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Hightlights

- Confirmatory factor analysis indicated support for the 4-factor structure of SPQ-G
- Other models (2- and 3-factor models) had poorer fit indices
- Partial measurement invariance was obtained across migrational group and sex
- Non-migrants had higher Cognitive-Perceptual scores than German migrants

RUNNING HEAD: GERMAN SCHIZOTYPAL PERSONALITY QUESTIONNAIRE

A Reassessment of the Higher-Order Factor Structure of the German Schizotypal Personality Questionnaire (SPQ-G) in German-Speaking Adults

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Abstract

The Schizotypal Personality Questionnaire (SPQ) is a widely-used self-report instrument for the assessment of schizotypal personality traits. However, the factor structure of scores on English and non-English translations of the SPQ has been a matter of debate. With little previous factorial evaluation of the German version of the SPQ (SPQ-G), we re-assessed the higher-order factor structure of the measure. A total of 2,428 German-speaking adults from Central Europe (CE) and the United Kingdom (UK) completed the SPQ-G. Confirmatory factor analysis – testing proposed 2-, 3-, and 4-factor models of SPQ-G scores – indicated that the 4-factor solution had best fit. Partial measurement invariance across cultural group (CE and UK) and sex was obtained for the 4-factor model. Further analyses showed CE participants had significantly higher scores than UK participants on one schizotypal facet. These results suggest that scores on the SPQ-G are best explained in terms of a higher-order, 4-factor solution in German migrant and non-migrant adults.

Keywords: Schizotypy; Schizotypal Personality Questionnaire; SPQ-G; Confirmatory Factor Analysis; Invariance

1. Introduction

The concept of personality and its disorders has become increasingly central to the understanding of mental illness, particularly as dimensional and continuum models begin to dominate conceptual explorations of mental illness (Baumeister et al., 2017; Elahi et al., 2017; Subramaniam et al., 2017). One particular personality factor that has received sustained attention is *schizotypy*, which describes a latent personality organisation expressing an assumed liability for schizophrenia-spectrum disorders (Ettinger et al., 2015, 2018). Although the dimensionality of schizotypy continues to be debated (e.g., Fonseca-Pedrero et al., 2017), the available literature consistently indicates that the phenotypic expression of schizotypy is multidimensional (see Raine, 2006). In the general population, schizotypic traits can lead to deficits in cognition, socio-emotional function, and behaviour, and tend not to reach the clinical diagnostic threshold for psychotic disorders (Cohen et al., 2015; Lenzenweger, 2011). Scholars have identified schizotypy as an important bridge to the onset of psychosis in general and schizopgrenia in particular (Kwapil and Barrantes-Vidal, 2015; Zarogianni et al., 2017), highlighting the need for accurate screening and assessment tools.

One well-established measure that assesses schizotypal personality as defined in the third, revised edition of the *Diagnostic and Statistical Manual* (*DSM-III-R*; American Psychiatric Association, 1987) is the Schizotypal Personality Questionnaire (SPQ; Raine, 1991). The SPQ was designed to have one subscale for each of the nine symptoms of schizotypal personality disorder (Raine, 1991), namely no close friends, constricted affect, ideas of reference, odd beliefs and magical thinking, unusual perceptual experiences, odd or eccentric behaviour, odd speech, suspiciousness, and excessive social anxiety. To date, the SPQ has been translated into a number of different languages, including Malay (Barron et al.,, 2018), Chinese (Chen et al., 1997), German (Klein et al., 1997), Greek (Stefanis et al., 2004a), Spanish (Fumero et al., 2009), and Turkish (Şener et al., 2006). The extensive use of

this questionnaire, particularly in different linguistic and cultural contexts, has made the SPQ one of the leading measurement tools for schizotypal research (Mason, 2015). However, as the SPQ was constructed to reflect schizotypal symptomatology, rather than endogenous factorial domains, the higher-order domain structure has been the subject of a great deal of scholarly debate (Cicero, 2015).

Raine and colleagues (1994) grouped the nine subscales into three higher-order domains: Cognitive-Perceptual, Interpersonal, and Disorganised (see Figure 1B). Early exploratory and confirmatory factor analyses, with scores on English and non-English versions of the SPQ, indicated that this 3-factor model had adequate fit (Chen et al., 1997; Claridge et al., 1996; Reynolds et al., 2000; Rossi and Daneluzzo, 2002) and appeared to be invariant across sex and age groups (e.g., Badcock and Dragović, 2006). However, fit indices reported in later studies have been below acceptable levels. Indeed, support for the 3-factor structure through exploratory (e.g., Chmielewski and Watson, 2008; Miller and Tal, 2007) and confirmatory factor analysis (CFA; e.g., Compton et al., 2009) has been problematic. Alternative 3-factor models have been proposed, with Venables and Rector (2000) suggesting a model in which Positive Schizotypy, Social Avoidance, and Negative Schizotypy are independent domains, as have 4-factor models. In terms of the latter, Stefanis and colleagues (2004a) proposed a model comprised of Cognitive-Perceptual, Paranoid, Negative, and Disorganised dimensions. Confirmation of the fit of this model over alternative solutions, including the 3-factor models, has since been obtained in multiple linguistic and cultural groups (Bora and Baysan Arabaci, 2009; Cicero, 2015; Compton et al., 2009; Fonseca-Pedrero and Debane, 2017; Fonseca-Pedrero et al., 2014, 2018).

