Autistic Spectrum Disorder: The Development of Semantical Memory by Means of the Creation of Cognitive Nodes

Manuel Ojea Rúa
Universitat of Vigo
Spain

Summary

The present paper shows a study which analyses the perceptive-cognitional process that affects particularly people who suffer from autism spectrum disorder, which is characterized by limitations concerning the spontaneous creation of meaningful marks in the memory, which happens to severely complicate the semantical recovery of the information. The data found in this study's analysis, carried out by means of an almost experimental methodology, of two groups, the experimental one (N: 17) and a control group (N: 22), come to the conclusion that the participants within the experimental group, which has been applied a semantical development integrated program, which includes the facilitator keys of the contents' construction, obtain significant improvements in memory tasks with semantical components of information, in relation with the control group, which has been applied the same program, but without the support of the relations and nexus which have been mentioned above. To conclude, it can be deduced that the educative programs which are applied should keep in mind in a specific way the inclusion of relations, nexus, nodes or keys among the informative units, which have to become, in turn, in learning contents, with the aim of making easier the cognitional development, by the extension of the map of cognitional nets.

Keywords: Autism Spectrum Disorder, Semantic Memory, Conceptual Categories, Conceptual Relationships

Introduction

According with the International Classification of Mental Disorder of the American Psychiatric Association (2014), people who suffer from autism spectrum disorder (ASD), in its three levels of intensity of the diagnosis (level 1-3), show, in general, a peculiar perceptive processing in relation with the reception of the stimulus which come from the background, which also spreads towards the evaluation of the experience, external as well as internal, given that for being conditioned the analysis procedures and codification of the entering information, then the information which comes from the outside is affected, as well as the one stock up in the permanent memory previously or long-term memory.

Then, depending on the level of the diagnosis, specificity is found which is typical in relation with the two general dimensions: 1) Interaction and social communication, and 2) Restricted Interests and Repetitive Behaviours. For what concerns the first dimension, level 1 of the diagnosis is characterised by the presence of mild deficits in social communication (verbal and non-verbal), level 2 is associated with deficits related to social abilities and communication, and level 3 is characterized by severe alterations in verbal social communication. Meanwhile, the second dimension, in other words, regarding repetitive and restrictive behaviours, level 1 of the diagnose is characterized by the presence of rituals and interests which provoke impediments for the functioning of one or more social contexts, level 2 is related with the presence of restrictive interests which frequently interfere in the social functioning and finally, level 3 is associated with the presence of an excessive worry, fixed rituals which interfere intensely on the social functioning.

Therefore, from a cognitive perspective, people who suffer from ASD are characterized by a particular way of processing information, in relation with the attentional perceptive focalisation and the cognitive codification of the initial stimulus, which is focalised on the parts or partial units that compose the global stimulus, with the resulting limitations to create, in terms of meanings, the information or learning processes initially perceived.

In this sense, Frith (1989), Frith & Snowling (1983) and Lopez, Leekam & Arts (2008) suggest that ASD are characterized by a processing which consists in the weakness of the informative processing, in other words, the way of perceiving information is based on a process which is focused on the parts or details of the observed stimulus, which provokes, from a procedural perspective, the creation of traces in the memory which are dominated by mechanical processes that contain a low semantical or meaningful content, and as a result the deficit concerning the storage of the information into the permanent memory. Furthermore, this perceptual style also affects the process of conceptual integration and in consequence, the categorical formations which facilitate the hierarchical organization of the information and therefore, of the economy of the memory's need of storage. This situation provokes obvious deficits on the spontaneous creation of relations concerning the new information or *inputs* which come from the outside and the *mnesic* contents or knowledge that were previously adopted, in other words, the lack concerning the creation of nexus and relations between both types of information, the one that comes from data and the one that existed in a cognitive way, complicating the subsequent access to it, this fact is proved and is based on empirical finding, from these evidences related to semantic memory and tasks processing (Hermelkin & O'Conor, 1970; Tager– Flusberg, 1991; Tager– Flusberg & Joseph, 2003; Happé, 1997; Jolliffe & Baron– Cohen, 1999; Plaisted, Dobler, Bell &Davis, 2006).

