ISSN 2522-9400 **European Modern Studies Journal** Vol 7 No 6
available at www.journal-ems.com
DOI: 10.59573/emsj.7(6).2023.15

Healing Perceptual Process in Autism Spectrum Disorder or Initial Misdiagnosis?

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Abstract. Autism spectrum disorder is characterized by the presence of particularities over neural networks of the information flexible transmission, which affects the perceptual-cognitive and socio-behavioural levels of the disorder. This research appoints a longitudinal Single Case Study performed throughout 32 years, structured in five intervals-evolutionary phases (0–4.5; 4.6–9: 9.1–12; 12.1–16.5; 16.6–32 years-old), that confirms the importance of the influence of neural networks variable on criteria that had enclosed to disorder symptomatic group.

The successive differential changes through the five phases of analysis, in relation to the variables "perceptive", "social" and "behaviour" of the analysis found highly significant, which have been found through the Friedman comparative test; while the "nodes" variable has remained constant, with high evolutive development level. Likewise, it has been shown by Pearson correlation analysis, the variables relationship is significantly related at .1 critical level. The conclusions confirm that variable related to nodal relationships "nodes" decisively influences the evolutionary improvement to other variables investigated, that has been progressively modified the symptomatic group of the disorder to this Case Study.

The fundamental conclusion has been suggested that neuropsychological variables of processing, especially related to the functional ability to relational networks of information processing must be exhaustively complemented to the socio-behavioural criteria along the disorder evaluation process to avoid possible initial errors in the diagnostic conclusions.

Keywords: Autism spectrum disorder, Autism diagnosis, Perceptive cognition, Semantic memory

Introduction

Autism spectrum disorder (ASD) has been defined by the DSM-5 International Classification of Disabilities of the American Psychiatric Association (APA) (2013), based on the presence of a socio-behavioural deficits symptomatic group at three levels of intensity, which set a disorder highly heterogeneous specific feature of neurodevelopment. This neuropsychological structure involves perceptual-cognitive needs that affect the whole neurocognitive information processing, especially, to area of creating significant relationships or neural nodes between the incoming information and the previous semantic information found in the permanent memory.

Specificities has been due to genetic structural deficits that influence neuronal systems, including the cerebral cortex, in which, according Polleux y Lauder (2004), affect, above all, the synaptic interconnection development, that controls the equilibrium between excitation-inhibition processes of the cerebral cortex and cerebellum throughout evolutive development.

Heterogeneous multifactorial analysis of this disorder has shown a highly hereditary genetic origin; however, genetic process is greatly complex made up of multiple variants affecting the whole genome, which involves the different neurobiological processes, especially to the neuropsychological components linked to information synaptic transmission (de la Torre-Ubieta, Won, Stein & Geschwind, 2016; Grove et al., 2019; Tick, Bolton, Happé, Rutter & Rijsdijk, 2016).

The shapes derived from this phenotypic diversity are observable at symptomatic presence level, such as are the structural motor rigidity structure, attentional deficit, hyperactive and anxious behaviours and/or socio-emotional skills disabilities (Jones, 2015; Arenella et al., 2022).

However, genetic factors haven´t been just ones responsible for information synaptic-neuronal deficits, since neuronal and non-neuronal plasticity can also be affected by neuronal remodelling produced by environmental and developmental processes, caused by infectious diseases, such as meningitis and/ or encephalitis, which affect the hippocampus dentate gyrus, which, lastly, influence glial plasticity in the whole brain functioning, affecting to the myelin basic protein, which is responsible for the transport of the information inter-neuronal synaptic fluidity (Dong & Greenogh, 20004).

Then, the neurotransmission systems have shown be responsible of the structural and functional formations and their direct consequences over the organizational system of the neural networks or relational nodes, that further the connectivity between the information setting on the permanent memory and incoming context stimuli.

These connectional networks are recurrently researched through functional magnetic resonance procedures (Fox & Raichle, 2007), that, widely, have been based on the analysis of correlations between behavioural scores and measures of structural resistance regarding to functional synaptic connectivity.