As noted above, a German translation of the SPQ exists in the literature (i.e., the SPQ-G; Klein et al., 1997), but it has not received the same psychometric attention as other translations of the SPQ. Indeed, only one study has examined the higher-order structure of the

SPQ-G (Klein et al., 1997; see also Klein et al., 2001). Principal-components analysis, with 683 undergraduate students, revealed that higher-order scores on the SPQ-G reduced to two dimensions (Cognitive-Perceptual and Interpersonal [or Positive and Negative]). This 2-factor model has been used in many subsequent studies that have included the SPQ-G, such as studies on creativity (Fink et al., 2014), electrophysiological associations (Klein et al., 1999), implicit memory (Nenadic et al., 2015), and visual encoding and working memory (Kopp et al., 2002). This is notable because studies in other linguistic contexts have suggested that the 2-factor model does not meet standard thresholds for acceptable fit (e.g., Compton et al., 2009).

While it is possible that the 2-factor model of SPQ-G has adequate fit, it is also important to note that Klein et al. (1997) did not examine alternative models. Thus, there is an urgent need to re-assess the higher-order factor structure of the SPQ-G, so as to determine whether alternative models may present better fit than the 2-factor model that is currently used by most researchers using the SPQ-G. This is particularly important, as lack of contemporary support for models other than the 2-factor model may raise questions about the conclusions drawn in studies that have used higher-order SPQ-G facets. As an example, it is possible that scholars relying on the 2-factor model in data treatment are missing out in terms of greater multi-dimensionality of SPQ-G facets or neglecting potentially relevant associations between unmeasured SPQ-G facets and outcome measures. A related limitation concerning the SPQ-G is that the factorial validity of its scores has not previously been examined in community samples, which is important given research suggesting that the dimensionality of SPQ-G scores may differ in college and community samples (Zhang and Brenner, 2017).

1.1 The Present Study

In the present study, therefore, we sought to re-assess the dimensionality of higher-order SPQ-G scores in a large sample of German-speaking adults, testing the fit of the proposed 2-, 3-, and 4-factor models using CFA. As recommended by various scholars (e.g., Jackson et al., 2009; Nunkoo et al., 2013), the selection of models for inclusion in CFA testing was based on hypothesised latent dimensionality in the existing literature concerning the SPQ. Specifically, based on recent studies of SPQ higher-order dimensionality (e.g., Barron et al., 2018; Stefanis et al., 2004a), we hypothesised that the 4-factor model would present best and superior fit compared to the 2- and 3-factor models. This is an important first step in the present study because establishing the precise factorial validity of SPQ-G may provide important clues about latent dimensionality of schizotypal expression in German-speaking populations.

In addition, we also assessed the extent to which the best-fitting model would demonstrate evidence of invariance across sex and across two groups of German-speaking adults, namely those who were resident in their home countries (i.e., Austria and Germany) and those who had migrated to, and were resident in, the United Kingdom (UK). Previous studies have examined differences in SPQ facet scores in different ethnic groups across cultures (e.g., Barron et al., 2015; Fonseca-Pedrero et al., 2015; Kwapil et al.,, 2012) and within the same culture (e.g., Barron et al., 2018; Cicero, 2015; Tsaousis et al., 2015), but studies of the impact of migration on schizotypal expression are infrequent. The little available evidence suggests that migrants to Europe, particularly those who have intrinsic vulnerabilities (e.g., familial load of psychopathology) and are exposed to social adversity (e.g., ethnic discrimination), have significantly higher SPQ scores than non-migrants (van der Stelt et al., 2012). In addition, meta-analytic work suggests that migrant populations have markedly raised prevalence rates of schizophrenia and other psychotic disorders compared to non-migrants (Cantor-Graae and Selten, 2005).

A number of explanations have been suggested for the elevated rates of schizophrenia in migrant populations, including higher rates of psychotic disorders in the birth country, selective migration of pre-psychotic individuals, misdiagnosis, and higher frequencies of risk factors for psychosis in migrant groups (Morgan et al., 2010; Selten and Cantor-Graae, 2005). An additional possibility is that environmental factors (e.g., exposure to social disadvantage, discrimination, and marginalisation) increase the risk for psychotic illness in migrant populations (Collip et al., 2008; Morgan et al., 2010; Morgan and Hutchinson, 2010). To date, however, the vast majority of research has focused on migrants from developing or non-Western countries (Cantor-Graae and Selten, 2005) and we could find no previous study comparing either schizotypy or psychosis scores within the same European ethnic group residing in different nations. Thus, in the present study, we first examined the extent to which SPQ-G scores are invariant in German-speaking migrants and non-migrants (a pre-condition for examining between-group differences in latent mean scores; Chen, 2008); to the extent that invariance is established, we would be able to examine the extent to which migration in this group is associated with higher SPQ-G scores.

2. Method

2.1 *Participants*

In the present study, there were 2,428 participants, grouped into two sub-samples. The first subsample comprised of 2,318 White, German-speaking adults from Central Europe (CE; n = 1,406 from Austria and n = 912 from Germany). The German participants were from southern Germany, which is culturally similar to Austria, and previous studies using similar participant sets have treated these samples as homogeneous (e.g., Swami et al., 2011). The second subsample consisted of 110 White German-speakers that were resident in the UK at the time of recruitment. Of this subsample, the majority were from southern Germany (n = 96), while the remainder were from Austria (n = 14). For the sake of clarity, we refer to the

first subsample as the CE subsample and the migrant sample as the UK subsample. The mean age of participants in the CE subsample was 33.23 years (*SD* = 13.09), with 1,234 (53.3%) women and 1,083 (46.7%) men (one participant did not provide a response for sex and was excluded from the invariance testing for this variable). The mean age of the UK subsample was 35.95 years (*SD* = 10.94), with 82 (74.5%) women and 28 (24.5%) men.

