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Comparability of Social Anhedonia Across Epidemiological Dimensions: A Multinational Study of Measurement Invariance of the Revised Social Anhedonia Scale

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Social anhedonia, or the loss of motivation in and pleasure from social engagement, is an important feature in understanding the etiology and outcome of various psychopathologies. While the Revised Social Anhedonia Scale (RSAS) represents one of the most commonly used self-report measures of social anhedonia, little is known regarding the construct comparability across populations. We examined measurement invariance of the full and brief RSAS in a diverse, international sample of 14,064 participants across nine epidemiological dimensions, including gender, age, ethnicity, education, community income, continent, migrant status, ethnic density, and urbanicity. Both the full and brief RSAS, as represented by a three-factor structure, achieved metric invariance for all dimensions. The full version showed considerable scalar noninvariance for ethnicity and continent, which was significantly reduced in the brief version. These findings suggest that while the scales measure the same construct across diverse groups, mean comparisons are only appropriate for the brief, and not the full, version. Future research may consider using the brief RSAS to ensure cross-national comparability.

Public Significance Statement
The Revised Social Anhedonia Scale is one of the most commonly used self-report measures of social anhedonia. This study found that the brief version of this scale outperformed the full version with respect to comparability of scores across nine epidemiological dimensions using a large and diverse international sample.

Keywords: social anhedonia, schizophrenia, measurement invariance, exploratory structural equation modeling, epidemiology

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Loss of motivation in and pleasure from social engagement, or social anhedonia, is a common symptom observed across a number of psychopathological conditions. Social anhedonia represents a cardinal feature of schizophrenia-spectrum disorders but is also prevalent among individuals with depression, eating disorders, posttraumatic stress disorder, and autism spectrum disorders (Shankman et al., 2014). Importantly, social anhedonia has been linked to many disorders' etiological pathways, with elevated levels associated with a host of adverse clinical and social outcomes over and above the influences attributable to other illness

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features (for a review, see Barkus & Badcock, 2019). The detrimental effects of social anhedonia are evident even among nonclinical populations. Socially anhedonic but otherwise healthy individuals display prominent emotional and cognitive abnormalities (Li, Fung, Moore, & Martin, 2019; Martin, Cicero, & Kerns, 2012), display reduced social skills and support (Blanchard, Collins, Aghevli, Leung, & Cohen, 2011; Llerena, Park, Couture, & Blanchard, 2012), and are at risk for developing schizophrenia-spectrum disorders (Gooding, Tallent, & Matts, 2005; Kwapil, 1998). Taken together, understanding social anhedonia serves as a critical step into clarifying the etiology of various psychopathologies and can inform the development of preventative strategies.

Accurate understanding of social anhedonia is predicated on valid assessment of this construct. Current assessment approaches range from measures of social anhedonia phenomenology (e.g., interview and self-report) to examinations of underlying neurophysiology (e.g., electroencephalogram and functional MRI) and neurobiology (e.g., cytokines and genes; Barkus & Badcock, 2019). Notably, self-report questionnaires represent an inexpensive and noninvasive assessment strategy, and one of the most commonly used measures is the Revised Social Anhedonia Scale (RSAS; Eckblad, Chapman, Chapman, & Mishlove, 1982). The 40-item RSAS was developed almost 40 years ago based on White college students from the United States but has been used extensively in diverse populations ranging in age, racial/ethnic, and socioeconomic background and from countries all around the world (e.g., Blanchard et al., 2011; Chan et al., 2016; Miettunen et al., 2012; Shah et al., 2012). Despite its widespread use, there is some evidence showing that the RSAS has significant bias between men and women as well as between African American and White groups (Winterstein, Ackerman, Silvia, & Kwapil, 2011). Subsequently, the brief version of the RSAS, which is comprised of 15 items from the full scale, was developed by removing poor-performing items using modern measurement techniques (i.e., item response theory and differential item functioning; Winterstein, Silvia, et al., 2011). While allowing for a more time-efficient assessment with comparable content coverage and construct validity to the full version (Gross, Silvia, Barrantes-Vidal, & Kwapil, 2012; Winterstein, Silvia, et al., 2011), the brief RSAS has showed adequate measurement invariance across gender and a number of ethnic groups (i.e., White, Asian, Hispanic, and multiethnic; Cicero, Martin, & Krieg, 2019). That is, there is preliminary evidence from a college student sample in the United States that the brief RSAS measures the same construct in the same way across gender and some ethnic groups.

Despite initial inquiry of measurement invariance across some demographic variables, research is still lacking in other important dimensions such as age and education. Without a firm establishment of measurement invariance, it is unknown whether any group differences result from genuine differences in levels of social anhedonia or different psychometric properties of the scale items across groups. For example, consider the items concerning high school friends (e.g., "It made me sad to see all my high school friends go their separate ways when high school was over"). It is conceivable that college students, for whom the items were developed, might interpret the item differently than those who have not been to high school (e.g., early adolescents or those without a high school degree) or those for whom the high school experience represents a distant past (e.g., middle-aged and older adults). This might contribute to biased interpretations that levels of social anhedonia vary by age and education since some items do not have the same meaning across age and education cohorts in the first place. Critically, there is a need to evaluate measurement invariance in a large, international sample to ensure construct validity and generalizability in a cross-national context. Previous measurement invariance studies exclusively focused on samples drawn from Western, educated, industrialized, rich, and democratic (WEIRD) societies (Henrich, Heine, & Norenzayan, 2010). Thus, whether the results regarding gender and ethnicity generalize to non-WEIRD societies remains to be answered.

