American Psychological Association

Psychological Assessment

ISSN: 1040-3590

2020, Vol. 32, No. 4, 383–393
http://dx.doi.org/10.1037/pas0000798

Differential Item Functioning of the Multidimensional Schizotypy Scale and Multidimensional Scale-Brief Across Ethnicity

Lilian Y. Li
University of California, Irvine

Monet S. Meyer
University of Hawaii at Manoa

Elizabeth A. Martin
University of California, Irvine

Georgina M. Gross
VA Connecticut Healthcare System, West Haven, Connecticut, and Yale University

Thomas R. Kwapil
University of Illinois at Urbana-Champaign and University of North Carolina at Greensboro

David C. Cicero
University of North Texas

Schizotypy refers to traits or symptoms similar to schizophrenia, but in a diminished form, and schizotypy is thought to reflect a liability for the future development of schizophrenia. The Multidimensional Schizotypy Scale (MSS) is a new measure of schizotypy that improves on existing measures. The MSS contains full and brief subscales for positive, negative, and disorganized schizotypy. Although MSS scores have been validated in a variety of populations, the scales have not been thoroughly examined for differential item functioning in East Asian, Southeast Asian, Hispanic, Multiracial, and White participants. The current study included 567 East Asian, 351 Southeast Asian, 360 Hispanic, 230 Multiracial, and 345 White undergraduate participants from the United States. Overall, few of the items in the full or brief versions of the scales displayed differential item functioning across groups. The full and brief versions of the scales also displayed similar and not-significantly different validity coefficients with the Detachment and Psychoticism scales of the Personality Inventory for *DSM–5*. These findings suggest that the MSS measures the same constructs across ethnic groups, and the scale scores represent the same latent level of schizotypy among groups. Future research may use the MSS in these diverse groups without concern that the psychometric properties differ significantly among groups.

Public Significance Statement
The Multidimensional Schizotypy Scale and Multidimensional Schizotypy Scale-Brief are self-report assessments that measure the risk for developing schizophrenia-spectrum disorders in the future. This study found that the scales are not biased against East Asian, Southeast Asian, Hispanic, Multiracial, or White participants and can be used in all of these populations.

Keywords: Wisconsin Schizotypy Scales, measurement invariance, Personality Inventory for *DSM–5*, exploratory structural equation modeling, item response theory

Supplemental materials: http://dx.doi.org/10.1037/pas0000798.supp

Schizotypy represents the latent liability for schizophrenia-spectrum psychopathology and is manifested across a broad range of conditions from individual differences to subclinical and clinical disorders (Kwapil & Barrantes-Vidal, 2012, 2015; Lenzenweger, 2006; Meehl, 1962). Schizotypy is a multidimensional construct typically characterized by positive (psychotic-

This article was published Online First January 16, 2020.

Lilian Y. Li, Department of Psychological Science, University of California, Irvine; Monet S. Meyer, Department of Psychology, University of Hawaii at Manoa; Elizabeth A. Martin, Department of Psychological Science, University of California, Irvine; Georgina M. Gross, VA Connecticut Healthcare System, West Haven, Connecticut, and Yale University School of Medicine, Yale University; Thomas R. Kwapil, Department of Psychology, University of Illinois at Urbana-Champaign, and Department of Psychology, University of North Carolina at Greensboro; David C. Cicero, Department of Psychology, University of North Texas.

The research reported in this article was not funded.

Correspondence concerning this article should be addressed to David C. Cicero, Department of Psychology, University of North Texas, 1155 Union Circle #311280, Denton, TX 76203-5017. E-mail: david.cicero@unt.edu

like experiences), negative (diminution in experiences), and disorganized dimensions (Fonseca-Pedrero, Debbané, et al., 2018; Kwapil & Barrantes-Vidal, 2015). Research on schizotypy offers a window into identifying the mitigating and aggravating factors that contribute to vulnerability for schizophrenia-spectrum disorders. At the same time, nonclinical schizotypy serves as a model for understanding the expression and etiology of schizophrenia without the confounds of patient research, such as medication and hospitalization (Barrantes-Vidal, Grant, & Kwapil, 2015).

The Multidimensional Schizotypy Scale (MSS; Kwapil, Gross, Silvia, Raulin, & Barrantes-Vidal, 2018) and its brief version, Multidimensional Schizotypy Scale-Brief (MSS-B; Gross, Kwapil, Raulin, Silvia, & Barrantes-Vidal, 2018), were recently developed in an effort to provide conceptually based and psychometrically sound assessment of positive, negative, and disorganized schizotypy dimensions. Unlike many other questionnaire measures of schizotypy (Mason, 2015), the MSS and MSS-B comprehensively assess the three schizotypy dimensions and were developed using modern measurement models including item response theory (IRT) and differential item functioning (DIF). Initial derivation studies reported excellent psychometric properties, including high reliability, high item discrimination, and minimal bias for sex and ethnicity (Gross, Kwapil, Raulin, et al., 2018; Kwapil, Gross, Silvia, et al., 2018). The subscales have good test–retest reliability, and there is good concordance of the analogous subscales of the MSS and MSS-B (Kemp, Gross, & Kwapil, 2019). In addition, accumulating evidence supports the construct validity of MSS and MSS-B. For example, the Positive, Negative, and Disorganized subscales of the MSS and MSS-B are strongly associated with the corresponding positive (cognitive-perceptual), negative (interpersonal), and disorganized factors of the Schizotypal Personality Questionnaire-Brief (SPQ-B), which is a widely used questionnaire measure of schizotypy (Gross, Kwapil, Burgin, et al., 2018; Kwapil, Gross, Burgin, et al., 2018). Furthermore, the MSS Positive, Negative, and Disorganized subscales are associated with differential patterns of interview-rated symptoms and impairment (Kemp, Bathery, Barrantes-Vidal, & Kwapil, 2019).

There are several analogous methods for examining whether a scale has the same psychometric properties among different groups of people (e.g., race/ethnicity, gender, age, etc.). These methods all involve evaluating the invariance of item performance between groups after controlling for differences on the underlying construct, but the advantages and disadvantages of the methods vary based on features of the scales and the underlying structure of the construct. Two common techniques are DIF and measurement invariance analyses. In the current research, we chose DIF within an IRT framework for several reasons. Akin to factor analysis (FA) for categorical variables, IRT includes two parameters that are commonly termed discrimination (factor loadings in FA) and difficulty (intercepts in FA). The MSS and MSS-B were designed to be unidimensional measures of each of the three dimensions of schizotypy with binary indicators. IRT analyses assume unidimensionality of the data, and allow for examining uniform DIF (i.e., equivalence of difficulty/intercepts) and nonuniform DIF (i.e., equivalence of discrimination/factor loadings). This approach to testing DIF also has advantages of providing more precise estimates through its use of latent trait as opposed to observed scores typically used in Mantel-Haenszel and logistic regression methods (Clauser & Mazor, 1998; MacIntosh & Hashim, 2003; B. Muthén, Kao, & Burstein, 1991). If the items are equivalent among groups, the items are said to lack DIF, whereas the equivalence among groups is indicated as the presence of measurement invariance in multigroup CFA analyses.

Examining the DIF of the MSS and MSS-B may be especially important because previous research has provided mixed results for whether items on existing scales function differently among groups. For example, a recent study with over 27,000 participants from 12 countries found that the SPQ-B had configural invariance, but lacked strong measurement invariance, which suggests that the scale is likely measuring the same construct across countries, but that observed scores might represent different latent levels of schizotypy across countries (Fonseca-Pedrero, Ortuño-Sierra, et al., 2018). This finding is consistent with other work suggesting the full SPQ has configural and metric invariance, but lacks scalar invariance in Asian, Pacific Islander, Multiracial, and White participants, which again suggests that the scale measures the same construct across groups, but that observed scores might represent different latent levels of schizotypy across groups (Cicero, 2016). Within a DIF framework, these findings are analogous to the presence of uniform but not nonuniform DIF. Moreover, the original Wisconsin Schizotypy Scales—another widely used measure of schizotypy—showed mixed evidence for DIF, with some studies showing bias against ethnic minorities, while others finding more of a balance (Cicero, Martin, & Krieg, 2019; Winterstein, Ackerman, Silvia, & Kwapil, 2011; Winterstein, Silvia, et al., 2011). Taken together, these results suggest that new measures of schizotypy need to be thoroughly evaluated for DIF before broad use with diverse populations.