In consideration of the difference in size of the two sub-samples, an age-matched, random selection of participants from the CE subsample (*n* = 110; women = 57, men = 53) was selected by a computer programme for comparisons with the UK sample[1]. The mean age of participants for the CE subsample comparison group was 34.12 years (*SD* = 13.18). There was no significant difference in age between comparison subsamples, $t(218) = 1.12$, $p = 0.262$, $d = 0.15$. All participants self-reported as not having a history of mental health problems relating to psychosis. Further, as additional analyses on these data are at the latent factor level, rather than the total of schizotypal score, participants from the CE comparison subsample were found to be matched on total schizotypy (*M* = 15.37, *SD* = 11.96) with the UK subsample (*M* = 13.11, *SD* = 8.36), $t(218) = 1.63$, $p = 0.105$, $d = 0.22$.

2.2 ***Measures***

Schizotypal Personality Questionnaire**.** Participants completed the 74-item German version of the SPQ (SPQ-G; Klein et al., 1997; see Appendix 1 for items in German). Each *Yes* response counts as one point and 9 factor scores were computed as the total score for all items associated with each subscale. As Klein and colleagues (1997) originally grouped the 9 lower-order domains in a bidimensional higher order structure (Model A), Raine et al. (1994) grouped the parent SPQ into a 3-factorial model (Model B), with other studies (e.g., Barron et al., 2015; Cicero, 2015; Compton et al., 2009) finding at least partial support for two solutions of the 4-factor structure (Model C; Stefanis et al., 2004a; Model D; Compton et al., 2009), we evaluated fit of each of these models. These models are presented in Figure 1.

2.3 *Procedure*

Ethics approval for this study was obtained from the departmental ethics committee at University of Westminster for data collection in all research sites. Local ethics approval in Austria was not required: according to national laws (Austrian Universities Act 2002), effective at the time when this study was carried out, only medical universities were required to operate research ethics committees for evaluating and approving basic, clinical, and applied medical research proposals. As this was not applicable, this study was exempt from ethics approval in Austria. Nevertheless, the study was conducted in accordance with institutional guidelines of the School of Psychology, University of Vienna, and the principles of the Declaration of Helsinki (6th revision, 2008).

Questionnaire dissemination in both sites was undertaken via multiple routes, through both online and offline methods. First, an internal online research participation scheme was utilised. This scheme gives course credit to students eligible for this incentive. Second, where the course credit scheme did not apply, the general public were invited to participate. Inclusion criteria included being of adult age and fluency in German. In both the offline and online versions, participants completed a consent form before completing the questionnaire. The UK-based sample were recruited primarily online, while the Austrian sample were recruited via an offline method. Despite the use of both offline and online methods of recruitment, research suggests that there is equivalence between platforms in non-clinical settings (Briones and Benham, 2017). No monetary incentives were offered to the participants for completion of the survey. All participants received written debrief information at the end of the study.

2.4 *Data Analysis*

Missing data constituted < 2% of the total dataset and were missing completely at random (MCAR), as determined by Little's (1988) MCAR analysis. We, therefore, inputted

missing values using pooled estimates from multiple imputations. Internal consistency coefficients for the SPQ-G subscales were assessed using ordinal coefficient alpha, with values greater than .70 reflecting adequate internal reliability (Zumbo et al., 2007).

CFAs were conducted using the Lavaan package (see Rosseel, 2012) with *R* (*R* Development Core Team, 2014) to examine the higher-order factor structure of SPQ-G scores. Further, measurement invariance was conducted to ensure that latent mean comparisons at domain level were appropriate, that is, difference in means reflect true deviation in scores and not an error in the measurement tool. The sample size for this was deemed acceptable as there were over the recommended 100 observations for each subsample (Kline, 2015). Standard goodness-of-fit indices were selected *a priori* to assess the measurement models. The normed model chi-square (χ^2_M) is reported with lower values of the overall model chi-square indicating goodness-of-fit. Good fit cut-off metric recommendations for χ^2_M range from 5.0 (Wheaton et al., 1977) to 2.0 (Tabachnick and Fidell, 2013). The Steiger-Lind root mean square error of approximation (RMSEA) and its 90% confidence interval provide a correction for model complexity. RMSEA values close to 0.06 indicate good fit, with values ranging to 0.10 representing mediocre fit (Hu and Bentler, 1999). The standardised root mean square residual (SRMR) and the weighted root mean square residual (WRMR) assesses the mean absolute correlation residual and is a badness-of-fit index: the smaller the values, the better the model fit. A cut-off value for SRMR indicating a reasonable fit is recommended to be < 0.09 and < 0.08 for WRMR (Brown, 2015; Hu and Bentler, 1999). The comparative fit index (CFI) measures the proportionate improvement in fit by comparing a target model with a more restricted, nested baseline model. The CFI reflects a goodness-of-fit index and is recommended to close to or > 0.95 for adequate fit (Hu and Bentler, 1999). The Tucker-Lewis index (TLI) indicates a level of relative fit, with values close to or > 0.95 for adequate fit (Hu and Bentler, 1999). Bollen's Incremental Fit Index

(BL89) was also used, again, with values close to or > 0.95 indicating an acceptable fit (Hu and Bentler, 1999). The Akaike information criterion (AIC) and Bayesian information criterion (BIC) provide measures to compare non-hierarchical factor structures, with the lowest values being preferred. Further, measures of parsimony-corrected fit index (the Parsimony Goodness-of-Fit Index [PGFI] and Parsimony Normed Fit Index [PNFI]; Hooper et al., 2008) were used. No thresholds have been recommended for PGFI and PNFI, but Mulaik and colleagues (1989) suggested that PGFI values should be in the region of 0.50-0.90. Even so, these recommended cut-off values should be considered subjective guidelines (Heene et al., 2011). To determine if the best-fitting model was invariant across the CE and UK subsamples, measurement invariance was tested at the configural (i.e., whether similar factors are measured), metric (i.e., whether the magnitude of factor loadings is the same), and scalar (i.e., whether the intercept of the regression relating each item to its factor is the same) levels (Chen, 2007). Finally, a multivariate analysis of variance (MANOVA) was used to examine subsample differences with the higher-order factor scores derived from the model of best fit.

