



## BRIEF COMMUNICATION

# Brazilian Portuguese Childhood Autism Spectrum Test: an investigation of the factor structure of autistic traits in school-aged children

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**Objective:** There is limited evidence about the cross-cultural validity of autistic symptoms in school-aged children in Brazil. We used data from a large school survey to evaluate the factor structure of autism symptoms in community-dwelling children and adolescents.

**Methods:** We translated the Childhood Autism Spectrum Test to Brazilian Portuguese and performed factor analyses to investigate the factor structure of parent-reported autistic symptoms in a large sample (n=8,571) of children/adolescents from a school survey in the metropolitan area of São Paulo.

**Results:** Autistic symptoms were best conceptualized under a correlated-factors model with two factors: one predominantly characterized by social-communication symptoms and the other by symptoms of inflexible/restricted language, behaviors, and interests.

**Conclusions:** These findings provide evidence that the structure of autistic symptoms in Brazil is similar to that described in other countries, indicating the cross-cultural validity of autism in Brazil.

**Keywords:** Autism spectrum disorder; autism; Brazil; CAST

## Introduction

Autism spectrum disorder (henceforth autism) is a psychiatric condition characterized by symptoms of social communication and interaction deficits, restricted, repetitive patterns of behaviors, interests, or activities, sensory anomalies and varying levels of intellectual disabilities.<sup>1</sup> Autism is relatively prevalent in the general population, with estimates of ~2% in the most recent epidemiological studies.<sup>2</sup> Although there is interindividual variation in the course of autism across the lifespan, older studies, prior to the development of early intervention strategies, have described associations between autism and negative outcomes, such as poor educational attainment, sub-optimal work performance, and even a higher mortality risk than typically developing youth.<sup>3,4</sup>

Although autism is universal and presents strong biological underpinnings,<sup>5</sup> the behavioral manifestation of autistic symptoms, as well as their clinical interpretation, is largely dependent on the cultural context to which the children, parents, teachers, and clinicians belong.<sup>6</sup> For instance, different expectations and demands are placed on the child at home and at school across different

cultures, which could help mask or unmask autistic symptoms.<sup>7</sup> In other words, the standards for “typical” and “atypical” behaviors and the conceptualizations of autism symptoms could vary across cultures.

To date, very little research has been devoted to autism in Brazil,<sup>8,9</sup> with only a single study based on a small sample from a rural area evaluating how autistic symptoms are distributed in our population.<sup>10</sup> Such a lack of evidence about the distribution and structure of autistic symptoms in Brazil has likely contributed to the dearth of autism research in our country. To address this gap, we leveraged data from a large school survey in an urban area to evaluate the factor structure of autism symptoms as distributed in community-dwelling children and adolescents in Brazil.

## Methods

### Participants and survey procedures

The participants in this study were children aged between 5 and 19 years enrolled in public schools in the city of São Caetano do Sul in 2014. São Caetano do Sul is in the

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metropolitan area of São Paulo, the largest city in Brazil. São Caetano do Sul has a Human Development Index of 0.862, ranking first among cities in Brazil, and an estimated population of 149,263 inhabitants according to the 2010 national census. Protocols consisting of consent forms, information leaflets, and questionnaires were sent to the parents of every child enrolled in public schools in São Caetano do Sul. Protocols were fully anonymized to protect the identity of participants. Overall, 10,525 questionnaires were sent to parents, although only those who had signed the informed consent form ( $n=8,571$ ) were included in the analyses. The mean age of the included participants was 11.26 (standard deviation [SD] 3) (range 5-19), and 50% were boys.

### Measures

#### Childhood Autism Spectrum Test (CAST)

The CAST, previously known as the Childhood Asperger Screening Test, is a 37-item parent-reported questionnaire that covers the domains of autism as defined by the DSM-IV, namely restrictive and inflexible social communication behaviors.<sup>11</sup> The CAST was originally developed in English as a screening instrument for primary-school-aged children and has since been translated into more than 20 languages. Items are completed by parents in a dichotomized manner. The Brazilian Portuguese version (Table S1, available as online-only supplementary material) was used in this study.

