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The stability of schizotypy across time and instruments

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ABSTRACT

Little is known about the stability of schizotypy across relatively long time periods and instrumentation. This study assesses the degree of stability between schizotypy and its three factor structure as assessed by the Survey of Attitudes and Experiences (SAE) at age 17, and the Schizotypal Personality Questionnaire (SPQ) at age 23. A sample of 678 at ages 17 and 23 years from a birth cohort in Mauritius were split into two random samples, with initial analyses on the first sample independently replicated on the second sample. Cognitive–perceptual, interpersonal, and disorganized factors at age 17 correlated from 0.28 to 0.32 with their respective factors at age 23. Total scores correlated 0.41 ($d=0.90$) across this six year time period and increased to 0.58 ($d=1.42$) after correcting for measurement error. Receiver operating characteristic (ROC) analyses showed an area under the curve value of 0.74, confirmed prediction over time. Findings on predictive validity were closely replicated in the second independent sample. In contrast, social anhedonia at age 17 was unrelated to interpersonal deficits at age 23. Results provide replicable support for the moderate stability of cognitive–perceptual, interpersonal, and disorganized schizotypy across time, instrumentation, and a period of rapid developmental change.

1. Introduction

A growing body of research is being built up on individual differences in schizotypal personality traits in ostensibly normal individuals in the general population (Raine, 2006). A frequently-used instrument is the Schizotypal Personality Questionnaire (SPQ – Raine, 1991). The SPQ was developed in the U.S. and assesses the nine signs and symptoms of schizotypal personality disorder as listed in DSM-III-R (American Psychiatric Association, 1987) in both adults (Raine, 1991) and children (Raine et al., 2011). This definition of schizotypal personality disorder has remained essentially unchanged from DSM-III-R to DSM 5 (American Psychiatric Association, 2013). A three-factor structure to the SPQ (cognitive–perceptual, interpersonal, and disorganized) has been confirmed in both adolescents (Fossati et al., 2003) adults (Wuthrich and Bates, 2006), mature adults (Badcock and Dragović, 2006), and even children (Raine et al., 2011). Other instruments have also reported a three-factor structure. Cella et al., (2013) using the O-LIFE scale (Mason, 1995) reported three classes of schizotypy traits which resemble the factor structure of the SPQ, in addition to a fourth "impulsive non-conformity" factor. Nevertheless, other researchers have argued that more cross-cultural research needs to be conducted to establish the robustness of this finding (Schiffman, 2004).

A much shorter instrument to assess schizotypy is the Survey of Attitudes and Experiences (SAE – Venables et al., 1990b). This self-report instrument has a different conceptual basis from DSM, is considerably shorter (30 versus 74 items), and was developed on a relatively homogenous English population (versus an ethnically mixed Californian population). It also contained positively and negatively worded items (versus all positive SPQ items), and used more subtle, less clinically obvious questions in an attempt to avoid defensive responding compared to the DSM-oriented SPQ items (Venables, 1990a). Furthermore, in contrast to the SPQ, the SAE has been found to have a two factor structure (positive and negative schizotypy – Venables et al., 1990b), with negative schizotypy consisting of social and physical anhedonia. Social (but not physical) anhedonia has been associated with the interpersonal factor of the SPQ (which includes no close friends and constricted affect), but not the cognitive–perceptual and disorganized factors (Wang et al., 2014).

A key issue in the field concerns the stability of schizotypal personality over time. In dizygotic twins, stability over three years from ages 12 to 15 years ranges from 0.26 to 0.48 (Ericson et al., 2011). In young adults two-year test–retest reliability for the SPQ total score (74 items) was 0.53, although stability coefficients for the shorter individual scales were lower (e.g. 0.29 for unusual perceptual experiences – Stefanis et al., 2006). Both studies used the same instrument (the SPQ) at both time-points. To our

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knowledge there have been no longer-term assessments of the stability of schizotypal traits in community samples, particularly the time-period moving from adolescence into adulthood which is characterized by significant environmental and brain changes. Furthermore, little is known on long-term stability in non-Western countries, or stability across different instruments.