3. Results

3.1 Descriptive Statistics, Internal Consistencies, and Normality

Table 1 shows descriptive statistics, inter-scale correlations, and ordinal coefficient alpha for the nine subscales in the present sample (range = 0.85-0.92, mean = 0.89), which is in-line previous findings (e.g., Fonseca-Pedrero et al., 2017). Shapiro-Wilk tests for normality were violated across all subscales in the present sample, with Mardia's multivariate coefficient for both skewness (5608.308) and kurtosis (54.091) also violated (*p*s < 0.001).

3.2 Confirmatory Factor Analysis

Parameter estimates were obtained using the robust maximum likelihood method with the Satorra-Bentler correction because the multivariate normality of observed variables did

not hold (Satorra and Bentler, 2001). Table 2 shows the fit indices for the models under examination. Fit indices for Model A, the 2-factor model of Klein et al. (1997), was deemed to have poor fit and, relative to other examined models, the poorest fit for our data. Indices for Model C, the multidimensional 3-factor model (Raine, 1994), were also found to be below levels of acceptability and had poor fit for our data. The inclusion of the paranoid factor for Models C and D improved fit for our data. While the fit indices for Model D (Compton et al, 2009) were found to be acceptable, when using indices of comparison (AIC and BIC), Model C (Stefanis et al., 2004a) was deemed have the best fit for the present data; $SB\chi^2_M = 8.033$, df = 19, robust RMSEA = 0.053 (90% CI = 0.044-0.062), robust CFI = 0.985, robust TLI = 0.971, SRMR = 0.020, WRMR = 1.681, BL89 = 0.984, PGFI = 0.348, PNFI = 0.518, AIC = 81639.524, BIC = 81842.343.

3.3 Multi-Group Invariance

Next, we tested for measurement invariance across sex for the full sample and across culture between the CE (n = 110) and UK groups (n = 100). For sex, differences between ΔCFI and ΔRMSEA were above acceptable levels (ΔCFI < 0.01 and ΔRMSEA < 0.015; Cheung & Rensvold, 2002). Therefore, univariate test scores were examined to relax constraints within the model. Excessive social anxiety was found to have that greatest difference between subsamples for sex, $\chi^2 = 172.197$, $p < 0.001$; when relaxing this constraint, fit indices were found to be acceptable at the partial scalar level (ΔCFI = 0.009 and ΔRMSEA = 0.013). For culture, this subscale was again found to have the greatest difference between CE and UK subsamples, $\chi^2 = 28.943$, $p < 0.001$; when relaxing this constraint with the latent Negative domain, fit indices were found to be acceptable at the partial scalar level (ΔCFI = 0.001 and ΔRMSEA = 0.004). Therefore, we found support for partial invariance across sex and culture, thus allowing for latent means comparison. However, we removed the Negative domain from further analyses.

3.4 Between-Group Differences

We examined subsample differences in scores for cultural group with the three higher-order domains of the 4-factor model, excluding the Negative domain. Sex was not included in the analysis due to the sex imbalance of the CE subsample. A MANOVA was conducted, with the three factor scores entered as dependent variables, and the subsample (CE versus UK) as the independent variable. As the design of the observations were not balanced – that is, with regard to the sex imbalance of the UK subsample – Box's *M* test for equality of covariance was assessed. As Box's *M* test was significant ($p < 0.001$), Pillai's trace criterion was used for interpretation of the MANOVA, rather than the less conservative Wilk's Λ (Tabachnick and Fidell, 2013). Results indicated a significant omnibus MANOVA result, $F(1, 214) = 4.39$, $p = 0.005$, Pillai's trace = 0.06, $\eta_p^2 = 0.06$. As reported in Table 4, CE participants has significantly higher scores on the Cognitive-Perceptual dimension than participants from the UK. All other comparisons did not meet significance.

4. Discussion

The present findings revealed that the 4-factor (Stefanis et al., 2004a) structure had the best fit of the models under examination, with a moderate fit for the hierarchically-related 4-factor structure (Compton et al., 2009). As the 3-factor (Raine et al., 1994) solution did not fit as well as the two 4-factor structures, this suggests that the presence of a Paranoid factor may improve fit. Indeed, our support for the inclusion of a Paranoia factor is consistent with previous investigations (e.g., Barron et al., 2018, Stefanis et al., 2004a). Importantly, the originally-proposed factorial structure of the SPQ-G, the 2-factor solution (Klein et al., 1997), had the poorest of fit for the models under investigation. In short, our reassessment of scores derived from the SPQ-G suggest that they are best-explained in terms of four higher-order facets.

