CROSS-CULTURAL VALIDATION OF THE FIVE-FACTOR STRUCTURE OF NEGATIVE SYMPTOMS IN SCHIZOPHRENIA

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Abstract

Objective: Negative symptoms are currently viewed as having a two-dimensional structure, with factors reflecting diminished expression (EXP) and motivation and pleasure (MAP). However, several factor-analytic studies suggest that the consensus around a two-dimensional model is premature. The current study investigated and cross-culturally validated the factorial structure of BNSS-rated negative symptoms across a range of cultures and languages.

Method: Participants included individuals diagnosed with a psychotic disorder who had been rated on the Brief Negative Symptom Scale (BNSS) from five cross-cultural samples, with a total N = 1,691. First, exploratory factor analysis was used to extract up to six factors from the data. Next, confirmatory factor analysis evaluated the fit of five models: 1) a one-factor model, 2) a two-factor model with factors of MAP and EXP, 3) a three-factor model with inner world, external, and alogia factors; 4) a five-factor model with separate factors for blunted affect, alogia, anhedonia, avolition, and asociality, and 5) a hierarchical model with two second-order factors reflecting EXP and MAP, as well as five first-order factors reflecting the five aforementioned domains.

Results: Models with four factors or less were mediocre fits to the data. The five-factor, six-factor, and the hierarchical 2nd-order five-factor models provided excellent fit with an edge to the five-factor model. The five-factor structure demonstrated invariance across study samples.

Conclusions: Findings support the validity of the five-factor structure of BNSS-rated negative symptoms across diverse cultures and languages. These findings have important implications for the diagnosis, assessment, and treatment of negative symptoms.

Keywords: Negative symptoms; five factors; anhedonia; avolition; asociality; alogia; blunted affect; Brief Negative Symptoms Scale (BNSS); confirmatory factor analysis; exploratory factor analysis

Introduction

Early factor-analytic studies indicated that negative symptoms are a domain of psychopathology that is distinct from psychosis and disorganization in individuals with schizophrenia.[1-3] These studies relied on *broad-bandwidth* rating scales such as the full Positive and Negative Syndrome Scale (PANSS) and the Brief Psychiatric Rating Scale (BPRS) that assess negative symptoms along with other symptoms of schizophrenia. However, the use of broad-bandwidth measures to adjudge the factor structure of negative symptoms is flawed because covariance patterns in the symptom data cause negative symptom items to aggregate together, making the construct arbitrarily unidimensional.

Factor analyses evaluating the structure of negative symptoms with *narrow-bandwidth* scales—that is, measures of negative symptoms alone, with no items included from other constructs—suggest that the structure of negative symptoms is multidimensional.[4] A two-factor solution has commonly been reported for a range of narrow-bandwidth measures, including the Scale for the Assessment of Negative Symptoms (SANS), Schedule for the Deficit Syndrome (SDS), Brief Negative Symptom Scale (BNSS), Clinical Assessment Interview for Negative Symptoms (CAINS), and negative symptom items of the PANSS.[5-15] The two dimensions reflect: 1) diminished expressivity (EXP), consisting of alogia and blunted affect items, and 2) motivation and pleasure (MAP), consisting of avolition, asociality, and anhedonia.[5-12] These findings have led the field to widely accept the two-dimensional structure of negative symptoms.[4] This two-dimensional model has been very influential, impacting important decisions, such as how negative symptoms are described in the DSM-5, how treatment targets are defined, how scales are scored for statistical analysis, and how studies search for pathophysiological mechanisms.[13]

However, the two-dimensional conceptualization of negative symptoms may be statistically or theoretically insufficient. Support for the two-dimensional structure comes from studies using exploratory factor analysis (EFA), a data reduction method that infers the presence of latent factors responsible for shared variance among items in a scale.[14-15] EFA is limited in that it does not specify an underlying structure of negative symptoms, but rather assumes that each item in a scale could be related to each underlying latent factor.[15] Prior EFA studies were important for generating hypothesis about dimensions in negative symptoms. They are not, however, actual tests of the validity of a two-factor structure and their exploratory nature does not allow direct assessment of their factorial validity relative to competing factor models of negative symptoms.[13] Moreover, Garcia-Portilla and colleagues[16] using EFA concluded that a three-factor structure that distinguished inner-world experiences (i.e., avolition and blunted affect) from external features (anhedonia and asociality), and alogia was preferable to a two-factor model. The three-factor model has yet to be replicated, but it shows that the consensus that two factors best describe the multidimensionality of negative symptoms is premature.

Confirmatory factor analysis (CFA) is required to test competing models and evaluate the dimensional structure of BNSS-rated negative symptoms. Published CFA studies have examined the SANS, and were problematic because they included items not part of the negative symptom construct, which limits conclusions that can be drawn.[17-18] Axelrod and colleagues[19-20] conducted two early CFA studies of negative symptoms measured with the Negative Symptom Assessment (NSA). In the first study of a 26-item NSA, they found that a multidimensional model that included communication, emotion/affect, social involvement, motivation, retardation, and gross cognition as six separable factors best described negative symptoms. In the second study, they used a 16-item version of the measure which now excluded items that originally loaded onto the "gross cognition" factor. The authors replicated five of the original factors-- communication, emotion/affect, social involvement, motivation, and retardation. The statistical fit indices

obtained in both studies favored their chosen five or six-factor models over one- to four-factor solutions. Their chosen models however proved to be mediocre fits to the data based on statistical fit indices. Further, both 26 and 16-item versions of the NSA did not include items that assess anhedonia.

