Original Article

Artigo Original

Syntactic awareness: probable correlations with central coherence and non-verbal intelligence in autism

Consciência sintática: prováveis correlações com a coerência central e a inteligência não-verbal no autismo

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Keywords

Autistic disorder
Child
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Evaluation

ABSTRACT

Purpose: To evaluate syntactic awareness, central coherence, non-verbal intelligence, social and communication development, interests and behavior of children with autistic spectrum disorders and to examine their probable correlations. **Methods:** Participants were ten subjects diagnosed with autistic spectrum disorder, eight male and two female, with ages between 4 years e 9 months and 13 years and 4 months (mean age 9 years), who used oral language for communication. The following tests were used: Syntactic Awareness Test – Adapted (*Prova de Consciência Sintática – Adaptada*), Computerized jigsaw puzzles with picture and background and only with background; and Raven's Coloured Progressive Matrices – Special Scale. Subjects' parents answered the protocol Autism Diagnostic Interview – Revised (ADI-R). **Results:** The children with autism presented syntactic awareness performance similar to that of 6-year-old children with typical development. Sixty percent of the subjects showed non-verbal intelligence at a superior or average level. There were no correlations between the performances in syntactic awareness and the other tested variables. **Conclusion:** There was no relationship between the performance in syntactic awareness and the results related to central coherence, non-verbal intelligence and social interaction deficits, difficulties in communication and restrict patterns interests of subjects with autism. The results suggest that these children seem to follow the development pattern of typically developing 6-year-old children in syntactic awareness abilities, only delayed.

Descritores

Transtorno autístico
Criança
Desenvolvimento da linguagem
Cognição
Avaliação

RESUMO

Objetivo: Avaliar consciência sintática, coerência central, inteligência não-verbal, desenvolvimento social e da comunicação, comportamentos e interesses de crianças no espectro autístico e verificar suas prováveis correlações. **Métodos:** Participaram dez sujeitos diagnosticados dentro do espectro autístico, que utilizavam linguagem oral para a comunicação, sendo oito do gênero masculino e dois do gênero feminino, com idades entre 4 anos e 9 meses e 13 anos e 4 meses (média de idade de 9 anos). Foram utilizadas as provas de: Consciência Sintática (Adaptada); Quebra-cabeça computadorizados com figura e fundo e somente com fundo; e Matrizes Progressivas Coloridas de Raven – Escala Especial. Os pais dos sujeitos responderam ao protocolo *Autism Diagnostic Interview – Revised* (ADI-R). **Resultados:** As crianças com autismo apresentaram desempenho em consciência sintática similar ao de crianças de desenvolvimento típico com 6 anos de idade. Do total, 60% das crianças apresentaram nível de inteligência não-verbal médio ou superior. Não houve correlações entre os desempenhos em consciência sintática e as outras variáveis testadas. **Conclusão:** Não houve relação entre o desempenho em consciência sintática e os resultados referentes a coerência central, inteligência não-verbal, falhas na interação social, dificuldades de comunicação e padrões restritos de interesses dos sujeitos com autismo. Os resultados fornecem indicações de que essas crianças parecem acompanhar o padrão de desenvolvimento em consciência sintática das crianças de desenvolvimento típico de 6 anos de idade, porém com atraso.

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INTRODUCTION

Autism is a developmental disorder which is defined based on behavioral criteria, once biological markers are not known[1]. It's a lifetime disorder characterized by social interaction and communication deficits and by the presence of a restrict repertoire of activities and interests.

Language in autism has been the target of several researches and the focus of most of them has been the pragmatics. Contradictory results of researches on the grammatical development among subjects on the autistic spectrum have been common. There are researchers who believe that the grammatical development is preserved, while there are others who have already reported grammatical deficits in their investigations[2-4].

In general, these studies have been made under the linguistic perspective, which is one of the ways of evaluating the meta-language. Under this perspective, meta-language is secondary to the language as such and the meta-linguistic evaluation has its focus on the verbal production as a way of finding indicators in the use of language to refer to language itself. There is, however, the psycholinguistic form of evaluation in which language is evaluated as an object whose characteristics can be investigated through conscious and explicit monitoring[5].

Many times the evaluated children do not correct syntactic mistakes for not being sufficiently motivated to do so, in the spontaneous speech. Therefore, the studies that involve spontaneous speech must be complemented by the exam of the ability in syntactic correction, in a more controlled situation[6]. The controlled situation of syntactic correction mistakes is made through the psycholinguistic approach, in which the self-monitoring permeates the process of correcting and/or judging agrammatical sentences.

In the present research, the syntactic awareness, activity of meta-linguistic nature which involves cognitive processes of conscious management of the linguistic aspects[7], was the chosen ability for investigation. The syntactic awareness can be defined as the ability to reflect upon the syntactic structure of the language. Therefore, to evaluate it, involves not only to detect the level of the syntactic development, but mainly to verify the abilities of thinking about and analyzing on the structural aspects of the language in a conscious manner.