This study aims to address the issue of the stability of schizotypal personality across time and instrumentation in the context of a longitudinal study in a non-Western country. The primary goal was to assess degree of association between total SAE scores measured at age 17 and total SPQ scores assessed six years later in the same population at age 23, and to assess degree of prediction using receiver operator characteristic (ROC) curve analysis. The secondary goal, given the level of interest in the three factor structure of schizotypy, was to assess the degree of stability/change for three factors derived empirically from the SAE which could then be cross-correlated over time with the three corresponding factors of the SPQ. Thirdly, we examined whether social anhedonia at 17 is selectively associated with interpersonal schizotypy at age 23. It was hypothesized that some degree of temporal stability could be documented across a six-year time period from ages 17 to 23 years for schizotypal personality, with somewhat lower stability for each of the three schizotypy factors. It was also hypothesized that correcting for measurement error would result in increased stability coefficients, and that findings would replicate across independent samples.

2. Method

2.1. Participants

Participants were drawn from a birth cohort of 1795 children from the Mauritius Child Health Project. Full details of the study are given elsewhere (Raine et al., 2010). All children born between 1969 and 1970 in two main towns in Mauritius were recruited into the study when they were 3 years old. The ethnic distribution of the sample was Indian 68.5%, Creole (African Origin) 25.7%, and others (Chinese, English and French origin) 5.8%. Boys constituted 51.4% and girls 48.6% of the sample. After receiving a full description of the study, written informed consent was obtained from the participants at ages 17 and 23. Research activities were conducted in accordance with the principles outlined in the Belmont (1979) report. Institutional review board approval was obtained from the University of Southern California.

To compare longitudinal associations between anhedonia and schizotypy with concurrent associations, the SAE and SPQ were assessed in 302 male and female undergraduates (mean age 19.28 years) from the U.S. at the same point in time (see Raine, 1991 for further details). The SAE and SPQ correlate 0.65 ($p < 0001$) in this sample, indicating that these instruments are broadly measuring a similar construct of schizotypy.

2.2. Schedule of Attitudes and Experiences (SAE) at age 17

The SAE consisted of 30 binary items (scored 1=no, 2=yes) drawn from multiple sources. It is predicated on the concepts of social and physical anhedonia, perceptual aberration, magical thinking (Chapman et al., 1976, 1978, 1980) and also "schizophrenism" (Nielsen and Petersen, 1976). For use in Mauritius, questions were translated into "patois creole", checked by back-translation, vetted for wording by local psychiatrists, and administered by trained research assistants. Full details of the construction of this schizotypy measure together with its two-factor structure and construct and convergent validity are reported elsewhere (Venables, 1990a; Venables et al., 1990b). Internal reliability for the scale in the current sample is 0.55.

2.3. The Schizotypal Personality Questionnaire (SPQ) at age 23

The SPQ (Raine, 1991) assesses the nine DSM features of Schizotypal Personality Disorder, and was constructed using a face validity approach. A point-biserial correlation of 0.60 between clinically-diagnosed schizotypal personality disorder and SPQ scores supports criterion validity for this self-report instrument (Raine, 1991). Confirmatory factor analysis of this scale has shown that three main factors – cognitive–perceptual, interpersonal, and disorganized – underlie individual differences in schizotypal personality (Raine et al., 1994). This same structure has been confirmed on the Mauritius sample used here, and generalizes across different gender and ethnic groups (Reynolds et al., 2000). For use in Mauritius, questions were translated into "patois creole", checked by back-translation, and vetted by a clinical psychologist for wording. Internal reliability (coefficient alpha) in this sample is high (0.92). See Raine (1991) for full details on reliability and validity.

