Validity of the multidimensional schizotypy scale: Associations with schizotypal traits and normal personality

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Abstract:

The present study provided the first examination of the construct validity of the Multidimensional Schizotypy Scale (MSS) and the first assessment of its psychometric properties outside of its derivation samples. The MSS contains 77 items that assess positive, negative, and disorganized schizotypy. A large multisite sample of 1,430 participants completed the MSS and measures of schizotypal personality traits and the five-factor model of personality. The MSS subscales had good-to-excellent internal consistency reliability that showed no shrinkage relative to the MSS derivation samples. The psychometric properties and intercorrelations of the MSS subscales were closely consistent with the derivation findings. The MSS Positive Schizotypy subscale had a strong association with cognitive–perceptual schizotypal traits (large effect), positive associations with personality traits of neuroticism and openness to experience, and negative associations with agreeableness. The MSS Negative Schizotypy subscale had a strong association with interpersonal schizotypal traits (medium effect) and negative associations with personality traits of extraversion, openness, and agreeableness. The MSS Disorganized Schizotypy subscale had a strong association with disorganized schizotypal traits (medium effect), a positive association with neuroticism, and a negative association with conscientiousness. The findings were consistent with the a priori predictions and support the construct validity of the MSS.

Keywords: schizotypy | schizotypal | personality | schizophrenia-spectrum | psychometric assessment

Article:

Current models of schizophrenia-spectrum disorders suggest that schizophrenia represents the most extreme manifestation of a continuum of clinical and subclinical symptoms and impairment often referred to as schizotypy (Kwapil & Barrantes-Vidal, 2012; Lenzenweger, 2010; Meehl, 1990). Schizotypy offers a useful construct for understanding the etiology, development, and expression of schizophrenia-spectrum psychopathology (Kwapil & Barrantes-Vidal, 2015). Moreover, schizotypy offers a unifying framework for encompassing a broad spectrum of

conditions including psychotic disorders, personality disorders, the prodrome, and subclinical expressions. The ability to identify nondisordered schizotypes should enhance our ability to detect and understand risk and resilience factors and allow us to examine etiological processes relatively unaffected by the often catastrophic and confounding consequences of schizophrenia, such as medication, hospitalization, and stigma.

Schizotypy, and by extension schizophrenia, is heterogeneous in terms of developmental progression, symptom expression, and treatment response. This heterogeneity can be captured in part by a multidimensional structure. Current models support the presence of positive, negative, and disorganized dimensions (American Psychiatric Association, 2013; Kwapil & Barrantes-Vidal, 2015; Mason & Claridge, 2006; Tandon, Nasrallah, & Keshavan, 2009; Vollema & van den Bosch, 1995). The positive dimension involves disruptions in the content of thought (ranging from odd beliefs to delusions), perceptual disturbances (including illusions and hallucinations), and paranoia. The negative dimension is characterized by alogia, anergia, avolition, anhedonia, flattened affect, and social disinterest. The disorganization dimension is characterized by disturbances in the ability to organize and express thoughts, speech, and behavior.

Questionnaire measures of schizotypy have proven especially useful for assessing schizotypic characteristics, especially in nonclinical samples (see reviews by Chapman, Chapman, & Kwapil, 1995; Kwapil & Chun, 2015; Mason, 2015; Mason, Claridge, & Williams, 1997). These measures tend to be inexpensive and noninvasive and can be used efficiently to screen large numbers of participants. Questionnaire measures of schizotypy effectively identify people with schizophrenic-like symptoms and impairment (Blanchard, Collins, Aghevli, Leung, & Cohen, 2011) and predict the development of schizophrenia-spectrum disorders (Kwapil, Gross, Silvia, & Barrantes-Vidal, 2013). However, many of the currently available measures suffer from limitations, including the lack of a multidimensional structure that maps onto current conceptual models, items that are outdated or biased, and psychometric shortcomings.

