveryII	.81(e)	2	.40	.46	.63
	RelatingII	3.94(f)	2	1.97	3.07	.06
	UnderstandingII	5,.29g)	2	2.66	3.01	.06
	RecoveryIII	4,.56h)	2	2.02	2.24	.12
	RelatingIII	**9.14(i)**	**2**	**4.57**	**7.22**	**.00**
GROUP	UnderstandingI	.02	2	.01	.01	.98
	RecoveryI	.22	2	.11	.10	.90
	RelatingI	.22	2	.11	.18	.83
	UnderstandingII	1.73	2	.86	.93	.40
	RecoveryII	.81	2	.40	.46	.63
	RelatingII	3.94	2	1.97	3.07	.06
	UnderstandingIII	5.32	2	2.66	3.01	.06
	RecoveryIII	4.05	2	2.02	2.24	.12
	RelatingIII	**9.14**	**2**	**4.57**	**7.22**	**.00**

a) R^2 = .001 (Adjusted R^2= -.079) b) R^2= .008 (Adjusted R^2= -.071) c) R^2= .014 (Adjusted R^2= -.065) d) R^2= .070 (Adjusted R^2= -.005) e) R^2= .036 (Adjusted R^2= -.042)

f) R^2= .197 (Adjusted R^2= .133) g) R^2= .194 (Adjusted R^2= .130) h) R^2= .152 (Adjusted R^2= .084) i) R^2= .366 (Adjusted R^2= .316)

Post-hoc analysis allows observe when model is analyzed jointly, studying variables effects as whole, significant differences between three groups are found regarding Relating III variable (Sig= .00), with high level of R squared explicative (R^2= .366, Adjusted= .316), comparing other measures which not obtain significant comparative critical levels among study and R squares are sensibly low.

Indeed, same comparative data found when individual interaction of main effects to Group variable is analyzed, just third measure: Relating III, which achieves significant critical level on study (Sig= .00).

Nevertheless, if previous scores in Relating are observed, there´s positive tendency is also indicated in Relating II variable (Sig= .06), regarding other repeated measures compared agreed to Group type. However, Relating I variable didn´t significant differential scores (Sig= .83).

DISCUSSION

This quantitative study analyzes main effects evolution to repeated measures found three groups of people with ASD, organized according program type applied. Analysis focus especially in creation of relational link-nodes, which facilitate concepts semantic understanding and its posterior recovery. Beside ease relationships development between concepts, between concepts and categories and inter-categories.

As observed in predictive-estimative analysis of programs effectiveness indicated in Table 5, academic evolution prediction is significantly differential inter-groups. Indeed, link-nodes program was better comparative scores relating Group variable along this study.

Indeed, people with ASD present obvious difficulties in automatically structuring networks or relational-nodes between concepts-categories, therefore, there´s specific needs to meanings formation in permanent memory (long term memory) (LTM) and, consequently, contents fragmented are memorized. These needs interfere offshore concept relationship creation and subsequently there´s deficits over information recovery levels learned. Deficits in self-regulation and perceptual-cognitive control processes significantly obstruct the input of new concepts- information and progressively influence to global learning process owing limitations to modifying the stimuli interoceptive and modulating process [20, 21, 22, 23].

However, neuro-typical people carry out ones relationships automatically, generating neuro-cerebral networks induced regarding incoming information, which, according Posner [24], these relationships act as synapse that facilitates the new information intercommunication in relation to previously learned information, and, hence, generates neuro-psychophysiological reactions necessary to implement perception-encoding activity and posterior information recovery. Otherwise, concepts is fragmented and separated and, thus, when it´s necessary retrieve this contents it´s very difficult owing being disconnected and meaningless [25].

Since, neuronal space proximity in a convergence zone establishes the significant similarity of some new contents-components with others contents previously attributed and, consequently, facilitates conceptual assimilation in meaningfully semantic memory creating mnesic traces with conceptual meanings.

Relationships improvement along this study found owing application of specific complementary program that involves six well-structured phases: 1) conceptual stimulus input, 2) stimulus de-codification for meaningful analysis, 2) link-codes association regarding decoded concept, 3) stimulus reconstruction from link learned, 5) related information recovery, and 6) functional experience of learning process. Concept-category levels and method-curriculum way depends on capacities and competences of students with ASD.