The 2005 NIMH-MATRICS consensus conference on negative symptoms sought to establish the scope of negative symptoms in order to foster the development of evidence-based measures and treatments for negative symptoms.[21] The conference identified affective flattening, alogia, asociality, avolition, and anhedonia as domains of negative symptoms. These domains subsequently informed the content coverage of the BNSS and the CAINS. Strauss et al.[22] conducted CFA of three current negative symptoms scales, the BNSS (n=192), CAINS (n=400), and SANS (n=268). Four competing models were evaluated. The first model was unidimensional and evaluated whether all items best reflect a single latent negative symptom construct. The second model evaluated the two dimensions identified in prior EFA studies[7,11-13], reflecting EXP and MAP factors. The third model was a five-factor model, which specified one factor for each of the five domains identified in the 2005 NIMH consensus development conference on negative symptoms: anhedonia, avolition, asociality, alogia, blunted affect.[21] The fourth model was a hierarchical five-factor model. It specified two second-order factors reflecting EXP and MAP, as well as five first-order factors reflecting the five consensus domains. First-order factors represented anhedonia, avolition, and asociality, which were specified to load on the MAP second-order factor; and blunted affect and alogia first-order factors were specified to load on the EXP second-order factor. The results were consistent across all three of these scales. The one- and two-factor models provided poor fit for the data. The five-factor and hierarchical models provided excellent fit, with the five-factor model slightly outperforming the hierarchical model and being most parsimonious. These findings suggest that the recent trend toward conceptualizing negative symptoms in relation to the MAP and EXP does not capture the complexity of negative symptoms, which is best represented by the five NIMH consensus domains.

The current study attempted to determine the correct factorial structure of BNSS-rated negative symptoms using data obtained across a range of cultures and languages. We took both an empirical exploratory (EFA) and a model-based (CFA) approach to determining the correct factor structure. A model-based approach allowed 1) a comparison of the NIMH consensus five-factor model with alternate models including—the unidimensional/one-factor model, MAP/EXP two-factor, Garcia-Portilla et al.'s three-factor model, and the hierarchical five-factor model; and 2) testing the cross-cultural measurement invariance of the correct factor structure using data from five samples including N=1,691 participants from Italy, Spain, China, Switzerland, and the United States. The EFA extracting one to six factors from the data allowed us to 1) examine the relative viability of several factor models (e.g., four-factor and six-factor models) in the absence of guiding theory or *apriori* evidence; 2) determine if CFA and EFA converge to support the same factor structure; 3) assess if the preferential loading of BNSS items supports existing models; and 4) in the absence of guiding theory determine the loading preference of Item4 "Lack of Normal Distress" in fitted factor models. Although not adjudged as a negative symptom in the 2005 NIMH-MATRICS conference, Item4 "Lack of Normal Distress" was included in the BNSS because of its association with reduced emotional expression and deficit symptoms. In previous factor analytic studies, the item loads with BNSS factors albeit with lower saturation than other items.[23] EFA was used to adjudicate the correct factor location of this item in the BNSS. It was predicted that EFA and CFA will demonstrate preference for a five-factor model of BNSS-rated negative symptoms over alternate models. In concert with Strauss et al.[22], the five-factor and hierarchical models were expected to provide excellent fit to the data, with the five-

factor model producing the best fit. It was further predicted that the preferred factor structure would be cross-culturally invariant and produce strong fits in multinational cross-validation samples.

Method

Participants

The datasets used to investigate the factorial structure of negative symptoms in the current study were drawn from several international investigations of the psychometric properties of the BNSS and its clinical utility. These included samples obtained from collaborations in Italy (n=937), Spain (n=115), China (n=163), and Switzerland (n=119) that used versions of the BNSS formally translated into Italian, Spanish, Chinese (simplified script), and German respectively.[24-27] The study also included a USA-based sample (n=357) obtained with the original English version.[11] Additional sample details are provided in the Supplement. **Table 1** summarizes the demographic characteristics and clinical composition of the study samples. Participants from Italy, Spain, and the United States were evaluated to ensure that they met Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) criteria for schizophrenia or schizoaffective disorder using the Structured Clinical Interview for DSM-IV (SCID). Swiss participants were adjudged as meeting DSM diagnostic criteria using the Mini-International Neuropsychiatric Interview (MINI). Participants from China were assessed with the International Classification of Diseases and Related Health Problems, Tenth Revision (ICD-10) criteria.

Procedures

Each study administered the BNSS as part of broader research aims to illuminate the phenomenology and treatment of negative symptoms. Given that investigators in Italy, Spain, Switzerland, and China administered translated versions of the BNSS, a standard method of translation served to ensure the equivalence of the translated versions to the original English version. First, the BNSS was forward translated to the target language. Next, the translated version was independently back-translated and forwarded to the scale authors (BK and GS), who worked with the translators to reconcile the translation with the original English version.

The inter-rater reliability of the BNSS was established at each site through the use of gold-standard training videos and ratings of face-to-face interviews completed by the BNSS authors. All raters completed BNSS training using standardized training materials and received feedback from completing ratings on gold-standard videos. Raters in each study had at minimum, bachelors-level training and/or extensive experience completing psychiatric interviews. BNSS raters in each parent study met minimum standards of inter-rater reliability with intraclass correlation coefficients that exceed 0.90 (**Table 1**).

Data Analysis

The overall analytic strategy was to establish the factor structure of BNSS-rated negative symptoms in a calibration sample and then cross-validate the established factor structure across languages and cultures. Rather than test all factor models in every study sample, the decision was made to first estimate alternate factor models in a calibration sample and then cross-validate best fit models in order to: 1) decrease the number of separate factor models that would need to be estimated; and 2) decrease the likelihood that models with apparent fit in one sample but had

capitalized on chance (Type I error) are interpreted. The calibration sample included 566 cases (60.4%) drawn randomly from the largest study sample, the Italian dataset. The remaining 371 cases in the Italian dataset were designated as one of the five cross-validation samples; therefore, each language and data source served in the cross-validation of the preferred factor structure.

