Development of the PSI: A phone interview for screening for Autistic Spectrum Disorder (ASD) symptoms

Desenvolvimento da PSI: Uma entrevista telefônica para detecção de sintomas de Transtorno do Espectro Autista (TEA)

Desarrollo de la PSI: Una entrevista telefónica para la detección de los síntomas del Trastorno del Espectro Autista (TEA)

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Resumo

A pesquisa descreve o desenvolvimento da Phone Screening Interview (PSI) para detecção telefônica de sintomas do Transtorno do Espectro Autista (TEA). Trinta e sete pais de crianças (2 a 12 anos) com TEA do Serviço de Psicologia Aplicada da PUC-Rio foram entrevistados. As crianças foram avaliadas por psiquiatras e a escala CARS foi aplicada para determinar a gravidade do

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transtorno. Análises estatísticas descritivas e inferenciais multivariadas (ANOVA e conglomerados hierárquicos) foram realizadas. Os resultados apontam que o desempenho na PSI não varia em função da idade, escolaridade, gravidade e desenvolvimento linguístico ou motor. A análise de conglomerado para variáveis mostrou um agrupamento de sintomas de comunicação social e outro de padrão estereotipado. A análise de conglomerado das respostas dos pais na PSI mostrou dois grupos que diferem no grau de dificuldade nas habilidades comunicativas e sociais. Concluindo, a PSI mostrou-se: (1) de fácil aplicação; (2) breve; (3) abrangendo faixa etária ampla (2 a 12 anos); (4) aplicável a sintomas de TEA leves a moderados; (5) incluindo crianças verbais e não verbais; (6) consistente com os critérios diagnósticos do DSM-5. O estudo discute a precisão da percepção do cuidador quanto aos sintomas de alerta centrais, bem como a heterogeneidade do fenótipo de TEA.

Palavras-chave: Transtorno do Espectro Autista; triagem; sinais de alerta; triagem telefônica.

Abstract

The research describes the development of the Phone Screening Interview (PSI) for screening for Autistic Spectrum Disorder (ASD) symptoms. Thirty-seven parents of ASD children (2 to 12 years old) from the Applied Psychology Service of PUC-Rio were interviewed. The children were evaluated by psychiatrists and the CARS scale was applied to determine the severity of the disorder. Multivariate descriptive and inferential statistical analyses (ANOVA and hierarchical clusters) were performed. The results indicate that performance in PSI is invariant regarding age, education, severity, and linguistic and motor development. Cluster analysis for variables uncovered a grouping of social communication symptoms and another of stereotyped pattern ones. Cluster analysis of parents' responses in PSI found two groups that differ in the degree of difficulty in communication and social skills. In conclusion, PSI is shown as: (1) easy to apply; (2) brief; (3) encompassing a broad age range (2 to 12 years); (4) applicable to mild to moderate ASD symptoms; (5) including verbal and nonverbal children; (6) consistent with DSM-5 diagnostic criteria. The study discusses the accuracy of the caregiver's perception regarding signs of ASD, as well as the heterogeneity of the ASD phenotype.

Keywords: Autistic Spectrum Disorder; screening; warning signs; phone screening.

Resumen

La investigación describe el desarrollo de la Phone Screening Interview (PSI) para la detección telefónica de los síntomas de los Trastornos del Espectro Autista (TEA). Se entrevistó a 37 padres de niños (de 2 a 12 años) con TEA del Servicio de Psicología Aplicada de la PUC-Rio. Los niños fueron evaluados por psiquiatras y se aplicó la escala CARS para definir la gravedad del trastorno. Se realizaron análisis estadísticos descriptivos e inferenciales multivariados (ANOVA y conglomerados jerárquicos). Los resultados muestran que el rendimiento en la PSI no varía según la edad, la educación, la gravedad y el desarrollo lingüístico o motor. El análisis de conglomerado para las variables mostró una agrupación de los síntomas de los medios de comunicación y otra de los patrones estereotipados. El análisis de conglomerado de las respuestas de los padres en la PSI mostró dos grupos que difieren en el grado de dificultad en las habilidades sociales y de comunicación. En conclusión, la PSI resultó: (1) fácil de aplicar; (2) breve; (3) con amplio rango de edad (2 a 12 años); (4) aplicable a síntomas de TEA de leves a moderados; (5) incluyendo niños verbales y no verbales; (6) consistente con los criterios de diagnóstico del DSM-5. El estudio discute la exactitud de la percepción del cuidador respecto a los síntomas centrales de alerta, además de la heterogeneidad del fenotipo de TEA.

Palabras clave: Trastorno del Espectro Autista; detección; señales de advertencia; detección telefónica.

Introduction

Autistic Spectrum Disorder (ASD) is regarded by the Diagnostic and Statistical Manual of Mental Disorders – DSM-5 (APA, 2014) as a neurodevelopmental disorder. ASD involves persistent deficits in communication and social interaction as well as restricted and repetitive patterns of behavior, interests and activities, which are present since early childhood. The diagnosis is clinical, based on identification of behavioral signs, from observation and reports of caregivers (Matson et al., 2012). Symptoms are usually recognized during the child's second year (12 to 24 months), though they can be spotted before 12 months old in severe cases (APA, 2014). Some signs are described in the literature, such as impairment in eye contact, social smiling, joint attention (absence of pointing and of following the gaze and pointing of others), unresponsiveness to being called by name, absence of vocalization and delayed language development (Garcia & Lampreia, 2011; Ozonoff et al., 2010).

Given the existence of early signs, instruments for ASD screening have been developed in the last few years and tailored to the Brazilian population (Backes et al., 2014). Bishop et al. (2017) point out that use of comprehensive sets of evaluations, such as the *Childhood Autism Rating Scale* – CARS (Pereira et al., 2008), should be preferred; however, it is not always possible to undergo lengthy diagnostic evaluations. In this case, trials are more feasible, due to their quick identification of signs. From this, children with symptoms can be selected for further diagnostic evaluation (Meisels, 1985, cited by Ibañez et al., 2014). Among trial interviews, phone models stand out.