In this sense, comparative study shows how initially there aren´t significant differences regarding three groups, but third measure, substantial improvements are indicated regarding link-node relationships of concepts. These data improvements found in experimental group that englobe to perceptive- cognitive system as whole. Thus, third measure: Understanding III, it´s differentially significant level tendency is already found (Sig= .06). In addition, possibly, it would be necessary continue with temporal measures to find systemic difference in all psycho-neurologic-basic processes as whole to achieve positive- significant critical level.

However, this study shows the children with ASD are able to constructing integrated knowledge when learning components are presented with associated link-nodes relational information to learning process [26].

In effect, people with ASD are characterized by as much heterogeneity as general population, which must be substantial issue element to diagnostic process, therefore one and inflexible tools of diagnostic can propose the same intervention measures to all cases, which can constitute a specific error. Therefore, it´s need delve into empirical evidence of analysis of semantic processes instruments to assess the conceptual-categorical processing level carried out, in order effectively point the perceptual-cognitive level within autism spectrum level, as well as facilitating basic aims plan for adapted psychosocial- educational intervention to improve conceptual pragmatic components [27, 28].

Coderre, Chernenok, Gordon y Ledoux [29] and Nagy y Townsend [30] indicate that semantic processing of people with ASD isn't so impaired on non-linguistic stimuli, however there´re significant deficits in linguistic stimuli, which shows the disorder heterogeneity.

Hence, SIS test [13] In relation above, SIS test can constitute an obvious alternative to specific needs diagnostic and, consequently, propose the programmatic adjustments necessary to each specific situation, as is collected along six-subdimensions, especially regarding subdimension 4, which refers link-node relations construction in people with ASD.

CONCLUSSION

In synthesis, it´s therefore necessary deepen the learning semantic components analysis, as proposed different international organizations: National Autism Project [31], Center of the Developing Child at Harward University [32], Institute of Education and Sciences [33], National Center for Special Education Research [34], National Scientific Council of the Developing Child- Council of Child with Disabilities [35], Center for Disease Control and Prevention [36] and Spanish Documentation Center on Disability [37, 38]. These organizations propose the need delve into these specific issues, prioritizing as a general aim to design plans for the

scientific research future on people with ASD.

In this sense, SIS test, which was configured from perceptive-cognitive information semantic coding, constitutes one diagnosis specific core criterial element to specific needs effectiveness analysis, in order complement ASD structural diagnosis. Likewise, SIS test recognizes ASD heterogeneity, with which reduce the base errors along initial evaluation processes, especially if diagnosis carried out at very early age.

This study concluded with some recommendations highlighting following:

1) Carry out an exhaustive measurement of pragmatic and semantic competences, as well as relational links-nodes construction level.
2) Promote the development of well-structured significant neural relationships offshore intrinsic learning of concepts and contents in a well-structured way alongside learning itself.
3) Improve functional applied interactive development of concepts and contents between basic cognitive neuro-psychological processes. Since, attentional network interaction performs as specific neuronal correlation for facilitate development of other psychological components of processing system in people with ASD.
4) Incorporate these conceptual criteria to new international classification, with main aim to including the perceptual-cognitive semantic dimension as a diagnosis particular basic dimension join with SDM- 5 current diagnosis behavioral indicators.

However, always, learning method constitute a fundamental element of adapting teaching-learning process to students with ASD. In this process, it´s necessary adapt teaching-learning interactive methodological strategies and the joint participation regarding all factors functionality involved along psycho- educational development of students with ASD [39].

STUDY LIMITATIONS

This study limitations are related two basic factors: 1) it´s sample size, but it´s very usual it comes to individuals with such highly specific characteristics, and 2) it´s necessary also consider limited temporalization relationship with measures (I,II,III) found, which are limited to one just school year.

ACKNOWLEDGEMENTS

I´m grateful to all participants and their parents for taking part in the study.

DECLARATION OF CONFLICTING INTERESTS

Author declared no potential conflicts of interest with respect to the research, authorship, and/or this publication.