Multidimensional Schizotypy Scale

Kwapil, Gross, Silvia, Raulin, and Barrantes-Vidal (2018) recently developed the Multidimensional Schizotypy Scale (MSS) to assess current multidimensional formulations of schizotypy. The schizotypy items tap experiences that are characteristic of people with nonpsychotic schizotypy, schizotypal and schizoid personality disorder, and the schizophrenia prodrome, but do not assess full-blown psychotic symptoms such as hallucinations, delusions, or formal thought disorder that are tapped by measures such as the Personality Inventory for DSM-5 psychoticism scale (Krueger, Derringer, Markon, Watson, & Skodol, 2012). The MSS was built upon the strengths of existing psychometric measures of schizotypy and was specifically designed to address shortcomings of previous schizotypy questionnaires. The scale contains 77 true–false items that assess positive, negative, and disorganized schizotypy. The MSS was developed following procedures recommended by DeVellis (2012): (a) development of comprehensive trait specifications for the three schizotypy dimensions; (b) generation of a large pool of candidate items based on these specifications; (c) review of the items by expert and nonexpert reviewers; (d) repeated administrations of the candidate items to large and diverse samples from multiple sources (n = 6,265) interspersed with evaluation, modification, and dropping of items; (e) selection of final items based on content validity, classical test theory,

item response theory (IRT), and differential item functioning; and (f) evaluation of the psychometric properties of the items and subscales in a large independent, cross-validation sample (n = 1,000). The authors recommended that investigators use the individual subscale scores, not a total schizotypy score, given the multidimensional nature of the construct.

The MSS subscales have good-to-excellent internal consistency reliability (coefficient α was .89 for both the Positive and Negative Schizotypy subscales and .94 for the Disorganized Schizotypy subscale; Kwapil et al., 2018). The items have high discrimination based upon two-parameter logistic IRT models, and they exhibited minimal item bias for sex and ethnicity based on differential item functioning analyses using two-parameter logistic IRT models. Test information curves indicated that the subscales are maximally discriminating at higher levels of the traits. Positive and disorganized schizotypy scores did not differ by sex, although, as expected, negative schizotypy scores were slightly higher in men than women (a small effect size). Positive and negative schizotypy were modestly correlated, whereas disorganized schizotypy had moderate correlations with the other two dimensions. The psychometric properties of the subscales were invariant across their derivation and cross-validation samples. However, the scale developers did not examine the construct validity of the MSS.

Goals of the Present Study

The present study provides the first investigation of the construct validity of the MSS using questionnaire measures of schizotypal traits (the Schizotypal Personality Questionnaire—Brief; SPQ-B; Raine & Benishay, 1995) and normal personality dimensions (the NEO—Five-Factor Inventory; NEO-FFI; McCrae & Costa, 2010). The study follows the work of Gross, Mellin, Silvia, Barrantes-Vidal, and Kwapil (2014), who examined the associations of the Wisconsin Schizotypy Scales (Chapman, Chapman, & Raulin, 1976, 1978; Eckblad & Chapman, 1983; Eckblad, Chapman, Chapman, & Mishlove, 1982) with the Schizotypal Personality Questionnaire (SPQ; Raine, 1991), and NEO Personality Inventory—Revised (NEO-PI-R; Costa & McCrae, 1992). Our goal was to quantify the degree of overlap between the MSS and the SPQ-B as well as the unique elements of each scale. In addition, we wanted to identify traditional personality domains associated with the MSS and how they may differ from the alternative three-dimensional model of schizotypy (the SPQ-B).

The SPQ and SPQ-B were developed to assess schizotypal personality traits as defined by the *Diagnostic and Statistical Manual of Mental Disorders, Third Edition—Revised* (American Psychiatric Association, 1987). Thus, they tap aspects of schizotypy, although they were not designed to be a measure of schizotypy, per se. Both the SPQ and SPQ-B are reported to have three underlying factors that assess cognitive–perceptual, interpersonal, and disorganized aspects of schizotypal personality disorder (Fonseca-Pedrero et al., 2018). These SPQ dimensions are overlapping with, but not identical to, the positive, negative, and disorganized schizotypy dimensions. The cognitive–perceptual factor closely maps onto positive schizotypy, as it taps ideas of reference, odd beliefs, magical thinking, unusual perceptual experiences, and paranoid ideation. Gross et al. (2014) reported that the correlation between the Wisconsin Schizotypy Scales positive schizotypy factor and the SPQ cognitive–perceptual factor was .68. The SPQ interpersonal factor primarily assesses social discomfort and disinterest characteristic of schizotypal personality disorder. This factor partially overlaps with negative schizotypy, but it is

also characterized by neuroticism, social anxiety, and paranoia, which are not typically thought to be part of negative schizotypy. Furthermore, the SPQ interpersonal factor does not tap anhedonia, alogia, or avolition, which are thought to be core components of negative schizotypy. The SPQ disorganized factor reportedly taps odd behavior and odd speech. However, as noted by Gross et al. (2014), many of the SPQ disorganized items seem to tap oddness or eccentricity that may be secondary to positive schizotypy, rather than due to cognitive or behavioral disorganization. In the present study, it is hypothesized that the MSS Positive Schizotypy subscale will have the strongest relationship with the SPQ-B cognitive–perceptual factor (large effect size). Likewise, it is expected that the MSS Negative Schizotypy subscale will have the strongest association with the SPQ-B interpersonal factor, and that the MSS Disorganized Schizotypy subscale will have the strongest association with the SPQ-B disorganized factor. However, in the latter two cases, we expect that these will only be moderate effect sizes, given that the SPQ-B interpersonal and disorganized factors only partially tap negative and disorganized schizotypy, respectively.

