Construction and psychometric evaluation of a short form of the Broad Autism Phenotype Questionnaire

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Broad Autism Phenotype (BAP) represents a group of personality traits expressed in limitations in social relations and pragmatic speech dimension, and rigid behavior. The Broad Autism Phenotype Questionnaire (BAPQ) measures personality traits which are crucial in defining the BAP. In the present research, three studies were conducted with the general aim to create a short form of the BAPQ. Study 1 was carried out to determine the factor structure of the BAPQ in a sample of 501 students and to select items for the short form. Obtained components: Aloofness, Rigidity, and Pragmatics, corresponding to the structure of the instrument proposed by authors, accounted for 26.61% of variance. Study 2 was conducted to examine factor structure of the BAPQ short form (BAPQ-SF), in a sample of 298 students. This solution explained 45.76% of the total variance. The aim of Study 3 was to determine psychometric characteristics of the BAPQ-SF in a sample of students (N = 294). Three-factor model of the BAPQ-SF was confirmed. Correlations of the BAPQ-SF with the Autism-Spectrum Quotient (AQ) and the Delta 10 suggest convergent and discriminant validity of the BAPQ-SF.

Key words: autism spectrum disorder, The Broad Autism Phenotype Questionnaire, confirmatory factor analysis

Highlights:

- Three-factor structure of the BAPQ was determined.
- The BAPQ short form was constructed.
- Evidence for validity and reliability of the BAPQ short form was provided.

The concept of autistic continuum includes Autism Spectrum Disorder (ASD) which represents the extreme level of characteristics (Bhatia, Rajender,

Malhotra, Kanwal, & Chaudhary, 2010; Wing, 1994) with the severity of manifestations being reduced by moving towards the opposite side of the continuum (Berney, 2000). Thus, varying degrees of autistic tendencies may be detected in general population (Constantino & Todd, 2003; Constantino & Todd, 2005). Broad Autism Phenotype (BAP) represents a group of personality traits. Autistic traits predict the amount of social behavior and the level of discomfort experienced in social interactions (De Groot & Strien, 2017). Limitations in social interactions manifested in lower empathy, decreased desire for close friendship and shorter duration of friendships are present in persons with BAP (Bishop et al., 2004; Jamil, Gragg, & DePape, 2017; Murphy et al., 2000; Piven et al., 1997). Also, social functioning is limited due to the deficit in social communication-pragmatic speech domain (Faso, Corretti, Ackerman, & Sasson, 2016; Landa et al., 1992; Losh & Piven, 2007; Piven et al., 1997) and rigidity in behavior (Bolton, Pickles, Murphy, & Rutter, 1998). Increased presence of emotional problems, such as depression (Kunihira, Senju, Dairoku, Wakabayashi, & Hasegawa, 2006; Piven & Palmer, 1999), aloofness, anxiety (Kunihira et al., 2006; Murphy et al., 2000), obsessive tendencies and experience of being bullied (Kunihira et al., 2006) have also been reported.

Research on BAP in general population confirmed the thesis on the concept of autistic continuum (Constantino & Todd, 2003). In general population, similarly to the population of the closest relatives of persons with ASD, BAP manifestations are related to limitations in social relations (Jobe & Williams White, 2007; Pollmann, Finkenauer, & Begeer, 2010; Sasson, Nowlin, & Pinkham, 2013; Wainer, Ingersoll, & Hopwood, 2011) and pragmatic speech dimension (Wainer et al., 2011). For example, with regards to pragmatic difficulties, studies point to deficits in nonverbal sensitivity, i.e. the ability to interpret nonverbal aspects of communication (Ingersoll, 2010). In research based on dimensional approach conducted in Great Brittan and Japan, the presence of mild symptoms of autism was determined in a sample of students. The observed symptoms were discreetly expressed so that their presence did not hinder daily social functioning of the participants (Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001; Wakabayashi, Baron-Cohen, Wheelwright, & Tojo, 2006). In a study on a student sample in USA, persons with more expressed characteristics associated with autism made fewer friends and their friendships lasted shorter (Jobe & Williams White, 2007).