To examine the fits of evaluated models, BNSS ratings were factor analyzed with model estimation methods that are robust to distributional non-normality in BNSS ratings. EFA models ranging from one to six classes were estimated first excluding and then including Item 4 "Lack of Normal Distress" to identify the item's preferred factor location. EFAs were completed with the oblique Quartimin rotation. Unlike previous EFA studies, the preferred factor structure was adjudged by examining pattern loadings and objective fit indices (discussed below). Next, CFA was used to test competing hypotheses about the factor structure of negative symptoms. Five models estimated included a unidimensional/one-factor, MAP/EXP two-factor, Garcia-Portilla et al.'s three-factor, the NIMH consensus five-factor, and the hierarchical five-factor models. Items included on each factor within the five models are presented in **Table 2**. The estimators were the weighted least squared estimator with standard errors and mean-and variance adjusted chi-square test that use a full-weight matrix (WLSMV), and the maximum likelihood with robust standard errors (MLR). All model estimations were carried out in M*plus* Version 5.0.[28] Model modification indices were obtained to assess and evaluate all fixed parameters (e.g., specified loading patterns) to determine which fixed parameters if freely estimated would have improved the model being evaluated. By convention, modification indices are used jointly with theory to guide attempts to re-specify poor fitting models.

Several indices served to evaluate the *goodness-of-fit* of estimated factor models. The chi-square (χ^2) test evaluates the degree to which the hypothesized factor structure fits data[29]; however, it is sensitive to large sample sizes that may cause the rejection of well-fitting models. The root-mean-square error of approximation (RMSEA)[30] measures the discrepancy between the hypothesized factor model and the population covariance matrix when the model has unknown but optimally-chosen parameter values. RMSEA values of .08 and lower are considered adequate fit and values .05 and lower indicate excellent fits[31]; however, the RMSEA is sensitive to model complexity and smaller sample sizes may cause RMSEA to over-reject true population models.[29] The Comparative Fit Index (CFI) and the Tucker Lewis Index (TLI) are incremental fit indices that compare the hypothesized factor model with the less restricted nested baseline model.[32-33] The TLI however penalizes overly complex models. CFI and TLI values of .95 and higher are considered indicative of strong fitting models.[29] The information criteria indices including Akaike Information Criteria (AIC), Bayesian Information Criteria (BIC) and the sample-size adjusted BIC (aBIC) are used for comparing non-nested models.[34-35] Information criteria consider the chi-square and the model complexity in penalizing models and therefore favor parsimonious models. Models with lower information criteria are preferred. The Standardized Root Mean Squared Residual (SRMR) and the Weighted Root Mean Squared Residual (WRMR) are residual-based indices based on the difference of the variance-covariance matrix of the hypothesized model and that of the observed sample data.[28,29] Both measure the average difference across all standardized residuals but WRMR uses a variance—weighted approach.[28-29,36] SRMR values range from 0 to 1 with values of 0.08 or lower indicative of good fitting models. WRMR values of about 1.00 and lower are considered strong fits.

Multi-group CFA was used to assess the measurement invariance of the BNSS-preferred factor structure across the multi-national samples. This comprised tests of configural, metric, scalar, and residual invariance that are conducted sequentially.[37-38] Configural invariance requires that items load on the same factor across subsamples. Metric invariance requires that

factor loadings be equivalent across the multi-national samples. Scalar invariance requires that both factor loadings and intercepts are equivalent across study samples. Residual factorial invariance adds an additional constraint requiring that residual variances are equal across samples. Changes in chi-square (χ^2diff), CFI, TLI, and RMSEA estimates as constraints were imposed on the model were used to evaluate the invariance models. CFI change has the most empirical support and values not exceeding 0.01 provide evidence that constraints imposed on model are tenable.[37-39]

Results

The study aims were addressed in three stages. First, EFA was used to extract up to six factors from the BNSS using the calibration sample. Two sets of EFAs were completed at this stage—BNSS ratings first excluding, and then including Item4 "Lack of Normal Distress." Next, model-based CFAs were used to compare the relative fits of the one-, two-, three-, five-factor, and hierarchical models in the calibration sample. The favored factor models were tested in each of the five cross-validation samples. Finally, measurement invariance of the preferred factor structure across study samples was sequentially evaluated for metric, scalar, and residual invariance.

Table 1 summarizes the characteristics of the study samples. Cronbach's alpha exceeded 0.90 in every study sample, suggesting that raters were able to reliable assess negative symptoms with the BNSS regardless of the language of administration or participants' country of origin. Save for one participant in the Italian sample who was subsequently excluded from the analysis due to missing data, complete ratings were obtained for all BNSS items in all of the study samples. The variability in BNSS total score across samples likely reflects the illness acuity of participants recruited in the particular parent study.

EFA of the BNSS Calibration Sample

The results of EFA runs in the calibration sample are summarized in **Table 3**. Although CFI and TLI estimates were acceptable for one through four-factor models, high RMSEA estimates suggested that these were mediocre fits to the data. With or without Item4, the EFA five-factor and six-factor models were strong fits to the data with CFI, TLI, RMSEA, and SRMR that fell in the excellent-fit range. Without Item4, the AIC and other information criteria favored a five-factor model over the six-factor model. Moreover, the six-factor solution produced two factors with single items.

With Item4 included in the model, the information criteria slightly preferred the six-factor solution. Subsequent examination of the matrix of rotated loadings of the six-factor solution showed that all BNSS items including Item4 weakly loaded on the sixth factor with all loading coefficients less than an absolute value of 0.11. This suggests that a sixth factor contributes little to explaining the pattern of covariances of BNSS items and the six-factor solution should be rejected in favor of the more parsimonious five-factor model.

The rotated five-factor matrices for all factor solutions are presented in **Supplemental Tables S1-S12**. Item4 cross-loaded onto two BNSS factors—Anhedonia and Asociality.

CFA of the BNSS-Rated Negative Symptoms in the Calibration Sample

The results of the CFAs conducted in the calibration sample are summarized in **Table 4**. All CFA models excluded Item4 given that it was not a recognized negative symptom in the NIMH-MATRICS conference. The one-factor, two-factor, and the three-factor models proved to be mediocre fits to the data. The one-factor models were a poor fit due to mediocre CFI, RMSEA, and WRMR values. Although the CFI and the TLI for the two-factor and three-factor

models exceeded the .95 threshold, both were poor fits to the data based on high RMSEA and WRMR values.