REFERENCES

1. American Psychiatric Association (APA). *Diagnostic and Statistical Manual of Mental Disorders (DSM-5)*, 2013. Arlington, VA.
2. Mazurek, M.O; Lu, F.; Macklin, E.A.; Handen, B.L. Factors associated with *DSM-5* severity level ratings for autism spectrum disorder. *Autism* 2019, *23*(2), 468- 476. https://doi.org/10.1177/1362361318755318
3. Buxbaum, J.D.; Baron-Cohen, S. DSM-5: the debate continues. *Molecular Autism* 2013, *4*(1), 11. https://molecularautism.biomedcentral.com/articles/10.1186/2040-2392-4-11
4. Stothers, M.E.; Cardy, J.; O. Oral language impairments in developmental disorders characterized by language strengths: a comparison of Asperger Syndrome and Nonverbal Learning Disabilities. *Research in Autism Spectrum Disorders* 2012, *6*(1), 519-534. http://dx.doi.org/10.1016/j.rasd.2011.07.013
5. Constable, P.A.; Ring, M.; Gaigg, S.B.; Bowler, D.W. Problem-solving styles in autism spectrum disorder and the development of higher cognitive functions. *Autis*m 2018, *22*(5), 597- 608. https://doi.org/10.1177/1362361317691044
6. Vladusich, T.; Olu- Lafe, O.; Kim, D-S.; Tager-Flusberg, H.; , Grossberg, S. Prototypical category learning in high-functioning autism. *Autism Research* 2010, *3*(5), 226- 236. DOI: 10.1002/aur.148
7. Gastgeb, H.Z.; Strauss, M.S.; Minshew, N.J. Do individuals with autism process categories differently? The effect of typicality and development. *Child Development* 2006, 77(6), 1717-1729. https://psycnet.apa.org/record/2006-21500-015
8. Kasirer, A.; Mashal, N. Verbal creativity in autism: comprehension and generation of metaphoric language in high-functioning autism spectrum disorder and typical development. *Frontiers in Human Neuroscience* 2014, *8*, 615. https://pubmed.ncbi.nlm.nih.gov/25157225/
9. Lin, H-Y.; Ni, H-C.; Tseng, W-T.; Gau, S.S-F. Characterizing intrinsic functional connectivity in relation to impaired self- regulation in intellectually able male youth with autism spectrum disorder. *Autism* 2020, *24*(5) 1201- 1216. DOI: 10.1177/1362361319888104
10. Eycke, K.D.; Müller, U. Drawing links between the autism cognitive profile and imagination: Executive function and processing bias in imaginative drawings by children with and without autism. *Autism* 2018, *22*(2) 149- 160. DOI: 10.1177/1362361316668293