As mentioned, the MSS and MSS-B were developed with IRT and DIF techniques, and biased items were systematically removed during test construction (Gross, Kwapil, Raulin, et al., 2018; Kwapil, Gross, Silvia, et al., 2018). As a result, preliminary evidence shows minimal DIF (i.e., measurement invariance) of the MSS and MSS-B items among select ethnicities (e.g., White, African American, Hispanic, and Asian). However, it is still unclear whether or to what extent DIF exists for other ethnicities (e.g., East Asian and Southeast Asian). Particularly, it is important to examine specific Asian subgroups, members of the fastest growing minority population in the United States (Pew Research Center, 2017), given the heterogeneity in terms of cultural practices, religious and spiritual affiliation, and mental health needs (U.S. Department of Health & Human Services, 2001). For instance, Southeast Asian refugees have been identified as at particularly high risk for developing posttraumatic stress disorder (Sue, Cheng, Saad, & Chu, 2012; U.S. Department of Health & Human Services, 2001), of which disorganized memory is considered a core feature (American Psychiatric Association, 2013). As a result, they might be more likely to report difficulties in organizing and expressing thoughts under the Disorganized Schizotypy subscale. Moreover, while Buddhism beliefs (e.g., ancestral spirits, spiritual energy, and reincarnation) are prevalent among Asian Ameri-

cans as a whole, they are held with greater commitment among Vietnamese Americans (Pew Research Center, 2012). This might lead to different interpretation of particular items in the Positive Schizotypy subscale (e.g., Item 10 of the MSS, "I believe that ghosts or spirits can influence my life."). Thus, testing DIF among Southeast Asian and East Asian subgroups is necessary in order to understand the extent to which the scales measure the same latent level of schizotypy across groups. Furthermore, it would be useful to replicate prior findings regarding lack of DIF across Hispanic and multiracial groups (Gross, Kwapil, Raulin, et al., 2018; Kwapil, Gross, Silvia, et al., 2018) in the current sample and compare their results with East Asian and Southeast Asian undergraduates in the same study.

At the same time, the MSS and MSS-B have been validated against other measures of schizotypy, but it is not known whether the construct validity of the scales is equivalent across ethnicities. That is, do the constructs measured by the MSS and MSS-B have the same meaning across ethnic groups? Note that a lack of DIF of the scales does not necessarily mean construct validity equivalence: The former refers to the properties of the scales, whereas the latter refers to the meaning of the construct assessed by the scales (Hui & Triandis, 1985). To this end, we examined the equivalence of the associations between MSS/MSS-B subscales and the Psychoticism and Detachment domains of the Personality Inventory for *DSM–5* (PID-5; Krueger, Derringer, Markon, Watson, & Skodol, 2012), which map onto positive and negative schizotypy, respectively (Grazioplene, Chavez, Rustichini, & DeYoung, 2016; Kotov et al., 2017).

The present study had two main goals. The first was to examine the DIF of the MSS and MSS-B across East Asian, Southeast Asian, Hispanic, Multiracial, and White undergraduate participants. The second was to examine the association between subscales of the MSS/MSS-B and the Psychoticism and Detachment domains of the PID-5 across the same ethnic groups to further assess construct validity of the MSS/MSS-B. We expected that the Positive and Negative Schizotypy subscales would be most strongly associated with Psychoticism and Detachment, respectively. Following previous research (Christensen, Gross, Golino, Silvia, & Kwapil, 2019; Gross, Kwapil, Raulin, et al., 2018; Kwapil, Gross, Silvia, et al., 2018), the Disorganized Schizotypy subscale would be moderately associated with both Psychoticism and Detachment.

Method

Participants

Participants were 2,057 students from a large Pacific public university and a large West Coast public university. Students were recruited from undergraduate psychology classes and received course credit in exchange for participation. The ethnic make-up of the sample included 989 Asian, 360 Hispanic, and 345 White students, and 230 students who identified with more than one race. The Asian group consisted of 567 East Asian (Chinese, Japanese, Korean, etc.), 71 South Asian (Indian, Pakistani, Sri Lankan, etc.), and 351 Southeast Asian (Vietnamese, Cambodian, Filipino, etc.). The 71 South Asian, 42 African American, 32 Pacific Islander, and 44 Native Hawaiian/American Indian/Alaskan Native students were excluded from the present analyses due to small group sample sizes. Fifteen additional participants were excluded due to missing ethnicity data. Of the remaining sample of 1,853 students, 73.3% identified as female. Seven students identified as neither male nor female, and 2 students declined to state their biological sex. Age ranged from 17 to 59 (M = 20.25, SD = 3.17). Thirty-two participants were missing age data. The current research was approved by University of Hawaii at Manoa and University of California, Irvine Institutional Review Boards.

Materials

Multidimensional Schizotypy Scale (MSS) and Multidimensional Schizotypy Scale-Brief (MSS-B). The MSS is a 77-item self-report scale designed to measure three dimensions of schizotypy through true–false questions (Kwapil, Gross, Silvia, et al., 2018). It is composed of 26 Positive Schizotypy items (Cronbach's alpha = .873), 26 Negative Schizotypy items (Cronbach's alpha = .858), and 25 Disorganized Schizotypy items (Cronbach's alpha = .937). To develop the MSS, Kwapil and colleagues followed the procedures outlined in DeVellis (2012), including generation of a large item pool and derivation of the final items after testing in large samples. Final items were selected based on content validity, and the results of classical test theory statistics (e.g., low endorsement frequency and high item-scale correlation within the schizotypy dimension), IRT statistics (e.g., high discrimination and difficulty values of approximately 0.5 to 2.5), and DIF across sex and ethnicity. During development, DIF was examined in individuals who identify as Caucasian, African American, Hispanic, Asian/Pacific Islander, Native American, or Other, but the sample was predominantly Caucasian. Items were removed from the original pool if they had elevated DIF. Of the 77 final items in the MSS, 10 were taken from existing scales, 8 were modified from existing scales, and the remainder were derived by Kwapil and colleagues based on the schizotypy literature. The MSS is intended for use in research settings, is validated for participants ages 18–59, and has an average reading grade level of 8.2.

The MSS-B is a shortened version of the MSS, with 13 Positive Schizotypy items (Cronbach's alpha = .764), 13 Negative Schizotypy items (Cronbach's alpha = .749), and 12 Disorganized Schizotypy items (Cronbach's alpha = .873; Gross, Kwapil, Raulin, et al., 2018). These items were derived from the MSS, and the two scales show comparable content coverage, psychometric properties, and subscale intercorrelations (Gross, Kwapil, Raulin, et al., 2018; Kemp et al., 2019). The MSS-B is also validated for participants ages 18–59 and has an average reading grade level of 8.7.

Both scales are scored by summing endorsement of answers that indicate schizotypy (including some reverse-scored items) within each subscale. Continuous scores are recommended for both scales, so the use of cut-off scores is not recommended.

Personality Inventory for *DSM–5* (PID-5). The PID-5 was developed in conjunction with the *Diagnostic and Statistical Manual of Mental Disorders*, Fifth Edition (American Psychiatric Association, 2013) to measure maladaptive personality facets associated with five personality domains. For the purpose of this study, participants completed the Detachment and Psychoticism domains only. The Detachment domain includes 24 items across 3

facets: Withdrawal, Anhedonia, and Intimacy Avoidance. The Psychoticism domain includes 33 items across 3 facets: Unusual Beliefs and Experiences, Eccentricity, and Perceptual Dysregulation. Each item is rated on a 4-point scale from *very false or often false* to *very true or often true.* The PID-5 is scored by averaging items across facets or domains of interest.

Data Analysis

All analyses were conducted with Mplus Version 8.1 (Muthén & Muthén, 2017). Data analyses were conducted separately for the three full subscales and the three brief subscales. The subscales of the MSS were designed to be unidimensional, and the original development studies confirmed a unidimensional structure (Gross et al., 2018; Kwapil et al., 2018). We first fit a unidimensional model to the data for each of the subscales. As recommended for categorical data (Brown, 2015; Muthén & Muthén, 2017), the models were fit using Maximum Likelihood with robust standard errors (MLR) and the categorical option to specify that the variables are binary. If the unidimensional model fit the data well, we proceeded to DIF analyses within a Multiple Indicators Multiple Causes (MIMIC) model framework, which is equivalent to a two-parameter IRT model with item thresholds corresponding to the difficulty parameter and factor loadings corresponding to the discrimination parameter (MacIntosh & Hashim, 2003; B. Muthén et al., 1991). If the unidimensional model did not fit the data well, we conducted the DIF analyses within an Exploratory Structural Equation Modeling (ESEM) framework as it provides flexibility in uncovering the underlying factor structure through exploratory FA. Following Hu and Bentler (1998), we used the following cutoffs for fit: (a) comparative fit index (CFI) $>$ .95 = excellent, $>$ .90 = acceptable, (b) Tucker-Lewis index (TLI) $>$ .95 = excellent, $>$ .90 = acceptable, and (c) root mean squared error of approximations (RMSEA) $<$ .05 = excellent, $<$ .10 = acceptable.

