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DEVELOPMENT OF GESTALT PERCEPTIVE INTEGRATION SKILLS OF STUDENTS WITH AUTISM SPECTRUM DISORDER

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Abstract

This study evaluates the effectiveness of the application of a specific program based on the Gestalt Integration Program "GIP" (Ojea, 2009), applied to a group of students with varying levels of autism spectrum disorder (ASD). This program has been developed out of the basic assumptions of the Central Cognitive Coherence Theory and the Perception Theory, and whose general objectives were to facilitate the development of the content of global learning and, consequently, to promote the development of perceptual-cognitive integration and improvements to the indices or values of the autism spectrum quotient that make up a diagnosis. This was empirically supported by an experimental design structured into pre-tests/program/post-tests, applied to 30 participants with ASD. The applied program spanned a 24-month period and its effects have been measured using a multiple comparative analysis. The results support the conclusion that its application has significantly improved scores for those criteria measured by operative variables: 1) visual-motor perception (BG), and 2) autism spectrum quotient (AQ).

Keywords

"Autism Spectrum Disorder", "Gestalt", "Perception", "Visual-Perception", "Cognition".

Introduction

People with ASD often present diagnoses characterized by varying degrees of development, based on the resources or services they require in order to address their specific needs, so that those classified as level 1 will generally require a lower level of intervention, while those diagnosed as level 3 will necessitate the maximum level of intervention. This establishes a continuous process of needs related to deficits in communication and social interaction, which in turn informs the diagnostic process of the spectrum, constituted by levels 1, 2 and 3 in accordance with the criteria laid out in the International Classification of Disabilities (American Psychiatric Association, 2013, p. 52).

One of the disorder's main characteristics is the presence of perceptual impairment in the evaluation of experiences because of deficits found in perceptual organization, which leads to only a partial perception and analysis of stimuli, not allowing said stimuli to be globally grouped or understood (Belinchon, Rivière & Igoa, 1992; Hadad & Ziv, 2015; Mottron, Dawson, Soulieres, Hubert & Burack, 2006; Schlooz et al, 2006).

Studies have been developed around the Theory of Central Cognitive Coherence, the Theory of Perception and Gestalt Psychology (Kaland, Mortensen & Smith, 2007; Rodgers, 2000). These relate to weak cognition characterized by deficits in the semantic-pragmatic linguistic area, which results in a tendency to recognize the phenomena only by the references created in relation to individual parts or details of the stimuli and received through one of the sensory modalities.

But just how does the perceptual grouping that lends coherence and organization to the information that we process take place? The proximity factor, proposed by Wertheimer (1912; 1923), offers an acceptable explanation for this. The author observed that when he placed a series of equally spaced out points, they did not produce any type of grouping, but when he varied the distance between adjacent points, he saw that the points were then grouped into pairs. These considerations however, imply an unlimited number of objects, so in order to reduce the number of mental representations to facilitate cognitive economy during the development of cognitive skills, Marr & Nishihara (1978) developed a theory that demonstrated that the visual recognition of objects is based on three keys aspects: 1) the consideration of an object-centred coordinate system; 2) the importance of the placement of the parts of the object in relation to the previously mentioned coordinate system; and 3) a comparative characterisation system of objects with shapes previously learned and stored in the memory, so that any object is perceived on the basis of a reference based on the object's shape.

The results led to the following conclusions: 1) each model has a limited complexity and constitutes an independent unity of information; 2) the information appears within a context that favours its recognition, and; 3) the representation can be flexibly manipulated. The information is then coded and stored in the permanent semantic memory generating mnesic traces characterized by its associative content or spatial, non-linear and multidimensional memory, and whose retrieval will be carried out by the diverse sensorial stimuli that act like clues for the learning constructed. Without these clues the retrieval process would be difficult, not because this content doesn´t exist, since it may be present, but because of the difficulties of accessing information that has been non-procedurally stored (Bolte, Holtman, Poustka, Scheurich & Schmidt, 2007; López, Leekam & Arts, 2008; Kern et al., 2006; McDonald et al., 2014; Rondan & Deruelle, 2007).