The present study also examined the five-factor model composition of the MSS subscales. Kwapil, Barrantes-Vidal, and Silvia (2008) and Gross et al. (2014) reported that the Wisconsin Schizotypy Scales positive schizotypy factor was characterized by elevated neuroticism and openness to experience and diminished agreeableness and conscientiousness, whereas negative schizotypy was characterized by low extraversion, openness, and agreeableness. It is expected that the MSS Positive and Negative Schizotypy subscales will demonstrate these same patterns of associations, and that the MSS Disorganized Schizotypy subscale will be characterized by elevated neuroticism and poor conscientiousness.

Method

Participants

A total of 1,789 participants at three universities (University of North Carolina at Greensboro, Tennessee Tech University, and Youngstown State University) and on Amazon Mechanical Turk (MTurk) enrolled in the study. Usable data were obtained from 1,430 participants (616 [43%] from MTurk and 814 [57%] from college student samples). Participants were dropped for invalid (based on high infrequency scores, $n = 221$ or 12%) or incomplete ($n = 99$ or 6%) protocols. Following recommendations from Kwapil et al. (2018), 39 participants (2%) aged 60–89 years were omitted from the analyses because (a) the scales were developed on participants aged 18–59, (b) schizotypy studies primarily focus on younger participants at or near the age of greatest risk for developing schizophrenia-spectrum disorders, and (c) we wanted to avoid age-related cognitive disruptions interfering with the measurement of disorganized schizotypy. Among the usable participants, mean age was 26.5 years ($SD = 10.2$, range = 18–59 years), 65% were female, and 96% indicated that English was their first language. The sample reported the following racial/ethnic backgrounds: 12% Black, 4% Asian/Pacific Islander, 75% Caucasian, 6% Hispanic/Latino, 0.4% Native American, and 3.3% other. The sample included 532 participants aged 18–19 years, 462 aged 20–29 years, 256 aged 30–39 years, 101 aged 40–49 years, and 78 aged 50–59 years (with one subject not reporting age).

Materials

Participants completed demographic questions (age, sex, ethnicity, and English as first language), the MSS, the SPQ-B, and the NEO-FFI. The MSS contains 77 true–false items designed to assess positive, negative, and disorganized dimensions of schizotypy. The SPQ-B contains 22 items that tap schizotypal personality traits. Raine and Benishay (1995) reported that the SPQ-B has three factors that tap cognitive–perceptual, interpersonal, and disorganized aspects of schizotypal personality disorder. Raine (2001) reported that coefficient alpha reliability for the SPQ-B factors ranges from .72 to .80. The NEO-FFI contains 60 items that assess five domains of normal personality: neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness. McCrae and Costa (2010) reported that coefficient alpha reliability for the domains range from .78 to .86. A 13-item infrequency questionnaire (Chapman & Chapman, 1983) was included to screen out invalid responders. Participants who endorsed more than two infrequency items were omitted from the analyses.

Procedures

All participants completed the survey online using Qualtrics software. University students were recruited electronically and received course credit. MTurk participants were recruited via the MTurk website and received $1.00. The project received institutional review board approval at each institution. The survey began with the informed consent form and demographic items. The MSS, SPQ-B, and infrequency items (which all have a dichotomous item-response format) were intermixed and presented in six blocks administered in random order, followed by the NEO-FFI items (which were not intermixed with the other items because they have a 5-point Likert response format).