When trying to operationalize the BAP, it is important to differentiate between autistic tendencies and schizotypy. Schizotypy represents a set of traits that predispose to psychosis (Claridge, 1997). A distinction is made between positive and negative schizotypal traits. Positive traits include unusual perceptual experiences and magical and paranoid thinking, while negative traits are manifested as tendency towards social isolation, flattened affect and heightened social anxiety. Constructs of autistic tendencies and schizotypy partially overlap, especially in terms of negative schizotypal traits. Further, like autistic traits, schizotypal traits are more pronounced in males than in females. An empirical study by Hurst and colleagues (Hurst, Nelson-Gray, Mitchell,

& Kwapil, 2007) showed positive correlations between autistic tendencies measured by the Autism Spectrum Quotient (AQ; Baron-Cohen et al., 2001) and schizotypy on the whole. At the subscales level, the strongest correlation was obtained between the Social skills domain of the AQ and the interpersonal domain of schizotypy which encompasses negative schizotypal traits. According to the findings of Ingersoll, Hopwood, Wainer, and Donnellan (2011), the Broad Autism Phenotype Questionnaire (BAPQ; Hurley, Losh, Parlier, Reznick, & Piven, 2007) measures personality traits which are crucial in defining BAP, and with regard to the type of subscales it most closely corresponds to the theoretical concept of BAP when compared to two other instruments, AQ (Baron-Cohen et al., 2001) and The Social Responsiveness Scale (Constantino, 2002; Ingersoll, 2010; Ingersoll et al., 2011).

An increase in use of brief measurement instruments has taken place in personality research during the last decades. By being less time-consuming for participants, shorter measures ensure higher participation rates (Konstabel, Lönnqvist, Walkowitz, Konstabel, & Verkasalo, 2012) and are less likely to trigger negative participants' reactions such as fatigue, boredom, or frustration (Robins, Hendin, & Trzesniewski, 2001), which may distort their answers. Further, shorter measurement instruments are more suitable for broad scope research in which measures of multiple constructs are employed. The general aim of the present research was defined based on these considerations.

General aim and specific aims

General aim of the research was construction of a Serbian short form of the BAPQ for the assessment of autistic personality traits in general population. The three studies, which are parts of this research, had their specific goals. The aim of the first study was to determine the factor structure of the BAPQ and to select items for the short form of the questionnaire. The aim of the second study was to examine factor structure of the BAPQ short form (BAPQ-SF). In the third study, the goal was to establish psychometric characteristics of the BAPQ-SF.

General procedure

Participants in each of the three studies were students of the Belgrade University. Bearing in mind that autistic traits are related to scientific/professional field in which a person is engaged, so that these traits are more pronounced among mathematicians, physicists and engineers compared to persons in the fields of humanities (Baron-Cohen et al., 1998; Baron-Cohen et al., 2001), we aimed to include students of various scientific disciplines in our samples. Thus, participants in the research were students of the following fields: special education and rehabilitation, traffic and transport engineering, political sciences, mathematics, physics, organizational sciences, medicine, agriculture, police studies, and geography. The samples in three studies were unrelated and did not overlap.

The students provided answers to the claims from the BAPQ scale at their faculties before or after lectures. Before data collection, participants were asked to participate in a research on their sociability and their relations with other

people. All addressed students agreed to participate. The researchers guaranteed the participants anonymity and that the obtained results will only be used for scientific purposes.

Study1

There is still no extensive data on psychometric characteristics of the BAPQ and other instruments measuring broad autistic phenotype in larger, non-clinical samples. Therefore, we decided to conduct a study with the aim to determine factor structure of the BAPQ in a sample of students of the University of Belgrade, with regard to the experience from other studies with similar samples (Ingersoll, 2010; Ingersoll et al., 2011) and to select items for the short form of the instrument. This study was aimed to be the first step of our research on the manifestations of BAP in Serbia.

Method

Sample. The questionnaire was filled out by 625 students of the University of Belgrade. The participants who gave answers to all the items were singled out, and the sample used for analyses consisted of 501 students. The participants were from 19 to 24 years of age ($M = 21.49$, $SD = 1.17$). With regard to gender, 29.2% of the participants were male, and 70.8% female.