Thus, both scientific researches based on empirical evidences that aim to understand concepts, and also investigations based on Gestalt-like recognition evidences, related to the study of faces perception and recognition (Lopez & Leekam, 2003; López, Donelly, Hadwin & Leekman, 2004) indicate that, although some differential results among people who suffer from ASD, what happens to be logical, given that these people show a large symptomatic variety and different levels within the autistic spectrum, show that, in general, clear complications to integrate the conceptual information as a whole or, at least, show a severe reduction in the efficiency of memory tests in terms of meaning when the experimental group that has been used is compared with the control one.

In effect, from this perspective, the hypothesis of the cognitive central coherence theory, investigated by Carmo, Duarte, Pinho, Filipe & Marques (2016), Ojea (2006) and Riches, Loucas, Baird, Charman & Simonoff (2016) among many others, exposes that when seeing the presentation of a global initial stimulus, for instance, an image of "food", people who suffer from ASD tend to perceive and point to a part or unit inherent to the initial stimulus, indicating, for instance, cup, pear (…) and, progressively, they consecutively construct the total component of the presented concept, in a way that the learnt sum of the parts, start shaping in a gradual way the meaning of the initial stimulus.

Then, the perceptive analysis and the ulterior processes of codification and recovery of the information, both from the outside, in other words, the information that comes from data, and the information that is in relation with the content previously learned or intern cognitive process, are based on the theoretical-conceptual principles of the theory of perception, in which the sensorial integration of the information is explained, in its semantical level, and depends, for sure, of the global perception of the information, which, in turn, depends on the fact that the unions (nodes) are facilitated between the new entering information and the information previously acquired and storage into the semantic memory, in a way that a continuous feedback is formed between the information which comes from the background and the accumulated experience, which, in a progressive way, turns into information that is susceptible from later recovering and codification (Brandein et al., 2015; Lieberman, 2012). Norman and Bobrow (1975) and Neisser (1988; 1995) note that the perceptual contents make reference, in summary, on one hand, whether the bottom-up processing or the other one, run by the data, can activate the memory codes in different levels of the analysis, from a physical analysis to a semantical one of the information, depending on the attentional levels and personal motivations; and, on the other hand, the top-down processing, or guided by cognition process, located into the permanent memory, which, depending on the specific needs, can be properly decoded by means of perceptual schemes or mental pictures.

Nevertheless, these processes are not discriminatory from each other, but, as the rest of cognitive psychological processes give room, as Treisman (1960) states, through her model of feature integration, to interactive forms of processing, in a way that the perceptive process follows a functional course, in which, the global visual stimulus is decomposed in form, movement, depth and colour; later, it is analysed in superior levels of processing, with the aim of bringing together all these features in meaningful elements or objects, in a way that a coherent figure is composed in the place of separate or unconnected features initially perceived. From the neurobiological point of view, the processing acts as a successive series of processual phases from the detection of a series of features, which constitute every physical and initial aspect of the perceived image and are also represented discreetly in the cognitive system.

In this moment, the neuronal system marks the strength and intensity of the detected signals, in a way that the process continues transforming the initial visual stimulus into neuronal impulses, which are transformed from the retina to the brain by plenty of tracts, of which, the most important one is the geniculated lateral nucleus and, later, it arrives to the primary visual cortex, in which begins the process of analysing the individual features that had been initially detected (Eberhard – Mosdicka, Jost, Raith & Maurer, 2015; Reales, 2014). Structurally, the discoveries found from this neurocognitive perspective (Marr, 1982) based on the analysis of the visual perceptive processing by means of neuroimage technique, point out the existence of a series of visual areas which are interlinked hierarchically in two tracts, the dorsal one, dedicated specifically to the visospacial processing of the object, in which the perceptive process is gradually more and more selective with the aim of analysing the complex objects or phenomena, answering, less and less, to disorganised images and, being precisely, the fact that various selective regions exist in different stimulating categories, what leads us to postulate the existence of these cortical nets or groups of neurons linked among them in order to do the same perceptive task.