The *Autism Symptom Interview* – ASI (Bishop et al., 2017) is an example of phone interview designed to identify individuals whose behavior is consistent with an ASD diagnosis, focusing questions on current behavior, observed in the three preceding months. It is based on a semi-structured interview, *Autism Diagnostic Interview, Revised* – ADI-R (Lord et al., 1994). The authors describe ASI as a useful instrument for ASD identification in a research context, though they also point out some shortcomings, such as the difficulty in recruiting non-verbal participants without ASD diagnosis above five years old. Thus, despite its usefulness, some omissions are seen in ASI, such as the use of a Likert scale for questioning, which raises its complexity and extends the time required for application; absence of retroactive evaluation of symptoms, which may lead to loss of data and difficulty in the recruitment of older children, since some symptoms of ASD, and of other development disorders, may be lessened or changed by interventions over the years, as ASI authors themselves remark. The *Modified Checklist for Autism in Toddlers* – M-CHAT (Losapio & Pondé, 2008; Robins, 2008) makes use of a yes/no interview, briefer than ASI, but focused exclusively on screening for early symptoms. In this context, the need arises for the development of a new phone trial instrument that balances the advantages and limitations of ASI and M-CHAT, which engendered the proposal of the *Phone Screening Interview* (PSI).

PSI has the advantages of being brief, objective and having unequivocal scoring, making it more suited to a trial model. PSI evaluates ASD symptoms encompassing the 2 to 12 year old age range, identifying symptoms in their current form and, in older children, retroactively. Another relevant aspect of PSI is that, being a phone trial, it is designed for long-distance application, particularly important during the Covid-19 pandemic, when social distancing and remote evaluation instruments are crucial.

This study aims to describe the development of a new phone trial instrument called *Phone Screening Interview* (PSI), for screening for ASD in children aged 2 to 12 years old, considering both current and retroactive symptoms.

Method

Development of the trial interview

The PSI was developed by the research group at the Neuropsychology Laboratory and by the graduate course in autism at the Pontifícia Universidade Católica do Rio de Janeiro (PUC-Rio), a catholic university. To that end, a discussion team was assembled with three researchers from the Neuropsychology Laboratory, the coordinator of graduate studies, and a child psychiatrist experienced in the clinical diagnosis of ASD.

The team decided the interview would be brief, objective and have unequivocal scoring, but also be compatible with ambulatorial trials. The *Modified Checklist for Autism in Toddlers* (M-CHAT), a screening instrument for early symptoms of ASD (Losapio & Pondé, 2008; Robins, 2008), was used as a model. However, the PSI aims not only at early detection but also at retroactively evaluating symptoms in the age range 2 to 12 years old. It starts with a standard contact to be established telephonically with the following information: (a) interviewer's name; (b) confirmation that the child has been placed in the waiting list for that specific service; and (c) the reason for the call. A brief collection of sociodemographic and social data about the child follows. The full interview can be found in Annex 1, and its Portuguese original version in Annex 2.

The interview probes for the main symptoms of ASD, taking into account development characteristics associated to joint attention, social communication, and stereotypical and inflexible patterns. Besides these aspects, language acquisition and motor development processes are assessed. The interview in its final form comprised 12 items checking warning and developmental symptoms, one of them about language acquisition, one about motor development and ten about specific ASD symptoms. Of the latter, three regarded joint attention, three related to social communication and four corresponded to stereotypical patterns.

Some items were subdivided or omitted according to age, for they might entail a response conflicting with what is expected in typical development. Thus, in item 1 an alternate question is posed, and in item 9 the question is omitted, depending on age. Verbal tense alternates were included in items 4 and 5, so that the questions would not stray from the child's actual circumstances (see Annex 1).

The responses were in an objective, yes/no format, and scored as 1 (presence of the symptom) or 0 (absence of the symptom). At the end, a general

score and a score by grouping symptoms in four categories were produced. The categories were named as follows: (1) Joint Attention (JA), with items about initiative and response to joint attention; (2) Social Communication (SC), with items related to interaction with the other, i.e., components of joint attention and other communication aspects (this distinction was made because this scale was not intended only for early detection, and items such as eye contact and response to the other were already integrated in broader communication models in older children); (3) Stereotypical Patterns (SP), with items related to rigid and stereotypical behaviors; and (4) Joint Attention plus Social Communication (JA+SC), an amalgam created because JA and SC symptoms interact and are theoretically and clinically close.

Category JA is made up of items 3, 4 and 5; Category SC, of items 6, 8 and 9; Category SP comprises items 7, 10, 11 and 12; and Category JA+SC merges items 3, 4, 5, 6, 8 and 9 (see Annex 1). Moreover, from the language development variable it is possible to ascertain whether the child displays verbal (VE) or non-verbal (NVE) communication.

Ethical considerations

This study is part of a project about the development of a theory of mind instrument for evaluation of ASD symptoms. During this project there was a need to perform a quick screening of children with ASD symptoms and a possible diagnostic, so they could be included in protocols for evaluation and validation of this instrument. This study was assessed by the ethics committee at Pontifícia Universidade Católica do Rio de Janeiro (PUC-Rio), under ruling no. 2017-28. This study did not pose health risks to the subjects. All participants signed the research project consent form.

Instruments

***Childhood Autism Rating Scale* – CARS** (Schopler et al., 1988), an instrument for assessing the severity of autism. This is a 15-item scale that helps in identifying and distinguishing autistic children. They include personal relations, imitation, emotional response, body use, object use, response to changes, visual response, auditory response, response and use of taste, smell and touch, fear or disquiet, verbal communication, non-verbal communication, activity level, level

and consistency of intellectual response, and general impressions. The scores for each domain range from 1 (within normal limits) to 4 (severe autistic symptoms). Total scores go from 15 to 60.