The five-factor and the hierarchical models produced CFI and TLI values that suggest strong fit to the data. The RMSEA values for both factor models just fell under the .08 threshold, suggesting adequate fits to the data. Both the five-factor and hierarchical models also produced WRMR estimates that fell below 1.00, suggesting strong fits to the data.

The AIC and other information criteria favored the five-factor model and the hierarchical model over the one-, two-, and three-factor models. The information criteria slightly favored the five-factor model over the hierarchical model.

Cross-Validation in Multi-National Samples

Given their strong performance in the calibration sample, we tested both the five-factor and hierarchical models in cross-validation samples. **Table 4** summarizes the results of cross-validating the BNSS five-factor and the hierarchical models. Both factor models proved to be strong fits to the data based on CFI and TLI estimates that far exceeded the 0.95 threshold in each sample. Across samples, the RMSEAs frequently fell below the .08 threshold that would suggest an adequate fit. The exceptions were the five-factor models in the Chinese and American sample and the hierarchical model in the Chinese sample. Like the CFI and TLI however, the WRMR suggested strong fits for both models in all samples.

The AIC and other information criteria produced values that were lower for the five-factor model than the hierarchical model in all of the samples. This suggests that although both the five-factor and hierarchical models are cross-culturally valid, the five-factor model is slightly stronger. Supplemental Table S13 includes internal consistency estimates of the five factors for each of the study samples.

Assessment of Measurement Invariance across Samples

We conducted tests of factorial invariance among the five multinational samples using the five-factor model. The analysis was completed on the full study sample. Due to the unequal group sizes, which may bias estimates in favor of the larger Italian and USA-based samples, the analysis was also completed in a subsample of 575 individuals with 115 individuals from each subsample. To this end, 115 individuals were randomly drawn from the Italian, Chinese, Swiss, and American samples, whereas the entire Spanish sample was included. The results were not remarkably different. **Table 5** summarizes all the fit indices of the measurement invariance model. Fit values from the configural model showed that the five-factor model held across all samples with CFI and TLI that exceed 0.99 and RMSEA falling below the 0.08 threshold. Metric invariance (equivalence of factor loadings) was similarly supported with CFI and TLI that exceed 0.99 and RMSEA close to 0.08. Scalar (equivalence of factor loading and intercepts) and residual (equivalence of loadings, intercepts, and factor residual variances) invariance was supported by high CFI and TLI values that decreased by less than 0.01 from the configural and metric models. The RMSEA value suggested a slight loss of absolute model fit however when assumptions of scalar invariance are violated. Using modification indices, it was determined that Item2 in the Italian sample had a higher intercept than in the other samples. When Item2 was freely estimated in the multigroup CFA, the RMSEA for scalar invariance model improves (CFI=0.989, TLI=0.998, RMSEA=.082). This suggests that Italian participants (all outpatients) tended to be rated as more impaired on Item2 “Frequency of Pleasurable Activities” compared to participants in other samples, particularly the Chinese sample (inpatients/outpatients).

Discussion

CFA was used to investigate latent dimensions in BNSS-rated negative symptoms. BNSS data was analyzed from five samples of different cultures and languages to determine the BNSS factorial structure. In both EFA and CFA runs, the five-factor model proved to be the preferred structure of BNSS-rated negative symptoms. The hierarchical 2nd-order five-factor model also provided excellent fit, similarly supporting its factorial validity. Although a two-factor model consistent with the MAP and EXP dimensions emerged from the EFA, this was rejected on the basis of its poor objective fit to the data. Previous studies erroneously accepted this solution for its parsimony and logic in the absence of objective fit indices. Evidence of factorial invariance across multinational samples indicated that the five-factor loading pattern holds cross-culturally and can be studied across translations. The current study extends evidence of the five-factor model of negative symptoms across five cultures and languages using translated or original English versions of the BNSS.

There are several important implications for these findings. First, the five-factor structure is not culturally-bound. This suggests that these five domains reflect core processes inherent to the diagnosis that are not dependent on language or cultural influences. Second, these results also demonstrate that not only are early views of negative symptoms as a single construct inaccurate, but the current trend toward viewing negative symptoms as a two-dimensional construct is also not fully justified. Rather, negative symptoms are best conceptualized in relation to the five negative symptom domains identified in the 2005 NIMH consensus conference: anhedonia, avolition, asociality, alogia, and blunted affect.[21] The two-dimensional conceptualization has had an important, but statistically unjustified influence on the field. For example, the DSM-5 describes negative symptoms in relation to the broad MAP and EXP dimensions, rather than the five consensus domains. This procedure may lead to underspecified diagnoses that do not capture the granularity of the construct. Future versions of the DSM may need to list and define each domain separately. Failure to do so will probably hamper efforts to identify the psychological and pathophysiological mechanisms of each domain. Treatments may also have differential efficacy for these five domains, and failing to evaluate the five domains separately may prevent observation of meaningful treatment effects that are domain-specific, rather than tied to the two broader dimensions. Treatment development efforts will be advanced by pharmacological and psychological treatments targeted to specific factors. Clinical trials testing such treatments should specify which of the five factors represent the primary target(s)/outcome(s).

The NIMH RDoC initiative provides a framework for exploring neurobiological processes associated with aspects of "positive valence systems" and "social processes" that map onto these five clinical domains.[40-41] Some of these pathophysiological processes may be broadly related to the MAP and EXP dimensions, whereas others may be tied to one of the five domains more specifically. Future investigations are needed to explore pathophysiology tied to each domain to promote targeted treatment development. Such trials should focus on one of the domains specifically. It is possible that trials already conducted have observed treatment effects, but these were masked by procedures for calculating overly broad scores. Reanalysis of large past studies with appropriate instruments may be warranted, and interpretation of future treatment trials would be strengthened by calculating scores for each of the five domains, rather than a global total score, or MAP and EXP dimensional scores, alone.