11. Vygotsky, L.S. Imagination and creativity in childhood. *Journal of Russian and East European Psychology* 2004, *42*(1), 7- 97. https://www.tandfonline.com/doi/abs/10.1080/10610405.2004.11059210
12. Kim, S.H.; Buzzell, G.; Faja, S.; Choi, Y.B.; Thomas, H.R.; Brito, N.H. … Fox, N. Neural dynamics of executive function in cognitively able kindergarteners with autism spectrum disorders as predictors of concurrent academic achievement. *Autism* 2020, *24*(3) 780- 794. DOI: 10.1177/1362361319874920
13. Ojea, M.; Tellado, F. Semantic Integration Evaluation Scale (SIS) for Children with Autism Spectrum Disorder. *Open Access Journal of Addiction and Psychology* 2018, *1*(3), 1-6. https://irispublishers.com/oajap/fulltext/semantic-integration-evaluation-scale-sis-for-children-with-autism-spectrum-disorder.ID.000514.php
14. Kelley, E.; Paul, J.J.; Fein, D.; Naigles, L.R. Residual language deficits in optimal outcome children with a history of Autism. *Journal of Autism and Developmental Disorders* 2006, *36*(6), 807- 828. http://dx.doi.org/10.1007/s10803-006-0111-4
15. Cronin, K.A. The relationship among oral language, decoding skills, and reading comprehension in children with Autism. *Exceptionality* 2014, *22*(3), 141-157. http://dx.doi.org/10.1080/09362835.2013.865531
16. Botting, N.; Adams, C. Semantic and inferencing abilities in children with communication disorders. *International Journal of Language and Communication Disorders* 2005, *40*(1), 49- 66. http://taylorandfrancis.metapress.com/link.asp?target=contribution&id=R092EJRQC636XB1F
17. Bennett, T.A.; Szatmari, P.; Georgiades, K., Hanna, S.; Janus, M.; Georgiades, S. ... Thompson, A. Do reciprocal associations exist between social and language pathways in pre-schoolers with Autism Spectrum Disorders? Journal of Child Psychology and Psychiatry 2015, 56(8), 874-883. http://dx.doi.org/10.1111/jcpp.12356
18. Brignell, A.; Williams, K.; Jachno, K.; Prior, M.; Reilly, S.; Morgan, A.T. Patterns and predictors of language development from 4 to 7 years in verbal children with and without Autism Spectrum Disorder. *Journal of Autism and Developmental Disorders*, 2018, *48*(10), 3282-3295. http://dx.doi.org/10.1007/s10803-018-3565-2
19. Ojea, M. *RELATEA program. Development of conceptual- categories in students with autism spectrum disorders* 2018. Madrid: Ed. Pirámide. https://www.edicionespiramide.es/libro.php?id=5151744
20. Althoff, R. R.; Verhulst, F. C.; Rettew, D. C.; Hudziak, J. J.; van der Ende, J. Adult outcomes of childhood dysregulation: A 14-year follow-up study. *Journal of the American Academy of Child & Adolescent Psychiatry* 2010, *49*, 1105- 1116. Doi:10.1016/j.jaac.2010.08.006
21. Ayer, L.; Althoff, R.; Ivanova, M.; Rettew, D.; Waxler, E.; Sulman, J.; Hudziak, J. Child Behavior Checklist juvenile bipolar disorder (CBCL-JBD) and CBCL posttraumatic stress problems (CBCL-PTSP) scales are measures of a single dysregulatory syndrome. *Journal of Child Psychology and Psychiatry* 2009, *50*, 129- 1300. Doi:10.1111/j.1469-7610. 2009.02089.x
22. Biederman, J.; Spencer, T. J.; Petty, C.; Hyder, L. L.; O'Connor, K. B.; Surman, C. B.; Faraone, S. V. Longitudinal course of deficient emotional self-regulation CBCL profile in youth with ADHD: Prospective controlled study. *Neuropsychiatric Disease and Treatment* 2012, *8*, 267- 276. Doi:10.2147/NDT.S29670
23. Heatherton, T. F. Neuroscience of self and self-regulation. *Annual Review of Psychology* 2011, *62*, 363-390. Doi:10.1146/annurev.psych.121208.131616
24. Posner, M. I. Orienting of attention. *Quarterly Journal of Experimental Psychology* 1980, *32*, 23-25. https://journals.sagepub.com/doi/abs/10.1080/00335558008248231
25. Simmons, W. K.; Barsalou, L. W. The similarity in topography principle: reconciling theories of conceptual deficits. *Cognitive Neuropsychology* 2003, *20*, 451-486. https://pubmed.ncbi.nlm.nih.gov/20957580/
26. Lucas, R.; Thomas, L.; Norbury, C. F. Can children with Autism Spectrum Disorders learn new vocabulary from linguistic context? *Journal of Autism and Developmental Disorders* 2017, *47*(7), 2205-2216. http://dx.doi.org/10.1007/s10803-017-3151-z
27. Adams, C.; Lloyd, J.; Aldred, C.; Baxendale, J. Exploring the effects of communication intervention for developmental pragmatic language impairments: A signal- generation study. *International Journal of Language & Communication Disorders* 2006, *41*(1): 41- 65. https://pubmed.ncbi.nlm.nih.gov/16272002/
28. Di Martino, A.; O'Connor, D.; Chen, B.; Alaerts, K.; Anderson, J. S.; Assaf, M.; . . . Milham, M.P. Enhancing studies of the connectome in autism using the Autism Brain Imaging Data Exchange II. *Scientific Data* 2017, *4*, Article 170010. doi:10.1038/sdata.2017.10
29. Coderre, E. L.; Chernenok, M.; Gordon, B.; Ledoux,

K. Linguistic and non-linguistic semantic processing in individuals with Autism Spectrum Disorders: An ERP study. *Journal of Autism and Developmental Disorders* 2017, *47*(3), 795- 812. http://dx.doi.org/10.1007/s10803-016-2985-0