The goal of the current study was to comprehensively examine measurement invariance of the full and brief RSAS across a variety of epidemiologic dimensions known to influence social anhedonia. Dimensions included gender, age, ethnicity, education, community income, continent, migrant status, ethnic density, and urbanicity. Specifically, we examined three levels of measurement invariance with increasing equality constraints imposed across categories within each dimension—configural (no parameter constraints), metric (equal factor loading), and scalar (equal factor loading and intercept). Mean comparisons are only meaningful when scalar invariance holds. Analysis was based on a large and diverse international sample made publicly available from Dodell-Feder and Germine (2018). Overall, results from the current study might be a useful starting point in facilitating studies of social anhedonia at the cross-national level.

Method

Participants and Measure

Details on the sample and study procedure are available in Dodell-Feder and Germine (2018). Briefly, after providing informed consent, participants completed a Social Pleasure Questionnaire (i.e., 40-item RSAS) and potentially other cognitive tasks or questionnaires via a noncommercial research website (TestMyBrain.org) in exchange for feedback on their performance. Participants then voluntarily provided demographic information (i.e., gender, age, ethnicity, education, and country of origin). The study protocol was approved by the university institutional review board. The current analysis included 14,064 participants from 137 countries and regions, of whom 5,072 (42.4%) were from the United States. Please refer to Table 1 for full demographic information. Migrant status was assessed by evaluating whether the reported country of origin matched the country of residence. Community income (i.e., median income of the city of residence), ethnic density (i.e., proportion of the same-city residents with the same ethnicity as the participant), and urbanicity (i.e., population of the city of residence) were calculated based on data from the United States Census Bureau (2011–2015 census period) and thus restricted to those residing in the United States. The median community income, ethnic density, and urbanicity in the current sample were 52,763, 71.6%, and 69,196, respectively.

Participants completed the 40-item RSAS (Eckblad et al., 1982) using a 5-point scale (0 = *strongly disagree*, 4 = *strongly agree*), with higher scores indicating greater levels of social anhedonia. The RSAS is designed to measure lack of relationships and lack of pleasure from relationships, which has been shown to predict the development of schizophrenia-spectrum disorders (Gooding et al.,

Table 1
Participant Characteristics

Variable	*N* (%)	Full version *M* (*SD*)	Brief version *M* (*SD*)
Gender	13,860		
Male	4,869 (35.1)	1.71 (0.53)	1.51 (0.64)
Female	8,991 (64.9)	1.62 (0.54)	1.43 (0.64)
Age[a]	14,030		
<15	1,839 (13.1)	1.61 (0.56)	1.40 (0.68)
16–30	8,863 (63.2)	1.65 (0.53)	1.46 (0.63)
31–45	2,117 (15.1)	1.71 (0.54)	1.54 (0.63)
46–60	989 (7.0)	1.66 (0.58)	1.49 (0.68)
>61	222 (1.6)	1.57 (0.54)	1.37 (0.60)
Ethnicity	12,344		
African	440 (3.6)	1.68 (0.55)	1.48 (0.68)
East Asian	928 (7.5)	1.68 (0.47)	1.51 (0.58)
South Asian	1,655 (13.4)	1.67 (0.45)	1.52 (0.57)
European	8,132 (65.9)	1.64 (0.58)	1.44 (0.67)
Middle Eastern	400 (3.2)	1.67 (0.47)	1.49 (0.59)
Biracial/multiracial	789 (6.4)	1.69 (0.57)	1.48 (0.66)
Education	13,807		
None	631 (4.6)	1.68 (0.49)	1.51 (0.62)
Middle school	869 (6.3)	1.62 (0.56)	1.41 (0.69)
High school	3,755 (27.2)	1.67 (0.55)	1.48 (0.67)
Some college	3,701 (26.8)	1.68 (0.54)	1.50 (0.64)
College	2,635 (19.1)	1.63 (0.53)	1.44 (0.62)
Graduate school	2,216 (16.0)	1.60 (0.54)	1.43 (0.62)
Community income[b]	4,131		
Low (≤52,763)	2,097 (50.8)	1.66 (0.59)	1.47 (0.69)
High (>52,763)	2,034 (49.2)	1.60 (0.58)	1.41 (0.66)
Continent	11,946		
Africa	191 (1.6)	1.79 (0.50)	1.60 (0.64)
Asia	2,280 (19.1)	1.69 (0.44)	1.53 (0.56)
Australia/Oceania	534 (4.5)	1.62 (0.52)	1.43 (0.61)
Europe	3,126 (26.2)	1.64 (0.56)	1.44 (0.66)
North America	5,713 (47.8)	1.64 (0.58)	1.45 (0.67)
South America	102 (0.8)	1.68 (0.54)	1.42 (0.65)
Migrant status	11,327		
Nonmigrant	9,926 (87.6)	1.65 (0.54)	1.46 (0.64)
Migrant	1,401 (12.4)	1.61 (0.53)	1.41 (0.62)
Ethnic density[c]	3,340		
Low (≤71.6%)	1,670 (50.0)	1.60 (0.58)	1.41 (0.67)
High (>71.6%)	1,670 (50.0)	1.65 (0.60)	1.46 (0.68)
Urbanicity[d]	4,137		
Low (≤69,196)	2,144 (51.8)	1.64 (0.58)	1.45 (0.68)
High (>69,196)	1,993 (48.2)	1.62 (0.58)	1.43 (0.67)