Instrument. The Broad Autism Phenotype Questionnaire (BAPQ; Hurley, Losh, Parlier, Reznick, & Piven, 2007). The BAPQ consists of 36 items distributed in three subscales: Social aloofness (Aloof, 12 items), Pragmatic language deficits (Pragmatic, 12 items), and Rigidity (Rigid, 12 items). The Aloof subscale refers to withdrawal and keeping aloof in social relations. The Pragmatic subscale includes problems in pragmatics, i.e. social aspects of language, and the Rigid subscale assesses unwillingness to accept changes and difficulties in adapting to changes (Hurley et al., 2007). The participants' responses to the BAPQ are given on a six-point Likert type scale from 1 (*never*) to 6 (*always*). The appropriate items (1, 3, 7, 9, 12, 15, 16, 19, 21, 23, 25, 28, 30, 34, 36) are reverse scored before computing summary scores by averaging across the items pertaining to a particular subscale or across all items to create total score (Hurley et al., 2007). A higher score represents higher levels of broad autism phenotype characteristics. Internal consistency of the BAPQ provided by authors is high: Aloof (Cronbach's α = .94), Rigid (Cronbach's α = .91), and Pragmatic (Cronbach's α = .85). Internal consistency of the total scale is high (Cronbach's α = .95; Hurley et al., 2007), and similar values of inter-item reliability (from .85 to .95) are also reported by other authors (Seidman, Yirmiya, Milshtein, Ebstein, & Levi, 2012).

Results

Data adequacy for factor analysis was determined by *Kaiser-Meyer-Olkin measure* (KMO .87), which exceeds the recommended value of .60, and by *Bartlett's test of sphericity* which reached statistical significance pointing to the factorability of the correlation matrix, $\chi^2(630) = 4555.55$, $p = .000$. With the aim to determine the BAPQ structure, *Principal axis factoring with Oblimin rotation* was applied on 36 items of the scale. Considering previous research of the instrument structure (Hurley et al., 2007; Ingersoll et al., 2011; Sasson et al., 2013; Wainer et al., 2011), three factors were specified to be extracted (Table 1).

Table 1

Results of Exploratory factor analysis of the 36 BAPQ items – Principal axis factoring with Oblimin rotation

	Items	Rotated Component Matrix			Communality
		I	II	III	
1	I like being around other people	**.78**	-.11	-.12	.56
9	I enjoy being in social situations	**.74**	-.09	-.10	.50
36	I enjoy chatting with people	**.73**	-.01	-.00	.52
31	I prefer to be alone rather than with others	**.68**	-.08	.02	.45
16	I look forward to situations where I can meet new people	**.66**	.22	-.13	.50
25	I feel like I am really connecting with other people	**.65**	.01	.02	.43
27	Conversation bores me	**.56**	.01	.09	.35
28	I am warm and friendly in my interactions with others	**.55**	.12	.03	.36
23	I am good at making small talk	**.52**	.08	.16	.38
12	People find it easy to approach me	**.49**	.14	.12	.35
11	I feel disconnected or "out of sync" in conversations with others	**.39**	.03	**.37**	.38
7	I am "in-tune" with the other person during conversation	**.35**	.08	.18	.22
18	When I make conversation it is just to be polite	**.34**	.04	.24	.23
5	I would rather talk to people to get information than to socialize	.27	-.01	.09	.09
30	I alter my daily routine by trying something different	.21	**.68**	**-.37**	.51
22	I have a hard time dealing with changes in my routine	-.03	**.59**	.03	.35
33	I like to closely follow a routine while working	-.07	**.47**	-.07	.20
19	I look forward to trying new things	**.32**	**.46**	-.13	.34
13	I feel a strong need for sameness from day to day	.18	**.41**	.10	.27
35	I keep doing things the way I know. even if another way might be better	-.12	**.38**	.08	.16
8	I have to warm myself up to the idea of visiting an unfamiliar place	.12	**.34**	.15	.21
15	I am flexible about how things should be done	.07	**.33**	-.01	.12
6	People have to talk me into trying something new	.19	.27	.08	.16
10	My voice has a flat or monotone sound to it	.13	.24	.19	.17
24	I act very set in my ways	-.14	.22	.13	.08
32	I lose track of my original point when talking to people	.04	-.08	**.50**	.25
29	I leave long pauses in conversation	.17	-.12	**.49**	.29
2	I find it hard to get my words out smoothly	.17	.13	**.40**	.28
14	People ask me to repeat things I've said because they don't understand	.07	.00	**.38**	.16
17	I have been told that I talk too much about certain topics	-.03	.02	**.35**	.12
20	I speak too loudly or softly	-.09	.09	**.34**	.13
4	It's hard for me to avoid getting sidetracked in conversation	-.01	-.01	**.31**	.09
34	I can tell when it is time to change topics in conversation	.20	.04	.23	.13
26	People get frustrated by my unwillingness to bend	.16	.13	.22	.14
21	I can tell when someone is not interested in what I am saying	.12	-.02	.19	.06
3	I am comfortable with unexpected changes in plans	.05	-.09	-.11	.02