DIF analyses were conducted within a MIMIC framework for unidimensional scales. We tested for both uniform and nonuniform DIF. Uniform DIF examines whether there are differences in the difficulty parameter across groups (e.g., a scale's difficulty parameter may be biased against one ethnic group compared to another), while nonuniform DIF examines whether the differences between groups varies as a result of the latent level of the underlying trait (e.g., the observed bias may only occur in people with high or low levels of the latent trait). To test for uniform DIF, the unidimensional latent factor and all of the individual observed items were then regressed on the dummy coded ethnicity variables with White as the reference group. To test for nonuniform DIF, product variables of the latent trait by dummy coded ethnicity variables were created with the XWITH command in Mplus (Woods & Grimm, 2011), and the new variables were also regressed on the individual items.

To account for the multiple comparisons, we adjusted alpha for family-wise comparisons at $\alpha = .05/4 = .0125$ since there were four comparisons made for each item and the latent variables. In DIF analyses, Type II errors are arguably more problematic than Type I errors. Thus, we chose to adjust alpha only family-wise rather than experiment-wise, which would have required a much lower alpha to determine significant DIF.

In these analyses, White participants were arbitrarily chosen as the reference group. As a result, the reported item parameters can be interpreted as the parameters for the White participants, and the β values for each group are a comparison between the group and the White group.

We used Exploratory Structural Equation Modeling (Asparouhov & Muthén, 2009) for scales that were not found to be unidimensional. If the unidimensional model did not fit well, we conducted an exploratory FA, and used parallel analysis to determine how many factors to extract. Then, the factors and each individual item were regressed on the dummy coded ethnicity variables in the same way as the unidimensional MIMIC model described above.

In addition to the DIF analyses, we examined the construct validity equivalence of the MSS and MSS-B across ethnicities by testing whether the Positive, Negative, and Disorganized Schizotypy subscales had equivalent correlations with the Detachment and Psychoticism scales of the PID-5. We fit a total of 12 separate models in which the Detachment and Psychoticism scales were regressed on each of the full and brief subscales. In the first set of models, the regression weights were free to vary among ethnicities. In the second set of models, the regression weights were constrained to be equal across the five ethnicities. Since Mplus does not allow the use of the categorical option for MLR with multigroup analyses, we used WLSMV as the estimator for these analyses. The fit of the models was compared. If the model in which the regression weights were constrained did not fit significantly worse than the model in which they were free to vary across groups, then we would conclude that the variables had the same relations across groups. In contrast, if the constrained models fit significantly worse than the unconstrained models, then we would conclude that the relations among the variables differed across ethnic groups.

Results

As can be seen in Table 1, the single group unidimensional model fit the data well for both the full and the brief versions of the Positive Schizotypy and Disorganized Schizotypy subscales. Thus, we tested the DIF of these four scales within the MIMIC framework with a single factor. In contrast, the single group unidimensional model did not fit the data well for either the full or the brief versions of the Negative Schizotypy subscale. Thus, we conducted an ESEM to examine DIF for the full and brief Negative Schizotypy subscales.

DIF of the Full Scales

As can be seen in Table 2, none of the groups had significantly different total latent positive schizotypy scores in comparison to the White group. A total of 6 of the 26 items displayed uniform DIF. Of these items, 4 displayed bias with respect to Southeast Asian (Items 5, 7, 10, and 21), 2 with respect to Hispanic (Items 13 and 22), and 2 with respect to Multiracial participants (Items 5 and 13). Four of the 26 items had nonuniform DIF, including one that was biased against East Asian (Item 11), 2 with respect to Hispanic (Items 11 and 13), and 2 biased toward Multiracial participants (Items 18 and 21; Table 3). Although 6 items had uniform DIF (23.07%), only

Table 1
Single Group Unidimensional Fit Statistics for the Full and Brief Scales

Model	χ^2	*df*	RMSEA	90% CI	TLI	CFI	SRMR
Positive							
Full	1348.69	299	0.046	[0.043, 0.048]	0.919	0.926	0.074
Brief	273.95	65	0.044	[0.039, 0.049]	0.944	0.954	0.062
Negative							
Full	2310.09	299	0.064	[0.061, 0.066]	0.842	0.854	0.116
Brief	524.44	65	0.065	[0.060, 0.070]	0.860	0.883	0.099
Disorganized							
Full	1708.63	275	0.056	[0.053, 0.058]	0.961	0.964	0.062
Brief	339.44	54	0.056	[0.051, 0.062]	0.981	0.984	0.047

Note. *df* = degrees of freedom; RMSEA = root mean square error of approximation; CI = confidence interval; TLI = Tucker-Lewis index; CFI = comparative fit index; SRMR = standardized root mean square residual.

four were biased against any one group, which represents only 15.38% of the items on the scale. Since methodologists have suggested DIF in less than 20% of the items may not be problematic (Byrne, Shavelson, & Muthén, 1989), this suggests that the total scale scores can be compared among groups. Taken together, these results suggest that the Positive Schizotypy subscale is invariant among groups.

As can be seen in Table 4, East Asian participants had higher total latent disorganized schizotypy scores than White participants. No items had uniform or nonuniform DIF (see Table 5). Thus, overall, the Disorganized Schizotypy subscale is invariant among groups.

As mentioned, the unidimensional model of the full version of the Negative Schizotypy subscale did not fit the data well. Thus, we examined DIF of the scale within an ESEM framework. We first conducted an EFA, and a parallel analysis suggested that two factors should be extracted. Factor 1 maps onto affective anhedonia (Items 1, 6, 9, 13, 19, 22, 23, and 25), and Factor 2 maps onto social anhedonia (Items 2, 3, 4, 5, 7, 8, 10, 11, 12, 14, 15, 16, 17, 18, 20, 21, 24, and 26). As can be seen in Table 6, all four ethnic

Table 2
Uniform Differential Item Functioning (DIF) for the Full Positive Schizotypy Subscale by Ethnicity

		IRT		East Asian	Southeast Asian	Hispanic	Multiracial
Item	Percent endorsed	λ (*SE*)	τ (*SE*)	β (*SE*)	β (*SE*)	β (*SE*)	β (*SE*)
Total				0.25 (0.15)	0.23 (0.17)	0.23 (0.17)	0.08(0.19)
1	20.6	1.78 (0.13)	2.04 (0.11)	−0.06 (0.17)	0.05 (0.18)	0.16 (0.16)	−0.27 (0.25)
2	10.6	1.58 (0.13)	2.92 (0.14)	0.51 (0.22)	0.32 (0.26)	0.12 (0.27)	−0.09 (0.34)
3	16.6	1.34 (0.11)	2.11 (0.1)	0.10 (0.22)	0.43 (0.19)	0.25 (0.21)	0.37 (0.20)
4	12.0	1.85 (0.15)	2.98 (0.16)	0.13 (0.19)	−0.05 (0.22)	−0.57 (0.30)	−0.09 (0.27)
5	9.7	1.95 (0.17)	3.4 (0.19)	0.74 (0.31)	0.80 (0.31)*	0.54 (0.35)	0.86 (0.33)*
6	9.4	1.84 (0.16)	3.33 (0.18)	−0.08 (0.23)	−0.47 (0.33)	0.16 (0.23)	0.09 (0.30)
7	42.6	1.19 (0.09)	0.39 (0.06)	0.17 (0.11)	0.42 (0.13)*	0.19 (0.11)	−0.08 (0.18)
8	5.8	1.96 (0.22)	4.12 (0.27)	−0.10 (0.24)	−0.11 (0.29)	−0.30 (0.28)	−1.38 (0.65)
9	13.1	1.88 (0.15)	2.87 (0.16)	−0.08 (0.22)	0.08 (0.21)	−0.04 (0.22)	−0.20 (0.30)
10	27.0	1.35 (0.10)	1.34 (0.08)	0.22 (0.14)	0.35 (0.13)*	0.15 (0.15)	0.12 (0.21)
11	7.6	1.85 (0.17)	3.63 (0.21)	−0.16 (0.20)	−0.34 (0.27)	−0.82 (0.31)	−0.31 (0.31)
12	10.2	2.06 (0.18)	3.42 (0.2)	0.05 (0.24)	0.07 (0.27)	−0.09 (0.29)	0.22 (0.27)
13	10.6	1.46 (0.13)	2.83 (0.14)	0.53 (0.27)	0.56 (0.28)	0.86 (0.23)*	0.80 (0.25)*
14	28.8	1.57 (0.11)	1.31 (0.09)	0.35 (0.15)	0.35 (0.16)	0.20 (0.17)	0.25 (0.18)
15	25.2	1.06 (0.08)	1.33 (0.07)	−0.01 (0.14)	0.08 (0.12)	0.06 (0.13)	−0.09 (0.20)
16	24.5	1.44 (0.11)	1.55 (0.09)	−0.09 (0.15)	−0.05 (0.16)	−0.08 (0.16)	0.01 (0.15)
17	17.0	1.63 (0.12)	2.27 (0.12)	−0.03 (0.21)	0.26 (0.18)	−0.05 (0.22)	0.28 (0.19)
18	8.4	2.40 (0.22)	4.08 (0.26)	−0.23 (0.31)	0.05 (0.33)	−0.12 (0.31)	0.43 (0.24)
19	20.1	1.18 (0.09)	1.73 (0.09)	0.30 (0.16)	0.37 (0.18)	0.22 (0.16)	0.15 (0.18)
20	12.5	1.96 (0.16)	3.02 (0.17)	−0.41 (0.21)	0.17 (0.17)	−0.34 (0.26)	−0.10 (0.28)
21	55.2	1.40 (0.10)	−0.27 (0.07)	0.05 (0.11)	0.36 (0.12)*	0.11 (0.11)	−0.01 (0.22)
22	19.6	1.12 (0.10)	1.74 (0.09)	0.30 (0.18)	0.36 (0.18)	0.46 (0.17)*	0.33 (0.20)
23	8.6	2.67 (0.25)	4.33 (0.30)	0.11 (0.35)	0.25 (0.39)	0.15 (0.36)	0.36 (0.35)
24	23.3	1.33 (0.10)	1.57 (0.09)	−0.08 (0.16)	0.19 (0.17)	0.11 (0.13)	0.07 (0.19)
25	15.6	2.02 (0.16)	2.69 (0.15)	−0.06 (0.21)	0.03 (0.22)	−0.13 (0.23)	−0.27 (0.29)
26	19.9	1.59 (0.12)	1.98 (0.11)	0.14 (0.43)	0.74 (0.39)	0.29 (0.47)	0.68 (0.44)