Results

Descriptive Statistics

Descriptive statistics for the MSS, SPQ-B, and the NEO-FFI are presented in Table 1 and are consistent with reports from other large samples (Kwapil et al., 2018; McCrae & Costa, 2010; Raine, 2001). The reliabilities for the MSS subscales were almost identical to values reported in the MSS derivation and cross-validation samples (Kwapil et al., 2018). Consistent with the findings from the derivation sample and our view that schizotypy and schizotypic experiences are relatively rare in the general population, mean endorsement rates for the three MSS subscales were relatively low (the average item endorsement rate was approximately 15%). Likewise, closely comparable with the derivation sample, 24% of participants did not endorse any positive schizotypy items, 25% did not endorse any negative schizotypy items, and 37% did not endorse any disorganized schizotypy items. Table 2 presents the zero-order correlations of the MSS, SPQ, and NEO-FFI subscales. To minimize Type I error and the likelihood of reporting statistically significant but inconsequential findings, α was set at .001 for all analyses due to the large sample size and number of analyses. Effect sizes are noted following Cohen (1992). Intercorrelations of the three MSS subscales were closely comparable with correlations for the MSS derivation and cross-validation samples. Furthermore, the correlation of neuroticism with the three MSS subscales was closely comparable with the correlations in Kwapil et al.'s derivation and cross-validation samples. Note that male and female participants did not differ on

the MSS positive, $t(1428) = 0.00$, $p = .99$, Cohen's $d = 0.00$, negative, $t(1428) = 2.56$, $p = .01$ Cohen's $d = 0.14$, or disorganized, $t(1428) = -1.48$, $p = .14$, Cohen's $d = 0.08$, schizotypy dimensions. Participant age was significantly, albeit modestly, correlated with positive schizotypy, $r = -.16$, $p < .001$, and disorganized schizotypy, $r = -.14$, $p < .001$, but not with negative schizotypy, $r = .05$, $p = .06$.

Table 1. Descriptive Statistics for the Multidimensional Schizotypy Scale, Schizotypal Personality Questionnaire—Brief, and NEO—Five-Factor Inventory (n = 1,430)

Criterion	*M*	*SD*	Range	Median	Interquartile range	Coefficient α
Multidimensional Schizotypy Scale						
Positive Schizotypy	3.80	4.41	0–25	2.00	5.00	.88
Negative Schizotypy	3.73	4.51	0–26	2.00	4.00	.88
Disorganized Schizotypy	3.92	5.55	0–25	1.00	5.00	.93
Schizotypal Personality Questionnaire—Brief						
Cognitive–Perceptual	3.04	2.18	0–8	3.00	4.00	.71
Interpersonal	3.88	2.38	0–8	4.00	4.00	.77
Disorganized	2.10	1.87	0–6	2.00	3.00	.74
NEO—Five-Factor Inventory						
Neuroticism	36.76	8.89	12–60	36.00	12.00	.88
Extraversion	39.44	7.69	14–28	40.00	11.00	.86
Openness to Experience	43.16	6.56	20–60	43.00	10.00	.79
Agreeableness	43.59	6.55	19–60	44.00	9.00	.78
Conscientiousness	43.43	7.39	18–60	44.00	9.00	.87

Table 2. Correlations of the Multidimensional Schizotypy Scale, Schizotypal Personality Questionnaire—Brief, and NEO—Five-Factor Inventory (n = 1,430)

	MSS-Pos	MSS-Neg	MSS-Dis	SPQ-CP	SPQ-I	SPQ-D	NEO-N	NEO-E	NEO-O	NEO-A
Multidimensional Schizotypy Scale										
Positive Schizotypy										
Negative Schizotypy	.19*									
Disorganized Schizotypy	**.47***	**.32***								
Schizotypal Personality Questionnaire										
Cognitive–Perceptual	***.73****	.16*	**.41***							
Interpersonal	**.34***	***.53****	**.43***	**.36***						
Disorganized	**.49***	**.37***	***.57****	**.47***	***.51****					
NEO—Five-Factor Inventory										
Neuroticism	**.40***	.24*	***.55****	**.44***	**.47***	**.45***				
Extraversion	−.09	***−.61****	−.22*	−.09	***−.60****	−.28*	**−.35***			
Openness to Experience	.24*	−.15*	.07	.21*	.02	.21*	.12*	.04		
Agreeableness	−.26*	**−.31***	−.17*	−.21*	−.23*	−.28*	−.19*	.13*	.16*	
Conscientiousness	−.22*	−.22*	***−.56****	−.24*	**−.30***	**−.38***	***−.54****	**.31***	−.05	.15*

Note. Medium effect sizes are in bold, and large effect sizes are in bold and italics. MSS-Pos = Multidimensional Schizotypy Scale—Positive Schizotypy; MSS-Neg = Multidimensional Schizotypy Scale—Negative Schizotypy; MSS-Dis = Multidimensional Schizotypy Scale—Disorganized Schizotypy; SPQ-CP = Schizotypal Personality Questionnaire—Cognitive–Perceptual; SPQ-I = Schizotypal Personality Questionnaire—Interpersonal; SPQ-D = Schizotypal Personality Questionnaire—Disorganized; NEO-N = NEO—Five-Factor Inventory—Neuroticism; NEO-E = NEO—Five-Factor Inventory— Extraversion; NEO-O = NEO—Five-Factor Inventory—Openness to Experience; NEO-A = NEO—Five-Factor Inventory—Agreeableness.
* $p < .001$.