So, according to the Theory of Central Cognitive Coherence (Frith 2004; Happé, 1994; Wing, 1981), as well as to the Theory of Perception (Ojea, 2008), children with ASD showed that the attention paid to the incoming information is focus on parts of the observed stimuli, which are perceived without semantic content and, therefore, there are no relational clues, so the result of the retrieval process of this learned information will be limited to a mechanical reproduction, and the processes of practical application and generalization of the learning to other situations will also be affected.

Relevant studies have revealed the contributions that research has made for effective programs that enable semantic content-based learning. But this study must be based on the strengths observed in people with ASD, that is, from focusing on the perceptual approximation of the parts of the stimuli in accordance with their levels of relevance, since these parts are assumed as part of the perceived object and then used to recompose the stimuli as a whole. This process must be aided by the integration of the clues that are significant in relation to the information learned (Alzahrani, 2015; Blacher, Baker & Berkovits, 2013; Cullen, 2015; Dallas, Ramisch & McGowan, 2015; Lovell & Wetherell, 2016).

Objectives

This study aims to fulfil the following objectives:

1) To analyse both perceptual-cognitive development and the autism index before and after the implementation of a Gestalt Integration Program (see Figure 1) in children diagnosed with three varying severity levels of ASD.
2) To analyse perceptual visual development (BG) and the autism-spectrum quotient (AQ) of the variables coded in the study in accordance with the three levels of autism diagnosis (ASD_{1-2-3}).
3) To conduct a comparative multivariate analysis in relation to the participant's diagnosis.
4) To analyse the post-hoc comparative data in relation to the 'diagnosis' and 'age' variables.
5) To uncover the theoretical and practical impacts of the psychosocial and educational intervention processes.

Methodology

Research design:

The research design has been developed following a pre-test-program-post-test experimental analysis model.

Participants:

Participants in the study were made up of 30 students diagnosed with ASD with three varying levels of severity. Each level related to the type of on-going special educational needs, ranging from those with the least needs (Level 1) to those with the most needs (Level 3).

Participants were grouped according to their diagnosis level (1-2-3), age, and gender variables (see Table 1).

Table 1: Participants (N: 30).

DIAGNOSIS	**ASD_1**		**ASD_2**		**ASD_3**	
AGE	*Men*	*Women*	*Men*	*Women*	*Men*	*Women*
4-6	3		4	1	1	1
7-9	3	1	4		3	
10-12	2	1	2		4	
Total	8	2	10	1	8	1

Variables:

To investigate global and Gestalt memory in children with ASD, the following variables were selected:

1) The diagnostic variable of the participants: "diagnosis".

2) The age variable: "age".

3) The visual-motor perceptual development and perceptual integration variable, analysed both before and after the application of the program (pre-test/post-test): "BG_{1-2}".

4) The development of the autism spectrum disorder severity levels, measured both before and after the implementation of the program (pre-test/post-test): "QA1-2".

The pre-test/post-test data variables were identified following the application of the following tests:

1. "BG" variable measured using the Bender Test (BG) (Bender, 2009).

2. "AQ" variable found through the Autism Spectrum Quotient Test (Baron-Cohen, 2003).

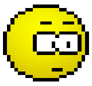
Procedure:

The study required and received the consent and ethical approval of the participants' families.

This study was developed over a 24-month period. Firstly, the pre-test data for the two variables selected, "BG" and "QA", were obtained. The "GIP" program (Ojea, 2009) was then applied, followed by the obtainment of the post-test data for the indicated variables.

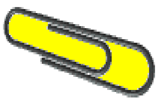
Figure 1 shows an example of the GIP program, which is structured across several steps: 1) observation of the initial stimulus; 2) decoding of conceptual stimulus units; and 3) reconstruction of the conceptual modality.

Figure 1: Activity 133 (Ojea, 2009, p. 199- 201).



Focus the child's gaze on the next stimuli and point to it with your finger or the palm of your hand. The teacher describes the image: "these are two children studying on a computer”.

Cut out the figures in the Table below and observe them, while the teacher describes the conceptual units: “a computer”, “two children".