#### Data analysis

The sample was randomly split in two sets of approximately equal size to perform exploratory factor analysis and confirmatory factor analysis separately. Exploratory factor analysis was conducted on symptom data using robust weighted least squares estimation, as recommended for dichotomous variables, and oblique rotation (goemin), allowing for correlation between latent factors. The factor solution was based on clinical interpretability and the “elbow” of the scree plot, i.e., the point where the lines drawn through the plotted eigenvalues change their slope, or the last significant decreasing trend for eigenvalues. We also computed model fit indices, such as the null hypothesis of the traditional chi-square test that the model is a good fit for the data, the root mean square error of approximation  $\geq 0.08$ , the standardized root mean square residual  $< 0.10$ , the Tucker-Lewis Index, and the comparative fit index  $\geq 0.95$ . Items with a factor loading  $< 0.5$  or only negative factor loadings were excluded from confirm-

atory factor analyses. Similar fit indexes were computed for confirmatory factor analysis to evaluate adequacy of the model. After identifying the optimal model solution, measurement invariance across sex was tested in a sensitivity analysis to confirm the robustness of the factor solution.

### Ethics statement

This project was approved by the secretary of education of São Caetano do Sul and by the ethics committee of the Faculdade de Medicina da Universidade de São Paulo (project 1.900.291).

### Results

Exploratory factor analysis ( $n=4,135$  participants) indicated that a correlated-factors model with two factors was the best-fitting and most interpretable model (see Table 1 for the goodness-of-fit values for each solution). Table S2, available as online-only supplementary material, shows the factor loadings for each item. The first factor involved items that measure social-communication symptoms such as “Does s/he join in playing games with other children easily?” (CAST 1), “Does s/he come up to you spontaneously for a chat?” (CAST 2), “Is it important to him/her to fit in with the peer group?” (CAST 5), “Does s/he find it easy to interact with other children?” (CAST 10), “Can s/he keep a two-way conversation going?” (CAST 11), “Does s/he often bring you things s/he is interested in to show you?” (CAST 16) and “Does s/he enjoy joking around?” (CAST 17). Thus, we identified this factor as “Socialization and communication.” The other factor involved items measuring inflexible/restricted language, behaviors, and interests, such as “Does s/he like to do things over and over again, in the same way all the time?” (CAST 9), “Does s/he have difficulty understanding the rules for polite behavior?” (CAST 18), “Does s/he often do or say things that are tactless or socially inappropriate?” (CAST 25), “Does s/he have any unusual and repetitive movements?” (CAST 28), “Does s/he try to impose routines on him/herself, or on others, in such a way that it causes problems?” (CAST 34), “Does s/he sometimes say ‘you’ or ‘s/he’ when s/he means ‘I’?” (CAST 30), “Does s/he sometimes lose the listener because of not explaining what s/he is talking about?” (CAST 32), “Does s/he often turn conversations to his/her favourite subject rather than following what the other person wants to talk about?” (CAST 36) and “Does s/he have odd or unusual phrases?” (CAST 37). Therefore, we identified this factor as “Inflexible/restricted language,

**Table 1** Model fit statistics by factor solution from exploratory factor analysis

	$\chi^2$	df	p-value	RMSEA	CFI	TLI	SRMR
<b>2</b>	<b>883.714</b>	<b>404</b>	<b>&lt; 0.0001</b>	<b>0.017</b>	<b>0.900</b>	<b>0.885</b>	<b>0.068</b>
3	663.458	375	< 0.0001	0.013	0.940	0.925	0.057
4	529.567	347	< 0.0001	0.011	0.962	0.949	0.046
5	430.446	320	< 0.0001	0.009	0.977	0.966	0.040

Bold type denotes items best-fitting model.