Thereby, Just, Cherkassky, Keller & Minshew (2004) have concluded that people with ASD present a specificity in the framework of the cortical network development, configured by deficit functioning of the cognitive- perceptive information integrating circuit.

The above theory regarding of the sub-connectivity processing has been developed by Courchesne y Pierce (2005), who suggested that ASD people are characterized by local overconnectivity and low connectivity at superior global levels located in the frontal cortex, which implies disorganized and poorly synchronized conduction of information connectivity processes.

Currently, also Li, Xue, Ellmore, Frye & Wong (2014) have proposed that people with ASD try to perform compensatory actions in the initial perceptual analyzes to reorganize the deficit connectivity, in order to improve their perceptual-cognitive activity, which, has also been empirically corroborated by Mevel, Fransson & Bölte (2015).

These analyzes of considerations on the neuropsychological processing of information have been correctly issued through the evaluation of the co-occurrence of errors in the socio-educational learning process, related to executive planning and other superior level cognitive-executive activities, in which, people with ASD have gave significant deficits, while they have improved significantly in mechanical- automatic homework, which don´t need an executive-cognitive strategic development of superior order (Bowers et al., 2018; Harper, Malone & Bernat, 2014; However; Kim et al., 2020).

From this biological perspective, there´s currently refuted scientific evidence about the presence of interruptions along levels of coordination and informative relationships in the different activities of the brain regions, regarding to the functional elements of brain information connectivity. Some studies have even related these deficits to the functional presence of a high degree of the cognoscitive information generalized synaptic dysconnectivity within the symptomatic group of this disorder (Hull, Jacobes, Torgerson, Irimia y Van Horn, 2016), which is especially related to altered networks in the frontoparietal area, corresponding to the circuits, that are involved in the psycho-emotional, cognitive and behavioural processing of people with ASD, being a differential fully specific aspect in relation to their neurotypical peers.

These specific particularities would be responsible for the perceptual- cognitive way, likewise to semantic memory processing, which affects the whole psychoneurological trial

system, logically including motivational, emotional, social and behavioural processing (Etkin, Buchel y Gross, 2015; Leibenluft, 2017).

In summary, the neural nodes creation facilitates the fluidity of information relating the new stimuli coming with previously information of permanent memory, therefore relational nodes, finally, forming a highly predictive cognitive component of the different theoretical propositional others explaining the ASD.

Therefore, the consequences are observable at a functional behavioural degree, but this asseveration, that is very determining at levels 2- 3 of this disorder, however, when it was referred to disorder of level-1 these observations can be very fine and present a very low intensity grade, which can lead to many errors regarding ASD´ initial diagnostic processes.

For this reason, it is essential that ASD´ diagnostic evaluation must be carried out throughout the behavioural and socio-emotional criteria, but also in the perceptual-cognitive area, especially, concerning to competencies and abilities to development of neuropsychological information relationships or neural nodes.

This study tries respond to the main aims related to these hypothesis basic regarding neuropsychological development of people with ASD, in order to contribute to the systemic understanding of the propositional functioning of thought related to this disorder, in order to : 1) describe the ASD´ diagnostic process and its progressive absence of co- occurrence between the perceptual- cognitive and the social-behavioural variables throughout the longitudinal study, 2) delimit the significance of the mutual interactive scores of the conclusive symptomatic group, and 3) analyze the prevailing correlations between the perceptual-cognitive and social-behavioural variables throughout the study analysis process.

Methods

Research Design

The empirical design of this study is based on the longitudinal observational analysis of a Single Case Study, carried out along 32 years of Case socio-personal evolutive development, throughout observations, interviews and daily task analysis. Data have subsequently been quantified according the operative variables codified.

Variables and Codes

Variables operationalized throughout the evolutionary process and their codes are the following: 1) “perceptive” (p), 2) “nodes” (n), 3) “social” (s), which includes the weighted average sum of communication and social interaction, and 4) “behaviour” (b), formed by the average sum of restrictive and stereotyped behaviours. The four variables correspond to five successive measures of the evolutional analysis, whose phase has been indicated after code of each variable, hence, e. g.: “perceptive” variable belonging to the first evolutive phase presents the coded 1: $p_{1,}$ or the code corresponding to the fifth phase: $p_{5.}$ Likewise, with each variable and its corresponding evolutive phase about.