Note. Factor loadings > .30 are in boldface.

Three extracted components together account for 26.61% of the total variance. The first factor (12 items, α = .88) accounts for 17.72% of the variance. The second factor (8 items, α = .69) accounts for 5.09%, and the third factor (8 items, α = .64) accounts for 3.79% of the variance. Items 3, 5, 6, 10, 21, 24, 26 and 34 were left out because they do not reach the minimum load level of .30.

Correlations between obtained factors are weak to moderate (Table 2).

Table 2
Correlation between the factors obtained in the factor analysis of 36 items of the BAPQ

Factor	1	2	3
1	1.00	-	-
2	.20	1.00	-
3	.28	.29	1.00

Discussion

The obtained item loadings on three extracted factors in our analysis are generally in accordance with the contents of the BAPQ subscales. All items from Factor I correspond to items which constitute the Aloof subscale in the original version of the BAPQ, with the exception of item 7 which refers to good understanding of interlocutors, and which belongs to the Pragmatic subscale in the original version, while it was placed in Factor I according to the results of our analysis. Sasson et al. (2013) obtained similar results. According to the results of their research, item 7 is distributed in both Aloof and Pragmatic subscales, but with higher loading on the Aloof subscale. Factor II includes all items as factor Rigid obtained by the authors of the scale. The only difference is that items 3, 6, 24 and 26 are left out in our analysis due to low values of factor weight (< .3). Wainer et al. (2011) also left out items 24 and 26, as well as items 19 and 30. Our Factor III consists of 8 items, while the factor Pragmatic in Hurley et al. (2007) includes 12 items. Each of the 8 items which belong to our Factor III correspond to the items from the factor Pragmatic defined by the authors of the scale (Hurley et al., 2007).

Item 7 which according to its content, corresponds to Factor 3, did not reach the load level of .30 on this factor in our analysis. Item 7 is highly loaded on the first factor. With nearly equal loadings, item 11 is distributed both in factor I and factor III. The content of this item refers to pragmatic aspects of speech, which is why we have decided to observe it as an item belonging to the Pragmatic factor. In Sasson et al. (2013), item 11 is distributed in both Pragmatic and Aloof with nearly equal loadings.

Based on the results of factor analysis, and on the presented item analyses, a short version of the BAPQ was devised in this study. The BAPQ short version includes 14 items obtained by eliminating items which belong to Factor I with loadings lower than .65 and communalities lower than .40 and items on factors II and III which had loadings lower than .35 and communalities lower than .20.

Study 2

The aim of Study 2 two was to explore the factor structure of the short version of the BAPQ devised in Study 1.

Method

Sample. In the second study, the sample consisted of 298 students aged between 19 and 24 ($M = 21.28$, $SD = 1.28$). Male participants constituted 14.1% of the sample, and female 85.9%.

Results

By means of *Exploratory factor analysis*, it was determined that most correlation coefficients in correlation matrix have the value over .30, that the value of KMO measure of sampling adequacy is satisfactory .87, and that the result of *Bartlett's spherical test* reaches the level of statistical significance $\chi^2(91)$ = 1419.49, p = .000. *Exploratory factor analysis – Principal axis factoring* with *Oblimin rotation* with fixed number of three factors was performed. Simple structure was obtained. The three factors accounted together for 45.76 % of the total variance. The first factor, which includes items 1, 9, 16, 25, 31, and 36, accounted for 31.50% of the variance (Cronbach's α = .86). The second factor which includes items 2, 11, 29, and 32, accounted for 8.28% of the variance (Cronbach's α = .71). Four items of the third factor: 13, 19, 22 and 30, accounted for 5.99% of the variance (Cronbach's α = .66) Results of the exploratory factor analysis are presented in Table 3.