The practical importance of this finding should not be underestimated. As mentioned, the SPQ-G has previously been operationalised through a 2-factor structure in many previous studies (e.g., Fink et al., 2014; Klein et al., 1999; Kopp et al., 2002; Nenadic et al., 2015). As this structure was shown to have the poorest fit of the models we investigated, caution should be applied in interpreting the findings of previous studies using the SPQ-G. To take one example, Kopp et al. (2002) examined brain structural changes in the medial and lateral prefrontal cortex, and other relevant areas, with degree of schizotypy measured through the SPQ-G. These authors found significant positive associations between bilateral inferior and right superior frontal cortices and positive schizotypy. However, the nuance of these, and indeed other, associations may not be fully explained due to underlying factorial issue reported here. Without re-investigation of the factor structure of SPQ-G scores in prior studies, it cannot be concluded that findings reflect true associations (i.e., associations may be due error in the classification of factors). That is, associations with the 2-factor structure may instead be artefactual results, as assumptions about factor structure were being made that may or may not be supported by the SPQ-G data.

Our results also showed that measurement invariance levels could not be fully supported for sex or cultural setting. This was particularly highlighted on the Negative domain, with Excessive Social Anxiety, where there was non-equivalence in scoring. Therefore, any between group differences should be interpreted with caution (and, indeed, we did not include any analyses on the Negative domain). That being said, we found that CE and UK participants were not significantly different in terms of their scores on two domains of the SPQ-G (i.e., Paranoid and Disorganised). On the other hand, our analyses indicated that CE participants had significantly higher scores on the Cognitive-Perceptual domain that UK participants, with a moderate effect ($\eta_p^2 = .06$). Bearing in mind the limitations of cross-sectional data, it might be speculated that migration has a protective effect in terms of at least

one facet of schizotypy in our sample. This runs counter to the general finding that migration increases the risk of psychoses and developing schizophrenia (Cantor-Graae and Selten, 2005) and is worthy of further, sustained research. One possible explanation is that, in the present case, predominantly White German migrants are not exposed to the same levels of social adversity (e.g., ethnic discrimination) as migrants from other world regions, which allows this group to flourish in the host culture. Another possibility is that individuals who are greater risk for high schizotypy are less likely to migrate (cf. Rosenthal et al., 1974). Certainly, this is an aspect of the present findings that deserves further investigation.

There are several other limiting aspects to this study that must be acknowledged. Although the UK subsample was used as a proxy measure of migrational effect, there was no direct measurement of this. That is, we did not take measure of duration, or reason for residing, in the UK. Indeed, to accurately measure the migration effect with schizotypy, a more sensitive measure would be required. Likewise, in the present study, we did not include measures that would have allowed us to test competing hypotheses for between-group differences as a function of migration (e.g., family comorbidity, exposure to social disadvantage and discrimination in the UK). This could be rectified in future research that specifically examines antecedents and correlates of SPQ scores in migrant groups (e.g., van der Stelt et al., 2012). Further, due to low numbers in this subsample, it was not possible to ascertain what underlying reasons influenced the measurement non-equivalence and between-group results. For example, Zhang and Brenner (2017) found a clear 3-factor solution with a community sample, whereas there was evidence of a 4-factor solution with an undergraduate sample. Therefore, it is unclear in the present study whether the method of recruitment played a role in our findings. Further, it is not immediately apparent whether factors such as urbanicity may help to explain our findings. Indeed, with studies of European adults (Stefanis et al., 2004b; van Os et al., 2001; van Os et al., 2002), it has been suggested that urbanicity is

associated with increased risk of expression of non-clinical psychosis. Therefore, with a larger sample, it would be possible to address issues such as these.

A further limitation of the present study was the lack of additional measures to assess the construct validity of SPQ-G scores, as well as a lack of measures to determine the extent to which participants responded randomly, pseudo-randomly, or dishonestly. Future work could rectify the latter element of our design by inclusion an appropriate measure, such as the Oviedo Infrequency Scale (Fonseca-Pedrero et al., 2008). In a similar vein, the data in the present study were based on self-reports and are, therefore, susceptible to false-positive ratings (see van Ost et al., 2001). Nevertheless, it should be noted that false positive ratings do not necessarily indicate the absence of risk for psychosis. Specifically, there is evidence to suggest that self-reports of psychotic experiences are strongly associated with future psychotic disorders (Bak et al., 2003; Poulton et al., 2000). Nevertheless, future studies could extend the present work by confirming self-reports through clinical interviews.

These limitations notwithstanding, the findings from the present study suggest that the inclusion of the Paranoid domain to the 3-factor solution, as suggested by Stefanis et al. (2004a), should be endorsed in future applications of this measure in German. By extension, this study adds to the growing literature that scores on the SPQ are suited to a 4-factor solution with the additional Paranoid domain included. While future work needs to consider a larger comparison group and perhaps consider the dimensionality of the SPQ-G at the level of items rather than subscales, the present findings suggest that scholars wishing to use the SPQ-G should consider the 4-factor model in future studies. This conclusion may also be informative *vis-à-vis* the putative factor structure of schizophrenia symptomatology. Studies consistently show that schizophrenia consists of Positive and Negative symptoms, as well as a Disorganised component similar to that described for schizotypy (Kim et al., 2012; Llorca et al., 2011; Wallwork et al., 2012). However, the same studies also suggest that that

schizophrenia consists of two additional factors, Excited and Depressed, that are not conceptually captured in factor analytic studies of schizotypy (Wallwork et al., 2012). Thus, one broad conclusion that might be drawn is that there are core components that are similar across schizotypy and schizophrenia (which may capture the essence of Positive and Negative symptom dimensions), but also that there are additional facets that diverge between schizophrenia and schizotypy. As such, it would be erroneous to treat schizotypy and schizophrenia as homogeneous (Kwapil and Barrantes-Vidal, 2015).