2.4. Procedures and statistical analyses

The SAE was administered at age 17 while the SPQ was administered at age 23. Only those participants ($N=678$) with complete data at ages 17 and 23 were retained for analyses. Those with complete data on both questionnaires did not differ to those without complete data on gender ($\chi^2=3.12$, d.f.=1, $p=0.08$), ethnicity ($\chi^2=1.08$, d.f.=1, $p=0.30$), social adversity ($t=-0.32$, d.f.=1101, $p=0.74$), and intelligence ((IQ) – $t=0.79$, d.f.=956, $p=0.43$). Participants were randomly assigned using the random allocation method in SPSS into two independent samples, the first "test" sample consisting of 339 participants, and the second "replication" sample also consisting of 339 participants. All initial analyses were conducted on the test sample, and then repeated on the replication sample to assess robustness of findings.

Several procedures were used with the test sample to select appropriate items from the SAE to form a putative three-factor structure that would be further tested in the replication sample, and which would parallel the three factors of the SPQ. First, relationships between the 30 SAE age 17 items and the three SPQ schizotypy factors at age 23 were assessed using multivariate analysis of variance, with each SAE item used as the independent variable and the three SPQ factors forming the dependent variables. Only those age 17 SAE items from the test sample which were significantly associated with at least one SPQ schizotypy factor at age 23 in the predicted direction on a one-tailed test were retained for further analyses. Fifteen of the 30 items were retained. Excluded items constituted the physical and social anhedonia scales of the SAE. Secondly, classification of items into the three factors was made based on results of a prior factor analysis of the original version of the SAE (Venables and Bailes, 1994) and also a face validity approach which had been used in the construction of the SPQ. On this basis, 12 of the 15 retained items were allocated into the three cognitive–perceptual, interpersonal, and disorganized factors, with 4 items representing each factor (see Table 1). The three remaining items were dropped due to lack of face validity or prior factor fit. All reference to the SAE and its factors from hereon are made with reference to this shorter 12-item instrument.

The final 12 items were then subjected to Confirmatory Factor Analysis (CFA) using the AMOS program (Arbuckle, 2010). A putative two factor model (Kendler and Hewitt, 1992) had the items defining the cognitive–perceptual factor as "positive schizotypy" and those defining the interpersonal and disorganized factors combined as "negative schizotypy". The fit of one, two and three factor structures were examined using recommended criteria which are more stringent that those previously employed (Hu and Bentler, 1999). Specifically, for a good fit the comparative fit index (CFI) should exceed 0.95 and the value of the root mean square error of approximation (RMSEA) should be less than 0.06. Finally, the recommendation that the Akaike information criterion (AIC) should be used for comparison between models was implemented.

Groups of high scoring subjects (top 10%) and low scoring subjects (bottom 50%) were created for each of the three factors from the age 23 SPQ data. Receiver operator characteristic (ROC) curve analysis was conducted to assess the extent to which High and Low scorers at age 23 could be predicted from age 17 schizotypy factors. Mean values for areas under the ROC curve (AUC) should be significantly greater than 0.5, and the lower 95% bound should not be below 0.5 for significant prediction (Faraone et al., 2005).

To correct for measurement error in assessing the stability of schizotypy from ages 17 to 23, two procedures were adopted. First, a disattenuated correlation, free of measurement error, was calculated by dividing the raw correlation between schizotypy at both ages by the square root of the geometric mean of the reliabilities of the two measures (Murphy and Davidshofer, 2004). Secondly, structural equation modelling which corrects for measurement error (Byrne, 2009) was used to model the association between the two latent SAE and SPQ constructs of schizotypy from their respective three factors using the Amos 18 program (Arbuckle, 2010). Reliabilities (Chronbach's alpha) for the SAE were 0.55 (sample 1), 0.56 (sample 2), and 0.56 (total sample). Reliabilities for the SPQ were 0.93 (sample 1), 0.92 (sample 2), and 0.92 (total sample).