Trial interview: Telephone trial interview for detection of ASD symptoms in 1- to 12-year-old children, that may be identified early on or retroactively. It is made up of 12 items, in four categories: Joint Attention (JA); Social Communication (SC); Joint Attention plus Social Communication (JA+SC); and Stereotypical Patterns (SP). Sociodemographic and clinical identification data about the child are also collected (age, sex, mother's name and contact; previous diagnosis and treatments, referral and complaint). Response to the items were in a yes/no format, scored as 1 (presence of symptom) or 0 (absence of symptom). At the end, a general score and a score by grouping symptoms in four categories were produced.

Participants

Thirty-seven parents of children with psychiatrically confirmed ASD diagnoses were included in the study. Proposed inclusion criteria were: (1) children between 2 and 12 years old; (2) ASD diagnosis confirmed by a child psychiatrist following application of CARS; (3) being in the waiting list at the applied psychology service of PUC-Rio. Exclusion criteria were: (1) impossibility of contact after three attempts; (2) children with genetic syndromes; and (3) children who missed the psychiatric evaluation.

Procedure

All interviewed families were selected from a waiting list for research with and assistance to children suspected of ASD; therefore all children came with a more specific ASD demand. This list was linked to an undergoing research by the Neuropsychology Laboratory and to the assistance offered by the graduation in ASD, both at PUC-Rio. Interviewers were previously trained by one of the researchers using another waiting list for diverse demands. Next, the calls to those in the ASD waiting list began. Participating parents were directed to have the psychiatric evaluation performed at the Applied Psychology Service

of PUC-Rio. This evaluation was the gold standard in the diagnosis of ASD in participating children.

The psychiatric evaluation was put together from DSM-5 (APA, 2014) criteria. The psychiatrist had a clinical interview with the parents and observed the child. In the parents' interview, the aspects of motor, social cognitive and affective development were assessed. The psychiatrist, experienced in ASD evaluation, analyzed information about delays, changes in or absence of speech, lack of interest in personal relations, absence of joint attention, cognitive inflexibility, difficulty in achieving or keeping eye contact, sensorial alterations, atypical use of toys or other objects, deficiencies in symbolic play (make-believe), and stereotypy. To complement the observation of the child in the attending room, the CARS instrument (Pereira et al., 2008) was used.

Statistical analysis

The descriptive analysis of participants' demographic and clinical characteristics was done, establishing frequency, share, average and standard deviation of variables. Age range was divided into three groups: 2–3 years, 4–6 years, and 7–12 years. Schooling was divided in two levels: preschool (infant education) and school (1st to 7th grades). Clinical variables comprised raw CARS score, beginning of language acquisition, beginning of walking ability, level of CARS severity (mild or moderate), and language command (VE or NVE). Descriptive statistics were also done for the children's performance by item, by category, and general score.

Differences in general score among age range groups were analyzed by an ANOVA one-way, whereas for schooling level, spectrum severity and language command a Student's *t*-test analysis was done.

An analysis of hierarchic clusters of variables was done to check for grouping of items and categories in the phone interview. Pearson correlation was the measurement of dissimilarity. This analysis intended to verify internal consistency of items in the screening interview and the relation between the items and ASD diagnostic model.

Next, an analysis of hierarchic clusters of cases was done to verify the existence of subgroups of ASD children from the symptoms evaluated by the screening interview, including the general score and category scores. The dissimilarity measurement was the Euclidean distance. The groups created from the results of children's screening were compared using the Student's *t*-test.

Results

The results describe the demographic, clinical and developmental characteristics of the set of ASD children interviewed. Table 1 presents the variation of the share according to age range, schooling level, severity, and language command, as well as averages and standard deviations of CARS total score, age (in months) of language acquisition and of walking ability onset. The results show a larger share of children between 4 and 6 years old (43.2%), with predominantly verbal communication (62.2%), a slightly higher share of preschool children (56.8%) and with moderate ASD (51.4%). Children learn to walk at an average age of 14.03 months (nearly one year old) and acquire language at an average age of 31.74 months (between 2 and 3 years old), with a standard deviation of 19 months, revealing a high variability in the language acquisition process. Average and standard deviation in the performance of these categories and in general score for the interview are also shown.

Table 1 — Demographic and clinical characteristics of ASD children

Demographic Variables		
Age range	**N**	**Share**
2–3 years	10	27.0%
4–6 years	16	43.2%
7–12 years	11	29.7%
Schooling level	**N**	**Share**
Preschool	21	56.8%
School	16	43.2%
Clinical Variables		
	Average	**Standard deviation**
CARS – total score	37.51	07.28
Language acquisition (months)	31.74	19.00
Walking ability (months)	14.03	03.92
Severity	**N**	**Share**
Mild	18	48.6%
Moderate	19	51.4%
Language command	**N**	**Share**
VE	23	62.2%
NVE	14	37.8%

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Performance in the Interview		
Category	Average	Standard deviation
SP	3.24	0.89
JA+SC	3.51	1.30
SC	1.73	0.87
JA	1.78	0.92
General score	6.76	1.44

CARS = Childhood Autism Rating Scale
VE = Verbal
NVE = Non-verbal
SP = Stereotypical patterns
JA+SC = Joint attention + Social communication
SC = Social communication
JA = Joint attention

Table 2 shows no significant differences were found related to age range, schooling level, CARS-based severity, and language command ($p > 0.05$). These results show that performance in the interview does not depend on demographic and clinical variables.

Table 2 — Comparison of phone screening general score for demographic and clinical variables

	Average (standard deviation)	Effect
Age range		
2–3	6.60 (1.71)	
4–6	6.38 (1.26)	F=2.02, p=0.149
7–12	7.45 (1.29)	
Schooling level		
Preschool	6.48 (1.50)	
School	7.12 (1.30)	t=−1.37 (35), p=0.179
Severity		
Mild	6.94 (1.21)	
Moderate	6.58 (1.64)	t=0.76 (35), p=0.449
Language command		
VE	7.00 (1.48)	
NVE	6.36 (1.34)	t=−1.33 (35), p=0.192

VE = Verbal
NVE = Non-verbal

Table 3 shows the children's performance in specific items of the phone screening. Each item corresponds to a question in the interview. Positive signs mean that the symptom is present, and negative that it is absent. More than 80% of the sample displayed positive signs for difficulty in eye contact, specific interest and motor stereotypies. Between 70% and 80% had positive signs for decontextualized speech and sensitivity to noise. Between 40% and 60% showed positive signs for other items involving communication and joint attention.