One of the theories which explain the autism is the existence of deficits in central coherence among the subjects on the autistic spectrum. Central coherence refers to the processing style, focused in details, proposed to characterize the autistic spectrum disorders[8]. In general, this ability is evaluated through tests that require the performance in tasks that demand the processing cognitive style focused in details (typical of subjects on the autistic spectrum) instead of the global processing style (expected among subjects with typical development). Children with autism tend to have a better performance in tasks in which they have to process parts of information, without having to take the whole into account, when compared to children of typical development[9-11].

Children on the autistic spectrum present the ability to perceive individual characteristics of a bigger entity and assemble jigsaw puzzles easily, being more oriented by the shapes of each piece than by the contextual clues of the picture to be assembled[9-13]. In this research, jigsaw puzzles with a picture and background and with only a background were created for the verification of the central coherence performance, once the children on the autistic spectrum seem to be able to assemble the jigsaw puzzle with only a background and without a picture, as well as the jigsaw puzzle with background and a picture. Children with autism wouldn't have difficulties to orient themselves by the specific shapes of each one of the pieces (with only a background and without a picture), without the need of using the global clues of the context (with a picture and background).

The jigsaw puzzles with background and a picture and with only a background, created for this research, were elaborated in a computerized version. Some of the advantages of using the computer for testing as well as for learning tasks among the subjects on the autistic spectrum were reported in previous researches[14,15]. The probable relationship of deficits in the syntactic awareness with deficits in central coherence, which is one of the theories that explain autism, can endorse syntax as a descriptive area of the autistic disorder.

Besides the verification of the relationship between the syntactic awareness performance and central coherence, it's important to establish some parameters of cognitive development that allow us to understand the performances of these children in the light of what is expected in a population of typical development. For that, non-verbal intelligence was chosen as a variable to be tested, through Raven's Coloured Progressive Matrices Test[16]. It's an instrument that showed to be effective in the evaluation of children on the autistic spectrum[17-20], which measures the non-verbal intelligence, once the cultural and linguistic influences are nullified with the geometrical patterns choice of the test[21].

In the same way, the syntactic awareness tasks are of a meta-cognitive nature, which implies in the activation of some action schemes which need to be planned and self-regulated and that depend on the availability of the central executive resources. In this way, it's expected that the children on the autistic spectrum present syntactic awareness performances positively correlated with the non-verbal intelligence performances.

For the characterization of the autistic disorders, the syntactic awareness deficits must present a significant relationship with the criteria which define autism: social development deficits, general communication and restrictive interests and stereotyped behaviors. In the specific case of this research, the Autism Diagnostic Interview - Revised (ADI-R) was used. It's an instrument created to elicit a complete range of necessary needs to produce a diagnosis of autism, as well as to qualitatively evaluate the present behavior and help in the evaluation of the correlated disorders referenced as autistic spectrum disorders[22,23].

The interview is administered to the caregivers. The administration of the interview requires a great amount of time, but the caregivers consider the experience comfortable because they have the opportunity to describe important aspects of their children's behavior, in their own words[22].

The results obtained in the ADI-R[22,23] can be evaluated based on two parameters: the current behavior algorithm and the

diagnostic algorithm. For the purpose of this research, the current behavior algorithm was used, once it allows the description of the current behaviors of the subject and the qualitative and quantitative interpretation of the data compared to the performances obtained in other tests, such as syntactic awareness and central coherence. The information obtained through the ADI-R are grouped in three domains: A) qualitative abnormalities in the reciprocal social interaction; B) qualitative abnormalities in communication and C) stereotyped, repetitive and restricted behavior patterns. The manual offers coding parameters for obtaining scores for each one of the questions. The scoring may vary from zero to three, according to the damages and severity of the evaluated behavior. The existence of a higher score in a specific evaluated area means that this area presents more significant deficits.

The research had the aim of evaluating the syntactic awareness, central coherence, non-verbal intelligence and social, communication and interests development, in order to verify the probable correlations between the results of the performances in these areas.

METHODS

The research was made with the consent of the Ethics Committee for the Analysis of Research Projects of the Clinical Board of *Hospital das Clínicas* and of the School of Medicine of *Universidade de São Paulo* (USP) under number 0380/08. The adults responsible for the children signed the Free and Informed Consent Term.

Subjects

Ten subjects on the autistic spectrum participated, diagnosed by psychiatrists, according to the proposed criteria by the DSM-IV and CID-10. To be included in the research, the subject should make use of oral language for communication, be available to cooperate and answer to the tests and attend the weekly language therapy at the Speech-Language Pathology Research Laboratory in Autism Spectrum Disorders of the School of Medicine of USP.

The data collection with the mothers took from three to six sessions of 45 minutes each; the administration of each one of the tests with the child lasted from one to two sessions of 45 minutes. Among the ten autistic subjects, eight of them were male and two were female, with ages varying from 4 years and 9 months and 13 years and 4 months. The schooling and the socio-demographic characteristics were not factors that were considered to be relevant for the sample characterization.