Table 3
Factor loadings – Results of Exploratory factor analysis – Principal axis factoring with Oblimin rotation of 14 items

Items	Rotated Component Matrix			Communality
	I	II	III	
1(A) I like being around other people	**.87**	-.09	-.04	.69
9(A) I enjoy being in social situations	**.83**	-.04	-.02	.65
36(A) I enjoy chatting with people	**.70**	.02	.03	.52
16(A) I look forward to situations where I can meet new people	**.64**	-.00	.18	.54
25(A) I feel like I am really connecting with other people	**.59**	.15	-.04	.41
31(A) I prefer to be alone rather than with others	**.54**	.19	.06	.44
32(P) I lose track of my original point when talking to people	-.05	**.75**	-.09	.51
29(P) I leave long pauses in conversation	.05	**.59**	.06	.40
2(P) I find it hard to get my words out smoothly	.06	**.53**	.15	.38
11(P) I feel disconnected or ''out of sync'' in conversations with others	.27	**.42**	.05	.36
30(R) I alter my daily routine by trying something different	.14	-.18	**.66**	.47
19(R) I look forward to trying new things	.23	-.04	**.54**	.44
22(R) I have a hard time dealing with changes in my routine	-.13	.09	**.51**	.25
13(R) I feel a strong need for sameness from day to day	.05	.17	**.49**	.35

Note. Factor loadings > .30 are in boldface. A = Aloof; P = Pragmatic; R = Rigid.

Correlations between the extracted factors are presented in Table 4. The obtained moderate intercorrelations (from .29 to .42) are in accordance with theoretical assumptions on the structure of the BAP (Hurley et al., 2007).

Table 4
Correlation between the factors obtained in the factor analysis of 14 items of the BAPQ-SF

Factor	1	2	3
1	1.00	.-	-
2	.33	1.00	-
3	.42	.29	1.00

Table 5 shows the values of reliability and inter-item correlation in three extracted groups of items.

Table 5
Internal consistency reliability of the BAPQ-SF scales

Factors	Number of items	Cronbach alpha Coefficient	Spearman-Brown Coefficient	Guttman Split-Half Coefficient	Inter-item correlation		
					Mid value	Min.	Max.
Aloof	6	.86	.86	.86	.51	.39	.74
Pragmatic	4	.71	.69	.69	.37	.32	.46
Rigid	4	.66	.60	.60	.34	.25	.47
BAPQ-SF total	14	.85	.74	.73	.29	-.01	.74

Discussion

The results of factor analysis confirmed grouping of items in three factors which determine BAP: Aloof, Rigid, and Pragmatic. As the original version, the short version of the BAPQ with 14 items also has solid reliability, when the number of items and criteria in social sciences are taken into account (Cortina, 1993). The employed criteria for the retention of items have proven to be adequate in a sense that the created short form preserved acceptable levels of internal consistency. Also, the percentage of the explained variance is higher compared to the factor analysis presented in Study 1.

Study 3

We conducted Study 3 with the aim to examine psychometric properties, i. e. validity and reliability of the BAPQ short version developed in studies 1 and 2. We sought to establish validity of the questionnaire by testing its construct, convergent, and discriminant validity. To examine the construct validity of the short form of the BAPQ confirmatory factor analysis was performed. We tested the three-factor model consisting of aloofness, pragmatic language deficits, and rigidity, as proposed by developers of the BAPQ.

To establish convergent validity of the BAPQ-SF we examined its correlations with the AQ (Baron-Cohen et al., 2001). AQ is one of the most widely used measures of BAP. It comprises five dimensions: Social skills, Communication, Attention to detail, Attention switching and Imagination. By comparing the

BAPQ and AQ structure it can be seen that they only partially overlap. Social skills, Communication and Attention switching conceptually correspond to the BAPQ subscales of aloofness, rigidity and pragmatic language deficit, respectively. We expected moderate to high correlations between corresponding subscales. On the other hand, we expected low correlations between the BAPQ-SF and Imagination and Attention to detail because these two dimensions are not included in the BAPQ.