Strauss et al.[22] demonstrated that other measures besides the BNSS—the SANS and the CAINS—similarly captured the five domains. Developers of future negative symptom scales should endeavor to generate candidate items that capture each of these five domains. This will support a more focused creation of items for initial review and psychometric testing. It will also

ensure that rating scales are brief yet comprehensive in their coverage of negative symptoms. The factorial validity of the hierarchical model also has implications for scale development. The MAP and EXP 2nd-order factors represent higher-order broad dimensions that subsume the lower-order, narrow five domains. Measures like the BNSS and the CAINS that capture both narrow and broader facets of negative symptoms are potentially more comprehensive in their scope and maintain the relative advantages of capturing both broad and narrow facets of negative symptoms. Such measures have potentially better reliability and fidelity given that more items assess the broader, higher-order dimensions, and the narrow bandwidth domains within broad dimensions are inter-correlated.[42] These measures also maintain the relative advantage of narrow bandwidth assessments including: 1) severity ratings and differences on specific domains are captured; 2) the specific effects of narrow-band domains within broader dimensions on external variables can be captured when the same effects may be attenuated in broader dimensions; and 3) better interpretability when specific narrow facets are linked to external variables.[42-43]

The use of a multinational sample to cross-validate the five-factor and hierarchical five-factor models lends strong credence to conclusions about the factorial structure of negative symptoms. The results suggest that the five-factor model is unbounded by culture, language, or setting. It represents rather a structure of negative symptoms that is pervasive, universal, and likely linked to distinct psychological and/or pathophysiological processes found across cultures. The strong cross-validation results provide additional evidence of the excellent psychometric characteristics of the translated versions of the measure. Practically, these findings suggest that the five factors are domains that exist globally and are assessable in different languages with good reliability and validity. Observed differences in the intercepts of Item2 is informative rather than prohibitive of the use of the BNSS cross-culturally. It may suggest that cultural norms impact the definition of "normal" versus "impaired" in adjudging the frequency of pleasurable activities. Sociocultural and contextual factors have been shown to influence the expression and clinical trajectory of schizophrenia symptoms.[44-47] It is therefore possible that the frequency of pleasurable activities exhibits cultural and contextual variation that warrants further study.

The current study did not evaluate the measurement invariance of the five-factor model across other sources of symptom heterogeneity such as sex, diagnosis, and illness stage. These were adjudged as worthwhile for further validation of the five-factor model but beyond the scope of the current study. In addition, the study did not examine the five factors in relation to the origin or form of negative symptoms.[48-49] A next step is to determine if the five-factor model is valid regardless of sex, negative symptom type, illness stage, or illness severity. Any determination of equivalence or non-equivalence of the five domains would be informative about the phenomenology of negative symptoms.

References

1. Andreasen N, Arndt S, Del Miller D, et al: Correlational studies of the Scale for the Assessment of Negative Symptoms and the Scale for the Assessment of Positive Symptoms: an overview and update. Psychopathology 1995; 28:7-17

2. Arndt S, Alliger R, Andreasen N: The distinction of positive and negative symptoms. The failure of a two-dimensional model. Br J Psychiatry 1991; 158:317-322

3. Grube B, Bilder R, Goldman R: Meta-analysis of symptom factors in schizophrenia. Schizophr Res 1998; 31:113-120

4. Blanchard J, Cohen A: The structure of negative symptoms within schizophrenia: implications for assessment. Schizophr Bull 2005; 32:238-245

5. Kelley M, van Kammen D, Allen D: Empirical validation of primary negative symptoms: independence from effects of medication and psychosis. Am J Psychiatry 1999; 156:406-411

6. Kimhy D, Yale S, Goetz R, et al: The factorial structure of the Schedule for the Deficit Syndrome in schizophrenia. Schizophr Bull 2005; 32:274-278

7. Nakaya M, Ohmori K: A two-factor structure for the Schedule for the Deficit Syndrome in schizophrenia. Psychiatry Res 2008; 158:256-259

8. Strauss G, Horan W, Kirkpatrick B, et al: Deconstructing negative symptoms of schizophrenia: avolition–apathy and diminished expression clusters predict clinical presentation and functional outcome. J Psychiatr Res 2013; 47:783-790

9. Horan W, Kring A, Gur R, et al: Development and psychometric validation of the Clinical Assessment Interview for Negative Symptoms (CAINS). Schizophr Res 2011; 132:140-145

10. Kring A, Gur R, Blanchard J, et al: The Clinical Assessment Interview for Negative Symptoms (CAINS): final development and validation. Am J Psychiatry 2013; 170:165-172

11. Strauss G, Hong L, Gold J, et al: Factor structure of the Brief Negative Symptom Scale. Schizophr Res 2012; 142:96-98

12. Liemburg E, Castelein S, Stewart R, van der Gaag M, Aleman A, Knegtering H, et al. Two subdomains of negative symptoms in psychotic disorders: established and confirmed in two large cohorts. J Psychiatr Res. 2013;47(6):718–25.

13. Marder S, Galderisi S: The current conceptualization of negative symptoms in schizophrenia. World Psychiatry 2017; 16:14-24

14. Schmitt TA. Current Methodological Considerations in Exploratory and Confirmatory Factor Analysis. Journal of Psychoeducational Assessment. 2011;29(4):304–21.

15. Mulaik SA. A Brief History of the Philosophical Foundations of Exploratory Factor Analysis. Multivariate Behavioral Research. 1987;22(3):267–305.

16. Garcia-Portilla MP, Garcia-Alvarez L, Mané A, Garcia-Rizo C,Sugranyes G, Bergé D, Bernardo M, Fernández-Egea E, Bobes J. The negative syndrome of schizophrenia: Three - underlying components are better than two. Schizophr Res 2015; 166:115-25.