Table 1. Central measures of the subjects' ages at the beginning of the research

	Ages
Mean age	8.4
Minimum age	4.9
Maximum age	13.4
Median	7.6
SD	2.7

Note: SD = standard deviation

The chronological age was not a factor that was considered to be relevant in the selection of the subjects. The Table 1 presents the characterization of the sample.

Material and procedure

Used tests with the children

Tests were used to evaluate the subjects, according to the specific aims of the research (Chart 1).

- PCS (Adapted): based on Syntactic Awareness Test (PCS) [24,25]. It allows to evaluate the meta-linguistic ability at a meta-phonological level. It's divided in four subtests: grammatical judgment, grammatical correction of agrammatical sentences, grammatical correction of agrammatical and nonsemantic sentences and words categorization.

The subtest grammatical judgment predicts that the child judges the grammaticality of twenty sentences spoken by the experimenter and that can have morphemic anomalies or word order inversions. In the grammatical correction, the task is to correct the agrammatical sentences spoken by the experimenter. About the grammatical correction of agrammatical and nonsemantic sentences, sentences with semantic and grammatical incorrections are presented and the grammatical mistake must be corrected without modifying the semantic mistake. Concerning the words categorization, the child must be able to group different written words, described by pictures and spoken by the experimenter, in three different grammatical categories: noun, adjective and verb. This subtest was adapted with the inclusion of pictures which represent the words from the original test to allow illiterate children or children who are in the process of learning to read to understand them. Besides that, the verb conjugation was then presented in the infinitive.

The pictures of the subtest words categorization were drawn in pencil, on cards of 10 X 10 cm in diameter, on white background. The cards were laminated and had a magnet on their back that was attached to a metal board when they were placed in the spaces chosen by the children.

Chart 1. Tests used with the subjects according to the specific aims

Aim	Tests
1 – To verify the relationship between the syntactic awareness and central coherence	PCS (Adapted); Jigsaw puzzles with a picture and background and Jigsaw puzzle with only a background
2 – To verify the relationship between the syntactic awareness and non-verbal intelligence	PCS (Adapted); and the Raven's Coloured Progressive Matrices Test

The total score in PCS (Adapted) corresponds to the sum of the right answers in each subtest. Therefore, the maximum punctuation is 55.

- Jigsaw puzzle with a picture and background and Jigsaw puzzle with only a background: jigsaw puzzles of 9, 12, 16 and 20 pieces were used, elaborated as informatics games, through the program Flash Jigsaw Producer. The pictures of girl, tree, fish and house were chosen for being part of the children's repertoire. The task of the child was to assemble a jigsaw puzzle with a picture and background with a specific number of pieces (9, 12, 16 or 20) depending on their cognitive repertoire, estimated after clinical observation and the data analysis provided by their mother or responsible adult, through the Autism Diagnostic Interview – Revised (ADI-R), evaluation instrument used with their parents. Afterwards, the child should assemble a jigsaw puzzle with the same amount of pieces, nevertheless with only a one-colored background, without the picture. The time in both tasks was timed with a chronometer.
- Raven's Coloured Progressive Matrices Test: for the evaluation of the non-verbal intelligence of the subjects, the Raven's Coloured Progressive Matrices Test was used. In this test, the examiner shows a geometrical figure with a part missing in each item, reproduced in paper. The task of the child was to point which part of the figure would complete the main drawing, since the suggested and available parts under the main figure.

Used material with the parents or responsible adults

The Autism Diagnostic Interview-Revised (ADI-R) was used to gather information which would contribute for the evaluation of de communication abilities, social development, interests and behaviors related to the autistic spectrum disorders. The use of this protocol aimed to investigate how the communication development was and how it was being developed, as well as the social interaction and the patterns of behavior and interests of the subjects. As it is an instrument not validated for the Portuguese language, at the time of its administration in this research, the researcher, who is a sworn translator, used it in its original language, translating it orally in the moment of the interviews.

Data collection

The responsible adults (nine mothers and one father) were interviewed, through the ADI-R instrument, while their children participated in the language therapy session. The number of sessions varied from three to six, depending on the objectivity of the answer given by the interviewed adults and the need of clarifying some reported facts which raised some doubts for the researcher.

With the end of the interviews, the researcher administered the individual tests in the language therapy room, at the time usual therapists would see the children. The therapists, in general, did not participate of the sessions in the beginning of the data collection. However, they cooperated with the administration of the jigsaw puzzles in their electronic version.

The Syntactic Awareness Test (Adapted), based on PCS – Syntactic Awareness Test[24,25], was administered orally, except the subtest words categorization. In this subtest, the subject was oriented to look at some pictures whose names could be nouns, adjectives or verbs. After looking at the picture and listening to the word that corresponded to its definition, the subject should place it on a metal board that was divided in three columns, each one of them destined to a word category. The administration time of this test was about 30 minutes.