Note. Reference group is White. Percent Endorsed = the percentage of the total sample endorsing the item; IRT = item response theory; λ = discrimination; τ = difficulty; β = regression weight; *SE* = standard error.
* $p < .0125$.

Table 3
Non-Uniform Differential Item Functioning (DIF) for the Full Positive Schizotypy Subscale by Ethnicity

	East Asian	Southeast Asian	Hispanic	Multiracial
Item	β (*SE*)	β (*SE*)	β (*SE*)	β (*SE*)
1	0.31 (0.36)	0.12 (0.4)	0.07 (0.38)	0.43 (0.55)
2	−0.40 (0.48)	−0.05 (0.53)	−0.21 (0.53)	0.49 (0.73)
3	−0.03 (0.43)	−0.64 (0.4)	−0.21 (0.42)	−0.48 (0.44)
4	0.20 (0.42)	0.32 (0.47)	1.11 (0.59)	0.26 (0.61)
5	−0.80 (0.73)	−1.06 (0.75)	−0.90 (0.77)	−1.16 (0.81)
6	0.19 (0.47)	0.66 (0.64)	−0.34 (0.49)	0.04 (0.69)
7	0.26 (0.25)	0.42 (0.30)	0.11 (0.26)	0.73 (0.37)
8	0.38 (0.58)	0.35 (0.69)	0.72 (0.63)	3.41 (2.25)
9	0.41 (0.43)	−0.07 (0.45)	−0.08 (0.46)	0.25 (0.63)
10	0.26 (0.29)	0.001 (0.30)	0.28 (0.31)	0.85 (0.45)
11	1.18 (0.39)*	1.21 (0.53)	1.60 (0.59)*	0.53 (0.69)
12	0.17 (0.50)	0.43 (0.57)	0.15 (0.58)	−0.43 (0.61)
13	−0.66 (0.57)	−1.12 (0.59)	−1.43 (0.55)*	−1.47 (0.60)
14	−0.36 (0.37)	−0.45 (0.39)	−0.37 (0.39)	−0.40 (0.44)
15	0.08 (0.28)	−0.66 (0.27)	−0.25 (0.29)	0.28 (0.41)
16	0.25 (0.34)	0.16 (0.37)	0.12 (0.37)	−0.38 (0.37)
17	0.19 (0.44)	−0.58 (0.42)	−0.07 (0.45)	−0.45 (0.45)
18	0.33 (0.72)	−0.32 (0.79)	0.2 (0.76)	−1.81 (0.62)*
19	0.03 (0.31)	0.21 (0.35)	−0.26 (0.32)	−0.17 (0.37)
20	0.87 (0.47)	−0.22 (0.42)	0.70 (0.59)	0.50 (0.75)
21	0.15 (0.28)	0.05 (0.32)	0.14 (0.3)	1.33 (0.51)*
22	−0.64 (0.37)	−0.68 (0.39)	−0.71 (0.39)	−0.53 (0.43)
23	0.01 (0.80)	−0.26 (0.93)	−0.64 (0.81)	−1.27 (0.89)
24	0.58 (0.30)	0.54 (0.33)	−0.05 (0.29)	0.59 (0.39)
25	0.05 (0.51)	−0.47 (0.53)	0.02 (0.55)	0.24 (0.71)
26	−0.10 (0.41)	−0.72 (0.41)	−0.03 (0.46)	−0.48(0.47)

Note. Reference group is White. β = regression weight; *SE* = standard error.
* $p < .0125$.

groups had higher latent negative schizotypy scores on Factor 2 than White participants. Only one item had DIF in comparison to White participants (Item 19 in Multiracial participants). Thus, conditioning on the two factors, the full version of the Negative Schizotypy subscale is invariant among groups.

To further examine the reliability and validity of the Negative Schizotypy factors, we calculated the internal consistency, mean, standard deviation, skewness, and kurtosis of the factors, and found that they were similar to the full Negative subscale (see Table 1 in the online supplemental materials). As can be seen in Supplemental Table 2, both factors of the Negative subscale are significantly correlated with the Detachment, Anhedonia, Withdrawal, and Intimacy Avoidance scales of the PID-5. The Affective Anhedonia factor was more strongly associated with the Anhedonia scale, while the Social Anhedonia factor was more strongly associated with the Withdrawal and Intimacy Avoidance scales.

DIF of the Brief Scales

As can be seen in Supplemental Table 3, the groups did not differ in total latent brief positive schizotypy scores. None of the items had uniform (see Supplemental Table 3) or nonuniform DIF across groups (see Supplemental Table 4).

East Asian, Southeast Asian, and Hispanic participants had higher total latent brief disorganized schizotypy scores than White participants (see Supplemental Table 5). Only two items had uniform DIF (Item 9 in East Asian participants and Item 21 in Southeast Asian participants), and one item had nonuniform DIF (Item 21 in Southeast Asian; see Supplemental Table 6).

Since the brief Negative Schizotypy subscale did not have a unidimensional structure, we examined the DIF of the scale within an ESEM framework. The groups did not differ in total latent brief negative schizotypy scores (see Supplemental Table 7). One item had DIF among groups (Item 15 in the Southeast Asian group). Thus, all three brief scales are invariant across groups.

Mean Comparisons of Manifest Scores

As can be seen in Supplemental Table 8, scores varied across the five ethnicities for all six scales as well as the factors of the Negative scale. However, all of these differences had small effect sizes.

Validity Indicators

Next, we examined whether the relations among the MSS/MSS-B scores and the Detachment and Psychoticism scores of the PID-5 were equivalent across ethnic groups. As can be seen in Supplemental Tables 9 and 10, the models with PID-5 Detachment and Psychoticism regressed on the full and brief versions of the scales fit the data well. Moreover, the models in which Detachment and Psychoticism were constrained to be equal across all groups did not fit the data significantly worse than did the models in which the relations were free to vary across groups. This suggests that the relations between the MSS and PID-5 Psychoticism and Detachment scores are equivalent in these ethnic groups. As can be seen in Table 7, the Positive, Negative, and Disorganized MSS scores were significantly associated with both Psychoticism and Detachment PID-5 scores in all groups (with the exception of Factor 1 of the Negative MSS and Psychoticism in Southeast Asian and Hispanic participants). A similar pattern emerged with the brief scores, except Factor 1 of the Negative MSS was not significantly associated with Psychoticism PID-5 scores in East Asian, Southeast Asian, Hispanic, or Multiracial participants (see Table 8).