30. Nagy, W.; Townsend, D. Words as tools: Learning academic vocabulary as language acquisition. *Reading Research Quarterly* 2012, *47*(1), 91- 108. Doi:10.1002/RRQ.011.
31. National Autism Center. *National standard project ad dressing the need for evidence based practice guidelines for autism spectrum disorder*, 2009. http://www.nationalautismcenter.org/national-standards-project/.
32. Center on the Developing Child at Harvard University. *In brief: early childhood program effectiveness*, 2015. http://developingchild.harvard.edu/resources/briefs/inbrief_series/inbrief_program_effectiveness/15.
34. Institute of Education Sciences (IES). *Special education research grants CFDA*, 2014, *84. 324A*. http://ies.ed.gov/funding/pdf/2015_84324A.pdf.
35. National Center for Special Education Research (NCSER). *Summary of autism spectrum disorders research fy 2006- fy 2015*, 2015. http://ies.ed.gov/ncser/pdf/ASD_2015.pdf.
36. National Scientific Council of the Developing Child- Council of Chil with Disabilities. Early experiences can alter gene expression and affect long- term development. *Working Paper* 2010, *10*. www.developingchild.harvard.edu Newman.
37. Center for Disease Control and Prevention. Prevalence of Autism Spectrum Disorder among Children Aged 8 Years-Autism and Developmental Disabilities Monitoring Network, 11 Sites, United States, 2010. *Morbidity and Mortality Weekly Report* 2014, *63*(37). https://stacks.cdc.gov/view/cdc/22182
38. Spanish Documentation Center on Disability (SDCD). *Autism Documentation*, 2016. http://www.cedd.net/
39. Spanish Documentation Center on Disability (SDCD). *Resources and publications*, 2017. http://www.cedd.net/es/enlaces/ver/205/
40. Stahmer, A.C.; Suhrheinrich, J.; Schetter, P.L.; Hassrick, E. Training and implementation of Evidence- Based Practices (EBP): A study protocol. *Implementation Science* 2018, *13*(3). http://dx.doi.org/10.1186/s13012-017-0698-1

ANNEX I

SEMANTIN INTEGRATION SCALE (SIS) [13]

SUB-DIMENSION 1. Deficits to conceptual units understanding.	
1.1. There´s not significant conceptual units understanding.	8
1.2. There´s concretion of conceptual units' parts.	6
1.3. There´s conceptual units' analysis.	4
1.4. Conceptual units are understood, but with tendency to subdivide units into its parts.	2
1.5. There´s no qualitative deficit.	0
SUB-DIMENSION 2. Deficits to significant reconstruction.	
2.1. There´s no parts (units) reconstruction.	8
2.2. External help is need to stimulus reconstruction.	6
2.2. Stimuli parts reconstruction is carried out with learned relationships.	4
2.4. Stimuli parts are reconstructed as from relationships created.	2
2.5. There´s no qualitative deficit.	0
SUB-DIMENSION 3. Deficits to conceptual- categories hierarchy.	
3.1. There´s no belonging understanding.	8
3.2. There´s category construction is limited to some concepts.	6
3.3. External help is need to indicate units´ belonging level to categories.	4
3.4. There´s awareness of belonging, but it´s difficult assign an unit to its category.	2
3.5. There´s tendency to concepts hierarchize in corresponding category.	0
SUB-DIMENSION 4. Deficits to inter- conceptual relations development (nodes).	
4.1. No competences of relationships meaning between concepts.	8
4.2. Don´t creates relationships, but understands similarities and differences between concepts.	6
4.3. External help is needed to create relationships among concepts.	4

4.4. Relationships are used between two concepts if it´s previously learned.	2
4.5. There´s no limitations to form relationships between two new concepts.	0
SUB-DIMENSION 5. Deficits to setting inter- categories relationships.	
5.1. There´s no understanding relationship between conceptual categories.	8
5.2. Two different conceptual categories are understood, but it´s not able to attribute relationships.	6
5.3. External help is required to establish relationships.	4
5.4. It´s given learned relationships to different conceptual categories.	2
5.5. Relationships are created between different conceptual categories.	0
SUB-DIMENSION 6. Deficits to information remind.	
6.1. There´s information recovery, but it´s very limited.	8
6.2. External help is needed to facilitate information retrieval.	6
6.3. There´s information recovery, but from concrete concept.	4
6.4. There´s information recovery, from learned relationship.	2
6.5. There´s no qualitative deficit.	0

ANNEX II

COMPLEMENTARY SPECIFIC PROGRAM [19]

VERTEBRATE ANIMALS MAMMALS: A COW

- **Global stimulus: mammalian animals are characterized because are warm-blooded, vertebrate animals that grow within womb and it feed on milk.**

Cow grazing over field.