To assess discriminant validity of the questionnaire correlation with the Delta 10 (Knežević, Opačić, Kutlešić, & Savić, 2005) was investigated. The Delta 10 is a measure of disintegration, which is conceptualized as a basic personality trait of psychosis proneness. Disintegration encompasses following facets: General Executive Impairment, Perceptual Distortions, Enhanced Awareness, Depression, Paranoia, Mania, Flattened Affect, Somatic Dysregulations, and Magical Thinking. The facets are postulated to stem from disintegration of the information processing systems responsible for reality testing, hence the name of the trait (Knežević et al., 2016). Autism and schizophrenia are distinct, but partially overlapping phenomena (e.g., Chisholm, Lin, Abu-Akel, & Wood, 2015). Likewise, autistic traits are correlated with various indicators of psychosis proneness in general population (Claridge & McDonald, 2009; Hurst et al., 2007; Russell-Smith, Bayliss, & Maybery, 2013; Russell-Smith, Maybery, & Bayliss, 2011). Given these findings, we expected the BAPQ-SF and the Delta 10 to show low to moderate correlation as an evidence of discriminant validity.

Method

Sample. Questionnaires were administered to a sample of 294 students aged 19 to 26 years (M = 21.16, SD = 1.46). Male students comprised 43.2%, and female students 56.8% of the sample.

Instruments. The BAPQ short form, AQ (Baron-Cohen et al., 2001) and the Delta 10 (Knežević et al., 2005) were used in Study 3.

AQ (Baron-Cohen et al., 2001). The questionnaire consists of 50 items. Subjects rate to what extent they agree or disagree with the statements on a 4-point Likert scale. The item scores are summed to obtain total score and scores for subscales corresponding to dimensions of the questionnaire. Total scale Cronbach's α = .68.

The Delta 10 (Knežević, Opačić, Kutlešić, & Savić, 2005). The questionnaire measures personality trait of disintegration.The short version of the questionnaire consisting of 20 items was used. Respondents rate the degree in which each statement refers to them on a 5-point Likert scale (Cronbach's α = .93). The total score is obtained by averaging responses on all items. A higher total score indicates a higher level of disintegration.

Results

Correlations between the BAPQ-SF, the AQ, and the Delta 10 are presented in Table 6. As can be seen, the BAPQ-SF total score and its subscale scores show moderate to high positive correlations with the AQ total score and its subscales, with the exception of the attention to detail and imagination subscales of the AQ which are weakly or statistically insignificantly related to the BAPQ-SF scales. The BAPQ-SF total score is moderately positively related to the Delta. At the subscales level, Pragmatic subscale exhibits moderate, and Aloof and Rigid subscales exhibit weak correlations with the Delta.

Table 6

Correlations between the BAPQ-SF, the AQ and the Delta 10 (Pearson coefficient of linear correlation)

| | AQ | | | | | | |
	Social skills	Attention switching	Attention to detail	Communication	Imagination	AQ total	Delta
Aloof	.59**	.33**	.09	.43**	.12*	.53**	.29**
Pragmatic	.41**	.42**	.07	.58**	.03	.51**	.50**
Rigid	.37**	.49**	.10	.37**	.12*	.49**	.31**
BAPQ-SF total	.60**	.50**	.11	.57**	.12*	.65**	.44**

Note. p < .05*, p < .01**.