For what concerns this question, Ballesteros (2000) and Barsalou (2008; 2009) state that when categorising as "dog" the neighbour's pet, which barks anytime anyone walks by, is attributed features that, normally, any member of its category would have, what makes that during the process of construction of the categories perception participates, but also memory and reason. This process of relational connexion of the information is the one that seems deficient among people who suffer from ASD, a fact that limits, in the first place, the step from a cognitive codification process to the establishment of its correspondent representation and, in the second place, the process of spontaneous elaboration of nexus or links between the entering information and the one that already existed, what severely restricts its posterior recovering, and also its employed use to the resolution of problems and/or decision making in daily life events, being, precisely, from this level on when the rests of processes that follow the cognitive chain are clearly affected (Bauer, Varga & King, 2015; Elison et al., 2013; Margolis; 1994; Medin &Shoben, 1988).

Objectives of the Investigation

By doing this research, the main aim is to fulfil the general objectives that follow:

1. Constituting two groups composed by people who have been diagnosed ASD, an experimental group, which will be applied an experimental program, and a control group, and both adjusted according to equity principles in relation with the features of the components of both groups.
2. Designing and applying a Program of Semantic Integration, complemented with the use of nexus, relations or keys, applied to the experimental group.
3. Designing and applying a Program of Semantic Integration that does not use nexus or relations among contents, applied to the components that are into the control group.
4. Extracting the comparative results between the groups, consequents with the application of the program to both groups.
5. Elaborating, in consequence the conclusions that have been reached after the research, with the aim of improving the application of educative programs implied on the creation of cognitive webs of ASD people.

Method

Hypothesis of the investigation

The objectives that have just been exposed show, in effect, that the general hypothesis of the study is based on the expectative that the participants of the experimental group, who have been applied the program, supported by nodes of cognitive relations, would obtain a substantially better score in tasks that concerned semantical memory than their mates into the control group.

Design of the investigation

This investigation is based on a study almost experimental, constituted by an analysis pre- postest, of two groups, an experimental one, that has been applied a program of semantical integration supported by nodal relations; and a control group, that has been applied the same program without the use of those relations. The data found by means of the pre- postest analysis have been obtained by the application of the following psychometrical techniques: 1) GARS de Gilliam's (2006) measurement scale of the intrinsic features of the autism's dimensions 2) Bender's (1994) visual-motor perception test, 3) Frostig's (2009) test of visual perception and 4) Ojea's (2015) analysis of tasks and texts comprehension.

Variables

The investigation contains two groups of variables: 1) the static ones, that make reference to the participants' features in the study, in relation with the diagnose (*Diagnose*), age (*Age*) and sex (*Sex)* of the students, and 2) the dynamic variables, of which the score has been analysed before and after the application of the program: the level of the diagnose (*Level*), the processes of perception (*Perception*) and the semantical memory (*Semantic*).
The group of the dynamic variables pre- postests has been analysed by the following techniques, indicated in the design:

1. The intrinsic level or features of the disorder (*Level1 and Level2)* have been obtained by using Gilliam's GARS scale (2006), through the analysis of the following subtests or dimensions: 1) stereotyped behaviours 2) communication, and 3) social interaction.
2. The perceptive processes (*Perception1 and Perception2*), have been analysed by Bender's tests (Bender, 1994) and Frostig's (Frostig, 2009).
3. Semantic memory (*Semantic1 and Semantic2)* has been evaluated by means of the comprehension of different reading texts, which have been carried out before and after the realization of each activity indicated in the program.