[a] *M* (*SD*) = 25.77 (11.84), range = 9–72. [b] *M* (*SD*) = 58,442 (24,007), range = 8,864–242,782. [c] *M* (*SD*) = 63.77 (27.52), range = 0–100. [d] *M* (*SD*) = 459,723 (1,390,944), range = 63–8,426,743.

2005; Kwapil, 1998). The brief RSAS consists of 15 items from the full version (Winterstein, Silvia, et al., 2011). Items were selected based on content validity and the results of item response theory (i.e., high item difficulty and discrimination) and differential item functioning (i.e., items with high differential item functioning between men vs. women and between African American vs. White groups were removed; Winterstein, Silvia, et al., 2011). Both the full and brief versions of the RSAS were originally intended to be unidimensional; however, evidence for (Winterstein, Ackerman, et al., 2011) and against (Cicero et al., 2019; Reise, Horan, & Blanchard, 2011) unidimensionality has been obtained in previous research. In the current study, the full and brief versions showed excellent internal consistency, with Cronbach's alphas of .92 and .87, respectively. In addition, the full and brief versions were found to be highly correlated with each other, $r = .94$, $p < .001$.

Statistical Analyses

All analyses were performed using Mplus 8.4 (Muthén & Muthén, 1998–2017) with robust maximum likelihood estimator. Unidimensionality of the full and brief versions was examined using a one-factor confirmatory factor analysis (CFA). If the unidimensional model did not fit well, an exploratory factor analysis (EFA) with oblique geomin rotation was conducted to determine the optimal number of factors that should be retained via parallel analysis and factor interpretability (Costello & Osborne, 2005; Worthington & Whittaker, 2006; Yong & Pearce, 2013). Parallel analysis was conducted with 50 random data sets, and the 95th percentile of the randomly generated eigenvalues were compared with the observed eigenvalues (Hayton, Allen, & Scarpello, 2004).

Measurement invariance of the full and brief versions was examined within an exploratory structural equation modeling (ESEM) framework as it offers several advantages over the traditional CFA approach (Asparouhov & Muthén, 2009; Marsh, Morin, Parker, & Kaur, 2014; Marsh, Nagengast, & Morin, 2013). Specifically, the inconsistent factor structure of the RSAS observed in past research makes it challenging to specify a priori models (Cicero et al., 2019; Winterstein, Ackerman, et al., 2011). Further, the CFA approach requires that each item only loads on one factor, which is overly restrictive for multidimensional assessment instruments and thereby contributes to an overestimation of measurement invariance violations (Marsh et al., 2014).

In ESEM, a simultaneous EFA with an oblique geomin rotation was conducted in several groups. Then, multigroup tests of invariance were carried out by imposing a hierarchical set of equality constraints. First, a configural model was fitted to the item-level data, only requiring the number of factors to be equal across groups. Next, a metric model was estimated, imposing equal factor loadings across groups. If metric invariance was achieved, a scalar model was estimated where both factor loadings and intercepts were set to be equal across groups. Invariance was achieved if the more constrained model did not fit significantly worse than the less constrained one. On the other hand, metric noninvariance suggests that the scale does not measure the same construct across groups, while scalar noninvariance suggests that the same score does not represent the same level of the construct across groups. To identify the source of noninvariance, partial scalar invariance was tested by sequentially releasing constraints on item intercepts with the highest modification index until adequate model fit was achieved (Putnick & Bornstein, 2016; Yoon & Millsap, 2007).

To use the multigroup approach, continuous variables (i.e., age, community income, ethnic density, and urbanicity) were split into discrete categories. Based on the literature on personality development (Marsh et al., 2013) as well as results concerning the current sample (Dodell-Feder & Germine, 2018), there were five age categories that roughly correspond to early adolescence (<15; n = 1,839), late adolescence/emerging adulthood (16–30; n = 8,863), early adulthood (31–45; n = 2,117), middle adulthood (46–60; n = 989), and late adulthood (>61; n = 222). All other continuous variables were dichotomized into low versus high categories using median split. Naturally occurring categorical variables included gender (male and female), ethnicity (African, East Asian, South Asian, European, Middle Eastern, and biracial/multiracial), education (none, middle school, high school, some college, college, and graduate school), continent (Africa, Asia, Australia/Oceania, Europe, North America, and South America), and migrant status (nonmigrant and migrant). Note that a number of other ethnic categories were present in the sample (e.g., American Indian/Alaskan Native and Native Hawaiian/Pacific Islander), but they were not included in the analysis for ethnicity due to the small sample size ($n < 100$).