Footnotes

[1] This subsample was used in analyses of measurement invariance testing between country of residence (i.e., UK and CE subsamples) and between group comparisons. For analysis of best fit and sex invariance, the full, combined sample was used.

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Table 1. *Inter-Scale Correlations, Descriptive Statistics, Internal Consistencies and Normality for the German Version of the Schizotypal Personality Questionnaire (SPQ-G) Factors in the Present Study.*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) Ideas of Reference		0.38	0.37	0.55	0.43	0.26	0.41	0.28	0.58
(2) Excessive Social Anxiety			0.17	0.34	0.25	0.53	0.34	0.47	0.43
(3) Odd Beliefs or Magical Thinking				0.58	0.21	0.18	0.17	0.17	0.27
(4) Unusual Perceptual Experiences					0.39	0.31	0.341	0.33	0.47
(5) Odd or Excessive Behaviour						0.33	0.53	0.37	0.39
(6) No Close Friends							0.32	0.70	0.49
(7) Odd Speech								0.39	0.40
(8) Constricted Affect									0.47
(9) Suspiciousness									
M	2.18	1.92	1.30	1.56	1.30	1.47	2.57	1.54	1.77
SD	2.09	1.98	1.78	1.81	1.81	1.85	2.37	1.69	1.76
Shapiro-Wilk Univariate Normality	0.88	0.85	0.75	0.81	0.74	0.78	0.89	0.83	0.86
Ordinal α	0.85	0.90	0.91	0.88	0.92	0.89	0.89	0.86	0.89

Note: all correlational *ps* < 0.001

Table 2. *Indices for Each Proposed Model.*

	$SB\chi^2$	$SB\chi^2_M$	df	Robust RMSEA (90% CI)	Robust CFI	Robust TLI	SRMR	WRMR	BL89	PGFI	PNFI	AIC	BIC
Model A	1264.267	48.626	26	0.140 (0.132-0.147)	0.855	0.799	0.068	4.839	0.854	0.446	0.615	82737.154	82899.409
Model B	702.489	30.543	23	0.110 (0.102-0.118)	0.921	0.876	0.048	3.607	0.920	0.408	0.586	82181.376	82361.015
Model C	152.638	8.033	19	0.053 (0.044-0.062)	0.985	0.971	0.020	1.681	0.984	0.348	0.518	81639.524	81842.343
Model D	287.137	14.357	20	0.073 (0.065-0.082)	0.969	0.944	0.035	2.306	0.969	0.364	0.537	81772.024	81969.048

Note: Model A, bidimensional structure (Klein et al., 1997); Model B, 3-factor model (Raine, 1994); Model C, 4-factor model (Stefanis, Smyrnis et al., 2004); Model D; alternative 4-factor structure (Compton et al., 2009). $SB\chi2$ = Satorra-Bentler corrected chi-square, $SB\chi2_M$ =Satorra-Bentler corrected chi-square / df ratio, df = degrees of freedom, robust RMSEA = Satorra-Bentler corrected Steiger-Lind root mean square error of approximation, robust CFI = Satorra-Bentler corrected comparative fit index, robust TLI = Satorra-Bentler corrected Tucker-Lewis index, SRMR = standardised root mean square residual, WRMR = weighted root mean square residual, BL89 = Bollen's incremental fit index, PGFI = Parsimony goodness-of-fit index, PNFI = Parsimony Normed Fit Index, AIC = Akaike information criteria, BIC = Bayesian information criteria

Table 3. *Measurement Invariance Across Both Sex and Culture*

	χ^2	df	RMSEA	ΔRMSEA	CFI	ΔCFI	TLI	SRMR	WRMR	BL89	PGFI	PNFI
Sex												
Configural invariance	176.875	38	0.055	-	0.984	-	0.969	0.022	1.810	0.984	0.348	0.517
Metric Invariance	195.788	45	0.053	0.002	0.982	0.002	0.972	0.028	1.904	0.983	0.412	0.611
Scaler Invariance	460.475	50	0.082	0.029	0.952	0.030	0.931	0.045	2.920	0.952	0.450	0.658
Culture												
Configural invariance	45.956	38	0.044	-	0.988	-	0.978	0.038	0.923	0.989	0.343	0.496
Metric Invariance	65.545	45	0.064	0.020	0.970	0.018	0.952	0.065	1.102	0.971	0.401	0.571
Scaler Invariance	77.899	50	0.071	0.007	0.959	0.011	0.941	0.069	1.201	0.961	0.442	0.623

Note: χ2 = chi-square, RMSEA = Steiger-Lind root mean square error of approximation, ΔRMSEA = delta Steiger-Lind root mean square error of approximation, CFI = comparative fit index, ΔCFI = delta comparative fit index, TLI = Tucker-Lewis index, SRMR = standardised root mean square residual, WRMR = weighted root mean square residual, BL89 = Bollen's incremental fit index, PGFI = Parsimony goodness-of-fit index, PNFI = Parsimony Normed Fit Index

Table 4. Descriptive statistics and follow-up analyses of variance for the three retained facets in participants in Central Europe (CE) and the United Kingdom (UK)

Domains	Group Comparison		*F*	*p*	η_p^2
	Mean (*SD*)				
Disorganised	UK	CE	1.57	0.212	0.01
	3.23 (3.05)	3.63 (3.88)			
Cognitive-Perceptual	UK	CE	13.17	< 0.001	0.06
	1.74 (2.40)	2.88 (3.20)			
Paranoid	UK	CE	2.54	0.112	0.01
	5.26 (3.93)	5.76 (4.85)			