Participants

A total of 39 students who have been diagnosed ASD have participated in the study, subdivided in two groups, an experimental one (G_1), composed by 17 participants, and a control group (G_2) composed by 22 students. The selection of the participants of each group has been made following an equitable process in relation with the level of diagnose, the age and the sex. Thus, 16 of these 17 students within the experimental group are men and 1 is a woman, 9 present an ASD diagnose of level 1, 2 of level 2, and 4 participants present a level 3 diagnose. The participants range, likewise, from 4 to 20 years old, of which 4 students are between 4 and 6 years old, 3 are between 7 and 9 years old, 2 are between 10 and 12 years old, 6 are between 13 and 15 and finally, 2 participants are older than 16. The control group has been constituted by a total of 22 participants, of which 18 are men, and 4 are women; 14 present an ASD diagnose of level 1, 5 of level 2, and 3 of level 3; 9 students are between 4 and 6 years old, 4 are between 7 and 9 years old, 5 are between 10 and 12, and 4 are between 13 and 15 years old.

Procedure

The programs have been applied to both groups during 6 months, arranged in sequences of a week session of an hour of duration each. And, while the participants of the experimental group have been applied the program supported by nodes and significant links planned into the program; their counterparts in the control group have done the very same program, except for the absence of the help from the mentioned nexus or links. The psychometrical tests indicated have been applied before the starting phase of the programs (pretest) and after its application (postest), with the aim of comparing the possible changes found as a consequence of the programmatic application between both groups.

The program

Ojea (2015) has developed a program with the general aim of improving the development of the semantic memory in people who suffer from ASD. The program follows a structure which contains some phases: 1) observation of an initial global image (stimulus) and relation of the image with its written text, 2) subdivision and decoding of the initial image into partial units accordingly with the previous analysed competences, 3) implementation of the keys or nodes into the process of codification, of the information 4) active construction of the initial image from the sum of the meaningful learnt parts and 5) memory and recognition of the constructed information, based on the keys that have been used. As an example, in figures 1 and 2 it can be noted the programmatic design applied to both groups (the experimental one and the control one). Nevertheless, while people into the experimental group have been introduced into the learning program of nodes and relations associated with contents (see figures 3 and 4) their counterparts in the control group have not been applied the associated nexus.

Figure 1: "BEDTIME".

Observe the next image, while the text is read.

Text: "It is night time, bedtime, Alex is already lying down in his bed, while his dad tells him a tale before sleeping. Today he is telling him the tale of "The lost donkey". The tale of "The lost donkey" is based on Lucas' story, a farmer who went to a fair on Saint Michael's day and bought 6 donkeys, happy after having done so, he went back home. The first part of the trip he travelled walking, later he felt tired and rode a donkey. Suddenly, he counted the donkeys he had in front of him and oh! He could only see5 donkeys, there was 1 missing (…) When he got home, desperate because he thought he had lost a donkey, he asked his wife to count the donkeys, and she answered not to worry because although he had counted 5 donkeys, she could see 7."

In the second phase, the decoding takes place and also the comprehension of the stimulus through the subdivision of its units or significant parts which compose it, although this situation might depend on the previous competences of each participant (see figure 2).

Figure 2: Comprehension of the stimulus.

Subdivision 1: observe the following picture, point to it while you are asked "What is Alex doing?"

Alex is already laying down in his bed, while he listens to a tale his dad is telling him.

Subdivision 2: observe the picture, point to it and answer the following question:"What tale is his father telling him?"

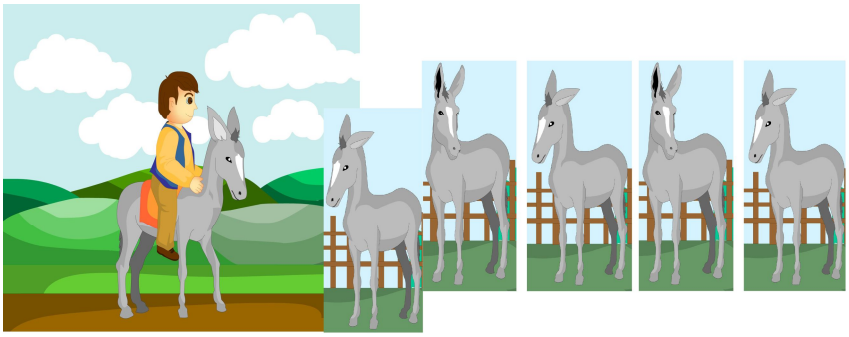
His father is telling him "The lost donkey"

From this learning or initial stimulus subdivided into its significant units, the construction and learning of the keys or related nexus takes place (see figure 3).