Model fit was evaluated using the root mean square error of approximation (RMSEA), the standardized root mean square residual (SRMR), the comparative fit index (CFI), and the Tucker-Lewis index (TLI). Following convention (Hu & Bentler, 1998), good fit is indicated by RMSEA and SRMR $\leq$ .05 and CFI and TLI $\geq$ .95, while RMSEA $<$ .08, SRMR $<$ 1.0, and CFI and TLI $>$ .90 are considered acceptable. Relative model fit was evaluated using change in the McDonald's noncentrality index (ΔMc; McDonald, 1989) and change in the CFI (ΔCFI). Support for the more parsimonious model, and thus measurement invariance, is indicated by ΔMc $\leq$ .02 and ΔCFI $\leq$ .01 (Chen, 2007; Cheung & Rensvold, 2002). Satorra-Bentler chi-square difference test (Satorra & Bentler, 2001) was also reported but was not used as an evaluation criterion because it is overly sensitive to small deviations in large samples (Chen, 2007; Cheung & Rensvold, 2002).

Results

For both the full and brief versions, the unidimensional CFA model did not fit the data well, full version: $\chi^2(740) = 46{,}761.269$, $p < .001$, RMSEA [90% CI] = 0.066 [0.066, 0.067], CFI = 0.673, TLI = 0.655, SRMR = 0.066; brief version: $\chi^2(90) = 8109.361$, $p < .001$, RMSEA [90% CI] = 0.080 [0.078, 0.081], CFI = 0.830, TLI = 0.802, SRMR = 0.056. For the EFA, parallel analysis suggested that five and three factors should be retained for the full and brief versions, respectively (see Figure 1). However, examination of the factor loadings showed that there was one factor with only two high-loading items (factor loadings $\geq$ .30) for both the five- and four-factor solutions of the full version (Item 1: "I sometimes become deeply attached to people I spend a lot of time with" and Item 25: "It is fun to sing with other people"). The main difference between the four- and five-factor solutions was that items that previously loaded onto one factor in the former were split into two factors in the latter (i.e., factors 1 and 3; see online Supplemental Table S2). Because a factor with fewer than three items is generally unreliable (Costello & Osborne, 2005; Worthington & Whittaker, 2006; Yong & Pearce, 2013) and the interpretability of this factor was low, the three-factor solution was retained for both the full and brief versions.[1] The factors were moderately correlated with each other (rs ranged from .32 to .50) and roughly map onto lack of interest in friendships, lack of emotional involvement, and preference for solitude (see online Supplemental Table S1 for factor loadings and correlations). The full, but not brief, version contained low-loading items with item loadings less than .30 on any factor (Item 10: "There are things that are more important to me than privacy," Item 17: "I like to make long distance phone calls to friends and relatives," and Item 28: "When things are bothering me, I like to talk to other people about it"); these items might not adequately represent the construct as indicated by the three factors.

With respect to the full version, the configural model provided a marginal fit to the data for all variables assessed (see Table 2). While RMSEA and SRMR indicated good model fit, CFI and TLI failed to meet the acceptable fit cutoff. Metric invariance was achieved for all variables, but only gender, community income, migrant status, ethnic density, and urbanicity met the criteria for scalar invariance. Partial scalar invariance was achieved after releasing the intercept equality constraints for seven items for age (Items 13, 15, 24, 27, 28, 29, and 38),[2] 11 items for ethnicity (Items 4, 8, 17, 21, 22, 23, 26, 29, 32, 33, and 37), one item for education (Item 15), and seven items for continent (Items 4, 8, 17, 21, 23, 32, and 37). Although age and education did not achieve scalar invariance, the resulting influence might not be problematic given that at most 10% of the items were noninvariant against any one group. On the other hand, the influence of scalar noninvariance might be especially problematic for participants of European descent (20% noninvariant) and from the continent of Asia (17.5% noninvariant; Putnick & Bornstein, 2016). Therefore, observed scores on the full RSAS are comparable across gender, community income, migrant status, ethnic density, urbanicity, and probably age and education categories but are biased for ethnicity and continent.

With respect to the brief version, all variables achieved adequate to good fit for the configural model (see Table 3). Again, metric invariance was achieved for all variables. Clear scalar invariance was met for gender, education, community income, migrant status, ethnic density, and urbanicity, while ethnicity and continent showed marginal scalar invariance, meeting the criterion for ΔMc but not ΔCFI. Age showed scalar noninvariance based on both criteria. Partial scalar invariance was achieved after releasing the intercept equality constraints for one item for age (Item 29), one item for ethnicity (Item 29), and one item for continent (Item 37). The influence of scalar noninvariance might not be problematic for the brief version since only one item (6.7%) was noninvariant against any groups. Thus, these results suggest that comparing observed scores on the brief RSAS would not be problematic for any of the epidemiological dimensions assessed in the current study.

Discussion

Scores on the RSAS have been routinely applied to indicate variations of underlying levels of social anhedonia in diverse populations around the world. This interpretation is only valid when the scale is invariant across these populations. In the present study, we were the first to comprehensively examine measurement invariance of the full and brief RSAS in a large, international sample across a number of important epidemiological dimensions. Overall, the brief version outperformed the full version in absolute model fit as well as measurement invariance and thus is a better

[1] EFA and ESEM results for the five-factor model of the full version are available in the online supplemental materials. Overall, findings regarding measurement invariance of the full version remained highly similar to that of the three-factor model.