Association of MSS and SPQ-B Factors

To examine the construct validity of the MSS subscales, we regressed each of the SPQ-B factor scores on the three MSS subscales (Table 3). Each row in the table represents a separate regression analysis in which the three MSS subscales were entered simultaneously as predictors to examine their unique prediction of each of the SPQ-B scores. The standardized regression coefficient (β), change in R^2, and effect size f^2 were reported for each predictor in the linear regressions. According to Cohen (1992), f^2 values above .15 are medium and above .35 are large

effect sizes. Note that f^2 and change in R^2 were computed for each predictor by rerunning the analyses with the specific MSS predictor entered at the second step, over and above the other two MSS subscales. As expected, each MSS subscale had its strongest association with the corresponding factor from the SPQ-B (in fact, the only medium or larger effect sizes were observed for those associations).

Table 3. Linear Regressions Examining Prediction by the Multidimensional Schizotypy Scale Factors (n = 1,430)

	MSS—Positive Schizotypy			MSS—Negative Schizotypy			MSS—Disorganized Schizotypy			
Criteria	β	ΔR^2	f^2	β	ΔR^2	f^2	β	ΔR^2	f^2	Total R^2
SPQ-B										
Cognitive–Perceptual	***.691****	***.372***	***.816***	.005	.000	.000	.086*	.005	.013	.543
Interpersonal	.148*	.017	.029	**.435***	**.170**	**.276**	.226*	.037	.060	.380
Disorganized	.279*	.060	.110	.196*	.034	.061	**.381***	**.105**	**.185**	.428
NEO-FFI										
Neuroticism	.175*	.024	.036	.070	.004	.006	**.444***	**.143**	**.213**	.329
Extraversion	.054	.002	.003	***−.598****	***.321***	***.511***	−.061	.003	.005	.372
Openness	.275*	.059	.065	−.206*	.038	.042	.006	.000	.000	.098
Agreeableness	−.214*	.036	.042	−.269*	.065	.075	.011	.000	.000	.136
Conscientiousness	.054	.002	.003	−.053	.002	.003	**−.570***	**.237**	**.347**	.320

Note. Medium effect sizes (f^2) are in bold, and large effect sizes are in bold and italics. Each row represents a separate regression analysis in which the three MSS factors were entered simultaneously as predictors to examine their unique prediction of each of the SPQ-B and NEO-FFI factor scores. MSS = Multidimensional Schizotypy Scale; SPQ-B = Schizotypal Personality Questionnaire—Brief; NEO-FFI = NEO—Five-Factor Inventory.
* $p < .001$.

Association of MSS and the Five-Factor Model Domains

We also simultaneously regressed each of the NEO-FFI domain scores on the three MSS subscales (Table 3). The results for positive and negative schizotypy mirror the findings from Kwapil et al. (2008) and Gross et al. (2014) for the Wisconsin Schizotypy Scales positive and negative schizotypy factors. Specifically, MSS positive schizotypy was associated with elevated neuroticism, elevated openness to experience, and low agreeableness. MSS negative schizotypy was associated with low extraversion (introversion), low openness to experience, and low agreeableness. MSS disorganized schizotypy had large loadings with elevated neuroticism and diminished conscientiousness.

For the sake of comparison, we also regressed each of the NEO-FFI domain scores on the three SPQ-B factors (Table 4). As expected, a notable difference between this analysis and the analysis of the MSS and the NEO-FFI is that the SPQ-B interpersonal factor showed significant overlap with neuroticism, whereas the MSS Negative Schizotypy subscale did not (highlighting a difference between negative schizotypy and the interpersonal factor). In fact, the SPQ-B interpersonal factor had the strongest association with neuroticism of all three SPQ-B factors. Consistent with the MSS findings, SPQ-B cognitive–perceptual and interpersonal factors had opposite loadings with openness to experience, albeit with smaller effect sizes. Notably, the SPQ-B disorganized factor had smaller loadings than MSS disorganized schizotypy with neuroticism and conscientiousness. Unlike the MSS, SPQ-B disorganized was positively associated with openness to experience, suggesting that it may load more on unusualness of ideas and behavior, than actual disorganization.