Figure 3: Keys' creation.

Observe the following picture and answer the next question **C** (key)

Point to them and count the number of donkeys in each box, how many donkeys did Lucas buy? And Why could he only count 5 donkeys?



How many donkeys are there in the picture? In the picture there are 6 donkeys.
Why could Lucas only count 5 donkeys? Because Lucas does not count the donkey he is riding.

In the last step, it is possible to initiate the process of recovery of the information in significant terms, accessing from the used key as link in the active construction of the concept/category (see figure 4).

Figure 4: Information recovery.

Cut the task of this activity indicated with a **C** and paste it on the superior box. Point and answer the next questions in the inferior box.

C
What tale does Alex's dad tell him?
Why does Lucas count just 5 donkeys?

Results

The statistical analysis collects these results: 1) a descriptive analysis of the dynamic variables of the study, 2) an analysis of the ranges referred to the same variables, 3) a comparative study for two independent samples of *Mann-Whitney* in function of the static variables, 4) a comparative study for both independent samples of *Mann-Whitney* in function of the dynamic variables, and 5) a comparative analysis of each pair of dynamic variables for two samples related to *Wilcoxon*. The descriptive analysis of the variables considered dynamic pre- postests of the study for both groups (experimental and control), in relation with: 1) the diagnose level (*Level 1, 2*), 2) the perception level (*Perception 1, 2*), and 3) the level of semantic integration (*Semantic1,2*) can be observed in table 1.

Table 1: Descriptive analysis.

VARIABLES	*N*	*M*	*SD*
Level1	39	2.58	.96
Level2	39	1.76	1.20
Perception1	39	1.56	.99
Perception2	39	2.48	.96
Semantic1	39	1.20	1.03
Semantic2	39	2.00	1.07

The descriptive study is completed with the comparative analysis of the score ranks and the partial sum for each dynamic variable, in relation with each group of participants that can be observed in table 2. In the results that have been found, it is visible that the only variables that descend the rank in the analysis are the punctuations referred to the *Perception 2* variable (22, 71, 17, 91) being this descent especially significant in the variable *Semantic2* (26, 50, 14, 98), what constitutes an indicator of the foreseeable improvements in those variables as a consequence of the application of the program.

Table 2: Ranks.

VARIABLES	*Group*	*N*	*Rank*	*Sum*
Level1	G_1	17	16.97	288.50
	G_2	22	22.34	491.50
Level2	G_1	17	16.71	284.00
	G_2	22	22.55	496.00
Perception1	G_1	17	18.09	307.50
	G_2	22	21.48	472.50
Percetion2	G_1	17	22.71	386.00
	G_2	22	17.91	394.00
Semantic1	G_1	17	17.68	300.50
	G_2	22	21.80	479.50
Semantic2	G_1	17	26.50	450.50
	G_2	22	14.98	329.50

The comparative analysis of the data, found as a consequence of the application of the programs in both groups (G_1, G_2), in relation with the variables taken as static: *diagnose*, *age*, and *sex*, have been carried out, due to the unlimited amount of participants, by means of the use of the non-parametrical test for 2 independent *Mann-Whitney*'s tests (see table 3).

Table 3: Statistics.