[2] Item content is available from the corresponding author upon request.

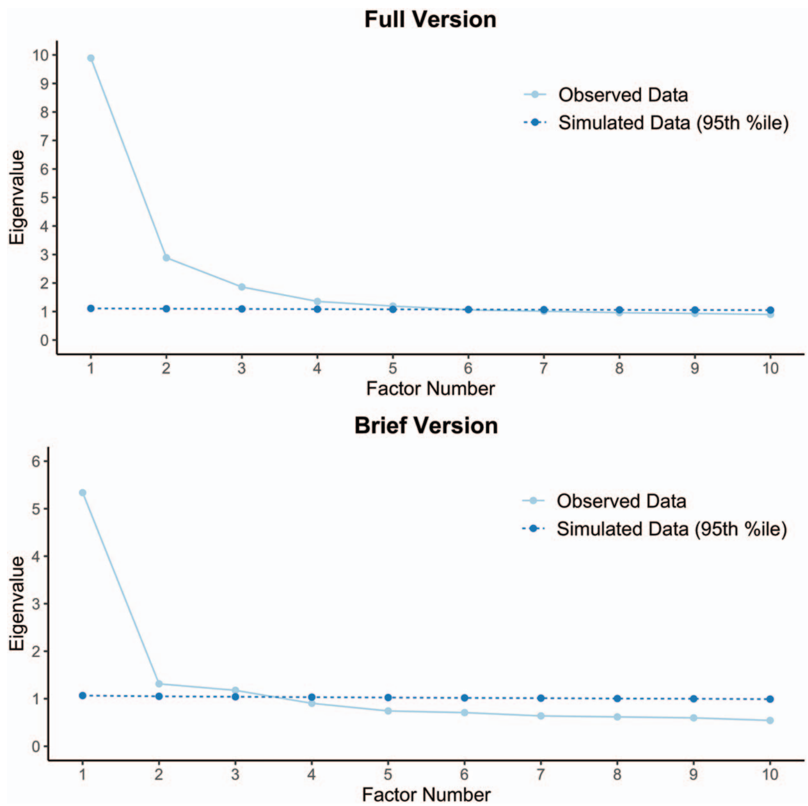

Figure 1. Eigenvalues of the factors from observed data and parallel analysis. Only results for the first 10 factors are shown. See the online article for the color version of this figure.

assessment instrument that could be used in cross-national contexts.

The current results paint a nuanced picture regarding the psychometric properties of the full RSAS. The scale showed some strengths in achieving clear measurement invariance in a number of dimensions, including gender, community income, migrant status, ethnic density, and urbanicity. This finding is noteworthy considering that the scale was developed before sophisticated measurement tools became readily available. The support for invariance over gender is in contrast with one previous study showing many items displaying significant bias between men and women when the scale was treated as unidimensional (Winterstein, Ackerman, et al., 2011) but is consistent with another that also treated the scale as multidimensional (Cicero et al., 2019). Thus, the lack of invariance found in Winterstein and colleagues (2011) might have resulted from the multidimensional nature of the RSAS. On the other hand, several weaknesses of the full RSAS have been identified. In line with previous studies (Reise et al., 2011; Winterstein, Ackerman, et al., 2011), we found that the scale contained items that did not fit well with the construct and thus could be removed without sacrificing the content coverage. Further, the scale showed considerable lack of scalar invariance for ethnicity and continent. Particularly, people who are of European descent and from the continent of Asia do not interpret a large portion of the items in the same way as non-European minorities and people from the other five continents (i.e., Africa, Australia/Oceania, Europe, North America, and South America). Given that relatively modest scalar noninvariance could result in significantly inflated Type I and II error rates (Steinmetz, 2013), researchers should exercise caution when interpreting mean comparisons from studies that used the full RSAS in the aforementioned populations.

Our findings lend further support to the superior psychometric properties of the brief version relative to the full version. The brief version was developed by removing items that showed bias between men and women as well as between African American and White groups (Winterstein, Silvia, et al., 2011) but also showed measurement invariance in ethnic groups not included in the scale development (Cicero et al., 2019). Extending prior measurement invariance findings, we showed that the brief RSAS had clear scalar invariance in gender, education, community income, migrant status, ethnic density, and urbanicity categories. For dimensions that failed to show unequivocal scalar invariance (i.e., ethnicity, continent, and age), only one item (6.7%) was noninvariant against any groups. It is difficult to precisely quantify the degree of bias of the brief RSAS as prior simulation studies only tested scalar noninvariance of at least 16.7% of the items (Putnick & Bornstein, 2016). Nonetheless, it is clear that the bias observed for the full version is largely, if not completely, reduced in the brief version given that the degree of bias is lower with the proportion of noninvariant items decreased (Chen, 2008). Thus, the noninvariant items in the brief RSAS might not contribute to significant bias and, considering the brevity of the scale, should be retained to ensure full content coverage. Notably, the greater degree of measurement invariance achieved for the brief (vs. full) version is