Appendix 1. *The German Version of the Schizotypal Personality Questionnaire (SPQ-G; Klein et al., 1997)*

1	Haben Sie manchmal das Gefühl, dass Dinge, die Sie im Fernsehen sehen oder in der Zeitung lesen, für Sie eine ganz besondere Bedeutung haben?
2	Ich vermeide es manchmal, an Orte zu gehen, wo sich viele Menschen aufhalten, weil ich dort Angst bekomme.
3	Haben Sie Erfahrungen mit dem Übersinnlichen gemacht?
4	Haben Sie oftmals Gegenstände oder Schatten für Menschen gehalten oder Geräusche für Stimmen?
5	Andere Menschen halten mich für ein wenig seltsam.
6	Ich bin wenig daran interessiert, andere Menschen kennen zu lernen.
7	Andere Leute finden es manchmal schwierig zu verstehen, was ich sage.
8	Die Leute finden mich manchmal unnahbar distanziert.
9	Ich bin sicher, dass man hinter meinem Rücken über mich redet.
10	Wenn ich zum Essen oder ins Kino ausgehe, merke ich, dass mich die Leute beobachten.
11	Ich werde sehr nervös, wenn ich höfliche Konversation machen muss.
12	Glauben Sie an Gedankenübertragung?
13	Haben Sie jemals gespürt, dass irgendeine Person oder Kraft um Sie herum ist, auch wenn

	niemand zu sehen ist?
14	Die Leute machen manchmal Bemerkungen über mein ungewöhnliches Gehabe und meine eigentümlichen Gewohnheiten.
15	Ich ziehe es vor, für mich allein zu bleiben.
16	Wenn ich spreche, springe ich manchmal schnell von einem Thema zum anderen.
17	Ich kann meine wahren Gefühle nicht gut durch meine Sprechweise und Mimik ausdrücken.
18	Haben Sie oft das Gefühl, dass andere Leute es auf Sie abgesehen haben?
19	Lassen manche Menschen Bemerkungen über Sie fallen, oder sagen sie Dinge mit einer doppelten Bedeutung?
20	Werden Sie jemals nervös, wenn jemand hinter Ihnen geht?
21	Sind Sie manchmal sicher, dass andere Menschen Ihre Gedanken lesen können?
22	Wenn Sie einen Menschen anschauen oder sich selbst im Spiegel betrachten, haben Sie jemals beobachtet, dass sich das Gesicht vor Ihren Augen verändert?
23	Manchmal denken andere Leute, dass ich ein bisschen merkwürdig bin.
24	In Gegenwart anderer Menschen bin ich meistens ganz still.
25	Ich vergesse manchmal, was ich gerade zu sagen versuche.
26	Ich lache oder lächle selten.

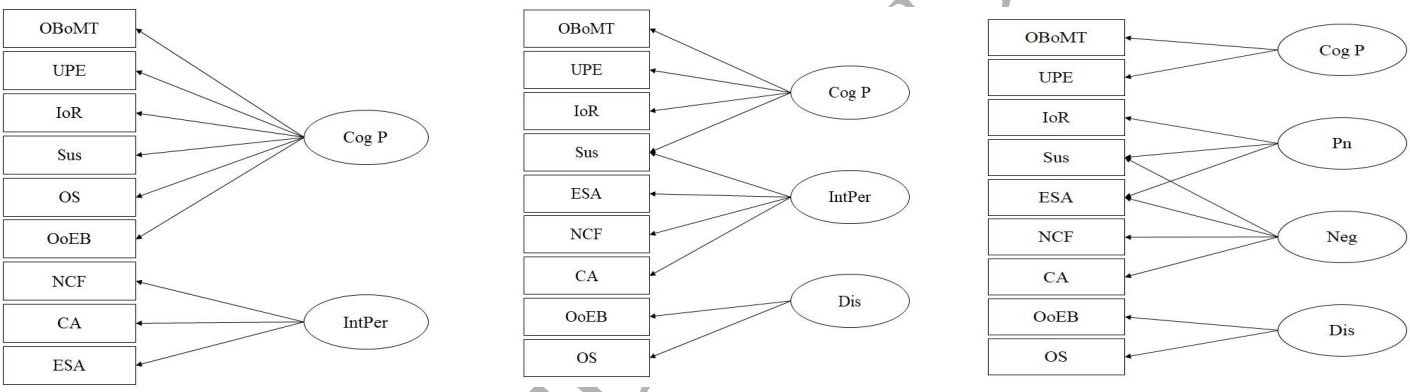
27	Machen Sie sich manchmal Sorgen darüber, ob Freunde oder Kollegen wirklich redlich und vertrauenswürdig sind?
28	Haben Sie jemals ein ungewöhnliches Ereignis oder einen ungewöhnlichen Gegenstand bemerkt, das oder der für Sie ein besonderes Zeichen darstellte?
29	Wenn ich Menschen zum ersten Mal begegne, werde ich ängstlich.
30	Glauben Sie an das Hellsehen?
31	Ich höre oft eine Stimme meine Gedanken laut aussprechen.
32	Manche Menschen denken, dass ich eine sehr wunderliche Person bin.
33	Ich finde es schwierig, einen engen emotionalen Kontakt zu anderen Menschen zu haben.
34	Beim Sprechen schweife ich oft zu sehr ab.
35	Meine „nicht-sprachliche“ Kommunikation (z.B. Nicken oder Lächeln im Gespräch) ist nicht sehr ausgeprägt.
36	Ich spüre, dass ich selbst bei meinen Freunden auf der Hut sein muss.
37	Sehen Sie manchmal besondere Bedeutungen in Anzeigen, Schaufenstern oder in der Art, wie Dinge um Sie herum angeordnet sind?
38	Fühlen Sie sich oft angespannt, wenn Sie sich in einer Gruppe fremder Menschen befinden?