Table 3 — Performance of ASD children in phone screening items

| Items (shortened*)	Presence of symptoms N (share)	Absence of symptoms N (share)
Social interest	21 (56.80%)	16 (43.20%)
Using the other's hand	23 (62.20%)	14 (37.80%)
Pointing	22 (59.50%)	15 (40.50%)
Eye contact	30 (81.10%)	7 (18.91%)
Response to the other	15 (40.50%)	22 (59.50%)
Talking	18 (58.10%)	13 (41.90%)
Specific interest	32 (86.50%)	5 (13.50%)
Decontextualized speech	28 (77.80%)	8 (22.20%)
Motor stereotypies	33 (89.20%)	4 (10.80%)
Sensitivity to noise	27 (73.00%)	10 (27.00%)

N = number of participants
* See Annex 1

Pearson correlation analysis was employed as a measure of the dissimilarity of the hierarchic cluster analysis for PSI symptom categories. It was found that JA+SC and SC join at the first level and are closely associated, forming the first group: group A. This group A joins variable JA at a distance of 10 to form group B. This group only joins category SP at the last level (25), to form group C. This result attests to a strong association between social communication (SC) and joint attention (JA), whilst there is a dissociation with signs of stereotypical patterns (SP).

In the hierarchic cluster analysis of PSI items, it was found that items **using the other's hand** and **pointing** are associated to form category A. This category joins item **response to the other** at level 17 to form category B. Items **specific interest** and **decontextualized speech** join at level 4 to form category C. Category C joins item **sensitivity to noise** to form category D. Items **eye contact** and **motor**

stereotypies join at level 4 to form category E. Items **social interest** and **talking** join at level 7 to form category F. Categories E and F join at level 14 to form category G. Categories G and D join to form category H at the last level: level 25.

Finally, a hierarchic cluster analysis was done using Euclidean distance as measure of dissimilarity. Figure 1 shows the graph (dendrogram) depicting two homogeneous groups joined only at a distance between 10 and 25 and distant by 3.25. The final centers of each group are characterized in Table 4.

Figure 1 — Dendrogram charting ASD children subgroups according to phone screening scores
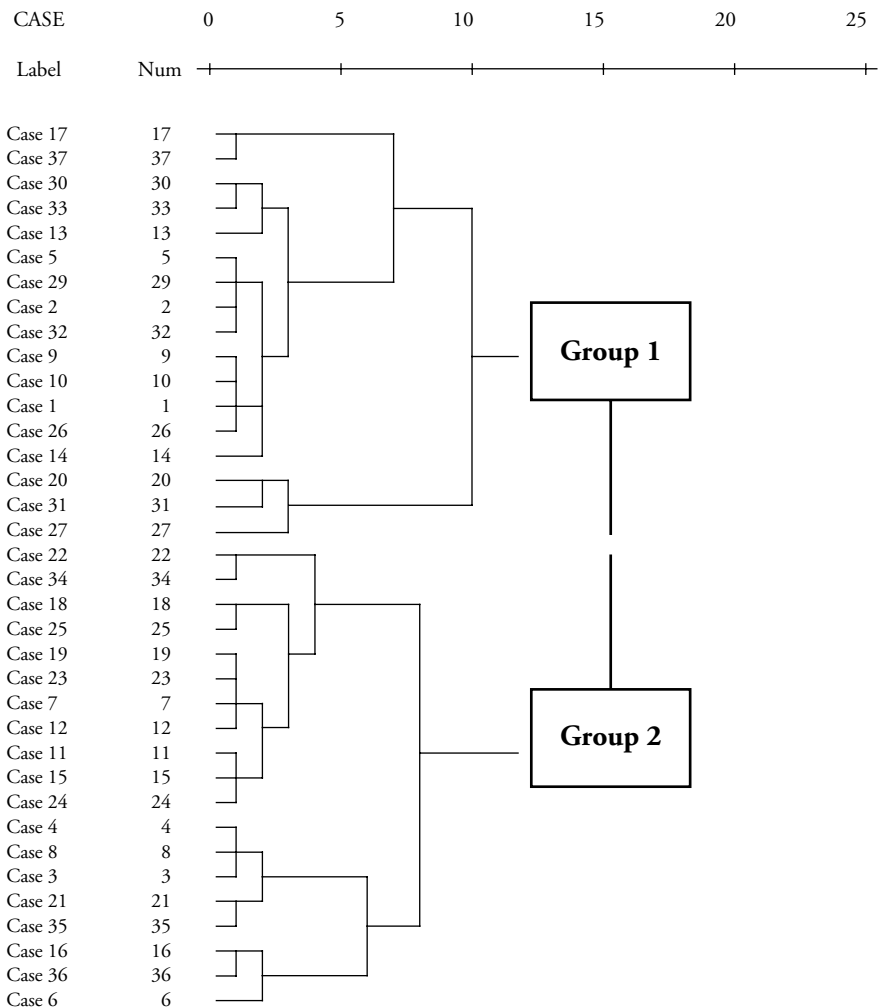
Table 4 — Final centers, average and standard deviation of groups established in the hierarchic cluster analysis

	Group 1 (n=15)	Group 2 (n=22)
	Center, average (std. deviation)	Center, average (std. deviation)
General score	8.0, 8.07 (0.88)	6.0, 5.86 (0.99)**
SP	3.0, 3.40 (0.83)	3.0, 3.14 (0.94)
JA+SC	5.0, 4.67 (0.82)	3.0, 2.73 (0.93)**
SC	2.4, 2.40 (0.63)	1.3, 1.27 (0.70)**
JA	2.3, 2.27 (0.78)	1.5, 1.45 (0.18)**

** t-test comparing the two groups and showing a significant difference with $p<0.05$
SP = Stereotypical patterns
JA+SC = Joint attention + Social communication
SC = Social communication
JA = Joint attention

The groups do not exhibit a significant difference in demographic variables (age and schooling), clinical variables (severity and CARS) and development (age of language acquisition, age of starting to walk, and language command) ($p>0.05$). The groups display a significant difference in general score, JA+SC, SC and JA ($p<0.05$). The groups do not differ regarding category SP ($p>0.05$). Group 1 shows a markedly higher amount of positive symptoms for social communication and joint attention than group 2, which reflects in the general score.