The assembly of the jigsaw puzzles was done in a portable computer. The task was initiated by the picture whose assembly was the simplest, in this case, the picture of "girl", that had an amount of nine pieces. After that, the subject should assemble the version with the one-colored background that corresponded to the picture of "girl" without the picture, only with the background and with the same amount of pieces. After the first two, the other pictures to be assembled were: "tree" with 12 pieces and "background without the tree" with the same amount of pieces, "fish" with 16 pieces and "background without the fish" with the same amount of pieces and "house" with 20 pieces and "background without the house" with the same amount of pieces. The execution times for each one of the pictures were written down.

Raven's Coloured Progressive Matrices Test was administered individually, according to the guidelines presented in its manual.

Register and data analysis

The answers given by the responsible adults in the ADI-R were registered by the researcher in a booklet that contained the questions, as well as clarifications on each one of the questions and the correspondent areas of investigation. This booklet was created by the authors of the protocol and translated by the researcher, for her own use.

The answers given orally in PCS (Adapted) were registered by the researcher in a protocol created by her specifically for this. The time used for the assembly of each picture of the jigsaw puzzle pictures' set was registered in a form created specifically for this purpose.

The answers of the Raven's Coloured Progressive Matrices Test were registered in a form created by the authors of the test. After the end of the administration of all the instruments, the data were analyzed according to the proposed criteria, having in mind the aims of the analysis of this research.

Statistical analysis

To examine the covariance between the variables (performance in syntactic awareness, non-verbal intelligence, central coherence and difficulties in communication, in reciprocal social interactions and the presence of stereotyped behaviors and repetitive interests) the correlation design. As it was a small sample extracted from a population which is not within the normal distribution, the non-parametric ρ de Spearman was used. The level of significance of 5% (0.05) was adopted.

Concerning the correlation intensity, the parameters of coefficient ρ de Spearman were adopted, and they vary from -1 and

1. The closer they are to these extreme numbers, the bigger is the association between the variables.

Specifically concerning the classification of the intensity of the correlations among the variables, the indicators recommended by BMJ – British Medical Journal were adopted: 0.00 – 0.19 absent or very weak; 0.20 – 0.39 weak; 0.40 – 0.59 moderate; 0.60 – 0.79 strong; 0.80 – 1.00 very strong[26].

RESULTS

The results show the descriptive statistics of central tendency (mean and median), dispersion (standard deviation) and size of the sample (n) in PCS (Adapted) and in its four subtests: Grammatical Judgement (JG), Grammatical Correction (CG), Grammatical Correction of Agrammatical and Nonsemantic Sentences (FA) and Words Categorization (CP). The general raw score and each subtest's score corresponds to the sum of right answers in the different items. They are: 55 items of PCS, 20 of JG, 10 of CG, 10 of FA e 15 of CP. The minimum score obtained by the children in PCS (Adapted) was 16 points, the mean was 24.4 and the maximum score was points (Table 2).

The necessary total time for the assembly of the jigsaw puzzles of 9, 12, 16 and 20 pieces with picture and background and without picture were obtained, in minutes and seconds, of the ten evaluated subjects (Table 3).

Of all the 36 situations of assembling the jigsaw puzzles with background and picture and with only a background, just in seven of the occasions the time spent for assembling the jigsaw puzzle with only a background was less than the one spent to assemble the jigsaw puzzles with a picture and background. This represents only 19.4% of the times. In fact, the subjects with autism do not usually rely on clues from the context for the assembly of the games and, therefore, the assembly of the jigsaw puzzles with only a background (without the contextual clue of the picture) would demand similar time to be done in both modalities of game. In general, the time spent in both situations (jigsaw puzzle with a picture and background and only with a background) were close, except for subject 3 in the 20-piece jigsaw puzzle and subject 4 in the 16-piece and 20-piece jigsaw puzzles. The difference in assembly time in both modalities was about five minutes. This result may have a relation with fatigue, once it was exactly the jigsaw puzzles assembled in the last part of the session.

Table 2. Central measures of PCS (Adapted) and its subtests

Variable	n	Minimum	Maximum	Mean	SD	Percentile 25	Median	Percentile 75
PCS	10	16.00	46.00	24.40	9.70	17.75	21.00	28.00
JG	10	9.00	17.00	11.30	2.26	10.00	10.50	12.00
CG	10	0.00	8.00	3.40	2.80	0.00	4.00	5.25
FA	10	0.00	8.00	2.50	2.84	0.00	1.00	4.50
CP	10	4.00	14.00	7.20	3.55	4.75	6.00	9.25

Note: PCS = PCS (Adapted); JG = grammatical judgment; CG = grammatical correction; FA = grammatical correction of agrammatical and nonsemantic sentences; CP = words categorization; SD = standard deviation

Table 3. Total amount of time spent in minutes (') and seconds (") in assembling the jigsaw puzzles by the ten subjects with autism