17. Sayers S, Curran P, Mueser K. Factor structure and construct validity of the Scale for the Assessment of Negative Symptoms. Psychol Assess 1996; 8:269-280

18. Peralta V, Cuesta M. Negative symptoms in schizophrenia: a confirmatory factor analysis of competing models. Am J Psychiatry 1995; 152:1450-1457.

19. Axelrod BN, Goldman RS, Alphs LD. Validation of the 16-item Negative Symptom Assessment. J Psychiatr Res. 1993; 27(3): 253-258.

20. Axelrod BN, Goldman RS, Woodard JL, Alphs LD. Factor structure of negative symptom assessment. Psychiatry Res 1994; 52(2): 173-179.

21. Kirkpatrick B, Fenton WS, Carpenter WT, Marder SR. The NIMH-MATRICS Consensus Statement on Negative Symptoms. Schizophr Bull. 2006;32(2):214–9.

22. Strauss GP, Nunez A, Ahmed AO, Barchard KA, Granholm E, Kirkpatrick B, Gold JM, Allen DN (under review). The latent structure of negative symptoms in schizophrenia.

23. Strauss GP, Hong LE, Gold JM, et al. Factor structure of the Brief Negative Symptom Scale. Schizophr res. 2012;142(1-3):96-98.

24. Mucci A, Galderisi S, Merlotti E, Rossi A, Rocca P, Bucci P, et al. The Brief Negative Symptom Scale (BNSS): Independent validation in a large sample of Italian patients with schizophrenia. Eur Psychiatry. 2015;30(5):641–7.

25. Mané A, García-Rizo C, Garcia-Portilla MP, Bergé D, Sugranyes G, Garcia-Alvarez L, et al. Spanish adaptation and validation of the Brief Negative Symptoms Scale. Comprehensive Psychiatry. 2014;55(7):1726–9.

26. Yao J, Cui JF, Chen N, Fan HZ, Wang YH, Li YJ, et al. Reliability and validity of the Chinese version of Brief Negative Symptom Scale. Chinese Mental Health Journal 2014; 28(4): 302-307.

27. Bischof M, Obermann C, Hartmann MN, Hager OM, Kirschner M, Kluge A, et al. The brief negative symptom scale: validation of the German translation and convergent validity with self-rated anhedonia and observer-rated apathy. BMC Psychiatry. 2016;16(1):415.

28. Muthen LK, Muthen BO. M*plus* User's Guide. Fifth Edition. Los Angeles, CA: Muthen & Muthen; 1998-2007.

29. Hu L, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. Structural Equation Modeling. 1999;6(1):1–55.

30. Steiger JH. Structural Model Evaluation and Modification: An Interval Estimation Approach. Multivariate Behav Res. 1990; 25(2):173–80.

31. Browne, M.W. & Cudeck, R. (1993). Alternative ways of assessing model fit. In Bollen, K.A. & Long, J.S. [Eds.] Testing structural equation models. Newbury Park, CA: Sage, 136–162.

32. Tucker L, Lewis C. A reliability coefficient for maximum likelihood factor analysis. Psychometrika. 1973;38:1–10.

33. Bentler P. Comparative fit indices in structural models. Psycho Bull. 1990;107:238–246.

34. Akaike H. Factor analysis and AIC. Psychometrika. 1987;52(3):317–32.

35. Raftery AE. Approximate Bayes factors and accounting for model uncertainty in generalised linear models. Biometrika. 1996;83(2):251–66.

36. Yu CY. Evaluating cutoff criteria of model fit indices for latent variable models with binary and continuous outcomes. Doctoral dissertation. Los Angeles: University of California; 2002.

37. Byrne BM. Testing for multigroup equivalence of a measuring instrument: a walk through the process. Psicothema 2008; 20(4):872-882.

38. Horn JL, McArdle JJ. A practical and theoretical guide to measurement equivalence in aging research. Experimental Aging Research 1992; 18: 117-144.

39. Cheung GW, Rensvold RB. Evaluating goodness-of-fit indexes for testing measurement invariance. Structural Equation Modeling 2002; 9:233-255.

40. Cuthbert BN. Research Domain Criteria: toward future psychiatric nosologies. Dialogues Clin Neurosci. 2015;17(1):89–97.

41. Cuthbert BN, Insel TR. Toward the future of psychiatric diagnosis: the seven pillars of RDoC. BMC Med. 2013;11:126.

42. Chapman BP. Bandwidth and fidelity on the NEO-Five Factor Inventory: replicability and reliability of Saucier's (1998) item cluster subcomponents. J Pers Assess. 2007;88(2):220–34.

43. Paunonen SV, Ashton MC. Big five factors and facets and the prediction of behavior. J Pers Soc Psychol. 200;81(3):524–39.

44. Bauer SM, Schanda H, Karakula H, Olajossy-Hilkesberger L, Rudaleviciene P, Okribelashvili N, et al. Culture and the prevalence of hallucinations in schizophrenia. Compr Psychiatry. 2011;52(3):319–25.

45. Bae S-W, Brekke JS. Characteristics of Korean-Americans with schizophrenia: a cross-ethnic comparison with African-Americans, Latinos, and Euro-Americans. Schizophr Bull. 2002;28(4):703–17.

46. Brekke JS, Barrio C. Cross-ethnic symptom differences in schizophrenia: the influence of culture and minority status. Schizophr Bull. 1997;23(2):305–16.

47. Bae S-W, Brekke JS, Bola JR. Ethnicity and treatment outcome variation in schizophrenia: a longitudinal study of community-based psychosocial rehabilitation interventions. J Nerv Ment Dis. 2004; 192(9):623–8.

48. Ahmed AO, Strauss GP, Buchanan RW, Kirkpatrick B, Carpenter WT. Are negative symptoms dimensional or categorical? Detection and validation of deficit schizophrenia with taxometric and latent variable mixture models. Schizophr Bull. 2015;41(4):879–91.