3. Results

3.1. Three factors of the age 17 SAE and their interrelationships

Table 1 shows items from the SAE retained to represent the cognitive–perceptual, interpersonal, and disorganized factors, together with standardised factor loadings from the CFA analyses for both test sample and replication samples. Table 2 shows the CFA model fitting results. The three factor solution gave the best fit to the SAE by virtue of having CFI values of 0.99 (test sample) and

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Table 1
Items from the 12-item Schedule of Attitudes and Experiences (SAE) broken down into three factors, with standardised factor loadings from the CFA analyses for both test sample ($N=339$) and replication sample ($N=339$). (r)=reverse scored.

		Test Sample	Replication sample
Cognitive/Perceptual			
7	I often get a restless feeling that I want something but do not know what	0.62	0.62
16	Now and then when I look in a mirror, my face seems quite different from usual	0.55	0.46
25	Sometimes people who I know well begin to look like strangers	0.26	0.38
29	I have sometimes felt that strangers were reading my mind	0.34	0.47
Interpersonal			
4	I often change between positive and negative feeling toward the same person	0.40	0.39
13	I am not usually self-conscious (r)	0.22	0.10
10	I suddenly feel shy when I want to talk to a stranger	0.29	0.43
24	I prefer others to make decisions for me	0.31	0.33
Disorganized			
1	I am not easily confused if a number of things happen at the same time (r)	0.26	0.19
14	I find it difficult to concentrate, irrelevant things seem to distract me	0.53	0.49
17	People can easily influence me even when I thought my mind was made upon a subject	0.53	0.55
19	I often have grave difficulties controlling my thoughts when I am thinking	0.52	0.48

Table 2
Goodness of fit indices for one factor (general), two factor (positive–negative) and three factor (cognitive–perceptual, interpersonal, disorganized) solutions for the 12 SAE items at age 17 for the two independent (test and replication) samples. $N=339$ for each sample.

1. Factor solution	CFI	RMSEA	AIC	$\chi 2$
Test sample	0.841	0.059	191.16	118.30
Replication sample	0.808	0.055	183.23	110.38
2. Factor solution				
Test sample	0.924	0.035	150.72	75.79
Replication sample	0.927	0.040	157.08	92.86
3. Factor solution				
Test sample	0.993	0.011	134.05	50.05
Replication sample	0.969	0.028	146.78	61.43

CFI=comparative fit index.
RMSEA=root mean square error of approximation.
AIC=Akaike information criterion.

Table 3
Means, standard deviations, coefficient alpha reliabilities (α) of the SAE, and also longitudinal relationships (r) between SAE (age 17) and SPQ (age 23) factor scores and total scores. $N=339$ for each sample.

Factor	Test sample ($N=339$)				Replication sample ($N=339$)			
	Mean	S.D.	α	r	Mean	S.D.	α	r
Cognitive–Perceptual	6.2	1.1	0.37	0.27	6.2	1.2	0.49	0.35
Interpersonal	5.4	1.0	0.29	0.32	5.3	1.0	0.27	0.24
Disorganized	6.2	1.3	0.52	0.33	6.3	1.3	0.53	0.32
Total Score	17.86	2.8	0.63	0.44	17.72	2.6	0.70	0.38

0.97 (replication sample), RMSEA values of 0.011 and 0.028, and smaller $\Delta\chi^2$ values, documenting significantly better fits for the three factor model over the one and two factor models ($p<0.0001$ in both samples).

Mean values for each of the SAE factors, coefficient alpha, and longitudinal SAE–SPQ relationships for each sample are shown in Table 3. The alpha reliabilities for the SAE factors are highest for the disorganized factor and lowest for the interpersonal factor, and range from 0.27 to 0.53.

Intercorrelations between the three SAE factors were 0.46 (cognitive–perceptual with disorganized), 0.31 (cognitive–perceptual with interpersonal), and 0.37 (interpersonal with disorganized).