	Diagnosis	*Age*	*Sex*
Mann- Whitney's U	182.00	128.00	164.00
Wilcoxon's W	435.00	381.00	31.00
Z	-.16	-1.72	-1.12
Sig. (bilateral)	.88	.08	.26
Sig. (2* (sig. unilateral)	.90 (a)	.09(a)	.52(a)

As it can be observed, there are no significant differences in any variable for reasons related to diagnose, age or sex of the participants, in relation to both groups (experimental group and control group) in a way that the comparative data found between the groups are independent from the variables previously mentioned, as a consequence of the application of both programs of semantic development, one with the use of nexus (experimental group) and another one without nexus (control group). For its part, the comparative analysis done for the dynamic variables: *level 1, 2, perception 1, 2 and semantic 1, 2* in relation, additionally, with both groups of participants (G_1 and G_2), found by means of *Mann-Whitney*'s non parametrical test, it can be observed in table 4.

Table 4: Statistics.

	Level 1	*Level 2*	*Perception1*	*Perception 2*	*Semantic 1*	*Semantic 2*
Mann- Whitney's U	135.50	131.00	154.50	141.00	147.50	76.50
Wilcoxon's W	288.50	284.00	307.50	394.00	300.50	329.50
Z	-1.52	-1.65	-.95	-1.37	-1.16	-3.27
Sig. (bilateral)	.12	.97	.33	.16	.24	.00
Sig. 2* (sig. unilateral)	.14(a)	.11(a)	.36(a)	.20(a)	.26(a)	.00(a)

In effect, the application of both programs allows us to deduce that significant differences cannot be found between both groups in the vast majority of pre- postests variables: *Semantic 2*, which is related to the ability of creating meaningful concepts and categories (sig:00), that allows us to confirm the use of keys or nexus during the application of the program, which has allowed us to develop the creation of mnesic tracks with semantic contents in the permanent memory of the participants.

Finally, in order to confirm the difference into the found levels between each pair of variables in function of both groups, data has been analysed by means of the statistic non-parametric test of ranks for two related samples of *Wilcoxon* (see table 5). The results prove that the students who form the experimental group show significant improvements in every pair of studied variables, while the participants who form the control group have also improved in the 2 first groups of variables: *"Level 1, 2"* (sig: ,00), "*Perception 1,2"* (sig: ,00), nevertheless, the group of variables that measure the capacity of semantic integration "*Semantic 1, 2"* differentially significant scores are not found (sig: ,08),what lets us conclude that the found differences in the semantic memory between both groups are better sum up in significant contents tasks which are referred to the participants of the experimental group.

Table 5: Comparative analysis.

	G1 Experimental group			***G2 Control group***		
	Level1 Level2	*Perception1 Perception2*	*Semantic1 Semantic2*	*Level1 Level2*	*Perception1 Perception2*	*Semantic1 Semantic2*
Z	-2.56(a)	-3.78(b)	-3.71(b)	-3.69(a)	-3.60(b)	-1.73(a)
Sig. (bilateral)	.01	.00	.00	.00	.00	.08

This data show that the application of the program, complemented with the use of relations, nodes or nexus, improves the creation of semantic contents in the permanent memory.

Discussion

The processing levels of the information have to be carried through in a proper way to allow the regulation of the human behaviour, in a way that it is necessary to proceed by an attentional focalised process, which is able to run towards a sequentially taken stimulus, while, later, the comprehension of it will be built taken as a totality, what happens to be well explained from the theoretical estimations and also the practical ones concerning cognitive neuropsychology , neurophysiology or the linking approaches explain that the cognitive process is subjected to structured learning or chained by successive webs duly connected by nexus or relations that facilitate maturation and personal growth (Beattie and Manis 2014; Iskandar and Barid, 2014). Geng and Schnur (2015, Phaf, Van der Heijden and Hudson (1990) and Humphreys & Müller (1993) state that the learning process, from the cognitive perspective, is formed by a number of units of processing or nodes that are interlinked among themselves, and which are of a esencial nature, given that the information, and thus, the levels of socio-personal development, do not depend on any of these units activities separately, but are the result of the union in the net of all of them and also of their systemic functioning as a conjunct.