Discussion

This article describes the development of the PSI, a phone screening interview for detection of ASD symptoms, on the basis of an analysis of answers in a 37-child sample. The interview proved to be a speedy (no more than 15 minutes), easy-to-manage and easy-to-train tool. Such are desirable attributes in a phone trial instrument (Bishop et al., 2017; Sands et al., 2012). Moreover, by analyzing the demographic and clinical characteristics of the sample, of ages 2 to 12 years old, no significant differences were observed in age range, schooling level, raw CARS score, severity and language command that could influence the performance in the interview. These results suggest the performance is independent of these variables, which points to: (1) a broadly applicable detection; (2) possibility of identifying warning signs in an ample part of childhood; (3) recognition of current and retroactive symptoms; (4) detection of signs of ASD in diverse levels of severity, from mild to moderate.

However, there is a clinical aspect that, despite not affecting the performance of the interview, shows greater variation in this sample. This concerns the variable age of verbal language acquisition, which was on average 31.74 months (between 2 and 3 years), with a 19-month standard deviation. This variability is expected in a sample presenting ASD symptoms, in which language anomalies often draw a lot of attention, notably of parents (Adamson et al., 2019; Zanon, Backes & Bosa, 2014). Regardless of language no longer being a nosological criterion for this diagnosis, its changes are purported to be relevant in this circumstance (Adamson et al., 2019). For some authors, verbal language would be subsidiary to sociocognitive aspects essential for understanding ASD, such as joint attention, theory of mind, and intentionality (Adamson et al., 2019; Tomasello, 2003; Zanon et al., 2014, 2015).

When evaluating the presence of warning signs in this sample, those most often seen (above 80%) were: (1) difficulty with eye contact, (2) specific interest, and (3) motor stereotypies; between 70 and 80% there were: (4) decontextualized speech, and (5) sensitivity to noise. It should be noted that these items comprise behavioral manifestations characteristic of ASD, compatible with DSM-5 diagnostic criteria (APA, 2014) in the areas of social communication and stereotypical patterns, but are also more explicit and easily observable behavioral signs.

Other items had a positive sign between 40% and 60%. Among these are: (6) social interest, (7) pointing, (8) response to the other, and (9) talking. We emphasize these items involve aspects of joint attention and social interaction and are, therefore, central to ASD clinical characterization (Adamson et al., 2019). However, these attributes are harder to identify and distinguish in the general population. Pointing, for instance, comprises two aspects (Pecukonis et al., 2019): protodeclarative, in which the child points to show or share something, and protoimperative, in which the child points to something he wants. Some of the literature describes protodeclarative pointing as more related to communication ability than protoimperative pointing, with some variation related to methodological characteristics (Pecukonis et al., 2019; Van der Paelt et al., 2014). ASD children may also display protoimperative pointing (Baron-Cohen, 1989; Goodhart & Baron-Cohen, 1993). Thus, perception of intentionality in communication also concerns listener accuracy (Bosa, 2002).

Listener accuracy may also bear on observations related to items like social interest, talking and response to the other, for brief dialog is often a matter of personality or language, and scant response may be due to lack of attention. As such, it is likely that these are not noticed as attributes of joint attention and social communication (disengagement and reengagement of attention focus in social interaction).

Regarding the analysis of the internal consistency of the interview, at first its categories JA, SC, JA+SC and SP are evaluated. Initially, categories JA+SC and

SC join to form a first group, called **social interaction** (affected by items such as talking, keeping eye contact, responding to the other). Then they join category JA, with items pointing and using the other's hand, forming a larger group we call **social communication deficit**. Category SP is farther away, making up a group by itself we call **stereotypy and inflexibility**. The group social communication deficit joins category SP at the last level, forming a group we call **social communication deficit and inflexibility**. These results point to a strong link between categories JA+SC, SC and JA, which constitute the **communication pattern**, and a detachment of category SP, more related to the **inflexibility pattern**. This is compatible with the theoretical formulation of these categories, considering the behaviors and signs were brought together by similarity of manifestation. In this case, behaviors of social interaction and communication are strongly linked to characteristics of joint attention, as reported in the literature (Pecukonis et al., 2019; Van der Paelt et al., 2014). Goodhart and Baron-Cohen (1993), for instance, debate that protodeclarative pointing would be mostly associated to the theory of mind, ability to converse and use of symbols. The groups stemming from the categories are shown in Figure 2.