Subject	QC girl 9p	QC back_girl 9p	QC tree 12p	QC back_tree 12p	QC fish 16p	QC back_fish 16p	QC house 20p	QC back_hou 20p
1	02'05"	03'54"	03'36" **	03'04" **	02'53" **	02'01" **	07'48"	09'28"
2	01'28"	02'26"	02'19"	02'47"	04'47"	06'42"	05'40"	06'17"
3	02'22"	02'22"	04'26"	02'59"	03'39"	06'09"	05'30" ***	10'21" ***
4	02'41"	05'30"	03'32"	05'07"	04'32" ***	10'17" ***	07'52" ***	12'18" ***
5	03'05" **	02'58" **	03'19"	03'30"	06'08" **	03'17" **	03'24"	05'10"
6	19'01" **	04'55" **	09'11"	10'25"	*	*	*	*
7	01'38"	02'35"	02'08"	02'22"	04'00" **	** 03'20"	03'11"	03'51"
8	05'43"	07'13"	04'46"	07'06"	*	*	*	*
9	01'34"	06'26"	03'00"	03'30"	07'20" **	05'59" **	09'03"	12'41"
10	01'19"	02'38"	02'33"	03'31"	03'46"	05'20"	05'05"	06'48"

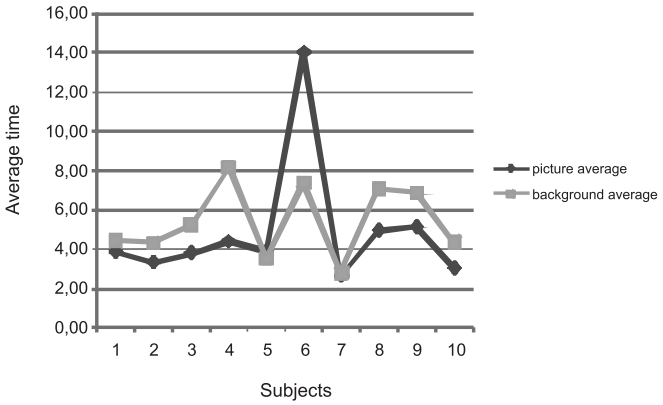
* Picture not assembled for refusal or inability of the subject

** Situations in which the amount of time spent for the assembly of the jigsaw puzzle with only a background was smaller than the assembly of the jigsaw puzzle with a picture and background

*** Situations in which the difference in the assembly time of both modalities was around 5 minutes

Note: QC girl 9p = jigsaw puzzle with background and the picture of girl of nine pieces; QC back_girl 9p = jigsaw puzzle with background without the picture of girl of nine pieces; QC tree12p = jigsaw puzzle with background and the picture of tree of 12 pieces; QC back_tree 12p = jigsaw puzzle with background without the picture of tree of 12 pieces; QC fish16p = jigsaw puzzle with background and the picture of fish of 16 pieces; QC back_fish 16p = jigsaw puzzle with background without the picture of fish of16 pieces; QC house 20p = jigsaw puzzle with background and the picture of house of 20 pieces; QC back_hou 20p = jigsaw puzzle with background without the picture of house of 20 pieces

A graphic with the means of the total time obtained by the ten subjects with autism in assembling the jigsaw puzzles with a picture and background and with only a background were obtained (Figure 1).



Note: picture average = average time spent in the assembly of the jigsaw puzzle with a picture and background; background average = average time spent in the assembly of the jigsaw puzzles with background without the picture

Figure 1. Average time spent in the assembly of the jigsaw puzzles

According to Figure 1, the subjects took more time for assembling the jigsaw puzzles with only a background. Subject 6 presented the biggest discrepancy regarding the means of time in both jigsaw puzzles' modalities.

For checking the probable relationship between the performances in PCS (Adapted) and the necessary time for assembling the jigsaw puzzles with only a background and with a picture and background, correlation analysis were made.

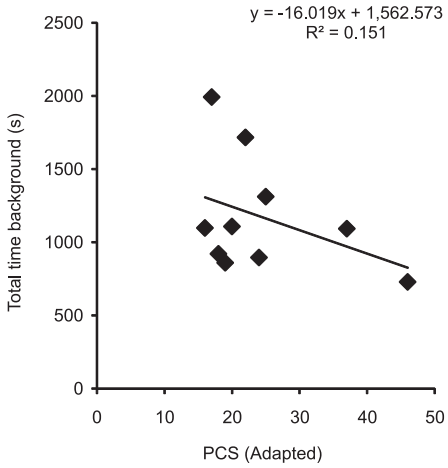
Based on the total spent time analysis in assembling the jigsaw puzzles with only a background and the results in PCS (Adapted), through ρ of Spearman Test, it was possible to verify a weak negative correlation (r=-0.333), nevertheless, without significance (p=0.347).

The correlation between the total spent time in assembling the jigsaw puzzles with only a background (Total Time Background – s) and the raw scores of PCS (Adapted) (Figure 2) was made.

From the analyses of the total time spent in assembling the jigsaw puzzles with a picture and background and the results obtained in PCS (Adapted), a weak negative correlation was observed (r=-0.261), but also without significance (p=0.467). The correlation between the necessary total time for assembling the jigsaw puzzles with a picture and background and the raw scores of PCS (Adapted) can be observed through a graphic (Figure 3).