39	Können andere Menschen Ihre Gefühle fühlen, auch wenn sie gar nicht anwesend sind?
40	Haben Sie jemals Dinge gesehen, die für andere Menschen unsichtbar waren?
41	Sind Sie der Meinung, dass es außerhalb Ihrer engsten Verwandtschaft niemanden gibt, dem Sie wirklich nahe stehen, oder dass es niemand gibt, dem Sie vertrauen können oder mit dem Sie über persönliche Probleme reden können?
42	Manche Menschen finden, dass ich im Gespräch etwas unbestimmt und schwer zu begreifen bin.
43	Höflichkeiten und gesellige Gesten kann ich nicht gut erwidern.
44	Erkennen Sie in dem, was andere sagen oder tun, oft versteckte Drohungen oder Demütigungen?
45	Haben Sie während des Einkaufens das Gefühl, dass andere Menschen Notiz von Ihnen nehmen?
46	Unter Menschen, die ich nicht näher kenne, fühle ich mich sehr unwohl.
47	Hatten Sie bereits Erfahrungen mit Astrologie, Vorhersehen der Zukunft, UFOs, übersinnlicher Wahrnehmung oder dem Sechsten Sinn?
48	Erscheinen alltägliche Gegenstände ungewöhnlich groß oder klein?
49	Briefe an Freunde zu schreiben bringt mehr Schwierigkeiten als Gewinn.

50	Ich benutze Worte manchmal in einer unüblichen Weise.
51	Wenn ich mich mit anderen unterhalte, neige ich dazu, den Blickkontakt zu vermeiden.
52	Haben Sie die Erfahrung gemacht, dass es am besten ist, andere Leute nicht zu viel über Sie wissen zu lassen?
53	Wenn Sie sehen, dass andere Menschen sich unterhalten, fragen Sie sich dann öfters, ob sie sich über Sie unterhalten?
54	Ich würde mich sehr ängstlich fühlen, wenn ich vor einer großen Gruppe von Menschen eine Rede halten müsste.
55	Haben Sie jemals das Gefühl gehabt, mit einer anderen Person mittels Gedankenübertragung zu kommunizieren?
56	Wird Ihr Geruchssinn manchmal ungewöhnlich sensibel?
57	Bei geselligen Ereignissen neige ich dazu, im Hintergrund zu bleiben.
58	Neigen Sie in einem Gespräch dazu, vom Thema abzukommen?
59	Ich habe oft das Gefühl, dass andere es auf mich abgesehen haben.
60	Haben Sie manchmal das Gefühl, dass andere Menschen Sie beobachten?
61	Fühlen Sie sich jemals plötzlich von entfernten Geräuschen abgelenkt, die Sie normalerweise nicht wahrnehmen?

62	Enge Freunde zu haben bedeutet mir nicht viel.
63	Haben Sie manchmal das Gefühl, dass die Leute über Sie reden?
64	Sind Ihre Gedanken manchmal so stark, dass Sie sie fast hören können?
65	Müssen Sie oft darauf Acht geben, dass andere Sie nicht übervorteilen?
66	Haben Sie das Gefühl, dass Sie mit anderen Menschen nicht „warm“ werden können?
67	Ich bin eine merkwürdige, ungewöhnliche Person.
68	Meine Art zu reden ist weder ausdrucksvoll noch lebendig.
69	Ich finde es schwierig, meine Gedanken anderen klar mitzuteilen.
70	Ich habe ein paar exzentrische Gewohnheiten.
71	Mir ist sehr unbehaglich zumute, wenn ich mit Leuten spreche, die ich nicht gut kenne.
72	Die Leute sagen gelegentlich, dass das Gespräch mit mir verwirrend ist.
73	Ich neige dazu, meine Gefühle für mich zu behalten.
74	Manchmal starren mich die Leute wegen meines sonderbaren Auftretens an.

Figure 1. Models under examination



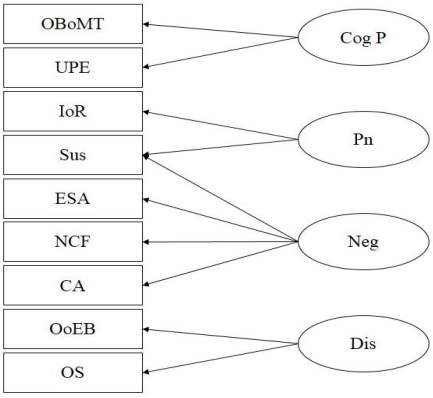
A: 2-factor SPQ-G model (Klein et al., 1997)

B: The 3-factor model (Raine et al., 1994)

C: The 4-factor model (Stefanis, Smyrnis et al., 2004)

Figure 1. The measurement models under examination. High order factors: Cog P = Cognitive-Perceptual, Pn = Paranoid, Neg = Negative, Dis = Disorganised, IntPer = Interpersonal. Lower-order subscales: OboMT = odd beliefs or magical thinking, UPE = unusual perceptual experiences, IoR = ideas

German Schizotypal Personality Questionnaire



D: Modification of A. (Compton et al., 2009)

of reference, Sus = suspiciousness, ESA = excessive social anxiety, NCF = no close friends, CA = constricted affect, OoEB = odd or eccentric behaviour, OS = odd speech.