Discussion

Schizotypy offers a useful construct for understanding the development and expression of schizophrenia-spectrum psychopathology. Psychometric assessment provides a promising method for tapping multidimensional schizotypy. However, many extant measures of schizotypy suffer from psychometric issues such as DIF that limit their applicability to different racial/ethnic groups. The present study is the first to comprehensively assess DIF of the MSS and MSS-B in East Asian, Southeast Asian, Hispanic, Multiracial, and White groups using an undergraduate sample from the United States. Overall, few of the items displayed significant DIF, which suggests that the Positive, Negative, and Disorganized subscales of both full and brief versions are equivalent across the ethnic groups assessed. This indicates that the scales measure the same latent level of schizotypy across groups, permitting mean comparisons of these groups. This is consistent with the scale

Table 4
Uniform Differential Item Functioning (DIF) for the Full Disorganized Schizotypy Subscale by Ethnicity

		IRT		East Asian	Southeast Asian	Hispanic	Multiracial
Item	Percent endorsed	λ (*SE*)	τ (*SE*)	β (*SE*)	β (*SE*)	β (*SE*)	β (*SE*)
Total				0.64 (0.19)*	0.47 (0.22)	0.42 (0.22)	0.36 (0.25)
1	14.0	3.19 (0.26)	3.90 (0.26)	−1.89 (1.22)	−0.66 (1.19)	0.40 (0.95)	−2.31 (1.91)
2	17.9	1.67 (0.12)	2.20 (0.11)	−0.03 (0.48)	−0.07 (0.56)	−0.16 (0.57)	−1.63 (0.95)
3	16.1	3.96 (0.33)	4.23 (0.31)	2.40 (2.63)	2.30 (2.76)	2.15 (2.83)	2.08 (2.95)
4	34.0	1.55 (0.10)	0.94 (0.08)	−0.39 (0.37)	−0.36 (0.46)	−0.13 (0.41)	−0.63 (0.56)
5	11.7	2.55 (0.19)	3.67 (0.21)	0.09 (1.00)	0.69 (1.04)	−0.64 (1.21)	0.08 (1.15)
6	29.9	1.63 (0.11)	1.24 (0.09)	−0.72 (0.42)	−0.35 (0.45)	−0.77 (0.54)	−0.52 (0.51)
7	14.3	2.77 (0.21)	3.48 (0.21)	0.37 (0.94)	−0.46 (1.29)	−0.34 (1.26)	1.38 (1.00)
8	32.1	1.92 (0.12)	1.19 (0.09)	−0.77 (0.55)	−0.51 (0.58)	−0.33 (0.50)	−0.45 (0.50)
9	30.8	2.17 (0.14)	1.39 (0.10)	0.34 (0.53)	−0.06 (0.71)	0.12 (0.65)	−0.55 (0.86)
10	15.8	2.26 (0.15)	2.84 (0.15)	−0.71 (0.66)	0.36 (0.68)	−0.64 (0.83)	−0.60 (0.95)
11	21.4	3.44 (0.26)	3.04 (0.22)	0.003 (1.20)	1.11 (1.18)	−0.96 (1.47)	−0.49 (1.71)
12	23.6	2.76 (0.18)	2.34 (0.15)	−0.04 (0.70)	−1.14 (1.15)	−0.09 (0.86)	0.35 (0.80)
13	12.0	3.42 (0.28)	4.48 (0.31)	−0.48 (1.21)	−1.27 (1.70)	−0.73 (1.42)	−1.82 (2.53)
14	12.7	1.94 (0.14)	2.97 (0.15)	−1.00 (0.71)	0.19 (0.68)	−0.18 (0.76)	−0.66 (0.96)
15	17.6	2.41 (0.16)	2.75 (0.16)	0.26 (0.69)	−0.29 (0.85)	−0.09 (0.84)	−0.77 (0.96)
16	18.8	2.45 (0.17)	2.64 (0.15)	0.09 (0.73)	−0.48 (1.03)	0.20 (0.83)	−0.17 (0.92)
17	18.2	1.91 (0.13)	2.33 (0.13)	−0.54 (0.62)	0.30 (0.60)	−0.10 (0.58)	−2.25 (1.30)
18	34.2	1.64 (0.11)	0.96 (0.08)	−0.21 (0.40)	−0.24 (0.54)	0.29 (0.40)	−0.44 (0.60)
19	15.1	3.57 (0.27)	4.06 (0.27)	0.51 (1.24)	0.76 (1.45)	0.81 (1.39)	−0.51 (2.16)
20	14.1	2.63 (0.20)	3.38 (0.20)	0.62 (1.00)	−0.29 (1.32)	1.21 (1.06)	0.47 (1.33)
21	21.7	3.10 (0.21)	2.76 (0.18)	−1.38 (0.88)	−2.32 (1.41)	−0.42 (0.87)	−0.55 (0.89)
22	11.1	3.51 (0.29)	4.75 (0.32)	−1.34 (1.15)	−3.67 (1.83)	−1.98 (1.56)	−3.72 (2.46)
23	11.1	2.35 (0.17)	3.57 (0.19)	0.73 (1.14)	1.44 (1.16)	0.96 (1.14)	1.24 (1.25)
24	13.7	4.22 (0.35)	4.94 (0.36)	9.83 (6.31)	7.93 (6.43)	6.34 (6.48)	8.7 (6.43)
25	14.6	1.24 (0.11)	2.22 (0.11)	0.96 (0.47)	0.69 (0.50)	0.53 (0.51)	1.04 (0.50)

Note. Reference group is White. Percent Endorsed = the percentage of the total sample endorsing the item; IRT = item response theory; λ = discrimination τ = difficulty; β = regression weight; *SE* = standard error.
* $p < .0125$.

development procedures and findings from the validation studies. However, the derivation samples were limited in their diversity and highlighted the need for ongoing assessment of the scales' psychometric properties in racially and ethnically diverse samples. Both the full and brief scale also showed equivalent associations with Psychoticism and Detachment scales of the PID-5 across groups, providing further evidence of construct validity of the MSS and MSS-B in these diverse groups.

That MSS and MSS-B lacked significant DIF in the current study lends support to their psychometric properties in diverse populations. The Positive Schizotypy subscale of the MSS showed the greatest amount of DIF, with six items displaying uniform DIF and four items displaying nonuniform DIF. Nonetheless, less than four items (15.38%) were biased against any one ethnic group, which does not suggest problematic scale contamination based on simulation studies (Rouquette, Hardouin, & Coste, 2016). At the same time, the brief version of the Positive Schizotypy subscale did not contain any items with uniform or nonuniform DIF. Thus, the pruning strategy used by Gross and colleagues (2018) appears successful in limiting DIF, even when Asian subgroups were not specifically considered in the study. It is worth noting that the success of MSS and MSS-B in achieving a lack of items with DIF stems from the scale developers' close attention in ensuring cross-cultural generalizability during test construction. Specifically, the scale developers employed a large and diverse derivation sample as well as modern measurement tools (i.e., IRT and DIF), which are not typically utilized in developing other questionnaire measures of schizotypy. Our findings reinforced the value of good scale development procedures that consider eliminating item bias across ethnic groups.

We found that ethnic groups differed in their latent levels of negative and disorganized schizotypy, which suggests that there might be genuine group differences in schizotypy. For the full version of the Negative subscale as well as full and brief versions of the disorganized subscales, ethnic minorities were found to display greater levels of latent schizotypy compared to White participants. This is particularly true for the East Asian group, in which we found evidence for greater levels on all three schizotypy subscales. Our results are consistent with previous findings of ethnic differences across other questionnaire measures of schizotypy (Chmielewski, Fernandes, Yee, & Miller, 1995; Cicero, 2016; Cicero et al., 2019), as well as the elevated rates of schizophrenia-spectrum disorders observed among ethnic minorities (Fearon et al., 2006; Morgan & Hutchinson, 2010; Veling, 2013). This finding, however, is in contrast to the original derivation study, which did not observe any mean-level differences between ethnic groups (Kwapil, Gross, Silvia, et al., 2018). It is possible that the derivation study, through having a combined Asian/Pacific Islander group, might have masked subtle differences between Asian subgroups. Our findings underscore the importance of examining specific Asian subgroups in future examinations of cross-cultural measurement equivalence.

Contrary to the full scale, ethnic groups did not differ in their latent levels of negative schizotypy as measured by the brief scale.