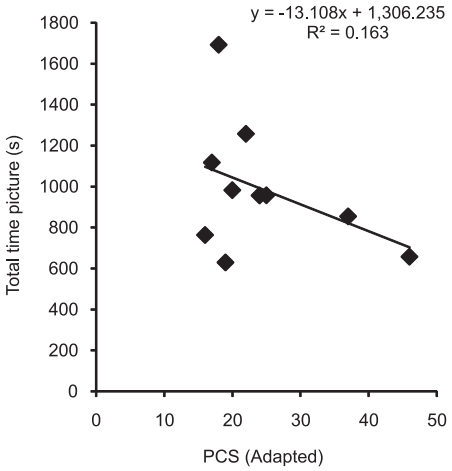
In spite the fact the graphics in Figures 2 and 3 present dispersion points in an ascending trajectory, which is expected in this case, the degree of association between the variables has no difference. Therefore, the results in PCS (Adapted) do not present correlation with the time spent in assembling the jigsaw puzzles. So, the best results in PCS (Adapted) do not have relation with the smallest time values spent in assembling the jigsaw puzzles.

The results still show the descriptive statistics of central tendency (mean Me median), dispersion (standard deviation)



Spearman coefficient analysis (p≤0.05)
Note: s = total time spent in the jigsaw puzzle with only a background; PCS = PCS (Adapted); R² = = coefficient of determination

Figure 2. Correlation between the performance in PCS and the total time spent in the jigsaw puzzle with only a background



Spearman coefficient analysis (p≤0.05)
Note: s = total time spent in the jigsaw puzzle with a picture and background; PCS = PCS (Adapted); R² = coefficient of determination

Figure 3. Correlation between the performance in PCS and the total time spent in the jigsaw puzzle with a picture and background

and size of the sample (n) of the raw scxore in the Raven's Coloured Progressive Matrices – Special Scale and of its three series (A, AB e B) administered to ten subjects with autism. The raw scoring of the test is the sum of all the right answers, in a total of 36 points. The general punctuation in each series corresponds to the sum of the right answers in the items that compose the test in each series. They are: 36 items of RAVEN, 12 items of series A, 12 of series AB and 12 of series B. The minimum punctuation obtained in Raven's Coloured Progressive Matrices – Special Scale was 10 points and the maximum of 30 points. The average punctuation obtained by the subjects was 19.20.

The average age of the children with autism, at the time of Raven's administration was nine years. Percentiles were obtained from the punctuation obtained in Raven's Coloured

Table 4. Raw scoring in Raven's Coloured Progressive Matrices Test – Special Scale e in its three series (A, AB e B)

Variable	n	Minimum	Maximum	Mean	SD	Percentile 25	Median	Percentile 75
Raven	10	10.00	30.00	19.20	6.83	14.00	18.50	26.25
A	10	3.00	10.00	7.60	2.32	5.75	8.50	9.25
AB	10	2.00	11.00	6.20	3.01	3.75	5.50	9.25
B	10	2.00	10.00	5.40	2.32	3.75	5.50	7.00

Note: Raven = Raven's Coloured Progressive Matrices Test – Special Scale; A = series A of Raven; AB = series AB of Raven; B = series B of Raven; SD = standard deviation

Chart 2. Percentiles in Raven's Coloured Progressive Matrices and classifications of non-verbal intelligence of the ten subjects of the sample

Subjects	Percentiles	Classification
1	20	Definitely below the average in intellectual capacity
2	80	Definitely above the average in intellectual capacity
3	30	Intellectually on average
4	10	Definitely below the average in intellectual capacity
5	60	Intellectually on average
6	10	Definitely below the average in intellectual capacity
7	60	Intellectually on average
8	10	Definitely below the average in intellectual capacity
9	80	Definitely above the average in intellectual capacity
10	60	Intellectually on average

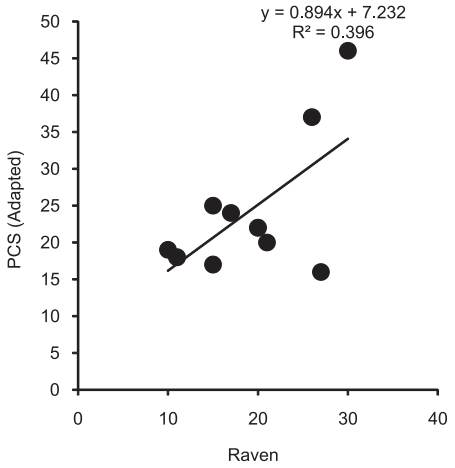
Progressive Matrices – Special Scale, with the classification of the coreespondent non-verbal intelligence (Chart 2).

Among the ten evaluated subjecs, 40% obtained non-verbal intelligence classification of "definitely below the average in intellectual capacity". Other 40% obtained non-verbal intelligence classification of "intelectually on average". Only 20% of the evaluated subjects obtained non-verbal intelligence classification of "definitely above the average in intellectual capacity". So, 60% of the evaluated subjects presented non-verbal intelligence that would not interfere negatively in the performance of cognitive tasks.

From the analyses of the raw scoring in Raven's Coloured Progressive Matrices – Special Scale and the chronological age os the subjects, it was possible to verify a moderate positive correlation (r=0.529), however without significance (p=0.116).