Paste the cut-out shapes into the following outline.
Then, using your finger or the palm of the hand, point to and/or verbally name the image or its content in response to the question asked by the teacher: What are the children doing?
- "They are studying on the computer."

Results

The results demonstrate that an analysis of the scores recorded before and after the application of the program reflects those modifications that are significant in the development of the two selected variables ("BG" and "QA").

Table 2 shows that of the two groups of variables analysed by the t-test for two related samples, significant critical levels (Sig: .00) were obtained, indicating that the changes found in the pairs of related pre-test and post-test variables (perceptual motor variable "BG" and autism-spectrum quotient variable "AQ") are significant and were achieved as a result of the program's implementation.

Table 2: Paired samples test.

	Paired Differences					t	gl	Sig
	Mean	**Std. Deviation**	**SE**	**95% Confidence Interval of the Difference**				
				Lower	**Upper**			
BG_1 - BG_2	-,93	,63	,11	-1,17	-,69	-7,99	29	,00
QA_1-QA_2	-1,00	,58	,10	-1,21	-,78	-9,32	29	,00

The pre-test/post-test "BG" variable (perceptual motor variable) and the pre-test/ post-test "AQ" variable (autism-spectrum quotient) constitute "Factor 1", and pre-test/post-test analyses have been compared across the three levels of diagnosis (see Table 3).

Table 3: Multivariate tests (c).

Effect		Value	F	Hypothesis df	Error df	Sig
factor1 (BG_1 - BG_2 & QA_1-QA_2)	Pillai's Trace	,90	75,26(a)	3,00	25,00	,00
	Wilks' Lambda	,10	75,26(a)	3,00	25,00	,00
	Hotelling's Trace	9,03	75,26(a)	3,00	25,00	,00
	Roy's Largest Root	9,03	75,26(a)	3,00	25,00	,00
factor1 * DIAGNOSIS	Pillai's Trace	,65	4,189	6,00	52,00	,00
	Wilks' Lambda	,36	5,49(a)	6,00	50,00	,00
	Hotelling's Trace	1,71	6,84	6,00	48,00	,00
	Roy's Largest Root	1,68	14,61(b)	3,00	26,00	,00

The results found that for Factor 1 there were two fundamental conclusions: 1) there are significant changes in Factor 1, found in all comparative pre-test/post-test (BG_1 - BG_2/ QA_1- QA_2) measures (Sig: .00), and; 2) likewise, the changes found in Factor 1 have significant associations with ASD severity levels (Sig: .00).

Table 4 shows that the value of Mauchly's W statistic on the comparative analysis leads to the rejection of the sphericity hypothesis of the study (Sig: .42).

Table 4: Mauchly Test Sphericity (b).

Intra-subject effect	Mauchly's W	Approx chi-square	gl	Sig	Épsilon(a)		
					Greenhouse-e- Geisser	Huynh-Feldt	Lower-bound
factor1	,82	4,96	5	,42	,88	1,00	,33

Since Mauchly´s W statistic indicates that the condition of sphericity has not been met (Sig: .42), the epsilon corrector index (a) has been applied, whose estimated values, already, are shown below (see Table 5).

Table 5: Intra-subjects contrast test.

Source		Type III sum of squares	df	Mean-square	F	Sig.
factor1	**Sphericity Assumed**	27,69	3	9,23	73,49	,00
	Greenhouse-Geisser	27,69	2,66	10,41	73,49	,00
	Huynh-Feldt	27,69	3,00	9,23	73,49	,00
	Lower-bound	27,69	1,00	27,69	73,49	,00
factor1 * DIAGNÓSIS	**Sphericity Assumed**	5,22	6	,87	6,92	,00
	Greenhouse-Geisser	5,22	5,31	,98	6,92	,00
	Huynh-Feldt	5,22	6,00	,87	6,92	,00
	Lower-bound	5,22	2,00	2,61	6,92	,00
Error (factor1)	**Sphericity Assumed**	10,17	81	,12		
	Greenhouse-Geisser	10,17	71,81	,14		
	Huynh-Feldt	10,17	81,00	,12		
	Lower-bound	10,17	27,00	,37		

In fact, the corrected values of epsilon (Greenhouse-Geisser, Huynh-Feidt and Lower Bound) indicate significant critical levels (Sig: .00), meaning that there are significant changes found in “Factor 1”: BG_1 - BG_2 / QA_1- QA_2 as a consequence of participating in the program. Also, these changes are significantly different in relation to the three varying severity levels of ASD.