Confirmatory factor analysis was performed using IBM AMOS, version 24. Prior to CFA, data were screened for multivariate normality, outliers and missing data. There were no missing data or outliers, and Mardia's coefficient of multivariate kurtosis suggested no departure from normality. Model specifications included correlated factors, uncorrelated error variances, and the variance of one item on each factor fixed to one. Upon inspection of fit indices, a correlation between error terms between two items was allowed. Maximum likelihood estimation was employed. The path diagram of the model with allowed error term correlation, showing standardized regression weights and correlations between factors is presented in Figure 1.
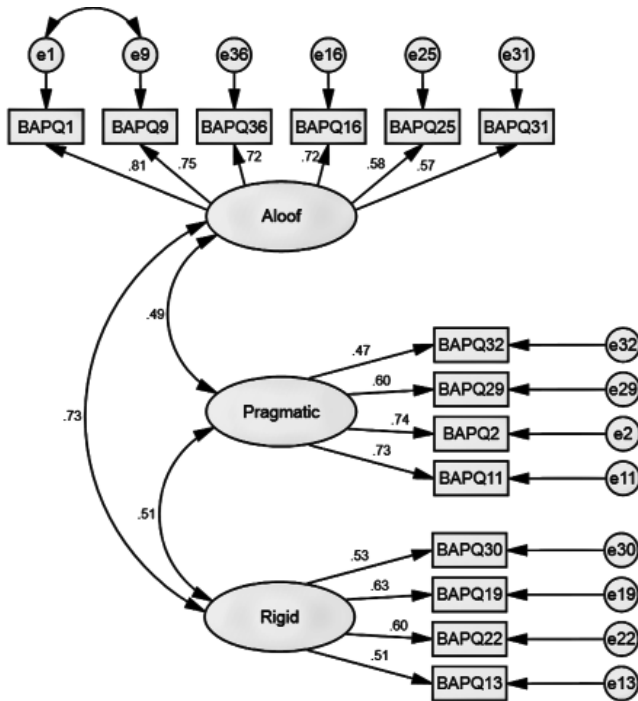

Figure 1. The path diagram for confirmatory factor analysis of the BAPQ-SF.

It is generally recommended to use several fit indices when assessing the model fit. We used the following indices: χ^2, the Comparative Fit Index (CFI), the Tucker-Lewis Fit Index (TLI), the Standardized Root Mean Square Residual (SRMR), and the Root Mean Square Error of Approximation (RMSEA). We have followed the recommendations by Hair Black, Babin, & Anderson (2010) who determine cut-off values of fit indices depending on the number of observed variables and on the sample size. For our analysis, significant chi-square is expected and does not imply rejection of the model, given the relatively large sample size. Criteria for goodness-of-fit to be applied in the analysis, according to Hair et al. (2010), are as follows: CFI or TLI > .92, SRMR = .08 or less, RMSEA < .07. At first, the obtained fit indices suggested that the model did not adequately fit the observed data (χ^2 = 190.29, p = .000, CFI = .91, TLI = .89, SRMR = .06, RMSEA = .073). Upon inspection of the modification indices, a correlation between error terms of two items of Aloof subscale was added to the model, which resulted in adequate model fit with the following values of fit indices: χ^2 = 166.09, p = .000, CFI = .93, TLI = .92, SRMR = .06, RMSEA = .066. The allowed error term correlation is justified because the meaning of the two items is practically identical, which is not the case with other items in Aloof subscale. Cronbach's α coefficients of internal consistency obtained in this study were as follows: .85 for the BAPQ-SF total, .85 for Aloof, .72 for Pragmatic, and .66 for Rigid.

General Discussion

The results obtained in three studies support validity of the BAPQ short form as a measure of the theoretical concept of the BAP (Bishop et al., 2004; Bolton et al., 1998; Piven et al., 1997).

Factor Aloof corresponds to the theoretical concept of social isolation. Social aloofness is present in general population among persons with more prominent autistic characteristics, and is characterized by difficulties in establishing social contacts and making friends. Social aloofness is characterized by lack of interest in social interactions, withdrawal in making contacts, and "keeping aloof" (Gerdts & Bernier, 2011). Items with high loadings on factor Rigid can be related to resistance to change, as well as to an individual's decreased flexible reaction ability. Rigidity, preservation, difficulty in initiating new activities, tendency to routines and rituals are common characteristics of persons who belong to autism spectrum and broad autism phenotype (Hill & Frith, 2003; Losh, Childress, Lam, & Piven, 2008). Factor Pragmatic consists of items which refer to pragmatic deficits in communication in a social context. By analyzing the content of items, we can assume that it includes intonation, basic voice loudness, focusing on the conversation topic, changing the topic according to interlocutor's expectations, and efficiency in conveying a message, which all together represent respecting conversation rules in the process of communication.