49. Ahmed AO, Strauss GP, Buchanan RW, Kirkpatrick B, Carpenter WT. Schizophrenia heterogeneity revisited: Clinical, cognitive, and psychosocial correlates of statistically-derived negative symptoms subgroups. J Psychiatr Res 2018; 97:8-15.

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Table 1. Characteristics of the Brief Negative Syndrome Scale (BNSS) Study Samples used in the Analyses

Author, Year	Source	Language	n	Population	Setting	Male %	Age M(SD)	BNSS M(SD)	Internal Consistency	ICC
Mucci et al., 2015	Italy	Italian	937	Schizophrenia	Outpatient	69.6	40.1(10.7)	35.83(18.04)	0.994	0.98
Mane et al., 2014	Spain	Spanish	115	Schizophrenia	Outpatient	67.0	33.9(8.82)	27.47(13.65)	0.922	0.97
Yao et al., 2014	China	Chinese	163	Schizophrenia	Inpatient & Outpatient	54.6	45.3(8.6)	18.25(12.67)	0.933	0.93
Bishof et al., 2016	Switzerland	German	119	Schizophrenia Schizoaffective	Inpatient & Outpatient	72.3	32.4(10.6)	27.34(15.5)	0.944	0.97
Strauss et al., 2012	USA	English	357	Schizophrenia Schizoaffective	Outpatient	67.2	40.6(11.9)	21.4(15.9)	0.934	0.96

Notes. ICC=Intraclass Correlation Coefficient. Internal consistency values are Cronbach's alpha estimates. When a scale has more than five response categories, Cronbach's alpha produces robust estimates of internal consistency comparable to other methods of computing internal consistency for categorical outcomes such as ordinal alpha or McDonald's alpha.

Table 2. *Confirmatory factor Analysis Models of the Brief Negative Symptom Scale (BNSS)*

BNSS Items and Domains	CFA Models					
	1-factor	2-factor	3-factor	5-factor	5-factor Hierarchical	
					1st order	2nd order
Anhedonia						
1. Intensity of past-week pleasure	1	1	1	1	1	1
2. Frequency of past-week pleasure	1	1	1	1	1	1
3. Intensity of expected pleasure	1	1	1	1	1	1
Asociaility						
5. Asociality behavior	1	1	1	2	2	1
6. Asociality internal experience	1	1	1	2	2	1
Avolition						
7. Avolition behavior	1	1	2	3	3	1
8. Avoliton internal experience	1	1	2	3	3	1
Blunted Affect						
9. Facial expression	1	2	2	4	4	2
10. Vocal expression	1	2	2	4	4	2
11. Expressive gestures	1	2	2	4	4	2
Alogia						
12. Quality of speech	1	2	3	5	5	2
13. Spontaneous elaboration	1	2	3	5	5	2

Table 3. Model Fit Results of the Exploratory Factor Analysis of BNSS Items

Italian Calibration Sample	**LL**	**k**	**AIC**	**BIC**	**aBIC**	**Chi-Square**	**k**	**CFI**	**TLI**	**RMSEA**	**SRMR**
Item 4 Excluded											
1-Factor	-9,660.29	84	19,488.58	19,853.02	19,586.36	$X^2(54)=5525.09$, $p < 0.001$	12	0.971	0.965	0.423	0.127
2-Factor	-9,080.54	95	18,351.08	18,763.24	18,461.66	$X^2(43)=3311.48$, $p < 0.001$	23	0.983	0.974	0.366	0.066
3-Factor	-8,874.36	105	17,958.72	18,414.27	18,080.95	$X^2(33)=2113.90$, $p < 0.001$	33	0.989	0.978	0.334	0.050
4-Factor	-8,575.45	114	17,378.89	17,873.49	17,511.60	$X^2(24)=829.02$, $p < 0.001$	42	0.996	0.988	0.243	0.022
5-Factor	**-8,512.69**	**122**	**17,269.39**	**17,798.70**	**17,411.40**	**$X^2(16)=53.90$, $p < 0.001$**	**50**	**1.000**	**0.999**	**0.065**	**0.005**
6-Factor	-8,516.94	129	17,291.88	17,851.56	17,442.05	$X^2(9)=24.33$, $p = 0.004$	57	1.000	0.999	0.055	0.004
Item 4 Included											
1-Factor	-10,563.52	91	21,309.03	21,703.85	21,414.96	$X^2(65)=5842.81$, $p < 0.001$	13	0.970	0.964	0.396	0.119
2-Factor	-9,967.65	103	20,141.30	20,588.18	20,261.20	$X^2(53)=3317.09$, $p < 0.001$	25	0.983	0.975	0.330	0.061
3-Factor	-9,672.65	114	19,573.29	20,067.89	19,705.99	$X^2(42)=2005.66$, $p < 0.001$	36	0.990	0.981	0.287	0.047
4-Factor	-9,591.27	124	19,430.54	19,968.52	19,574.88	$X^2(32)=651.91$, $p < 0.001$	46	0.997	0.992	0.185	0.021
5-Factor	**-9,565.03**	**133**	**19,396.05**	**19,973.08**	**19,550.87**	**$X^2(23)=74.55$, $p < 0.001$**	**55**	**1.000**	**0.999**	**0.063**	**0.007**
6-Factor	-9,529.95	141	19,341.89	19,953.64	19,506.03	$X^2(15)=38.65$, $p < 0.001$	63	1.000	0.999	0.053	0.006

Note. LL = loglikelihood; k = number of free parameters; AIC = Akaike Information Criterion; BIC=Bayesian Information Criterion, aBIC = sample size adjusted BIC;
CFI = Comparative Fit Index; TLI = Tucker Lewis Index; RMSEA = Root Mean Square error of Approximation; SRMR= Standardized Root Mean Square Residual; WRMR = Weighted Root Mean Square Residual. Both Weighted Least Square (WLSMV) and Maximum Likelihood (MLR) estimators were used in the analyses.
Chi-Square for the Baseline EFA model with item4 excluded: $X^2(66) = 190{,}846.57$, $p < 0.0001$
Chi-Square for the Baseline EFA model with item4 included: $X^2(78) = 194394.78$, $p < 0.0001$