Table 4. Linear Regressions Examining Prediction by the Schizotypal Personality Questionnaire—Brief Factors (n = 1,430)

	SPQ-Cognitive–Perceptual			SPQ-Interpersonal			SPQ-Disorganized			
Criteria	β	ΔR^2	f^2	β	ΔR^2	f^2	β	ΔR^2	f^2	Total R^2
NEO-FFI										
Neuroticism	.243*	.045	.067	.278*	.056	.083	.196*	.025	.037	.324
Extraversion	.157*	.019	.031	***−.646****	***.301***	***.485***	−.020	.000	.000	.379
Openness	.171*	.022	.024	−.145*	.015	.016	.199*	.026	.027	.074
Agreeableness	−.087	.006	.007	−.110*	.009	.010	−.184	.022	.024	.096
Conscientiousness	−.056	.002	.004	−.138*	.014	.017	−.279*	.051	.061	.160

Note. Large effect sizes are in bold and italics. Each row represents a separate regression analysis in which the three SPQ-B factors were entered simultaneously as predictors to examine their unique prediction of each of the NEO-FFI domain scores. SPQ = Schizotypal Personality Questionnaire; NEO-FFI = NEO—Five-Factor Inventory.
* $p < .001$.

Discussion

The development of the MSS was based on three broad premises: (1) schizotypy offers a useful and unifying construct for understanding schizophrenia-spectrum psychopathology (Kwapil & Barrantes-Vidal, 2015); (2) schizotypy is multidimensional, with positive, negative, and disorganized schizotypy factors (Mason & Claridge, 2006); and (3) psychometric screening questionnaires offer a powerful method for assessing schizotypy in clinical and nonclinical samples (Lenzenweger, 2010). The MSS appears to offer a number of strengths. It was based upon current multidimensional models of schizotypy and was developed following best practices in the field using large and diverse samples. The subscales are relatively short but appear to provide good content coverage of positive, negative, and disorganized dimensions of schizotypy. The preliminary psychometric properties indicate that the subscales have high reliability and good item and scale properties (Kwapil et al., 2018). Nevertheless, validation studies are needed to demonstrate the extent to which these psychometric properties hold up across other samples and the extent to which the subscales are measuring their constructs of interest.

The present study offers the first investigation of the validity of the MSS and the first assessment of its psychometric properties outside of the derivation samples. The means, standard deviations, and reliabilities of the Positive, Negative, and Disorganized Schizotypy subscales in the present study are closely comparable with the values reported by Kwapil et al. (2018). The coefficient alpha values are essentially identical across this sample and the two previous samples, and the Cohen's *d* values for comparison of the means of the three subscales across the three samples are all trivial (all *d* values < 0.05). Thus the psychometric properties of the MSS subscales appear solid and stable across samples. Further investigations should examine these properties in samples with diverse demographic and clinical characteristics.

Consistent with the findings from the derivation sample (Kwapil et al., 2018) and our view that schizotypy and schizotypic experiences are rare in the general population, mean endorsement rates for the three MSS subscales were relatively low. Kwapil et al. generated items that were expected to have low endorsement rates and retained items that largely had endorsement rates between .10 and .30. The expectation was that items with higher endorsement rates were likely tapping experiences other than schizotypy, such as normal personality. The average endorsement rate for the three subscales was approximately 15% in the derivation sample and the present

sample. As intended, this results in positively skewed distributions, which IRT test information curves indicate are maximally discriminating at the high end of the distributions.

Similar to the descriptive characteristics, the pattern and magnitude of the intercorrelations of the MSS subscales were closely comparable with those reported by Kwapil et al. (2018). As expected, the Positive Schizotypy subscale had a small association with the Negative Schizotypy subscale and a medium-to-large association with the Disorganized Schizotypy subscale. Disorganized and Negative Schizotypy subscales had a medium-sized association. This appears consistent with the notion that both positive and negative schizotypy show associations with disruptions in cognition and behavior (Kerns, 2006).

The present validation study of the MSS followed from Gross et al.'s (2014) investigation of the association of the Wisconsin Schizotypy Scales positive and negative schizotypy dimensions with schizotypal traits (assessed by the SPQ) and the five-factor model of personality (assessed by the NEO-PI-R). We believe that this approach provided an appropriate initial validation method for several reasons. Schizotypal traits and the five-factor model provide useful bases of comparisons, and the SPQ-B and the NEO-FFI are widely used measures of these constructs. We hypothesized that the MSS Positive, Negative, and Disorganized Schizotypy subscales should show differential patterns of associations with these constructs—and that the results of Gross et al. (2014); Kwapil et al. (2008), and Cohen and Fonseca-Pedrero (2017) provided a promising basis of comparison for the MSS Positive and Negative Schizotypy subscales, based on findings from the Wisconsin Schizotypy Scales. Finally, the use of questionnaire measures provided an efficient method for quickly obtaining information on the validity of the MSS. Obviously, the use of structured diagnostic interviews provides a gold-standard procedure for assessing the MSS subscales (a method we are currently pursuing); however, using validated questionnaires in a large and diverse sample provides a promising starting point in the construct validation process.