Table 2
Fit Statistics for the Full Version

Model	χ^2	*df*	RMSEA [90% CI]	CFI	TLI	SRMR	AIC	BIC	ΔS-Bχ^2 (*df*)	ΔMc	ΔCFI
Gender											
Configural	20,358.365	1,326	0.046 [0.045, 0.046]	0.861	0.837	0.032	1,539,184.210	1,542,153.695			
Metric	20,634.621	1,437	0.044 [0.043, 0.044]	0.860	0.848	0.033	1,539,422.254	1,541,555.157	365.822 (111)	0.003	0.001
Scalar	21,672.212	1,474	0.044 [0.044, 0.045]	0.853	0.844	0.034	1,540,497.508	1,542,351.552	1,101.726 (37)	0.018	0.007
Age											
Configural	23,270.372	3,315	0.046 [0.046, 0.047]	0.861	0.836	0.033	1,554,703.615	1,562,139.334			
Metric	24,157.829	3,759	0.044 [0.043, 0.045]	0.857	0.852	0.039	1,555,293.465	1,559,377.448	1,132.382 (444)	0.008	0.004
Scalar	26,633.762	3,907	0.046 [0.045, 0.046]	0.841	0.842	0.042	1,557,747.442	1,560,714.180	2,653.124 (148)	0.038	0.016
Scalar-mod	25,453.066	3,897	0.044 [0.044, 0.045]	0.849	0.849	0.040	1,556,403.774	1,559,446.002	1,345.437 (138)	0.020	0.008
Ethnicity											
Configural	22,887.641	3,978	0.048 [0.047, 0.049]	0.859	0.834	0.034	1,362,975.308	1,371,746.842			
Metric	24,213.514	4,533	0.046 [0.045, 0.047]	0.853	0.848	0.042	1,363,878.964	1,368,531.884	1,550.723 (555)	0.014	0.006
Scalar	26,465.226	4,718	0.047 [0.047, 0.048]	0.838	0.839	0.045	1,365,961.065	1,369,241.114	3,628.949 (185)	0.036	0.015
Scalar-mod	25,501.628	4,706	0.046 [0.046, 0.047]	0.845	0.846	0.043	1,364,890.533	1,368,259.633	1,329.761 (173)	0.020	0.008
Education											
Configural	23,358.913	3,978	0.046 [0.045, 0.047]	0.861	0.837	0.034	1,532,130.070	1,541,033.994			
Metric	24,200.144	4,533	0.043 [0.043, 0.044]	0.859	0.855	0.039	1,532,334.121	1,537,057.269	1,031.144 (555)	0.005	0.002
Scalar	26,040.895	4,718	0.044 [0.044, 0.045]	0.847	0.849	0.040	1,533,960.345	1,537,289.901	1,971.814 (185)	0.028	0.012
Scalar-mod	25,509.959	4,716	0.044 [0.043, 0.044]	0.851	0.852	0.040	1,533,343.258	1,536,687.880	1,361.968 (183)	0.020	0.008
Community income											
Configural	7,981.424	1,326	0.049 [0.048, 0.050]	0.866	0.842	0.034	451,972.655	454,465.208			
Metric	8,063.682	1,437	0.047 [0.046, 0.048]	0.867	0.855	0.036	451,904.432	453,694.767	122.927 (111)*	−0.002	−0.001
Scalar	8,166.133	1,474	0.047 [0.046, 0.048]	0.865	0.857	0.036	451,915.627	453,471.890	85.374 (37)	0.004	0.002
Continent											
Configural	22,267.302	3,978	0.048 [0.047, 0.049]	0.857	0.832	0.034	1,321,937.135	1,330,669.930			
Metric	23,437.260	4,533	0.046 [0.045, 0.046]	0.852	0.848	0.042	1,322,947.794	1,327,580.166	1,531.232 (555)	0.012	0.005
Scalar	25,407.727	4,718	0.047 [0.046, 0.047]	0.838	0.840	0.044	1,324,699.366	1,327,964.929	2,064.018 (185)	0.033	0.014
Scalar-mod	24,666.937	4,711	0.046 [0.046, 0.047]	0.844	0.845	0.043	1,323,878.118	1,327,195.398	1,260.670 (178)	0.020	0.008
Migrant status											
Configural	17,453.509	1,326	0.046 [0.046, 0.047]	0.860	0.836	0.032	1,257,715.889	1,260,605.857			
Metric	17,466.626	1,437	0.044 [0.044, 0.045]	0.861	0.849	0.033	1,257,669.693	1,259,745.482	137.531 (111)	−0.002	−0.001
Scalar	17,800.266	1,474	0.044 [0.044, 0.045]	0.859	0.850	0.033	1,257,908.225	1,259,712.621	313.969 (37)	0.006	0.002
Ethnic density											
Configural	7,264.859	1,326	0.052 [0.051, 0.053]	0.857	0.832	0.036	363,634.582	366,043.390			
Metric	7,361.251	1,437	0.050 [0.049, 0.051]	0.858	0.846	0.038	363,587.971	365,318.155	138.891 (111)	−0.001	−0.001
Scalar	7,450.542	1,474	0.049 [0.048, 0.050]	0.857	0.848	0.038	363,587.553	365,091.529	73.691 (37)	0.003	0.001
Urbanicity											
Configural	8,048.464	1,326	0.050 [0.048, 0.051]	0.865	0.842	0.034	452,634.444	455,127.568			
Metric	8,137.327	1,437	0.047 [0.046, 0.048]	0.866	0.854	0.035	452,563.050	454,353.797	122.135 (111)*	−0.001	−0.001
Scalar	8,192.557	1,474	0.047 [0.046, 0.048]	0.865	0.858	0.036	452,519.824	454,076.445	30.766 (37)*	0.001	0.001