Table 5
Non-Uniform Differential Item Functioning (DIF) for the Full Disorganized Schizotypy Subscale by Ethnicity

Item	East Asian β (*SE*)	Southeast Asian β (*SE*)	Hispanic β (*SE*)	Multiracial β (*SE*)
1	1.35 (0.80)	1.46 (0.84)	0.44 (0.72)	1.97 (1.24)
2	−0.19 (0.37)	0.21 (0.41)	0.22 (0.42)	0.82 (0.61)
3	−2.52 (2.03)	−1.6 (2.12)	−1.76 (2.15)	−1.82 (2.24)
4	0.003 (0.31)	0.32 (0.36)	0.11 (0.34)	0.44 (0.43)
5	0.001 (0.63)	0.13 (0.65)	0.48 (0.74)	0.07 (0.76)
6	0.09 (0.31)	0.17 (0.34)	0.62 (0.38)	0.08 (0.39)
7	−0.59 (0.62)	0.60 (0.84)	0.38 (0.81)	−1.09 (0.70)
8	0.73 (0.35)	0.68 (0.39)	0.38 (0.37)	−0.14 (0.37)
9	−0.07 (0.40)	0.56 (0.50)	0.45 (0.46)	0.67 (0.58)
10	0.25 (0.42)	0.12 (0.47)	0.87 (0.55)	0.40 (0.62)
11	−0.46 (0.93)	−0.65 (0.96)	0.28 (1.08)	0.29 (1.25)
12	−0.34 (0.50)	1.12 (0.80)	0.41 (0.63)	−0.61 (0.57)
13	−0.27 (0.80)	0.88 (1.08)	0.44 (0.93)	0.85 (1.61)
14	0.14 (0.47)	−0.20 (0.48)	0.30 (0.53)	0.24 (0.64)
15	−0.15 (0.46)	0.47 (0.55)	0.31 (0.56)	0.22 (0.66)
16	−0.50 (0.55)	0.81 (0.72)	−0.15 (0.62)	−0.12 (0.67)
17	0.26 (0.41)	0.06 (0.42)	−0.05 (0.42)	1.41 (0.83)
18	0.03 (0.31)	0.61 (0.39)	−0.003 (0.34)	0.51 (0.45)
19	−0.62 (0.90)	−0.09 (1.06)	−0.60 (1.02)	0.05 (1.46)
20	−1.22 (0.79)	−0.02 (0.95)	−0.96 (0.83)	−0.99 (0.97)
21	0.37 (0.58)	2.25 (1.02)	0.41 (0.62)	−0.05 (0.61)
22	0.09 (0.73)	2.03 (1.11)	0.79 (0.98)	1.79 (1.44)
23	−0.56 (0.75)	−0.50 (0.78)	−0.55 (0.77)	−0.68 (0.82)
24	−8.32 (5.00)	−5.99 (5.10)	−5.96 (5.10)	−7.59 (5.06)
25	−0.64 (0.40)	−0.70 (0.41)	−0.15 (0.43)	−0.77 (0.45)

Note. Reference group is White. β = regression weight; *SE* = standard error.

One potential explanation is that the full version of the Negative subscale found differences due to higher precision in measurement. Nevertheless, careful steps were taken in the construction of the brief versions to ensure comparable content coverage compared to the full versions, and recent research suggests the scales are very highly correlated, even when measured at different time points (Kemp et al., 2019). At the same time, the nonsignificant group comparisons were in the same direction and similar in magnitude to the significant results, which suggests that despite the difference in significance, these results may not be meaningfully different. As the first study to directly compare full and brief versions in a cross-cultural context, findings of the current study are in need of replication before meaningful conclusion can be reliably drawn.

Despite ethnic groups displaying different latent levels of schizotypy, the groups showed equivalent relations to another schizotypy measure, thereby achieving construct validity equivalence. For all ethnic groups, the Positive Schizotypy subscales of the MSS and MSS-B were more highly associated with the Psychoticism domain, while the Negative Schizotypy subscales were relatively more highly associated with the Detachment domain. The Disorganized Schizotypy subscales were associated with both Psychoticism and Detachment domains. Our results are largely consistent with prior validation studies of MSS and MSS-B using the SPQ-B (Gross, Kwapil, Burgin, et al., 2018; Kwapil, Gross, Burgin, et al., 2018). At the same time, the association of disorganized schizotypy with positive and negative schizotypy is in line with the broader schizotypy literature (Kerns, 2006) suggesting that disorganization in cognition and behavior can manifest in both positive and negative symptoms.

It is important to note that while the subscales were originally designed to be unidimensional, the one-factor model did not fit the data well for both full and brief versions of the Negative Schizotypy subscale. Alternatively, our ESEM findings suggested a two-factor model consisting of affective anhedonia and social anhedonia. This result is consistent with another study of MSS conducted in an exploratory framework (Christensen et al., 2019), which found the same 8 items loading on one factor and the same 16 items on the other. Thus, the same two factors can be reliably extracted from different, diverse, samples. In addition, other measures of negative schizotypy also suggested a two-factor structure (Cicero et al., 2019). Furthermore, interview measures of negative symptoms in schizophrenia often yield a multidimensional structure, typically composed of factors related to affective and social dysfunction (i.e., diminished expression and anhedonia–asociality; Blanchard & Cohen, 2006). Collectively, findings imply that at the construct level, negative schizotypy may contain two (or more) distinct facets. This finding might pose challenges in using sum-score of the Negative Schizotypy subscale as well as other negative schizotypy measures as reflecting one underlying construct (e.g., analyzing the association of a single negative schizotypy score with other constructs or selecting a "high negative schizotypy group" using cut-offs based on the sum-score). Instead, emphasis should be made in uncovering the distinct subsets of symptoms and examining whether these facets relate to different etiologies and outcomes.

There are, however, several limitations in our study. First, our sample is limited to college students, which tend to have higher levels of functioning compared to the general population (Ross & Mirowsky, 1999). However, college education does not preclude liability for psychopathology, with numerous studies demonstrating similar prevalence of psychopathology among college students and same-age nonstudent peers (Auerbach et al., 2016; Blanco et al., 2008). Moreover, symptoms in the psychotic spectrum are not uncommon in the college population (Pedrelli, Nyer, Yeung, Zulauf, & Wilens, 2015). At the same time, college student samples offer three distinct advantages for assessing the MSS. First, they are at an ideal age as they are just entering the age of greatest risk for exhibiting schizophrenia-spectrum symptoms and developing schizophrenia-spectrum disorders. Second, many of the potential users of the MSS will conduct studies employing college student or young adult samples. Finally, the MSS is effective at identifying young adults enrolled in college who have schizophrenia-spectrum psychopathology (e.g., Kemp et al., 2019). Nevertheless, future studies could examine whether results of the current study generalize to samples drawn from the community or clinical settings.

Second, due to the small sample size for select ethnic groups (e.g., South Asian, Pacific Islander), we are unable to examine measurement equivalence for these groups. Future research could examine the DIF of these scales among the other ethnic groups. Moreover, the results of the current study may not generalize across other demographic variables such as sex, country of birth, or native language spoken, and future studies could examine DIF across these variables. Last, findings related to the construct validity of the scales are limited to self-report

Table 6
Exploratory Structural Equation Modeling of the Full Negative Schizotypy Subscale With Invariance Estimates by Ethnicity

Item	Percent endorsed	F1 (*SE*)	F2 (*SE*)	East Asian β (*SE*)	Southeast Asian β (*SE*)	Hispanic β (*SE*)	Multiracial β (*SE*)
F1				0.23 (0.26)	−0.18 (0.31)	0.18 (0.27)	0.27 (0.3)
F2				0.69 (0.13)*	0.66 (0.14)*	0.57 (0.14)*	0.41 (0.16)*
1	13.7	0.08 (0.05)	0.59 (0.05)	0.19 (0.14)	0.07 (0.15)	−0.12 (0.15)	−0.12 (0.17)
2	19.9	0.69 (0.04)	−0.15 (0.06)	0.02 (0.18)	−0.11 (0.23)	−0.22 (0.20)	−0.29 (0.22)
3	7.60	0.78 (0.05)	0.02 (0.07)	0.01 (0.20)	0.04 (0.26)	0.06 (0.21)	−0.27 (0.23)
4	13.1	0.70 (0.03)	0.01 (0.02)	0.34 (0.19)	0.15 (0.24)	−0.02 (0.21)	−0.15 (0.22)
5	11.3	0.44 (0.06)	0.30 (0.06)	−0.27 (0.17)	0.02 (0.19)	−0.01 (0.17)	−0.25 (0.20)
6	19.0	0.12 (0.05)	0.65 (0.04)	0.03 (0.12)	0.08 (0.13)	0.01 (0.13)	0.01 (0.15)
7	26.9	0.74 (0.04)	−0.22 (0.06)	−0.03 (0.19)	0.06 (0.24)	−0.10 (0.21)	−0.27 (0.23)
8	28.3	0.68 (0.04)	−0.03 (0.05)	0.07 (0.18)	0.19 (0.22)	0.15 (0.19)	−0.09 (0.22)
9	13.0	0.01 (0.01)	0.89 (0.02)	0.03 (0.12)	−0.03 (0.12)	0.04 (0.12)	−0.02 (0.14)
10	10.1	0.46 (0.06)	0.11 (0.06)	0.05 (0.16)	−0.13 (0.20)	−0.21 (0.18)	−0.30 (0.20)
11	8.90	0.61 (0.06)	0.14 (0.07)	−0.11 (0.18)	−0.08 (0.22)	−0.20 (0.20)	−0.46 (0.23)
12	12.3	0.77 (0.04)	−0.14 (0.06)	0.22 (0.19)	0.33 (0.24)	−0.11 (0.22)	−0.19 (0.23)
13	8.10	0.01 (0.06)	0.57 (0.05)	−0.07 (0.15)	−0.19 (0.16)	−0.05 (0.16)	−0.17 (0.19)
14	9.10	0.38 (0.06)	0.33 (0.06)	0.21 (0.17)	0.14 (0.20)	0.15 (0.19)	−0.15 (0.22)
15	15.7	0.33 (0.05)	0.33 (0.05)	0.10 (0.15)	0.29 (0.17)	0.20 (0.16)	0.01 (0.18)
16	12.3	0.75 (0.04)	0.02 (0.06)	0.05 (0.20)	−0.06 (0.26)	−0.10 (0.22)	−0.23 (0.24)
17	18.8	0.85 (0.04)	−0.17 (0.06)	0.04 (0.21)	0.21 (0.26)	−0.01 (0.23)	−0.19 (0.26)
18	13.1	0.43 (0.05)	0.31 (0.06)	0.06 (0.15)	0.09 (0.18)	−0.07 (0.16)	−0.20 (0.19)
19	14.0	0.05 (0.05)	0.85 (0.03)	−0.19 (0.10)	−0.21 (0.11)	−0.25 (0.11)	−0.38 (0.14)*
20	6.50	0.35 (0.07)	0.12 (0.07)	0.08 (0.15)	−0.03 (0.19)	−0.17 (0.17)	−0.24 (0.21)
21	10.0	0.61 (0.05)	0.30 (0.06)	−0.22 (0.18)	0.03 (0.21)	−0.11 (0.20)	−0.27 (0.22)
22	21.0	−0.02 (0.05)	0.83 (0.03)	0.01 (0.10)	−0.02 (0.11)	−0.01 (0.11)	−0.11 (0.14)
23	20.5	0.08 (0.05)	0.63 (0.04)	−0.14 (0.12)	−0.22 (0.13)	−0.30 (0.13)	−0.34 (0.15)
24	3.90	0.54 (0.07)	0.35 (0.07)	−0.20 (0.19)	0.16 (0.22)	−0.13 (0.20)	−0.37 (0.26)
25	14.8	−0.08 (0.04)	1.02 (0.03)	0.16 (0.23)	0.47 (0.23)	0.49 (0.23)	0.47 (0.28)
26	3.50	0.71 (0.06)	0.10 (0.08)	0.21 (0.27)	−0.35 (0.29)	0.01 (0.27)	0.31 (0.35)

