

Assessing Cognitive Flexibility, Communication, Social Interaction and Interest Patterns of Persons with Autism as a Basis for Intervention

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Abstract

The prevalence of people on the autism spectrum can vary from 1% to 1.5% of the population, nowadays. Besides an adequate diagnosis, specialized treatment offered to these people must be a priority for the public health policies and a target of interest for researchers and health professionals. Autism is characterized by the presence of deficits in communication, social interaction and patterns of restricted interests and repetitive behaviors. One of the theories that explain autism points out to disorders in some higher order functions such as failures in cognitive flexibility, inhibitory control and working memory. In this study, 18 persons with autism were assessed in the areas of non-verbal intelligence, cognitive flexibility besides the affected areas in autism: communication, social interaction and patterns of interests and behavior. The aim was to verify if there was a correlation between failures in cognitive flexibility and the main impairments of the autism spectrum. Raven's Progressive Matrices, Wisconsin Card Sorting Test—WCST and Autism Diagnostic Interview-Revised—ADI-R were used. Although correlation between WCST and ADI-R scores did not reach conventional statistical significance on most categories, the category failure to maintain set (FMS) in WCST and difficulties in social interaction in ADI-R were positively correlated with statistical significance. This result indicates a deficit of focused attention related to the subjects' inability to successfully perform or maintain a social interaction situation. This would not support the idea that these subjects fail to flexibly shift their focus of attention from one stimulus to the other in a social interaction situation. On the contrary, it seems that they shift their focus of attention constantly, once their inability to maintain set is positively correlated with difficulties in social interaction. Nevertheless, further research with a larger number of subjects is necessary in order to clarify if FMS assesses distractibility or cognitive flexibility.

Keywords

Autism, Executive Function, Cognition, Autistic Disorder

1. Introduction

Autism is a disorder defined by impairments observed since before 36 months of age. It is characterized by qualitative delays and impairments in the areas of social, communication and play skills, as well as repetitive and restricted patterns of interests and behaviors. The prevalence of persons on the autism spectrum can vary from 1% to 1.5% of the population, nowadays (Baron-Cohen, Scott, Allison, Williams, Bolton, Matthews et al., 2009). Brazilian population, according to the census performed in 2010 (IBGE, 2010) is 190,073,788; so, there is an estimative of about two million Brazilian persons on the autism spectrum. Besides an adequate diagnosis, specialized treatment offered to these people must be a priority for the public health policies and a target of interest for researchers and health professionals.

One of the theories that explains autism points out to failures in some higher order functions, such as cognitive flexibility, inhibitory control and working memory (Deák & Narasimham, 2003; Hill, 2004; Rajendran & Mitchell, 2007; Robinson, Goddard, Dritschel, Wisley, & Howlin, 2009; Stahl & Pry, 2004; Zelazo & Müller, 2002). Failures in cognitive flexibility seem to favor the emergence and maintenance of disorders in other abilities such as social interaction, use of language and problem solving. Flexible cognition or cognitive flexibility implies in the dynamic activation and modification of the cognitive processes involved in answering to changes in the demands of tasks. When the demands and context factors of a task change, the cognitive system can adapt, shifting the attentional focus, selecting information for achieving the necessary answers, generating plans and new activation patterns to provide feedback to the system (Deák & Narasimham, 2003). If these procedures result in well-adapted representations and actions directed to the changes in the demands of the tasks or situations, it is possible to state that these processes happened due to the flexible cognition. Individuals on the autism spectrum present failures in cognitive flexibility and it is supposed that this may be related to their failures in communication and social interaction abilities and in patterns of restricted interests and stereotyped behavior (Varanda, 2011).

Therefore, the assessment of persons on the autism spectrum about their flexible cognition and communication, social interaction abilities and patterns of behavior and interests and the possible relationship between these abilities must be considered in planning an intervention proposal for the development of related communication, social and cognitive abilities.

The objective of this research was to verify the relationship between flexible cognition and communication, social interaction and patterns of restricted interests and stereotyped behavior for elaborating a plan of intervention to refine and/or develop cognitive flexibility in subjects on the autism spectrum.