Table 4. Confirmatory Factor Analysis of BNSS Items: Model Fit Results

	LL	k	AIC	BIC	aBIC	Chi-Square	CFI	TLI	RMSEA	WRMR
Italian Calibration Sample										
1-Factor	-9,659.56	84	19,487.13	19,851.57	19,584.91	$X^2(8)=818.89$, p<0.001	0.944	0.965	0.423	4.727
2-Factor	-9,188.17	85	18,546.35	18,915.13	18,645.29	$X^2(13)=660.10$, p<0.001	0.955	0.983	0.297	2.924
3-Factor	-9051.64	87	18277.27	18654.73	18378.54	$X^2(11)=548.36$, p<0.001	0.963	0.983	0.294	2.734
5-Factor	**-8715.77**	**94**	**17619.54**	**18027.36**	**17728.96**	**$X^2(19)=77.43$, p<0.001**	**0.996**	**0.999**	**0.074**	**0.487**
2nd-Order 5-Factor	**-8909.74**	**86**	**17991.48**	**18364.60**	**18091.59**	**$X^2(15)=93.26$, p<0.001**	**0.995**	**0.998**	**0.080**	**0.878**
Cross Validation Samples 5-Factor Model										
Italian Sample	-5,801.92	107	11,817.86	12,236.89	11,897.42	$X^2(18)=50.49$, p=0.001	0.997	0.999	0.070	0.399
American Sample	-5,222.13	94	10,632.25	10,996.76	10,698.55	$X^2(19)=105.47$, p=0.000	0.989	0.995	0.110	0.709
Spanish Sample	-2,162.97	91	4,507.94	4,779.45	4,491.48	$X^2(19)=34.30$, p=0.017	0.994	0.998	0.074	0.385
Swiss Sample	-1,701.47	91	3,584.94	3,837.84	3,550.15	$X^2(12)=12.69$, p=0.3919	1.000	1.000	0.022	0.309
Chinese Sample	-2,055.19	88	4,286.38	4,558.63	4,280.04	$X^2(18)=48.07$, p<0.001	0.989	0.996	0.101	0.468
Cross Validation Samples 2nd Order 5-Factor										
Italian Sample	-5,951.24	99	12,100.49	12,488.20	12,174.10	$X^2(13)=28.48$, p=0.008	0.998	0.999	0.057	0.502
American Sample	-5,288.10	86	10,748.20	11,081.69	10,808.85	$X^2(17)=63.49$, p=0.000	0.994	0.997	0.088	0.824
Spanish Sample	-2,254.80	84	4,677.61	4,928.23	4,662.42	$X^2(16)=20.11$, p=0.215	0.998	0.999	0.042	0.462
Swiss Sample	-1754.72	83	3,675.43	3,906.10	3,643.70	$X^2(12)=27.43$, p=0.007	0.996	0.997	0.084	0.682
Chinese Sample	-2,168.61	77	4,491.24	4,729.46	4,485.69	$X^2(15)=83.38$, p<0.001	0.975	0.990	0.167	0.942

Note. LL = loglikelihood; k = number of free parameters; AIC = Akaike Information Criterion; BIC=Bayesian Information Criterion, aBIC = sample size adjusted BIC;
CFI = Comparative Fit Index; TLI = Tucker Lewis Index; RMSEA = Root Mean Square error of Approximation; WRMR = Weighted Root Mean Square Residual;
Preferred factor structures in the calibration sample based on fit indices are presented in bold font.
Chi-Square for the Baseline Model: $X^2(5)=14,458.07$, $p < 0.001$ (Item 4 excluded).
Chi-Square for the Baseline Model: $X^2(6)=14,953.44$, $p < 0.001$ (Item 4 included).
Both Weighted Least Square (WLSMV) and Maximum Likelihood (MLR) estimators were used in the analyses. Monte Carlo-based numerical integration was used in the estimation of models to ease computation time. The number of Monte Carlo generated integration points ranged from 5,000 to 6,000.
Chi-Square for the Baseline model in the Italian sample: $X^2(5) = 9,279.67$, $p < 0.001$
Chi-Square for the Baseline model in the American sample: $X^2(9) = 7885.97$, $p < 0.001$
Chi-Square for the Baseline model in the Spanish sample: $X^2(7) = 2,531.37$, $p < 0.001$
Chi-Square for the Baseline model in the Swiss sample: $X^2(8) = 4,029.90$, $p < 0.001$
Chi-Square for the Baseline model in the Chinese sample: $X^2(6) = 2,760.20$, $p < 0.001$

Table 5. Goodness-of-fit Indices for the Invariance Testing of the BNSS Five-Factor Structure

Invariance Model	**Chi-Square**	**Chi-Square Difference Test**	**CFI**	**CFI Change**	**TLI**	**TLI Change**	**RMSEA**
Configural Model	$X^2(87)=252.36$, $p<0.0001$	--	0.996		0.999		0.074
Metric Invariance	$X^2(88)=304.29$, $p<0.0001$	$X^2(27)=121.44$, $p<0.0001$	0.995	0.001	0.998	0.001	0.083
Scalar Invariance	$X^2(164)=805.06$, $p<0.0001$	$X^2(114)=704.40$, $p<0.0001$	0.986	0.010	0.997	0.002	0.107
Residual Invariance	$X^2(163)=681.81$, $p<0.0001$	$X^2(36)=282.13$, $p<0.0001$	0.988	0.008	0.998	0.001	0.090

Note. N =1,691. CFI = Comparative Fit Index; TLI = Tucker Lewis Index; RMSEA = Root Mean Square error of Approximation;
Chi-Square for the Baseline model: $X^2(32) = 44{,}760.07$, $p < 0.0001$