Note. Reference group is White. Percent Endorsed = the percentage of the total sample endorsing the item; F1 = Factor 1 (affective anhedonia); F2 = Factor 2 (social anhedonia); β = regression weight; *SE* = standard error.
* $p < .0125$.

questionnaire measures, and more research is needed to validate the scales against interview measures of schizotypy symptoms.

As schizotypy scales are increasingly used in diverse populations, ensuring comparability between various ethnic groups should be a crucial starting point. As demonstrated in the current study, the newly developed MSS and MSS-B present promising psychometric properties cross-culturally, and thus may be a useful tool in assessing positive, negative, and disorganized schizotypy.

Table 7
Psychoticism and Detachment Regressed on the Full Positive, Negative, and Disorganized Schizotypy Subscales by Ethnicity

PID-5	Positive	Negative F1	Negative F2	Disorganized
White				
Psychoticism	0.65*	0.24*	0.21*	0.56*
Detachment	0.36*	0.40*	0.39*	0.48*
East Asian				
Psychoticism	0.70*	0.17*	0.20*	0.63*
Detachment	0.34*	0.46*	0.41*	0.47*
Southeast Asian				
Psychoticism	0.65*	0.01	0.40*	0.61*
Detachment	0.44*	0.28*	0.20*	0.51*
Hispanic				
Psychoticism	0.71*	0.01	0.48*	0.64*
Detachment	0.40*	0.38*	0.43*	0.48*
Multiracial				
Psychoticism	0.65*	0.19*	0.27*	0.54*
Detachment	0.38*	0.45*	0.31*	0.43*

Note. PID-5 = Psychoticism and Detachment domains of the Personality Inventory for *DSM–5*. Numbers are standardized β values.
* $p < .05$.

Table 8
Psychoticism and Detachment Regressed on the Brief Positive, Negative, and Disorganized Schizotypy Subscales by Ethnicity

PID-5	Positive	Negative F1	Negative F2	Disorganized
White				
Psychoticism	0.61*	0.24*	0.24*	0.55*
Detachment	0.32*	0.28*	0.51*	0.21*
East Asian				
Psychoticism	0.68*	0.13	0.26*	0.63*
Detachment	0.30*	0.37*	0.54*	0.46*
Southeast Asian				
Psychoticism	0.59*	−0.03	0.46*	0.62*
Detachment	0.35*	0.23*	0.60*	0.50*
Hispanic				
Psychoticism	0.72*	0.16	0.35*	0.64*
Detachment	0.33*	0.36*	0.44*	0.47*
Multiracial				
Psychoticism	0.67*	0.18	0.27*	0.56*
Detachment	0.38*	0.36*	0.42*	0.43*

Note. PID-5 = Psychoticism and Detachment domains of the Personality Inventory for *DSM–5*. Numbers are standardized β values.
* $p < .05$.

References

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: American Psychiatric Publishing.

Asparouhov, T., & Muthén, B. (2009). Exploratory structural equation modeling. *Structural Equation Modeling, 16,* 397–438. http://dx.doi.org/10.1080/10705510903008204

Auerbach, R. P., Alonso, J., Axinn, W. G., Cuijpers, P., Ebert, D. D., Green, J. G., . . . Bruffaerts, R. (2016). Mental disorders among college students in the World Health Organization World Mental Health Surveys. *Psychological Medicine, 46,* 2955–2970. http://dx.doi.org/10.1017/S0033291716001665

Barrantes-Vidal, N., Grant, P., & Kwapil, T. R. (2015). The role of schizotypy in the study of the etiology of schizophrenia spectrum disorders. *Schizophrenia Bulletin, 41,* S408–S416. http://dx.doi.org/10.1093/schbul/sbu191

Blanchard, J. J., & Cohen, A. S. (2006). The structure of negative symptoms within schizophrenia: Implications for assessment. *Schizophrenia Bulletin, 32,* 238–245. http://dx.doi.org/10.1093/schbul/sbj013

Blanco, C., Okuda, M., Wright, C., Hasin, D. S., Grant, B. F., Liu, S.-M., & Olfson, M. (2008). Mental health of college students and their non-college-attending peers: Results from the National Epidemiologic Study on Alcohol and Related Conditions. *Archives of General Psychiatry, 65,* 1429–1437. http://dx.doi.org/10.1001/archpsyc.65.12.1429

Brown, T. A. (2015). *Confirmatory factor analysis for applied research* (2nd ed.). New York, NY: Guilford Press.

Byrne, B. M., Shavelson, R. J., & Muthén, B. (1989). Testing for the equivalence of factor covariance and mean structures: The issue of partial measurement invariance. *Psychological Bulletin, 105,* 456–466. http://dx.doi.org/10.1037/0033-2909.105.3.456

Chmielewski, P. M., Fernandes, L. O. L. L., Yee, C. M., & Miller, G. A. (1995). Ethnicity and gender in scales of psychosis proneness and mood disorders. *Journal of Abnormal Psychology, 104,* 464–470. http://dx.doi.org/10.1037/0021-843X.104.3.464

Christensen, A. P., Gross, G. M., Golino, H. F., Silvia, P. J., & Kwapil, T. R. (2019). Exploratory graph analysis of the Multidimensional Schizotypy Scale. *Schizophrenia Research, 206,* 43–51.

Cicero, D. C. (2016). Measurement invariance of the schizotypal personality questionnaire in Asian, Pacific Islander, White, and multiethnic populations. *Psychological Assessment, 28,* 351–361. http://dx.doi.org/10.1037/pas0000180

Cicero, D. C., Martin, E. A., & Krieg, A. (2019). Differential item functioning of the Full and Brief Wisconsin Schizotypy Scales in Asian, White, Hispanic, and Multiethnic samples and between sexes. *Assessment, 26,* 1001–1013.

Clauser, B. E., & Mazor, K. M. (1998). Using statistical procedures to identify differentially functioning test items. *Educational Measurement: Issues and Practice, 17,* 31–44.

DeVellis, R. F. (2012). *Scale development: Theory and applications* (3rd ed.). Washington, DC: Sage.