Moderate to high correlations between the BAPQ short form and the AQ total scores and between corresponding subscales support convergent validity of the instrument. Correlations of the similar size between the BAPQ and the AQ total scores were obtained by other authors (Ingersoll et al., 2011; Nishiyama et al., 2014). Low to moderate correlations between the BAPQ-SF and its subscales and the Delta 10 obtained in this study are in line with the results of previous studies on the relationship between autistic traits as measured by the AQ and psychosis proneness (Claridge & McDonald, 2009; Hurst et al., 2007; Russell-Smith et al., 2013; Russell-Smith et al., 2011). This provides evidence for discriminant validity of the BAPQ-SF. Russell-Smith et al. (2013) point out that further research is needed to investigate the degree in which the observed correlations stem from actual overlap between autistic tendencies and schizotypy or reflect insufficient specificity of the instruments. Our findings that Pragmatic subscale is more strongly related to Disintegration ($r = .50$), than Aloof and Rigid subscales ($r = .31$ for both subscales) suggest that pragmatic language deficiencies represent an important area of intersection of the two phenomena or their operationalizations.

Our results provide evidence for construct validity of the BAPQ-SF. Confirmatory factor analysis results suggest that the structure of the scale corresponds to the three-factor structure of the original scale, with items in the short form loading on the same factors as in the original scale. The questionnaire and its subscales exhibit good to acceptable reliability as measured by internal consistency. Advantages of the short form of the BAPQ over the original scale, that stem from smaller number of items which require less time to respond, are the following: greater probability that a potential respondent will decide to participate, experiences of fatigue and boredom due to repetition of similar items are less likely to occur and to have an impact on respondents' answers (Konstabel et al., 2012; Robins et al., 2001). The short form of the instrument may be especially suitable for research encompassing a multitude of variables. On the other hand, potential limitations of the BAPQ short form should be noted. It could be less sensitive and less precise than the original form in the identification of persons who exhibit significant levels of the BAP. However, as it may be used primarily for the efficient screening, accompanied, when needed, by subsequent more detailed analyses using the BAPQ original form or similar instruments, these shortcomings may be overcome.

Limitations

There is limitation related to the use of a convenience sample of university students, which probably led to the reduction of results variability and limited the possibilities of their generalization. Further limitations of the research are non-balanced gender structure of the sample, and the lack of information on presence of autistic spectrum disorders or schizophrenia spectrum disorders in participants' families which could provide further important insights.

Conclusion

By eliminating items with low load level on particular factors, we obtained a short version of the BAPQ which has three factors corresponding to subscales Aloof, Rigid and Pragmatic. Reduction of the BAPQ scale to 14 items enables time efficient application by diminishing response burden. This may be especially suitable for studies in which multiple constructs are measured. All items included in the short version of the BAPQ are distributed in the subscales in accordance with the solution provided by the authors of the original instrument, and correspond to the theoretical concept of BAP.

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Konstrukcija i psihometrijska evaluacija kratke forme Upitnika šireg autističkog fenotipa

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Širi autistički fenotip (eng. *Broad Autism Phenotype – BAP*) predstavlja grupu crta ličnosti koje se manifestuju u vidu ograničenja u socijalnim odnosima, na dimenziji pragmatičnog govora i u rigidnom ponašanju. Upitnik šireg autističkog fenotipa (*The Broad Autism Phenotype Questionnaire – BAPQ*) meri crte ličnosti koje su ključne u definisanju šireg autističkog fenotipa. U ovom istraživanju su sprovedene tri studije sa opštim ciljem da se napravi kratka forma BAPQ. Prva studija je sprovedena da bi se utvrdila faktorska struktura upitnika na uzorku od 501 studenta i da se izaberu ajtemi za kratku formu. Dobijene su komponente Povučenost, Rigidnost i Pragmatika. Ove komponente odgovaraju strukturi instrumenta koju su predložili autori i objašanjavaju 26.61% varijanse. Druga studija je sprovedena da bi se ispitala faktorska struktura kratke forme BAPQ (BAPQ-SF) na uzorku od 298 studenata. Ovo rešenje objašnjava 45.76% ukupne varijanse. Cilj treće studije bio je da se utvrde psihometrijske karakteristike BAPQ-SF na uzorku studenata (*N* = 294). Potvrđena je trofaktorska struktura upitnika. Korelacije mera BAPQ-SF sa količnikom autističkog spektra (AQ) i Delta 10 merama govore u prilog konvergentne i diskriminativne validnosti upitnika.

Ključne reči: poremećaj autističkog spektra, Upitnik šireg autističkog fenotipa, konfirmatorna faktorska analiza