Procedure

Study has been based on observations evaluated throughout five evolutionary phases, which conclude with five repeated comparative scores corresponding to five phases: 1) 0- 4.5 years old, 2) 4.6- 9 years old, 3) 9.1-12 years, 4) 12.1-16.5, and 5) 16.6-32 years old. The observations have been quantified into direct scores (DS), according to a continuous observation scale of specific observed needs, which has been quantified from 0 (no deficit), 1 (slight deficit), 2 (average deficit), 3 (high deficit), and 4 (severe deficit).

Data Analysis

DS have been used according to each variable, which have subsequently been transformed into their percentiles corresponding (*p*). After, a total average sum corresponding to all variables has been found, regarding to each evolutive phase of development (Σμ) and their *p* related.

Statistics and significance levels of the evolutionary process have been found throughout *Friedman's* nonparametric statistical test.

Correlations between the categories of variables between the five phases through the *Pearson* statistic (*r*) have finally been found.

Results and Discussion

Firstly, the quantification of the different observations made throughout each evolutionary phase corresponding to each analysis variable has been indicated, expressed in DS and its *p* linked (see Table 1).

Table 1: SD and *p* for all analysis variables- phases

Variables	p_1	p_2	p_3	p_4	p_5	n_1	n_2	n_3	n_4	n_5
DS	4	3	3	1	0	0	0	0	0	0
p	1	.75	.75	.25	0	0	0	0	0	0

Variables	s_1	s_2	s_3	s_4	s_5	b_1	b_2	b_3	b_4	b_4
DS	4	3.5	2	1.5	.5	3	3	2.5	2	1
p	1	.87	.50	.37	.12	.75	.75	.62	.50	.25

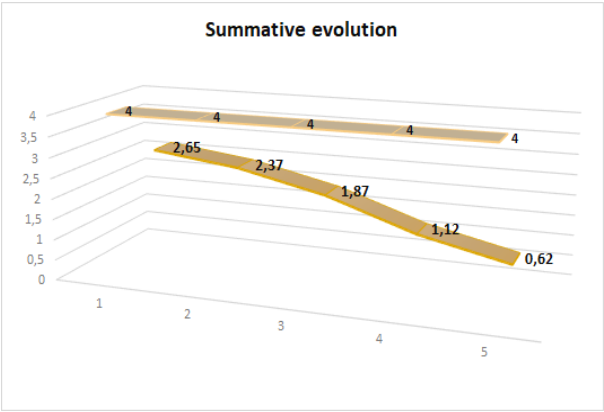
Data found allow conclude three very important aspects for this conclusive analysis: 1) all operational variables of evolutive development, excluding the variable "nodes", present high levels of deficit, especially throughout the first three evolutionary phases of development, 2) all variables successively reduce the levels of deficit throughout the longitudinal study, which is especially significant in the course of the fourth and fifth developmental evolutionary phase, and 3) the variable “nodes” have deepened constant throughout the all study, with no difficulty level: 0.

From the average total sum of all variables taken together (Σμ), it is possible find the *p* corresponding to whole of variables for each developmental evolutionary phase (see Table 2).

Table 2: Summative means to each evolutive phase

Variables	Phases				
	$pnsb_1$	$pnsb_2$	$pnsb_3$	$pnsb_4$	$pnsb_5$
Σμ	2.75	2.37	1.87	1.12	.62
p	.69	.58	.47	.28	.15

The visual expression of the data evolution regarding to overall average sum in each phase can be seen to phases in Graph 1.



Graph 1: average summative evolution by phases

As can be seen, pending the first three evolutionary phases, scores have been above or close to middle quartile of ASD´ symptomatic group, which is significantly has been lowered in the fourth phase (Σμ: 1.12, *p*: .28) and, specially, along the fifth (Σμ: .62, *p*: .15), which allows go for away the Case Study from the possible ASD symptomatic group to.