Fearon, P., Kirkbride, J. B., Morgan, C., Dazzan, P., Morgan, K., Lloyd, T., . . . Murray, R. M. (2006). Incidence of schizophrenia and other psychoses in ethnic minority groups: Results from the MRC AESOP Study. *Psychological Medicine, 36,* 1541–1550. http://dx.doi.org/10.1017/S0033291706008774

Fonseca-Pedrero, E., Debbané, M., Ortuño-Sierra, J., Chan, R. C. K., Cicero, D. C., Zhang, L. C., . . . Jablensky, A. (2018). The structure of schizotypal personality traits: A cross-national study. *Psychological Medicine, 48,* 451–462. http://dx.doi.org/10.1017/S0033291717001829

Fonseca-Pedrero, E., Ortuño-Sierra, J., Lucas-Molina, B., Debbané, M., Chan, R. C. K., Cicero, D. C., . . . Voracek, M. (2018). Brief assessment of schizotypal traits: A multinational study. *Schizophrenia Research, 197,* 182–191. http://dx.doi.org/10.1016/j.schres.2017.10.043

Grazioplene, R. G., Chavez, R. S., Rustichini, A., & DeYoung, C. G. (2016). White matter correlates of psychosis-linked traits support continuity between personality and psychopathology. *Journal of Abnormal Psychology, 125,* 1135–1145. http://dx.doi.org/10.1037/abn0000176

Gross, G. M., Kwapil, T. R., Burgin, C. J., Raulin, M. L., Silvia, P. J., Kemp, K. C., & Barrantes-Vidal, N. (2018). Validation of the Multidimensional Schizotypy Scale-Brief in two large samples. *Journal of Psychopathology and Behavioral Assessment, 40,* 669–677. http://dx.doi.org/10.1007/s10862-018-9668-4

Gross, G. M., Kwapil, T. R., Raulin, M. L., Silvia, P. J., & Barrantes-Vidal, N. (2018). The Multidimensional Schizotypy Scale-Brief: Scale development and psychometric properties. *Psychiatry Research, 261,* 7–13. http://dx.doi.org/10.1016/j.psychres.2017.12.033

Hu, L. T., & Bentler, P. M. (1998). Fit indices in covariance structure modeling: Sensitivity to underparameterized model misspecification. *Psychological Methods, 3,* 424–453. http://dx.doi.org/10.1037/1082-989X.3.4.424

Hui, C. H., & Triandis, H. C. (1985). Measurement in cross-cultural psychology: A review and comparison of strategies. *Journal of Cross-Cultural Psychology, 16,* 131–152. http://dx.doi.org/10.1177/0022002185016002001

Kemp, K. C., Bathery, A. J., Barrantes-Vidal, N., & Kwapil, T. R. (2019). *Differential associations of positive, negative, and disorganized schizotypy with interview measures of symptoms and impairment*. Manuscript submitted for publication.

Kemp, K. C., Gross, G. M., & Kwapil, T. R. (2019). Psychometric properties of the Multidimensional Schizotypy Scale and Multidimensional Schizotypy Scale-Brief: Item and scale test–retest reliability and concordance of original and brief forms. *Journal of Personality Assessment*. Advance online publication. http://dx.doi.org/10.1080/00223891.2019.1591425

Kerns, J. G. (2006). Schizotypy facets, cognitive control, and emotion. *Journal of Abnormal Psychology, 115,* 418–427. http://dx.doi.org/10.1037/0021-843X.115.3.418

Kotov, R., Krueger, R. F., Watson, D., Achenbach, T. M., Althoff, R. R., Bagby, R. M., . . . Zimmerman, M. (2017). The Hierarchical Taxonomy of Psychopathology (HiTOP): A dimensional alternative to traditional nosologies. *Journal of Abnormal Psychology, 126,* 454–477. http://dx.doi.org/10.1037/abn0000258

Krueger, R. F., Derringer, J., Markon, K. E., Watson, D., & Skodol, A. E. (2012). Initial construction of a maladaptive personality trait model and inventory for *DSM–5*. *Psychological Medicine, 42,* 1879–1890. http://dx.doi.org/10.1017/S0033291711002674

Kwapil, T. R., & Barrantes-Vidal, N. (2012). Schizotypal personality disorder: An integrative review. In T. A. Widiger (Ed.), *The oxford handbook of personality disorders* (pp. 437–477). New York, NY: Oxford University Press.

Kwapil, T. R., & Barrantes-Vidal, N. (2015). Schizotypy: Looking back and moving forward. *Schizophrenia Bulletin, 41,* S366–S373. http://dx.doi.org/10.1093/schbul/sbu186

Kwapil, T. R., Gross, G. M., Burgin, C. J., Raulin, M. L., Silvia, P. J., & Barrantes-Vidal, N. (2018). Validity of the Multidimensional Schizotypy Scale: Associations with schizotypal traits and normal personality. *Personality Disorders: Theory, Research, and Treatment, 9,* 458–466. http://dx.doi.org/10.1037/per0000288

Kwapil, T. R., Gross, G. M., Silvia, P. J., Raulin, M. L., & Barrantes-Vidal, N. (2018). Development and psychometric properties of the Multidimensional Schizotypy Scale: A new measure for assessing positive, negative, and disorganized schizotypy. *Schizophrenia Research, 193,* 209–217. http://dx.doi.org/10.1016/j.schres.2017.07.001

Lenzenweger, M. F. (2006). Schizotypy: An organizing framework for schizophrenia research. *Current Directions in Psychological Science, 15,* 162–166. http://dx.doi.org/10.1111/j.1467-8721.2006.00428.x

MacIntosh, R., & Hashim, S. (2003). Variance estimation for converting MIMIC model parameters to IRT parameters in DIF analysis. *Applied Psychological Measurement, 27,* 372–379.

Mason, O. J. (2015). The assessment of schizotypy and its clinical relevance. *Schizophrenia Bulletin, 41,* S374–S385. http://dx.doi.org/10.1093/schbul/sbu194

Meehl, P. E. (1962). Schizotaxia, schizotypy, schizophrenia. *American Psychologist, 17,* 827–838. http://dx.doi.org/10.1037/h0041029

Morgan, C., & Hutchinson, G. (2010). The social determinants of psychosis in migrant and ethnic minority populations: A public health tragedy. *Psychological Medicine, 40,* 705–709. http://dx.doi.org/10.1017/S003329170800490X

Muthén, B., Kao, C.-F., & Burstein, L. (1991). Instructionally sensitive psychometrics: Application of a new IRT-based detection technique to mathematics achievement test items. *Journal of Educational Measurement, 28,* 1–22.

Muthén, L. K., & Muthén, B. O. (2017). *Mplus user's guide* (8th ed.). Los Angeles, CA: Author.

Pedrelli, P., Nyer, M., Yeung, A., Zulauf, C., & Wilens, T. (2015). College students: Mental health problems and treatment considerations. *Academic Psychiatry, 39,* 503–511. http://dx.doi.org/10.1007/s40596-014-0205-9

Pew Research Center. (2012). *Asian Americans: A mosaic of faiths*. Washington, DC: Author.

Pew Research Center. (2017). *Key facts about Asian Americans, a diverse and growing population*. Washington, DC: Author.

Ross, C. E., & Mirowsky, J. (1999). Refining the association between education and health: The effects of quantity, credential, and selectivity. *Demography, 36,* 445–460. http://dx.doi.org/10.2307/2648083

Rouquette, A., Hardouin, J. B., & Coste, J. (2016). Differential item functioning (DIF) and subsequent bias in group comparisons using a composite measurement scale: A simulation study. *Journal of Applied Measurement, 17,* 312–334.

Sue, S., Cheng, J. K. Y., Saad, C. S., & Chu, J. P. (2012). Asian American mental health: A call to action. *American Psychologist, 67,* 532–544. http://dx.doi.org/10.1037/a0028900

U.S. Department of Health and Human Services. (2001). *Mental health: Culture, race, and ethnicity—A supplement to Mental Health: A Report of the Surgeon General*. Washington, DC: Author.

Veling, W. (2013). Ethnic minority position and risk for psychotic disorders. *Current Opinion in Psychiatry, 26,* 166–171. http://dx.doi.org/10.1097/YCO.0b013e32835d9e43

Winterstein, B. P., Ackerman, T. A., Silvia, P. J., & Kwapil, T. R. (2011). Psychometric properties of the Wisconsin schizotypy scales in an undergraduate sample: Classical test theory, item response theory, and differential item functioning. *Journal of Psychopathology and Behavioral Assessment, 33,* 480–490. http://dx.doi.org/10.1007/s10862-011-9242-9

Winterstein, B. P., Silvia, P. J., Kwapil, T. R., Kaufman, J. C., Reiter-Palmon, R., & Wigert, B. (2011). Brief assessment of schizotypy: Developing short forms of the Wisconsin Schizotypy Scales. *Personality and Individual Differences, 51,* 920–924. http://dx.doi.org/10.1016/j.paid.2011.07.027

Woods, C. M., & Grimm, K. J. (2011). Testing for nonuniform differential item functioning with multiple indicator multiple cause models. *Applied Psychological Measurement, 35,* 339–361. http://dx.doi.org/10.1177/0146621611405984

Received May 8, 2019
Revision received November 25, 2019
Accepted December 3, 2019 ■