Points his finger at green color symbol (inverted triangle), which´s related to mammalian animals category: a cow. Remember the red circle (previous concept) is related to vertebrate animals category to which cow belongs.

Cow is vertebrate animal.

- **Stimulus decoding: comprehensive analysis of mammalian vertebrate animal category.**

Look on images: a cow, milk.

Paints with white finger- paint about blue square.

- Learning of links association.

Cut out drawing you made with finger paint (milk) and paste it over background box.

Points your finger at green shape.

- **Information recovery.**

Cut out green inverted triangle and glue it below the animal it´s related (cow).

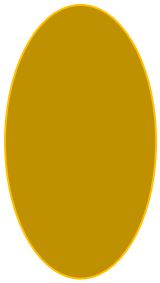
Cow

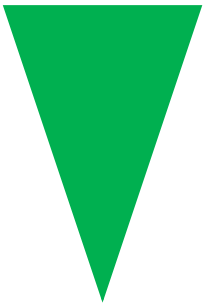
Dolphin

VERTEBRATE ANIMALS BIRDS: OWL

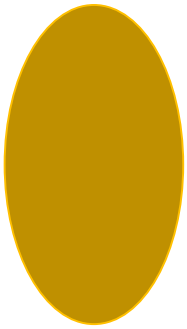
- **Global stimulus: birds are warm-blooded vertebrate animals that walk on their hind limbs, while their forelimbs have been modified on wings through which can fly.**

Points with finger touching the light brown figure image, which is related to vertebrate animals birds category: owl.



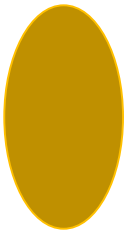


Owl is vertebrate animal, which belongs to birds group.



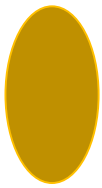
- Learning of links association.

Points the light brown image. Paint the owl, moon and stars with brushes of different colors.

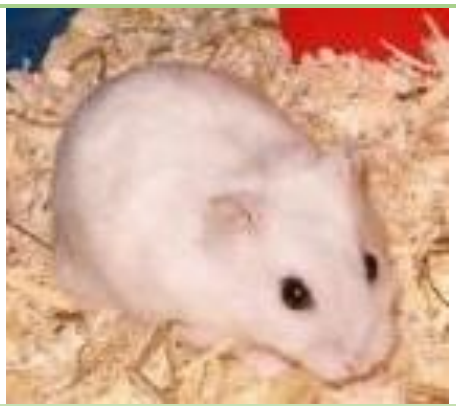


- Information recovery.

Cut out the brown circle and paste over related image (owl).



Owl

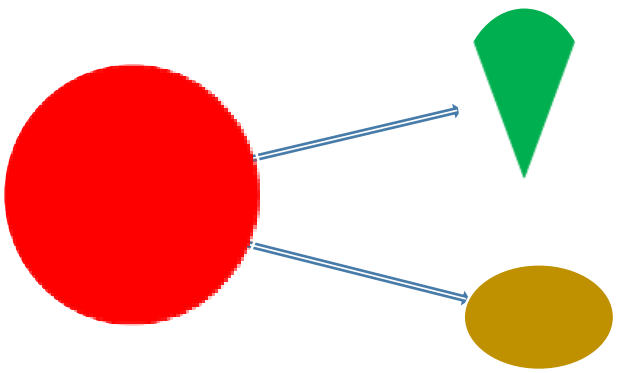


Mouse

RELATE

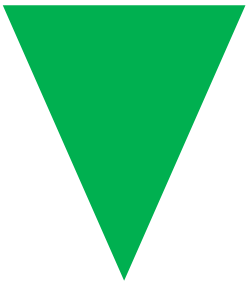
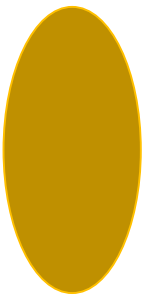
Choose the animal name and touch the relating symbol with your finger.

COW	OWL	ELEPHANT



RELATE

Draw a line to joins the concept (left) with relating symbol (right).

With wings	
With milk suckles	

CLASSIFY

Cut out each animal image (cow and owl) and stick it within related symbol box.

VERTEBRATES	
	
COW	OWL