CFI = comparative fit index; df = degrees of freedom; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual; TLI = Tucker-Lewis Index;  $\chi^2$  = chi-square.

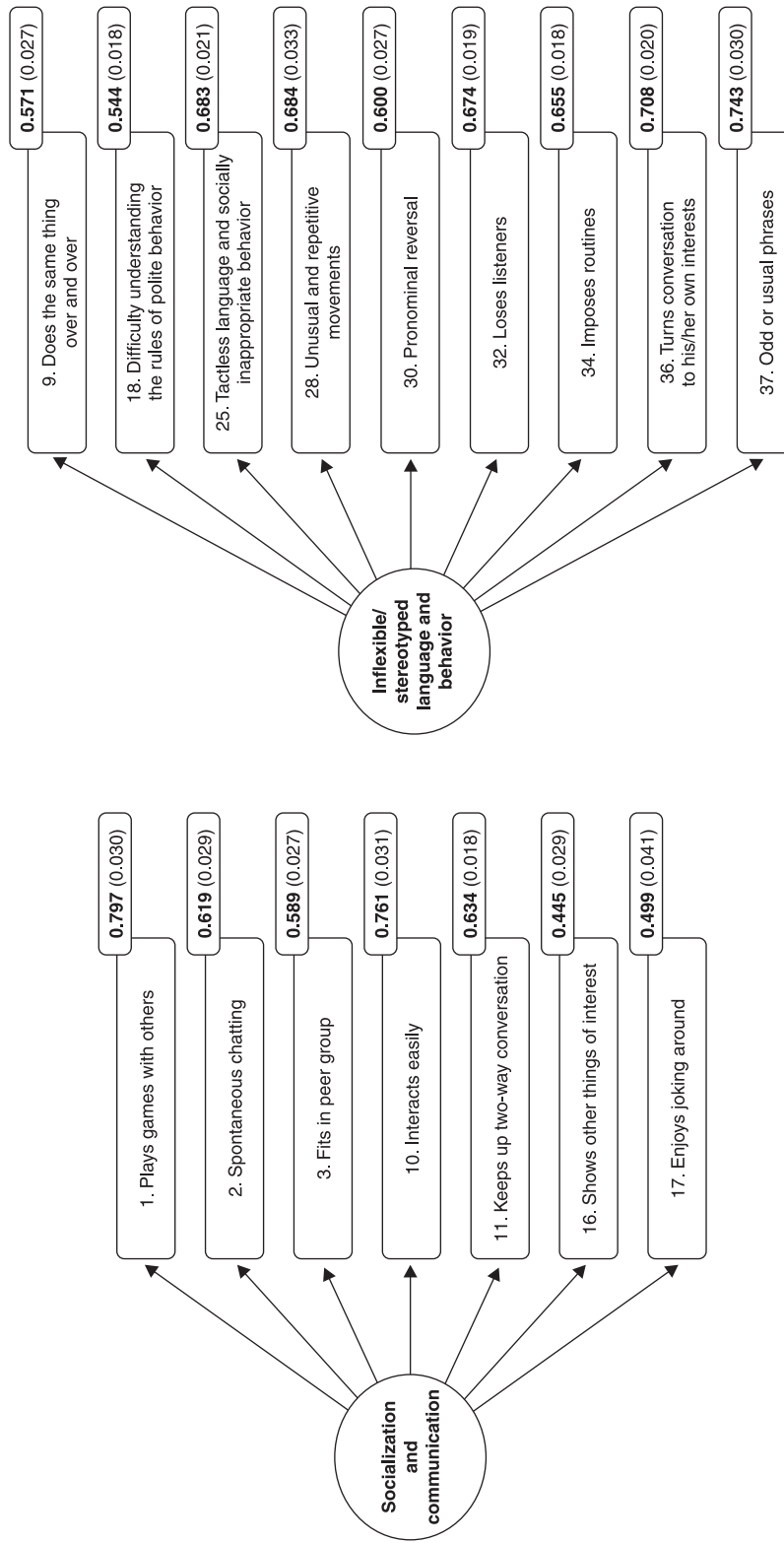


Figure 1 The two-factor correlated models obtained in confirmatory factor analysis.