From the analyses of the raw scoring in Raven's Coloured Progressive Matrices – Special Scale and the results in PCS (Adapted), it was possible to verify a weak positive correlation (r=0.359), however, also without significance (p=0.309). The correlation obtained between Raven's Coloured Progressive Matrices – Special Scale and the results in PCS (Adapted) can be observed through the graphic (Figure 4).

In spite the fact that the graphic presents the dispersion points in an ascending trajectory, which, in this case, would be expected, the degree of relation between the variables has



Spearman coefficient analysis (p≤0.05)
Note: PCS = scoring in PCS (Adapted); Raven = scoring in Raven's Coloured Progressive Matrices – Special Scale

Figure 4. Correlation between the raw score in RAVEN and the results in PCS - Adapted

no difference. So, the Best results in Raven's Coloured Progressive Matrices – Special Scale do not present a significant positive correlation with the results in PCS (Adapted). In this way, the best results in PCS (Adapted) do not relate to the best results in Raven.

Correlations between the raw scores in the Coloured Progressive Matrices Test and the results obtained in the subtests Grammatical Judgment (JG), Grammatical Correction (CG), Grammatical Correction of Agrammatical and Nonsemantic Sentences (FA) e Words Categorization (CP) in PCS (Adapted) were made. There were analyses between the total scores in Raven, in PCS (Adapted) and in its four subtests (Table 5).

Table 5. Spearman coefficient of correlation (ρ) among the scores in the subtests

	n	JG	CG	FA	CP
		ρ (p)	ρ (p)	ρ (p)	ρ (p)
Raven	10	0.213	0.542	0.309	0.344
		(0.555)	(0.106)	(0.384)	(0.331)

Spearman coefficient analysis (p≤0.05)
Note: Raven = Raven's Coloured Progressive Matrices – Special Scale; JG = subtest of grammatical judgment in PCS (Adapted);CG = subtest of grammatical correction in PCS (Adapted); FA = subtest of grammatical correction of agrammatical and nonsemantic sentences in PCS (Adapted); CP = subtest de words categorization in PCS (Adapted)

It was possible to observe correlations of weak to moderate magnitude in all the subtests, however without a difference in all of them.

In the same way, it was possible to verify, through the ρ Test of Spearman, the coefficients of correlation and the significance of the answers given by the parents in ADI-R, divided in three areas of the protocol: social (IN_SOC), communication (COM) and stereotyped behaviors (COM_EST) and the results of PCS (Adapted). The found results were: ADI-R (r=0.244; p=0.497); IN_SOC (r=0.062; p=0866); COM (r=0.297; p=0.405); COM_EST (r=-0.166; p=0.647).

DISCUSSION

The results of the syntactic awareness evaluation, through PCS (Adapted), indicated a pattern of performace that follows the one of the 6-yar-old children of typical development. There seems to be just a delay os this development compared to the typical development children.

The ability to categorize words obtained a bigger score than the one 6-year-old typical development children did. Taking into account that the children with autism had, on average, chronological age of eight years and nine months , the ability of categorizing words seemed very similar to the one typical development children presented. In the words categorization task, the subjects had only to classify them, according to their grammatical categories. These results are in accordance with the data obtained in another study which verified that the acquisition of grammatical morphemes of children with autism presents few differences regarding the acquisition of other children matched according to mental age with Down syndrome or typical development [27].

The average punctuation obtained by the subjects, 24,4, is practically ten points below the average punctuation in Syntactic Awareness Test - PSC[24] of 6-year-old subjects (whose average punctuation is 34.21) and of subjects in the 1st grade of basic education (whose average punctuation is 32.31)[28]. The evaluated children with autism, had, at the time of the administration of PCS (Adapted), an average age of eight years and nine months and median of age of eight years and one month. The inequality appears as a delay of the children with autism in this development compared to 6-year-old children of typical development. The results in the whole test indicate that, in spite the fact that the syntactic development does not diverge from the normative patterns, this development happens more slowly or starts to develop later[4].

In central coherence evaluation, through the assembly of the jigsaw puzzles, it was possible to observe that the children with autism had similar performances in both tests (jigsaw puzzle with a picture and background and jigsaw puzzle with only a background). This seems to endorse the Idea that failures in central coherence favor the accomplishment of tasks that require local processing, once the difference between the spent time values was not expressive. The expectation was that these children would not present a significant difference in the use of time for assembling of both jigsaw puzzles or even would use a smaller time value assembling the jigsaw puzzle with only a background. A typical development child takes more time for assembling the jigsaw puzzle with only a background, once it does not have clues of the picture as a whole (edges and pieces of picture that together make a concrete picture). Therefore, once the subjects did not present differences in the spent time for the accomplishment of both tasks, we have a strong indicator that the central coherence may be compromised. In general, the similar performance between both types of jigsaw puzzles corroborates the explanation that failures in central coherence or cognitive style focused in details, among subjects with autism, facilitate the accomplishment of tasks that require directed attention to the parts instead of the whole.