2. Methods and Material

Participants were 18 children and adolescents, with ages ranging from 6 to 15 years, enrolled in language therapy processes in the Autism Spectrum Disorders Speech and Language Research Laboratory of the School of Medicine, University of São Paulo, Brazil. Their psychiatric diagnosis was determined according to the criteria proposed by the DSM-IV TR (APA, 1995). The inclusion criteria were the availability to cooperate and participate answering to the tests and to attend the speech-language therapy sessions. The research was proceeded with the consent of the Ethics Committee for the Analysis of Research Projects of the School of Medicine of Universidade de São Paulo (USP) under number 408/12. The adults responsible for the children signed the Free and Informed Consent Term.

Participants were tested in non-verbal intelligence through Raven's Progressive Matrices in its Portuguese edition (Angelini, Alves, Custódio, Duarte, & Duarte, 1999). They were also tested in cognitive flexibility through Wisconsin Card Sorting 005; Test—WCST (Cunha, Trentini, Argimon, Oliveira, Werlang, & Prieb, 2005; Dawson, & Guare, 2010; Kaland, Smith, & Mortensen, 2008). WCST consists of four stimulus cards and 128 response cards and proceeds through a number of shifts in set that varies along three dimensions (color, form and number). Successful performance on the test requires the subject to determine the correct sorting prin-

ciple or set. Scores are based on the ratio of number of trials administered; total number of correct answers; number of errors; number of perseverative responses; number of perseverative errors; number of non-perseverative errors; number of categories completed; number of trials to complete the first category; conceptual level responses; failure to maintain set and learning to learn.

The Autism Diagnostic Interview-Revised—ADI-R (Rutter, Le Couteur, & Lord, 2003) was used to assess communication, social interaction, patterns of restricted interests and stereotyped behavior.

The scores in WCST and ADI-R were correlated with functional parameters using the Spearman rank correlation. The adopted level of significance was 5% ($p \leq 0.05$).

3. Results and Discussion

Only 16.67% of the subjects were found to be in the intellectually deficient range according to the results of Raven. **Table 1** shows the percentiles of Raven's test of all the 18 subjects.

Regarding the assessment of communication, social interaction, patterns of restricted interests and stereotyped behavior, **Table 2** shows the measures of central tendency according to the ADI-R.

Concerning the assessment of cognitive flexibility, **Table 3** shows the measures of central tendency in all subtests of WCST in the 18 subjects.

Comparing these results with those of groups of persons with autism tested in other studies (Lopez, Lincoln, Ozonoff, & Lai, 2005; Ozonoff, 1995) these subjects presented poorer performance in some subtests and had similar scores in others. This means that these individuals presented a performance in cognitive flexibility that is typical of individuals with autism, i.e., they showed poor flexible cognition.

However, the correlation between WCST and ADI-R scores did not reach conventional statistical significance on most categories. Nonetheless, the categories failure to maintain set (FMS) in WCST and difficulties in social interaction in ADI-R were positively correlated ($p = 0.509$), with statistical significance ($p = 0.031$), as can be observed in **Figure 1** that shows the graph of plotted points that shows the relationship between the two sets of data:

Table 1. Raven's percentiles of the 18 subjects.

Subjects	Raven's percentiles
1	5
2	95
3	10
4	70
5	30
6	30
7	99
8	60
9	90
10	60
11	1
12	50
13	99
14	99
15	60
16	1
17	80
18	60

Table 2. Measures of central tendency of ADI-R's total scores of the 18 subjects.

N = 18	
Mean	27.7
Median	26.5
Standard deviation	8.35
Minimum	13
Maximum	45
Percentile 25	22.5
Percentile 75	35.5

Table 3. Measures of central tendency in Wisconsin Card Sorting Test—WCST of the 18 subjects.