The present study used the brief version of Raine's widely used SPQ. Two limitations of this choice are (1) the SPQ-B only provides factor scores, whereas the full-length SPQ provides both factor scores and nine subscale scores that map onto the nine schizotypal personality disorder criteria, and (2) short scales tend to have diminished reliability (and by extension validity) relative to their original versions. However, several lines of evidence support the use of the SPQ-B in this study. Raine and Benishay (1995) reported that the SPQ-B factors correlated highly with their analogous SPQ factors. Furthermore, the SPQ-B factors have adequate internal consistency reliability (.72–.78), consistent with the present findings. A recent cross-national study with data from over 28,000 participants supported the reliability and validity of the SPQ-B (Fonseca-Pedrero et al., 2017). Finally, the present findings of the association of the SPQ-B factors with positive and negative schizotypy are consistent with Gross et al.'s (2014) findings of the association of SPQ factors with the Wisconsin Schizotypy Scales positive and negative schizotypy factors. However, it should be noted that the SPQ-B (like the original SPQ) was specifically designed to assess schizotypal personality disorder traits. Schizotypal personality disorder falls within the schizotypy spectrum but is not synonymous with schizotypy, and the underlying dimensions are not perfectly overlapping. Nevertheless, we would expect that the strongest associations of the MSS subscales would be with the corresponding SPQ/SPQ-B factors (a finding borne out in the present study).

As hypothesized, the MSS positive schizotypy factor had its strongest association with the SPQ-B cognitive–perceptual factor. In fact, these two measures correlate almost as highly as their respective reliabilities would allow. This association was expected, given that the cognitive–perceptual factor taps unusual perceptual experiences, odd beliefs, mild thought transmission, referential ideas, and suspiciousness (all core aspects of positive schizotypy). The MSS Positive Schizotypy subscale was uniquely associated with elevated neuroticism and openness to experience and low agreeableness, consistent with the association of the Wisconsin Schizotypy Scales positive schizotypy factor with the five-factor model domains (Kwapil et al., 2008). The MSS Positive Schizotypy subscale exhibited a zero-order association with low conscientiousness, but this relation appeared to be better accounted for by disorganized schizotypy in the regression analyses.

The finding that positive schizotypy was associated (albeit modestly) with elevated openness to experience is consistent with results from Kwapil et al. (2008) and Gross et al. (2014). However, these findings are notable, given that concerns have been raised about the extent to which Costa and McCrae's model and measures capture maladaptive high openness (Gore & Widiger, 2013). Costa and McCrae's (1980) initial formulations did not view openness as having maladaptive variants. Consistent with the concerns, Crego and Widiger (2017) noted that the NEO-PI-R (Costa & McCrae, 1992) "might not be providing the optimal assessment of openness, especially if one is concerned with its maladaptive variants" (pp. 606–607). However, subsequent personality models (Lee & Ashton, 2004; Tellegen & Waller, 1987) have been developed that appear to capture deviantly high expressions of openness. Although, other models have suggested that maladaptive high openness relevant to schizotypy may be captured in a separate oddity factor (Watson, Clark, & Chmielewski, 2008). Note that alternative measures of openness have been developed, such as the Experiential Permeability Index (Piedmont, Sherman, Sherman, Dy-Liacco, & Williams, 2009) and the Five-Factor Schizotypal Inventory (Edmundson, Lynam, Miller, Gore, & Widiger, 2011), that appear to better capture maladaptive variants of openness than the standard NEO measures. Thus, future studies should examine the association of the MSS with these alternative measures of openness to experience.

As expected, the MSS Negative Schizotypy subscale had its strongest association with the SPQ-B interpersonal factor. The interpersonal factor taps not only negative schizotypy characteristics such as social anhedonia and withdrawal but also social anxiety, guardedness, and interpersonal discomfort (hence its strong association with neuroticism). The patterns of associations of the MSS Negative Schizotypy subscale with the NEO-FFI domains closely mirrored the findings for the Wisconsin Schizotypy Scales negative schizotypy factor (Kwapil et al., 2008). Specifically, MSS Negative Schizotypy was uniquely associated with low extraversion, openness to experience, and agreeableness. Thus, positive and negative schizotypy are clearly differentiated by their associations with neuroticism, extraversion, and openness.