In fact, considering the corresponding mean of each variable in relation to the five evolutive phases, the general descriptive statistics of the Case Study evolution can be observed, both the scores referring to the mean, standard deviation, and the corresponding percentiles related (see Table 3).

Table 3: Descriptive statistics

Variables	μ	σ	min.	max.	25th	50th	75th
perceptive	2.20	1.54	.00	4.00	.75	3.00	3.25
nodes	.00	.00	.00	.00	.00	.00	.00
social	2.15	1.43	.00	4.00	.87	2.00	3.62
behaviour	2.25	.79	1.00	3.00	1.75	2.25	3.00

It is observed that greatest standard deviations have been found in the "perceptive" variable (σ: 1.54) and "social" variables (σ: 1.43), followed by "behaviour" (σ: .79), while "nodes" variable has found a constant score along all study, with value: 0 (there isn´t deficit).

Likewise, this significant analysis of the changes found in the successive evolutionary phases in the study variables total sum, that has been found through the Friedman test, indicate that the successive changes along evolutive phases have rightly been statistically significant (see Table 4).

Table 4: Friedman test

Chi-Square	17.19
df	3
Asymp. Sig.	.00

Indeed, the comparative analysis has shown that, for 3 degrees of freedom (df), the critical level is clearly significant to interphases (sig: .00, Chi- Square: 17.19), which allows verify that differences that have been found in the whole variables throughout the five phases evolutive development have caused a highly differential critical level.

The presence of level 0 (no deficit) regarding to ability to establish significant neuronal relational nodes between the information transmission, could constitute a predictive element of the positive evolutive development. Indeed, it has been indicated by the Chi-Square Test score;

therefore, it seems advisable to observe if there is a significant correlation between the all variables of this study, in order to verifying the expected predictive developmental level.

The correlational levels have been found using the *Pearson* correlation test (*r*) (see Table 5).

Table 5: Pearson correlation

Variables		perceptive	social	behaviour	nodes
perceptive	*r*	1			
	sig.				
social	*r*	.93(**)	1		
	sig.	.00			
behaviour	*r*	.90(**)	.94(**)	1	
	sig.	.00	.00		
nodes	*r*	.(a)	.(a)	.(a)	.(a)

Note: ** Correlation is significant at the 0.01 level (2-tailed).

a) Cannot be computed because at least one of the variables is constant.

As indicated about data, there is a significant correlation between all the variables of the study for the .01 significance level, being noteworthy the correlation between "behaviour" and "social" variables (*r*: .94) and, also, between "perceptive" and "social" variables (*r*: .93), as well as between "perceptive" and "behaviour" variables (*r*: .90).

Nevertheless, the variable: "nodes" isn´t computable in correlation analysis since remains constant throughout the set study.

Acknowledgment

It is especially important to acknowledge the participation of Cristian, who has collaborated in his Case Study, which has contributed to the observations and evaluations of this long longitudinal study, which has formed an analysis from 0–32 years old.

Study Limitations

This study has been limited to a Single Case Study, which are empirically assimilated for the description of scientific analyses, however, the generalization of its conclusions must be refuted with studies related to greater samples, which allow these descriptions to be corroborated about.

Conclusions

Criterial indices of the ASD´ diagnostic group indicated by the currently classifications have been based on the observable socio-behavioural components, about which, mostly of the ASD´ diagnostic scales have been designed. These basic considerations being rightly, it hasn´t been predicted the specific perceptual-cognitive differential particularities widely corroborated empirically that shaping this disorder have been to. (Frith, 1989; 2004; Happé, 1999; Happé & Frith, 2006; Shah & Frith, 1993; Caron, Mottron, Berthiaume & Dawson, 2006). For this reason, the diagnostic concept has been evolving scientifically, giving rise to the most recently basic hypotheses, which have configurated highly particular theories of the particular specific thought in people with ASD (Ojea, 2023a).

In all research, specific connotations are shown in the sequential perceptual process in people with ASD, which systemically have interrelated between all perceptive- cognitive basic processes corresponding to higher executive cognitive functions of specific thought. This interrelationship between cognitive processes is directly greatly determined by the specific ability to develop the neural relationships themselves that facilitate functional executive

processes to, that is, it going into the ability to establish relational interactions between the incoming information processed from sensory memory and content own learned found within the semantic memory.