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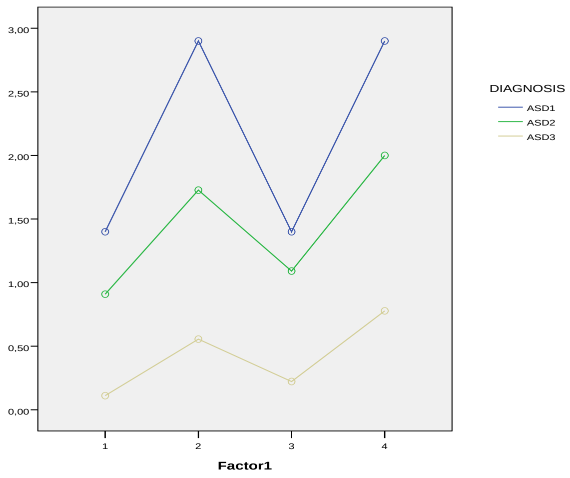
Figure 2 indicates the data for the pre-and post-tests (BG_1 - BG_2 /QA_1- QA_2) found in “Factor 1” grouped with the "diagnosis" variable.

Figure 2: comparative measures in the "BG" and "QA" variables, grouped to diagnosis variable.



Students with ASD 1 registered pre-test data (indices 1: "BG" and 3: "QA") that measured higher than their peers in the ASD 2 and ASD 3 groups, as well as significantly higher post-test scores as a consequence of the application of the program (indices 2: "BG" and 4: "QA").

The post-hoc comparative results for the three levels of the "diagnosis” variable are displayed in Table 6 below.

Table 6: Post-hoc test for "diagnosis".

(I) DIAGNOSIS DIAGNOSIS	J)	Mean difference (I-J)	Std. Error	Sig	95% confidence interval	
					Lower bound	Upper bound
ASD1	**ASD2**	,71(*)	,10	,00	,44	,99
	ASD3	1,73(*)	,11	,00	1,44	2,02
ASD2	**ASD1**	-,71(*)	,10	,00	-,99	-,44
	ASD3	1,01(*)	,11	,00	,73	1,29
ASD3	**ASD1**	-1,73(*)	,11	,00	-2,02	-1,44
	ASD2	-1,01(*)	,11	,00	-1,29	-,73

Bonferroni option.

The Bonferroni option test for the post-hoc comparative test, carried out for the "diagnosis" variable, indicates that the changes found in “Factor 1” are significantly different for each of the three levels of participant "diagnosis" (Sig: ,00).

A comparison of the results found in “Factor 1” related to the age of the participants, has been obtained from a post-hoc test for the variable "age" (see Table 7).

Table 7: Post-hoc test for "age".

(I) AGE	(J) AGE	Mean difference (I-J)	Std. Error	Sig	95% confidence interval	
					Lower bound	Upper bound
4-6 year	7-9 year	,04	,32	1,00	-,78	,87
	10-12 year	,38	,34	,80	-,48	1,26
7-9 year	4-6 year	-,04	,32	1,00	-,87	,78
	10-12 year	,34	,33	,94	-,51	1,20
10-12 year	4-6 year	-,38	,34	,80	-1,26	,48
	7-9 year	-,34	,33	,94	-1,20	,51

Bonferroni option.

Conversely, a comparative study grouped by the "age" variable confirm that there are no differences in the effects of the program on “Factor 1” for any comparative analysis of each of the participant’s age ranges for the variable “age” (Sig: <.05).

Discussion

Following further careful consideration of these results, and given that the study is limited due to the small number of participants, the following general considerations can be made.

The program applied in this body of research has aided an improvement in the development of levels of perceptual visual-motor integration, measured through the variable "BG" in the study's participants. It is important to indicate that there have been significant improvements to the autism-spectrum levels measured by the variable "QA".