Figure 2 — Classification of groups based on PSI categories
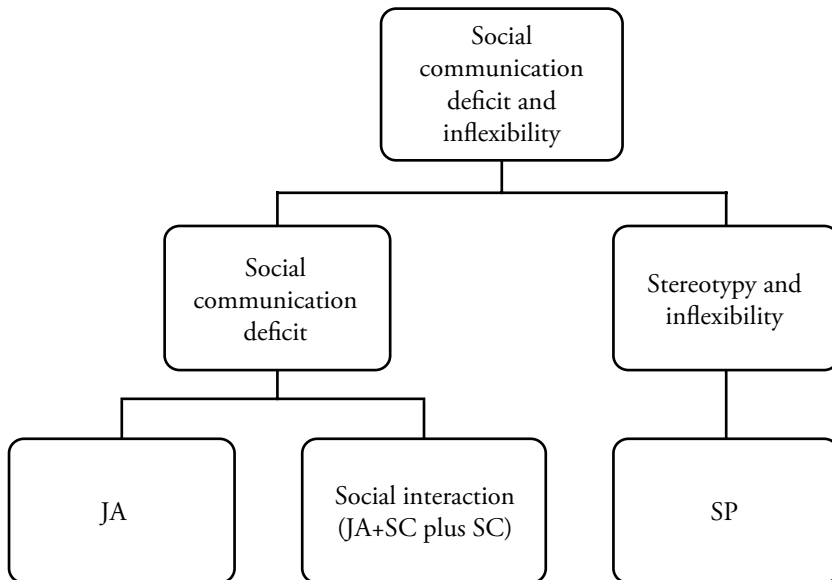
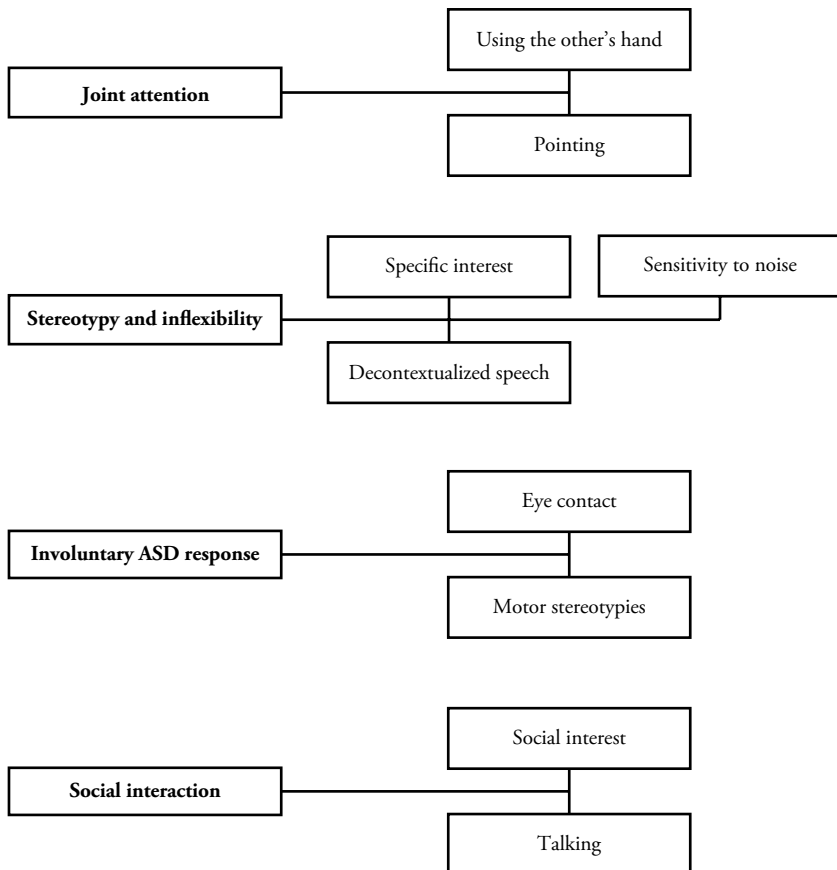JA+SC = Joint attention + Social communication
SC = Social communication
JA = Joint attention
SP = Stereotypical patterns

When evaluating internal consistency at level 10 from an analysis of the items, we find that the first two ("using the other's hand" and "pointing") join to form the **joint attention** group. The second group, **stereotypy and inflexibility**, is formed from two other items ("specific interest" and "decontextualized speech"), which then join another one ("sensitivity to noise"). Items "eye contact" and "motor stereotypies" join to form the third group, **involuntary ASD response**. Then, "social interest" joins "talking" to form the **social interaction** group. These four groups of symptoms are recognized to be characteristic and fundamental for ASD diagnosis (Adamson et al., 2019; APA, 2014; Zanon et al., 2015). They are shown in Figure 3.

Figure 3 — Classification of groups based on symptoms

Finally, the analysis of the dendrogram by cases produced two groups: one presenting a significantly larger number of positive symptoms for social communication and joint attention, and another one with fewer such symptoms. Actually, both groups present clear signs of stereotypical patterns, but group 1 is made up of cases with one or two more SC and JA symptoms, which impacts the general score. ASD is known for a large variability in its phenotype (Prigge et al., 2018). The literature contains discussions about variables that may be associated to these various phenotypes and severity levels, including cognitive ones (Paulais et al., 2019; Delehanty et al., 2018), as well as sociocognitive ones as the theory of mind (Altschuler et al., 2018). What can be perceived is a possible heterogeneity pattern, with one group marked by a higher social engagement than the other. Besides the heterogeneity model, this pattern is also consistent with the literature, which regards social cognition traits as the best markers for differential diagnosis between ASD and other neurodevelopmental disorders (Fernandes et al., 2018; Losh et al., 2009; Zanon et al., 2014).

The findings outlined in this article indicate the PSI to be a useful tool for screening for ASD symptoms in a clinical ambulatorial context and in clinical research. They also promote a relevant discussion regarding possible differences in the accuracy of a listener's perception of fundamental symptoms for ASD diagnosis, which stresses the need to map the ability in identifying such behavior in the general population. As to its internal consistency, there is an association between items related to communication and items that describe stereotypical patterns, indicating a theoretical closeness in the items and an alignment with current diagnostic criteria regarding the organization in two axes (social communication and repetitive stereotypical patterns). The analyses also found two groups alike in their inflexibility symptoms but distinct in social communication symptoms, suggesting an heterogeneity in ASD phenotype from social and interactive criteria.

Among the constraints in this study there were the size of the sample and the limitation to ASD diagnosis, which restricted checking for diagnostic sensitivity and specificity, as well as not using an already validated screening tool to broaden its psychometric characteristics. Thus, possibilities arise for further studies with larger and more diverse samples to check for clinical heterogeneity in the diagnosis of ASD and other neurodevelopmental conditions, and also carrying out studies of other psychometric attributes from the comparison with previously validated screening models.