Note. For the modified scalar model (i.e., scalar-mod), the intercept equality constraints were released for the following items to achieve partial scalar invariance: (age) Items 13, 15, 28, and 38 in the 9–15 group, Items 15 and 28 in the 16–30 group, Item 24 in the 31–45 group, and Items 24, 27, and 29 in the 46–60 group; (ethnicity) Items 17, 26, and 32 in the South Asian group, Items 4, 8, 21, 22, 23, 29, 33, and 37 in the European group, and Item 23 in the biracial/multiracial group; (education) Item 15 in the middle school and high school groups; (continent) Items 4, 8, 17, 21, 23, 32, and 37 in the Asia group. *df* = degrees of freedom; RMSEA = root mean square error of approximation; CI = confidence interval; CFI = comparative fit index; TLI = Tucker-Lewis index; SRMR = standardized root mean square residual; AIC = Akaike information criterion; BIC = Bayesian information criterion; ΔS-Bχ^2 = Satorra-Bentler chi-square difference test; Mc = McDonald's noncentrality index.
* $p > .05$.

unlikely the result of a reduced number of items as model size has been shown to be unrelated to the levels of measurement invariance achieved, especially when alternative fit indices (e.g., ΔMc and ΔCFI) were used rather than, or in addition to, chi-square difference test (Putnick & Bornstein, 2016). This, coupled with the high internal consistency and correlation with the full version, demonstrates the utility of the brief RSAS in measuring social anhedonia in people with various epidemiological backgrounds.

It is important to mention that social anhedonia as measured by the RSAS is a multidimensional construct consisting of three interrelated factors (i.e., lack of interest in friendships, lack of emotional involvement, and preference for solitude). Although the scale was originally intended to be, and has regularly been treated as, unidimensional (e.g., Winterstein, Ackerman, et al., 2011), accumulating evidence suggests a multidimensional structure of two to three factors (Cicero et al., 2019; Reise et al., 2011). This discrepancy stems, at least in part, from the overly homogenous sample used in a number of previous studies (e.g., predominately Caucasian college students from the United States). As sample heterogeneity increases, more factors are typically needed to adequately explain the data (Gaskin, Lambert, Bowe, & Orellana, 2017). For example, using a college sample with diverse ethnic backgrounds, Cicero and colleagues (2019) demonstrated a three-factor solution for the full RSAS and a two-factor solution for the brief version. Similarly, Reise and colleagues (2011) analyzed data from a community sample that ranged in various sociodemo-