behaviors and interests.” The confirmatory factor analysis ( $n=4,256$  participants) obtained good adequacy (comparative fit index = 0.97, Tucker-Lewis Index = 0.96, root mean square error of approximation = 0.02, standardized root mean square residual = 0.06). The two factors and their respective items are displayed, with factor loadings, in Figure 1. Invariance tests demonstrated that the model was stable across the sexes.

## Discussion

The present article reports on the factor structure of autistic symptoms in school-aged children and adolescents from a large school survey in Brazil. We found out that autistic symptoms are distributed among Brazilians as best conceptualized using a correlated-factors model with two factors. One factor involves symptoms related to socialization and communication and the other involves symptoms related to inflexible/restricted language, behaviors, and interests. This solution was invariant across sexes, indicating that its structure was stable.

Our findings are largely in line with other factor analytical studies of autistic symptoms from other countries. A relatively recent review of 36 factor analytical studies involving heterogeneous clinical samples of autistic individuals found that a combined social-communication domain and a separate restricted and repetitive behaviors and interests domain are frequently reported across studies.<sup>12</sup> More specifically, our findings are also in line with other factor analytical studies of the CAST in Chinese community-dwelling school-aged children.<sup>13</sup> Thus, our findings provide a stepping stone towards validating the cross-cultural validity of autistic symptoms in Brazil.

Our study has several strengths. First, its sample size is large. Second, to date, the evidence base for the distribution of autism and autistic symptoms in the Brazilian population is limited and based on rural regions.<sup>8</sup> Therefore, our study is, to the best of our knowledge, the first to describe autistic symptoms among individuals in an urban area in the country. Finally, Brazil is a middle-income country characterized by marked social inequality and suboptimal access to mental health care for low-income people. Autism manifests during early childhood and reliable diagnoses can be established in 2- and 3-year-old children.<sup>14</sup> However, autism might also remain underdiagnosed until school age, particularly among low-income children.<sup>15</sup> Access to health care may be worse for poor families, which could contribute to delayed diagnoses. Although there is debate about the topic of screening, i.e., a universal population-wide test to diagnose autism, such an approach could help identify autistic individuals in low- and middle-income countries. For instance, screening could identify “high risk” individuals for further assessment by health providers, since access to health care is suboptimal for the general population. Moreover, screening could help improve awareness of autism symptoms among teachers and parents, which could contribute to earlier detection and diagnosis. Although these claims are largely hypothetical and require direct investigation in future research, by adapting the

CAST to Brazilian Portuguese, we provided the first steps towards answering such important questions in Brazil.

Our study also has important limitations. First, given that 1,954 parents (~20%) did not return the consent forms signed, it is not possible to discard selection bias. Second, our study did not include a clinical sample of autistic individuals. Nonetheless, while autism is categorized in the DSM to guide diagnostic and treatment routines, neurodevelopmental symptoms behave as continuously distributed traits in the population without clear-cut thresholds in terms of associations with adverse outcomes. Understanding how autistic symptoms are distributed along the different ends of this continuum beyond categorical disorders, e.g., in community samples, is also of value for clinical research.

In conclusion, our study provides evidence that the structure of autistic symptoms in Brazil is similar to that described in other countries, indicating the cross-cultural validity of autism in Brazil.

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## Disclosure

EBC has served as consultant, advisory board member, and/or speaker for Aché, Mantecorp, and Takeda. GVP has served as consultant, advisory board member, and/or speaker for Abbott, Aché, Medice, Novo Nordisk, and Takeda; and has received royalties from Editora Manole. The other authors report no conflicts of interest.

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