Heyman, Van Rensbergen and Storms (2015) prove, in effect, that the entering of the information or initial perceptive system triggers the activation of the units that link with the entering content and, at the same time, the activation of the units with which these are related to, a fact that is possible thanks to the activation of the knowledge or previous experiences that took place at a personal level. This process takes place slowly and progressively in a serial and progressive way until achieving the activation of the system as a totality, which implies the comprehension of de meaning as totality of the stimulus and/or the contextual situation. In this way, as the theory of cognitive central coherence proves, by stating that the informative features of the learning processes are coded in separate elements to start, at first deconstructing and later, constructing, from those parts, in a sequential way, as a consequence of the learning, the initial global stimulus observed; also in the connectionist system (Molhom, 2015) is based on the consecutive cognitive integration of chained webs until reaching the expected semantical content, which aims to access the totality or gestalt of the information.

This learning process requires using strategies based on strongly meaningful processes and also functional which facilitate the progressive creation of relations well-connected among them, which intend to allow the successive cognitive growth. Volquete, Weaver &Houghton (1994) state that when learning situations are significant and functional, the processing of the information is able to accomplish a successive analysis that becomes increasingly more complex, until becoming able to do the analysis of the information in parallel of the constructed stimulus. But, what matters the most, when learning is functional, the actions are attributed a certain intent or target, and the meaning of the made attribution facilitates the systemic intrarred interconnection or gestalt unifying in its totality the disconnected units and isolated until that moment.

Certainly, people who suffer from ASD tend to focus their perceptive attention on parts of the stimulus, showing limitations to link elements in a spontaneous way and, consequently, their capacity of processing meanings and/or contexts in its totality is limited.

Precisely, for this reason Ojea (2009) presented a program to facilitate the gestalt-like development, structured and based on: 1) presenting the total initial stimulus, 2) to decompose it into the parts that compose it, 3) to facilitate the scaffold-like processes of learning by linking those parts, and 4) finally reaching the total meaning of the stimulus that hadn't been acquired in the first phase of the development. Once the concept has been understood, the process can continue, by means of the creation of cognitive webs, in order to get to compose the gradual learning of the category that belongs to it, and also gradually getting to the relations-between-categories' components or intermodal-relations in the complex chain of the learning process.

But, this process should be preceded by the design of relations, nexus, nodes or keys, which link some concepts with some others, among these and its categories and among categories, given that on the contrary, a learning process could have been produced, but it will be very difficult and, mostly, establishing the capacity of its application to other new situations, even, sometimes, in similar situations. To conclude, for the programs to be effective, the fetching cognitive webs' development of meaning creation and semantical tracks in the long-term memory, must accomplish, among many others, the following specific objectives:

1. Evaluating the participants' specific needs concerning the intrinsic level compatible with the diagnosis.
2. Making an evaluation of the competences and capacities previously acquired.
3. Designing the elements or contexts of the learning process that apply reinforcing values which are also strongly functional.
4. Designing the new capacities or programmatic objectives of the learning process, which are closely related to the competences that were detected in step 2.
5. Subdivide the global objective stimulus in as many significant parts as it is applicable, adapting the process to the intrinsic levels of the diagnosis that has been exposed in step 1.
6. Designing the links, nodes, nexus, that relate the units or parts that compose the stimulus/global concept. Those nexus would be considered as contents themselves.
7. Starting the active construction of the units or parts, and also the construction of the relations, until achieving the expected semantical levels.
8. Facilitating the functional recovery of the information in semantical terms that allow the active attribution of the contents.
9. Facilitating and disposing the necessary contexts for the practical application of the contents and constructed concepts.
10. Exchanging the learning contexts in order to manipulate the application of the learnt concepts, using them in similar or new situations.

Once the conceptual development process has been constructed, it is possible to start learning a new concept and/or categorical formation of which it is a part, and to increase, progressively, the socio-personal development level in a systemic way, with the aim of mutually affecting the totality of the cognitive process: perception, cognition, motivation, emotion, memory (Florit, Roch & Levorato, 2014; Greimel et al. Voss et al., 2013; Wit, 2014).

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