References

Adamson, L. B.; Bakeman, R.; Suma, K.; Robins, D. (2019). An expanded view of joint attention: Skill, engagement, and language in typical development and autism. *Child Development, 90*(1), e1-e18. https://doi.org/10.1111/cdev.12973

Altschuler, M.; Sideridis, G.; Kala, S.; Warshawsky, M.; Gilbert, R.; Carroll, D.; Burger-Caplan, R.; Faja, S. (2018). Measuring individual differences in cognitive, affective, and spontaneous theory of mind among school-aged children with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 48*(11), 3945-3957. https://doi.org/10.1007/s10803-018-3663-1

APA – American Psychiatric Association (2014). *Manual diagnóstico e estatístico de transtornos mentais (DSM-5)*. Porto Alegre: Artmed.

Backes, B.; Mônego, B. G.; Bosa, C. A.; Bandeira, D. R. (2014). Psychometric properties of assessment instruments for autism spectrum disorder: A systematic review of Brazilian studies. *Jornal Brasileiro de Psiquiatria, 63*(2), 154-64.

Baron-Cohen, S. (1989). The autistic child's theory of mind: A case of specific developmental delay. *Child Psychology & Psychiatry & Allied Disciplines, 30*(2), 285-297. https://doi.org/10.1111/j.1469-7610.1989.tb00241.x

Bishop, S. L.; Huerta, M.; Gotham, K.; Havdahl, K. A.; Pickles, A.; Duncan, A.; Hus Bal, V.; Croen, L.; Lord, C. (2017). The autism symptom interview, school-age: A brief telephone interview to identify autism spectrum disorders in 5-to-12-year-old children. *Autism Research, 10*(1), 78-88. https://doi.org/10.1002/aur.1645

Bosa, C. (2002). Atenção compartilhada e identificação precoce do autismo. *Psicologia: Reflexão e Crítica, 15*(1), 77-88. https://doi.org/10.1590/S0102-79722002000100010

Delehanty, A. D.; Stronach, S.; Guthrie, W.; Slate, E.; Wetherby, A. M. (2018). Verbal and nonverbal outcomes of toddlers with and without autism spectrum disorder, language delay, and global developmental delay. *Autism & Developmental Language Impairments, 3*, 1-19. https://doi.org/10.1177/2396941518764764

Fernandes, C. S.; Charchat-Fichman, H.; Barros, P. S. (2018). Evidências de diagnóstico diferencial entre Transtorno do Espectro Autista (TEA) e Transtorno do desenvolvimento intelectual (TDI): Análise de casos. *Neuropsicologia Latinoamericana, 10*(2), 29-41.

Garcia, M. L.; Lampreia, C. (2011). Limites e possibilidades da identificação de risco de autismo no primeiro ano de vida. *Psicologia: Reflexão e Crítica, 24*(2), 300-308. https://doi.org/10.1590/S0102-79722011000200011

Goodhart, F.; Baron-Cohen, S. (1993). How many ways can the point be made? Evidence from children with and without autism. *First Language, 13*(38), 225-233. https://doi.org/10.1177/014272379301303804

Ibañez, L. V.; Stone, W. L.; Coonrod, E. E. (2014). Screening for autism in young children. In: Volkmar, F. R.; Rogers, S. J.; Paul, R.; Pelphrey, K. A. (Ed.). *Handbook of Autism and Pervasive Developmental Disorders*, 4th ed. John Wiley & Sons.

Lord, C.; Rutter, M.; Couteur, A. (1994). Autism Diagnostic Interview–Revised: A revised version of a diagnostic interview for caregivers of individuals with possible pervasive developmental disorders. *Journal of Autism and Developmental Disorders, 24*(5), 659-685. https://pubmed.ncbi.nlm.nih.gov/7814313/ https://doi.org/10.1007/BF02172145

Losapio, M.; Pondé, M. (2008). Translation into Portuguese of the M-CHAT Scale for early screening of autism. *Revista de Psiquiatria do Rio Grande do Sul, 30*(3), 221-229. https://doi.org/10.1590/S0101-81082008000400011

Losh, M.; Adolphs, R.; Poe, M. D.; Couture, S.; Penn, D.; Baranek, G. T.; Piven, J. (2009). Neuropsychological profile of autism and the broad autism phenotype. *Archives of general psychiatry, 66*(5), 518-526. https://doi.org/10.1001/archgenpsychiatry.2009.34

Matson, J. L.; Beighley, J.; Turygin, N. (2012). Autism diagnosis and screening: Factors to consider in differential diagnosis. *Research in Autism Spectrum Disorders, 6*(1), 19-24.

Ozonoff, S.; Iosif, A. M.; Baguio, F.; Cook, I. C.; Hill, M. M.; Hutman, T.; Rogers, S. J.; Rozga, A.; Sangha, S.; Sigman, M.; Steinfeld, M. B.; Young, G. S. (2010). A prospective study of the emergence of early behavioral signs of autism. *Journal of the American Academy of Child and Adolescent Psychiatry, 49*(3), 256-266.

Paulais, M.-A. B.; Mazetto, C.; Thiébaut, E.; Nassif, M. C.; Souza, M. T. C. C. de; Stefani, A. P.; Blanc, R.; Gattegno, M. P.; Aïad, F.; Sam, N.; Belal, L.; Fekih, L.; Kaye, K.; Contejean, Y.; Wendland, J.; Barthélémy, C.; Bonnet-Brilhault, F.; Adrien, J.-L. (2019). Heterogeneities in cognitive and socio-emotional development in children with autism spectrum disorder and severe intellectual disability as a comorbidity. *Frontiers in Psychiatry*, 10. https://doi.org/10.3389/fpsyt.2019.00508

Pecukonis, M.; Plesa Skwerer, D.; Eggleston, B.; Meyer, S.; Tager-Flusberg, H. (2019). Concurrent social communication predictors of expressive language in minimally verbal children and adolescents with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 49*(9), 3767-3785. https://doi.org/10.1007/s10803-019-04089-8

Pereira, A.; Riesgo, R. S.; Wagner, M. B. (2008). Autismo infantil: Tradução e validação da Childhood Autism Rating Scale para uso no Brasil. *Jornal de Pediatria, 84*(6), 487-494. https://doi.org/10.1590/S0021-75572008000700004

Prigge, M. B. D.; Bigler, E. D.; Travers, B. G.; Froehlich, A.; Abildskov, T.; Anderson, J. S.; Alexander, A. L.; Lange, N.; Lainhart, J. E.; Zielinski, B. A. (2018). Social Responsiveness Scale (SRS) in relation to longitudinal cortical thickness changes in autism spectrum disorder. *Journal of Autism and Developmental Disorders, 48*(10), 3319-3329. https://doi.org/10.1007/s10803-018-3566-1

Robins, D. L. (2008). Screening for autism spectrum disorders in primary care settings. *Autism, 12*(5), 537-556.