Category	N = 18						
	Mean	Median	Standard deviation	Minimum	Maximum	Percentile 25	Percentile 75
Number of trials administered	123	128	14.57	81	128	128	128
Total number of correct answers	59.39	58	22.37	31	102	40	72
Total number of errors	63.6	70	28.28	11	97	33	88
Number of perseverative responses	64.16	63.5	44.11	6	127	16.5	107
Number of perseverative errors	12.55	12.5	17	0	32	5	17.5
Conceptual level responses	39.2	34.5	28.57	4	89	13.75	67
Number of categories completed	2.17	1.5	2.14	0	6	0	4.25
Number of trials to complete the first category	40.17	17	49.11	10	129	10	51.75
Failure to maintain set	0.9	0	1.45	0	4	0	2

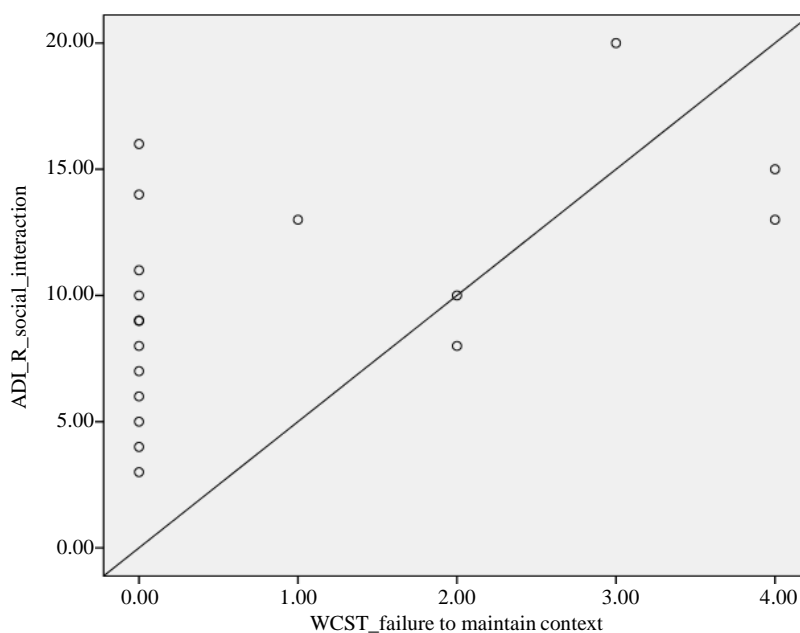


Figure 1. Graph of plotted points between failure to maintain set (FMS) in WCST and difficulties in social interaction in ADI-R.

This suggests a deficit of focused attention related to the inability to successfully perform or maintain a social interaction situation, which was not previously expected. In fact, concerning qualitative impairment in social interaction, the autistic marked deficits in the use of multiple nonverbal behaviors, the failure to develop peer relationships appropriate to developmental level, the lack of spontaneous seeking to share enjoyment, interests or achievements with other people and social or emotional reciprocity and the inability to shift social behavior or conversational topics to meet the changing contextual demands, would be related to the inability to shift visual attention from eyes to mouth, from one speaker to another speaker, to the rigid application of social rules, to not shifting attention to extra-personal space and not shifting to another person's perspective, respectively (Geurts, Corbett, & Solomon, 2009). So it would be expected that the ability to shift from one sorting principle or set would be associated with the ability for social interaction. In the comparison of the WCST and the ADI-R results this could be observed through a positive correlation between perseverative errors and bad performance in social interaction abilities. Surprisingly, a bad performance in focused attention was positively correlated with failure in social interaction, revealing that these subjects did not fail in shifting to one stimulus to the other, which would harm their ability to pay attention to multiple and varied situations. So, this would not support the idea that these individuals fail to flexibly shift their focus of attention from one stimulus to the other in a social interaction situation; on the contrary, they would shift their focus of attention constantly once their inability to maintain set was positively correlated with difficulties in social interaction. However, some authors consider that FMS (failure to maintain context) predicts distractibility rather than flexible cognition. In this case, FMS would occur when an individual lost focus on the task because of possible and different reasons such as boredom, mind wandering, or an inability to maintain task relevant goals (Figueroa & Youmans, 2013).

4. Conclusion

The relationship of failure to maintain set as a measure of distractibility rather than a measure of general cognitive flexibility abilities would explain the findings of this research. Nevertheless, further research with a larger number of subjects is necessary in order to clarify if FMS assesses distractibility or cognitive flexibility.

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