The SPQ and SPQ-B interpersonal factors appear to capture a broad range of social discomfort that characterizes schizotypal personality (including social anxiety). As noted, the SPQ and SPQ-B are frequently used as measures of schizotypy, and the interpersonal factor is often reported as a measure of negative schizotypy. However, the present findings, as well as the findings of Gross et al. (2014), suggest that negative schizotypy and the interpersonal factor are only moderately associated with each other. Furthermore, although both negative schizotypy and the interpersonal

factor share strong associations with introversion, the interpersonal factor has a stronger association with neuroticism than does negative schizotypy, and negative schizotypy has a stronger inverse association with openness to experience than does the interpersonal factor. Given that negative schizotypy is characterized by flattened affect and diminished reactivity, it is expected that measures of negative schizotypy should have minimal associations with neuroticism. Likewise, given that negative schizotypy is characterized by diminished interest in and engagement with ideas, emotions, and the world, it is expected that it should be inversely associated with openness to experience.

Finally, the MSS Disorganized Schizotypy subscale showed the strongest association with the SPQ-B disorganized factor. However, again, we suggest that these measures are not tapping identical formulations of disorganization. The MSS was designed to assess disruptions in thought and behavior, including confusion, racing thoughts, loose associations, disrupted speech, difficulty following conversations, and slowness of thought. The six SPQ-B disorganized factor items tend to tap the self-report of oddness or eccentricity (e.g., "I am an odd, unusual person" or "Some people think I am a very bizarre person"). The SPQ items may tap disruptions in behavior and cognition, but they could also tap oddness secondary to positive or negative schizotypy. For example, if someone has the positive schizotypy experience of believing that they can "split clouds," and they spend their time trying to split clouds, others may well view this person as odd, unusual, or bizarre, even though the person is not experiencing disorganized schizotypy. Nevertheless, the unique association of the MSS Disorganized Schizotypy subscale with the SPQ-B disorganized factor was at the level of a medium effect.

The five-factor model composition of the MSS Disorganized Schizotypy subscale revealed unique associations with elevated neuroticism and lowered conscientiousness. The association with neuroticism is consistent with the findings from the derivation samples reported by Kwapil et al. (2018) and with Kerns (2006), who reported that disorganized schizotypy, more so than positive schizotypy, was associated with emotional confusion and increased emotionality. It would be useful to examine the facets underlying neuroticism to determine what is driving this relationship (unfortunately, the NEO-FFI does not provide facet scores). The finding of diminished conscientiousness appears consistent with the nature of disorganized schizotypy—that is, disruptions in the ability to organize and enact thoughts and behavior appear likely to disrupt aspects of conscientiousness such as competence, order, self-discipline, and deliberation.

In summary, this is the first study to assess the psychometric properties of the MSS (outside of the derivation samples) and the first study to examine the construct validity of the MSS positive, negative, and disorganized schizotypy dimensions. The psychometric properties appear to be comparable across samples, and the coefficient alpha reliabilities are high and exhibited no shrinkage from the derivation samples. The MSS Positive and Negative Schizotypy subscales appear to perform comparably with the Wisconsin Schizotypy Scales positive and negative schizotypy factors—measures that provided an established standard in the field. However, the MSS has fewer than half of the items of the Wisconsin Schizotypy Scales, the subscales have better reliability and content coverage, and the MSS offers a Disorganized Schizotypy subscale—a domain not assessed by the Wisconsin Schizotypy Scales.

We recognize that construct validation is an ongoing process and view the present study as the first of an ongoing series of studies to examine the validity of the MSS and to continue to evaluate the validity and utility of schizotypy as a construct. The use of other questionnaire measures provides a quick method for assessing the validity of the MSS in a relatively large sample. However, we view the use of questionnaire measures as merely the first step in a program of research that includes the use of interview, laboratory, and daily life methods to assess the construct validity of the MSS. Obviously, these methods are more time-consuming but should provide more rigorous assessments of the validity of the positive, negative, and disorganized schizotypy dimensions. Furthermore, given that schizotypy involves both subclinical and clinical expressions, future studies should examine the psychometric properties and validity of the MSS in patients with schizophrenia-spectrum disorders. In summary, the present findings suggest that the MSS is a promising measure of multidimensionally operationalized schizotypy and encourage further validation studies.

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