Sands, N.; Elsom, S.; Gerdtz, M.; Henderson, K.; Keppich-Arnold, S.; Droste, N.; Prematunga, R.; Wereta, Z. (2012). Identifying the core competencies of mental health telephone triage. *Journal of Clinical Nursing, 22*(21-22), 3203-3216. https://doi.org/10.1111/j.1365-2702.2012.04093.x

Schopler, E.; Reichler, R. J.; Renner, B. R. (1988). *The childhood autism rating scale (CARS)*. Los Angeles: Western Psychological Services.

Tomasello, M. (2003). *Constructing a language: A usage-based theory of language acquisition*. Cambridge, MA: Harvard University Press.

Van der Paelt, S.; Warreyn, P.; Roeyers, H. (2014). Social-communicative abilities and language in preschoolers with autism spectrum disorders: Associations differ depending on language age. *Research in Autism Spectrum Disorders, 8*(5), 518-528.

Zanon, R. B.; Backes, B.; Bosa, C. A. (2014). Identificação dos primeiros sintomas do autismo pelos pais. *Psicologia: Teoria e Pesquisa, 30*(1), 25-33. https://doi.org/10.1590/S0102-37722014000100004

Zanon, R. B.; Backes, B.; Bosa, C. A. (2015). Diferenças conceituais entre resposta e iniciativa de atenção compartilhada. *Psicologia: teoria e prática, 17*(2), 78-90.

Annex 1 — PSI interview with specific ASD symptoms items and categories

Phone Screening Interview

Good morning,

My name is…. You have placed your child's name in the waiting list for neuropsychological evaluation in the Applied Psychology Service at PUC. Is that correct? We need to ask you a few questions for initial trial, alright?

Developmental items		
1 – Above 3 years old, ask: How old was he when he spoke? Between 2 and 3 years old, ask: Does he speak more than 2 words, besides *mommy* and *daddy*?		
2 – How old was he when he started walking?		
Specific ASD symptoms items	**In short**	**Category**
3 – Does he show interest in children? (Does he play or likes to play with them?)	Social interest	JA
4 – Does he use your hand to pick up things he wants? (If older than 6 years, ask "Did he…")	Using the other's hand	JA
5 – Does he point to objects? (If older than 6 years, ask "Did he…")	Pointing	JA
6 – Does he keep eye contact?	Eye contact	SC
7 – Does or did he get disturbed by noise?	Sensitivity to noise	SP
8 – Does he answer when called by name? Have you ever worried about his hearing?	Response to the other	SC
9 – (Do not ask this of under-3-year-olds or non-verbals.) Does he talk to you at home? (Telling about his day.)	Talking	SC
10 – Does he like something a lot? (Such as characters or cartoons and movies.)	Specific interest	SP
11 – Does he repeat dialogs or phrases he hears from TV or other people out of context?	Decontextualized speech	SP
12 – Does or did he make unusual movements with hands or fingers, or with the body? (Like circling or rocking.)	Motor stereotypies	SP
Other questions included in the interview		
How was the referral? By whom?		
Has he been diagnosed?		
Is he or was he in some sort of treatment? (neurological, phonoaudiological, psychological)		

Annex 2 — Entrevista PSI com itens e categorias de sintomas específicos do TEA

Entrevista de Triagem Telefônica

Bom dia,

Meu nome é…. Você colocou o nome de seu filho na lista de espera para avaliação neuropsicológica no Serviço de Psicologia Aplicada da PUC. Correto? Nós precisamos te fazer algumas perguntas para a triagem inicial, tudo bem?

Itens de desenvolvimento		
1 – Acima de 3 anos, perguntar: Falou com quantos anos? Entre 2 e 3 anos, perguntar: Ele fala mais de 2 palavras, além de *papai* e *mamãe*?		
2 – Andou com quantos anos?		
Itens referentes a sintomas específicos de TEA	**Abreviatura**	**Categoria**
3 – Interessa-se pelas crianças? (Ele brinca? Gosta de brincar com elas?)	Interesse social	AC
4 – Ele usa sua mão para pegar coisas que ele quer? (Se for maior de 6 anos, colocar no passado)	Usar a mão do outro	AC
5 – Ele aponta para os objetos? (Se for maior de 6 anos, colocar no passado)	Apontar	AC
6 – Mantém contato visual?	Contato visual	CS
7 – O barulho incomoda ou incomodava?	Sensibilidade a barulho	PE
8 – Responde quando chamado pelo nome? Alguma vez você já se preocupou com sua audição?	Resposta ao outro	CS
9 – (Caso seja menor de 3 anos ou não verbal, não fazer esta pergunta.) Ele conversa em casa com você? Conta o dia, por exemplo?	Conversar	CS
10 – Ele ou ela gosta muito de uma mesma coisa? (Personagens ou desenhos/filmes)	Interesse específico	PE
11 – Repete diálogos ou falas que ele escuta na TV ou de outras pessoas fora de um contexto?	Fala descontextualizada	PE
12 – Faz ou já fez movimentos diferentes com as mãos e dedos ou com o corpo? (por exemplo, circular ou balançar)	Estereotipia motora	PE
Outras questões incluídas na entrevista		
Como foi o encaminhamento? De quem?		
Já tem algum diagnóstico?		
Faz algum tratamento ou já fez? (p.ex.: neurologista, fonoaudiólogo, psicólogo)		