These conclusions lead to an interrelation between the processes of development of the semantic abilities or global codification of the information and the development of the indices of ASD. In fact, the relationship between the various neuropsychological processes, involving cognition and emotional processes, is a well-studied issue (Thomson, Bumham & Weiss, 2015), implying a direct influence on the development of holistic understanding, and therefore, in interaction and social communication, which form the basis measuring the variable "QA".

The program has significantly influenced the levels of the diagnostic variable. Thus, all participants have improved their development of the perceptual-cognitive process and the autism-spectrum quotient, but this development has been greater in the group of students with level 1 ASD, who have benefited most from its application, followed by students with level 2 ASD, and, finally, the students with level 3 ASD have achieved lower levels of improvement. It can then be concluded that the cognitive theoretical assumptions of the program have responded positively to the objectives of this research. In this sense, it can be affirmed that, from the sequential progressive presentation of the parts of the stimuli, global coding or Gestalt processes are achieved, that is to say, out of the perception of the details of the stimuli, which conforms the strengths of those suffering ASD, a global understanding of the stimuli can be learned. In doing so, it is shown that autism indices improve, as they are influenced by the development of the semantic memory, since both components influence each other through their intersection during the thought process (Wing, 1981; 1982; 1986).

However, thought is inherent to the semantic-pragmatic process, since it constitutes the codes through which experience is coded, and in turn, the development and creation of these codes influence the way that the reality is coded, and it is from this level that the other processes that follow in the cognitive chain are clearly influenced by any previous deficit. Thus, due to this specific difficulty, even when the areas of communication and social interaction are developed, the learning that those with ASD undertake is limited to the information received, without the presence of an inductive inferential process that makes this learning applicable to other situations or new stimuli, thus persisting strategies of literal thinking. When semantic processing is limited, not only is there a partial rupture to the system, but there are also integration difficulties for the presentation of new inputs, even at their most basic levels, due to the limitations of the conceptual baggage from which the successive levels of representation are overlapped, so this program could serve as a holistic support model for interventions with children with ASD (Ozonoff & Miller, 1995; Rutter, 1983).

Therefore, the basic assumptions of the Central Cognitive Coherence Theory (Gillberg & Peeters, 1995; Gray, 1998; 2002; Gray & Garand, 1993) are verified, where its conclusions are applicable to the higher levels of the perceptual process, because the determination of the cognitive style of weak coherence immediately affects any new stimulation. Indeed, there have been many psychoeducational studies that have addressed the cognitive-behavioural development of people with ASD (Hastin & Brown, 2002; Granot, 2016; Kunce & Mesibov, 1998; Lovaas 1981; Mundy, Kasari, Sigman & Ruskin, 1995; Nind & Hevett, 1994; Nind & Powell, 2000; Swaggart & Gagnon, 1995; Watson, 1989) and among these, those that are currently receiving the greatest attention are the programs that are based on those basic dimensions that are inherent to children with ASD (Alshurman & Alsreaa, 2015; Arick, Loos, Falco & Krug, 2004; Boyd et al., 2014; Lovell & Wetherell, 2016). Such interventions should be approached from a social mediation perspective in which families, teachers and other social institutions receive the necessary training to disseminate the program’s interventions in ordinary and regular contexts (Derguy, M´Bailara, Michel, Roux y Bouvard, 2016).

In this sense, O´Heam, Franconeri, Wright, Minshew & Luna (2013) suggest evidence that people with ASD rely less on holistic visual information than others generally do, as well as on their significant deficits related to visual perception and motor fluency. Intervention programs adapted for people diagnosed with ASD must then be designed according to the processes of individuation or of analysis of the separated elements, in order to later obtain the integration of these elements to form a Gestalt or global comprehension. Gestalt integration is then the basis of the semantic functioning of the permanent memory, which facilitates understanding in terms of meanings, as well as the establishment of relationships between new and previously learned information (Chabarri & Hommel, 2014, Fitch, Fein & Eigsti, 2015). Global processes involve perceptual and cognitive development, related to the perception and coding of stimuli, as well as visual motor development, so that both perceptual and visual motor aspects form the basis of a Gestalt or global construction.

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