In this context, working memory must achieved meaningful cognitive executions to allow the perceived information to be adequately related with previously learned information in order to facilitate its access to long-term memory or permanent memory or semantic memory.

Thus, this mediating process has been facilitated by the development of relationships and cognitive interrelation nodes (Ojea, 2023b), so that, the greater to be the capacity for relationship nodes elaboration, it will greater be the competence to develop superior-order cognitive processes as a cognitive process of synthesis, deduction and problem solving. And, when relational nodal development has been facilitated, sensory perception also improved in the successive perceptual analyses, giving higher levels of semantic meaningful attributions.

These relational attributions have observed very weakened in people with ASD, since, as has been confirmed previously in the theoretical basis of this study, there is a highly deficient synaptic neural component into the flexibility of the information transmission; accordingly, the analysis of Items relating to able to elaborate relationships and neural nodes constitute a basic component for predicting and conclude to disorder diagnostic group with effectivity.

In this Single Case Study, initial deficits are observed already from the first evolutive phase with evident deficits in the perceptual initial process variable (*p*: 1), as well as in the social (*p*: .75) and behavioural variables (*p*: .75).

Therefore, according to these data found regarding this first phase, it seems evident that this Case belonging to the ASD diagnostic group of level-1 (Σμ: 2.75, *p*: .69). However, the measurement verified regarding to the ability to develop relationships or interneural nodes indicates a right functioning of processing, which is already observable from first evolutive phase of study (*p*: 0). This evaluation score is a great predictive indicator of the possible Case progressive favourable evolution regarding to initial diagnostic group belonging to disorder.

Indeed, the successive evolution throughout the five develop evolutive phases is highly significant, as has been shown by the Friedman test (sig: .00), which, it´s already in the third evolutive phase (9.1 years old) there is total weighted average sum of all variables below the 50th quartile (Σμ: 1.87, *p*: .47), what allows that diagnostic group has been dismissed in the fourth evolutive phase (Σμ: 1.12, *p*: .28), whose improvement has been corroborated in the fifth phase evaluation (Σμ: .62, *p*: .15).

In this Single Case Study, a severe error would have been given if during this first or second evolutionary phase an affirmative conclusion of ASD´ diagnosis was would have been done, with all the psychosocial and educational repercussions that could have been assumed.

However, in cases mostly, justly, it inversed occurs, that´s, there´re almost imperceptible initial observations at the socio-behavioural level, since scores have been observed at the lower limit on disorder symptomatic group, while that their evolutive predictions could having persisted constant way owing to deficit on cognitive relational- nodes functioning and, consistently, have belonged to this diagnostic group, especially, if it´s level-1 ASD.

These imprecise evaluations could have also wrong lead to psycho- social- educational programs development, which have nothing related to perceptual-cognitive relational deficits, which involve the main matter of ASD and, consequently, people with ASD need a relational cognitive specific programs design properly mediated in order to improve its integral evolutionary development. Otherwise, in many situations, wrong programs would be being design regarding people with learning difficulties, attention deficits or mild personality disorders that don´t set up to particular needs of people with ASD.

For this reason, currently, the most currently research have focused on the evolutive-behavioural criterial complementation, throughout the design and empirical corroboration of

scales and tests to setting the perceptual-cognitive processes complementary to the socio-behavioural criteria (Ojea, 2023c).

In conclusion, it wasn't a coincidence that perceptual variable would has gone from *p*: 1 during the first evolutionary phase at *p*: 0 in the fifth and last evolutionary phase of this Single Case Study. The same has found on the other social variable (p_1: 1– p_5: .12) and behavioural variable (p_1: .75– p_5: .25); but, it is owing to the influence of effective skills over the information neural connectivity throughout all cognitive psycho-neurological processing, which, progressively, influence the whole psycho-socio-personal evolutionary development, which it is essential that ASD diagnostic processes the complemented evaluation of all the perceptive- cognitive processing and socio-behavioural criterial components to assure the efficacy and effectiveness of final diagnostic conclusion.

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