Table 3
Fit Statistics for the Brief Version

Model	χ^2	*df*	RMSEA [90% CI]	CFI	TLI	SRMR	AIC	BIC	ΔS-Bχ^2 (*df*)	ΔMc	ΔCFI
Gender											
Configural	1,735.322	126	0.043 [0.041, 0.045]	0.965	0.942	0.021	559,843.411	560,928.704			
Metric	1,826.284	162	0.039 [0.037, 0.040]	0.964	0.953	0.023	559,905.415	560,719.386	105.718 (36)	0.002	0.001
Scalar	2,097.452	174	0.040 [0.038, 0.041]	0.958	0.950	0.025	560,182.399	560,905.928	297.266 (12)	0.009	0.006
Age											
Configural	2,151.860	315	0.046 [0.044, 0.047]	0.962	0.936	0.023	565,464.370	568,181.993			
Metric	2,407.231	459	0.039 [0.037, 0.040]	0.959	0.953	0.032	565,639.588	567,270.162	336.703 (144)	0.004	0.003
Scalar	3,150.677	507	0.043 [0.042, 0.045]	0.945	0.943	0.038	566,396.640	567,664.864	823.439 (48)	0.023	0.014
Scalar-mod	2,907.618	505	0.041 [0.040, 0.043]	0.950	0.948	0.037	566,109.355	567,392.677	543.179 (46)	0.015	0.009
Ethnicity											
Configural	1,999.875	378	0.046 [0.044, 0.048]	0.964	0.940	0.023	495,341.244	498,547.083			
Metric	2,269.204	558	0.039 [0.037, 0.040]	0.962	0.957	0.032	495,431.969	497,302.042	338.890 (180)	0.003	0.002
Scalar	2,825.121	618	0.042 [0.040, 0.043]	0.951	0.950	0.035	495,925.057	497,349.874	607.813 (60)	0.018	0.011
Scalar-mod	2,704.616	617	0.041 [0.039, 0.042]	0.953	0.952	0.034	495,786.115	497,218.354	467.911 (59)	0.014	0.009
Education											
Configural	2,129.025	378	0.045 [0.043, 0.047]	0.962	0.937	0.023	557,553.980	560,808.206			
Metric	2,428.854	558	0.038 [0.037, 0.040]	0.960	0.955	0.031	557,644.057	559,542.356	343.785 (180)	0.004	0.002
Scalar	2,836.499	618	0.039 [0.038, 0.041]	0.952	0.951	0.033	557,964.033	559,410.356	436.649 (60)	0.012	0.008
Community income											
Configural	716.422	126	0.048 [0.044, 0.051]	0.965	0.941	0.023	163,168.021	164,079.005			
Metric	735.706	162	0.041 [0.038, 0.044]	0.966	0.955	0.025	163,135.312	163,818.549	30.375 (36)*	−0.002	−0.001
Scalar	774.284	174	0.041 [0.038, 0.044]	0.964	0.957	0.026	163,146.284	163,753.607	35.238 (12)	0.003	0.002
Continent[a]											
Configural	2,039.271	380	0.047 [0.045, 0.049]	0.961	0.935	0.024	480,650.992	483,827.897			
Metric	2,379.856	560	0.040 [0.039, 0.042]	0.957	0.952	0.034	480,873.875	482,720.913	423.384 (180)	0.006	0.004
Scalar	2,930.617	620	0.043 [0.042, 0.045]	0.945	0.944	0.037	481,361.016	482,764.765	597.800 (60)	0.019	0.012
Scalar-mod	2,825.118	619	0.042 [0.041, 0.044]	0.948	0.947	0.037	481,239.790	482,650.927	476.080 (59)	0.015	0.009
Migrant status											
Configural	1,542.833	126	0.045 [0.043, 0.047]	0.963	0.938	0.022	457,862.610	458,918.842			
Metric	1,591.992	162	0.039 [0.038, 0.041]	0.962	0.951	0.025	457,880.635	458,672.809	69.807 (36)	<.001	0.001
Scalar	1,661.016	174	0.039 [0.037, 0.041]	0.961	0.953	0.025	457,915.491	458,619.646	58.895 (12)	0.002	0.001
Ethnic density											
Configural	621.192	126	0.049 [0.045, 0.052]	0.964	0.939	0.024	131,485.777	132,366.153			
Metric	646.542	162	0.042 [0.039, 0.046]	0.964	0.954	0.027	131,458.933	132,119.216	34.749 (36)*	−0.001	<.001
Scalar	668.777	174	0.041 [0.038, 0.045]	0.964	0.956	0.028	131,451.725	132,038.642	16.867 (12)*	0.001	<.001
Urbanicity											
Configural	710.110	126	0.047 [0.044, 0.051]	0.965	0.942	0.023	163,376.641	164,287.833			
Metric	748.386	162	0.042 [0.039, 0.045]	0.965	0.955	0.026	163,364.791	164,048.186	47.034 (36)*	<.001	<.001
Scalar	766.818	174	0.041 [0.038, 0.044]	0.965	0.957	0.027	163,351.977	163,959.439	11.182 (12)*	0.001	<.001

Note. For the modified scalar model (i.e., scalar-mod), the intercept equality constraints were released for the following items to achieve partial scalar invariance: (age) Item 29 in the 31–45 and 46–60 groups; (ethnicity) Item 29 in the European group; (continent) Item 37 in the Asia group. *df* = degrees of freedom; RMSEA = root mean square error of approximation; CI = confidence interval; CFI = comparative fit index; TLI = Tucker-Lewis index; SRMR = standardized root mean square residual; AIC = Akaike information criterion; BIC = Bayesian information criterion; ΔS-Bχ^2 = Satorra-Bentler chi-square difference test; Mc = McDonald's noncentrality index.
[a] In the Africa group, there was a small, nonsignificant negative residual variance for Items 29 and 40. They were constrained to 0 in the Africa group for all models.
* $p > .05$.

graphic dimensions and obtained three major factors that resembled the current results (i.e., preference for solitude, socially aloof, and close friends not valued/important). Taken together, our findings, and those of others, imply that social anhedonia may be a collection of interrelated facets rather than one underlying construct. This might pose challenges in using the sum-score of the full or brief RSAS as representing the severity of one underlying pathology. Future studies may wish to investigate the distinctiveness of the facets in predicting etiology and outcome using diverse samples.

While the current study offers theoretical and practical implications of research on social anhedonia, it is not without limitations. As discussed in Dodell-Feder and Germine (2018), we relied on nonrandom, web-based data collection that may be limited in several ways (e.g., self-selection effects). Nevertheless, this method enables us to reach diverse populations that would not have been feasible with in-person testing. At the same time, web-based data has been shown to be highly reliable, with findings mirroring those of nationally representative population-based samples (Hartshorne & Germine, 2015). Further, there might be inaccuracies for migrant status, income, ethnic density, and urbanicity categories as they were not directly assessed but classified by proxies. More research is needed to examine measurement invariance across the above dimensions using more precise estimates.

As social anhedonia is increasingly recognized as the fundamental building block of various psychopathological conditions, it is exceedingly crucial that conclusions are drawn from assessment instruments with good psychometric properties. Findings of the current study support the psychometric soundness of the brief RSAS. Future studies may consider using the brief RSAS to ensure validity and generalizability of findings as well as to facilitate cross-national comparisons.

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