It's important to remember that the concept of failures in central coherence to explain the ability of subjects with autism has evolved. This ability is called cognitive style focused in details[8]. The individuals with autism can have the tendency of focusing in details, but through specific effort they may extract the global meaning of an event or situation[29]. The theory of failures in central coherence does not explain all the aspects of autism, but can be seen as a part of cognition in autism. Besides that, any cognitive theory which tries to explain autism should take a dynamic and developmental approach into consideration[29].

The syntactic awareness does not seem to be related to the cognitive style of the subjects to focus in parts instead of the whole, once these two variables did not present a significant negative correlation. Regarding the non-verbal intelligence, a fewer more than the half of the subjects presented level of non-verbal intelligence that would favor a good performance in cognitive tasks, once this group was classified as "intellectually on average" and "definitely above the average in intellectual capacity". The best results in the non-verbal intelligence test did not relate to the advance of age among the subjects. There seems to be an idiosyncratic cognitive development, regarding the ability to infer rules, to manage aims in a hierarchy and to elaborate abstractions of the highest level, which does not link to the advance in chronological age among these subjects. The Raven's non-verbal intelligence test indicates a measure of fluid intelligence[20]. The accomplishment of tasks of fluid intelligence requires coordinated executive function, attentional control and working memory. In this research, only 60% of the subjects would have to know how to accomplish these tasks of fluid intelligence, with no damage.

The best results in the non-verbal intelligence test did not present relation with the increase of the punctuation in syntactic awareness and in all of its subtests: Grammatical Judgment (JG), Grammatical Correction (CG), Grammatical Correction of Agrammatical and Nonsemantic Sentences (FA) e Words Categorization (CP). Children of typical development, with an average age of 9 years, from public schools of the state of São Paulo, obtained a mean of 20 points in RAVEN[30]. So, comparing the children with autism evaluated in this sample to the children from the sample of São Paulo, there is not a great discrepancy between the performances of non-verbal intelligence in both groups. The group of children with autism had an average of performance of 19,20, with a mean age of

9 years, against the children of typical development, with the same mean age, who obtained a mean of performance of 20 points.

Al the developmental areas evaluated (communication, social interaction and a range of restricted interests) did not present any relation with the results obtained in syntactic awareness. Just the area referent to the stereotyped behaviors and the restricted interests presented negative correlation with the syntactic awareness, although without significance. This area involves the existence of unusual preoccupations, restricted interests, verbal rituals, compulsions, hand and finger or body mannerisms, repetitive use of objects, unusual sensory interests. The perseveration that is present in these behaviors can be related to the difficulty of the subject in answering to a test such as the Syntactic Awareness Test which presents some items alike and distributed along different subtests. During the administration, some subjects perseverated in some answers, independently of having or not realized the shift from one subtest to the other.

CONCLUSION

Due to the variability among the subjects of the sample and to the lack of statistical data that corroborates the hypothesis that probable deficits in syntactic awareness could define and characterize the autistic syndromes the results of this study are not extensive to the population of children with autism. The results of the correlation analysis among the variables indicated no relationship between the performance in syntactic awareness and central coherence, non-verbal intelligence and failures in social interaction, in communication and pattern of interests of the subjects with autism.

However, the presented results provide indications of some differences between the syntactic awareness of the children with autism and children with typical development. The children with autism of this research seem to follow the pattern of development in syntactic awareness of 6-year-old children of typical development, however with delay. Based on the results of the non-verbal intelligence test, one can infer that 40% of these children would need support for the development and the refinement of cognitive flexibility that has to do with the executive functions and that requires adequate attentional control.

The performance in syntactic awareness did not present any relationship with the non-verbal intelligence. It was expected that the better the performance in non-verbal intelligence, the better would be the results in syntactic awareness. The syntactic awareness é an activity of meta-linguistic nature and requires resources from the central executive such as self-monitoring and self-regulation to be performed successfully.

The developmental areas affected by autism (communication, social interaction and the presence of stereotyped behaviors) do not show any relationship with performance in syntactic awareness, even if this relationship has appeared in the restricted behaviors area (with no significance). It's convenient to remember that these results on the development of the areas affected by autism were attributed based on the answers provided by the children's mothers. This leads to the possibility of overestimation or underestimation of these difficulties.

In general, the results presented indicate the need of the presence of some abilities for the success of these tasks accomplishment. Some of them are the self-monitoring, the self-regulation, the cognitive flexibility and attentional control.

The delay in the syntactic development indicates that the children with autism, at first, would possess the linguistic apparatus which is adequate for development and use, as a typical development child. The idiosyncrasies appear in the developmental trajectory: slower that the expected, not keeping up with the age advance, not directly linked to the difficulties which are common to autism. Then, there is the need of understanding these profiles through a dynamic and developmental perspective. The cognitive profiles of these children may interfere with the development of syntax, in the way that, because of these cognitive peculiarities (peculiar functioning of the central executive, for instance), these children do not process the linguistic information at the same time or speed the typical development children do, in the initial moments of language exposure.

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