3.2. Longitudinal associations

Total SAE schizotypy scores at age 17 correlated 0.44 ($d=1.0$) and 0.38 ($d=0.80$) in the two samples with total SPQ schizotypy scores at age 23 (see Table 3) with $r=0.41$ ($d=0.90$) for the total sample. Associations over this six-year period (from age 17 to 23) for the three factors range from 0.24 ($d=0.5$) to 0.35 ($d=0.75$). All of these associations are highly significant, and all replicate across the two samples.

After correcting for measurement error, the disattenuated correlations between the total scores of the two different schizotypy measures across time were $r=0.62$ (sample 1), $r=0.53$ (sample 2) and $r=0.58$ (total sample). Similarly, structural equation modelling of the two latent schizotypy constructs (total SAE and SPQ scores) in the total sample resulted in a correlation of 0.58. For the three factors, disattenuated longitudinal correlations for the two samples respectively were as follows: cognitive–perceptual (0.50, 0.56), interpersonal (0.64, 0.50), and disorganized (0.50, 0.48).

3.3. ROC predictive analyses

Results of the ROC analyses where the age 17 SAE factors are used to predict age 23 high- and low-scoring groups on the three factors are shown in Table 4. In all cases the AUC measure was significant, with the lower 95% bound not reaching a value of 0.5. The mean AUC value across all samples was 0.74, indicating reasonable prediction over the six year period from adolescence to adulthood. These findings based on the test sample were closely replicated in the replication sample (see Table 4).

3.4. Associations between anhedonia and schizotypy

The items from the age 17 SAE which were not used to create the three schizotypy factors consisted of items from the social and physical anhedonia scales. Longitudinal associations between these age 17 scales and the three SPQ schizotypy factors at age 23 are shown in Table 5. No replicable associations were observed.

Table 5 (far right) also presents *concurrent* associations between the same anhedonia scales and the three SPQ factors in the U.S. sample. As expected, social anhedonia was positively associated with the interpersonal factor ($r=0.35$). Physical

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anhedonia showed no significant association with the three schizotypy factors.

4. Discussion

This study aimed to assess the stability of schizotypy across different instruments bridging an extended time period. The central finding was that total schizotypy scores correlated 0.41 ($d=0.90$) from adolescence to adulthood, indicating modest temporal stability. Confirmatory factor analysis showed that the SPQ three factor structure could be generated from the original SAE, a measure of schizotypy premised on very different suppositions. These schizotypy factors at age 17 correlated approximately 0.30 ($d=0.62$) with their respective factors at age 23. ROC analyses further documented adequate prediction over a six year period. Findings were replicated on an independent sample, attesting to the robustness of findings. Importantly, correcting for measurement error resulted in a 0.58 correlation ($d=1.42$) between two very different assessments of schizotypy across time in a non-Western culture very different from countries that had developed these instruments. Results provide some support for the moderate stability of schizotypy and its three factors across time and instrumentation during a period of rapid late adolescent/early adulthood change when developmental instability would be expected to be significant. To our knowledge, this is the first study to document stability in schizotypy across different instruments, and one of the few to track schizotypy over an extended (six year) time period from adolescence into adulthood.

4.1. Temporal stability

Continuity in the structure of schizotypy was observed over a six year period from age 17 to age 23. While the uncorrected correlation of 0.41 is modest, it is comparable to the two-year reliability of 0.53 reported for the SPQ (Stefanis et al., 2006) and four-year reliabilities of 0.45 and 0.55 for dimensional clinical rating and self-report clinical schizotypy assessments during adulthood (Lenzenweger, 2004). The SAE–SPQ relationship also spanned a longer period of time (six years) and was based on two different instruments with notably different constructions. Furthermore, it spans the transition from adolescence to adulthood when there are considerable social and biological changes, including work, family, brain development, and marriage. Furthermore, the fact that comparative stability was found for a short 12-item instrument also suggests that lack of strong internal reliability does not necessarily limit construct validity, particularly given the good fit for the three-factor structure of the SAE that replicated across samples.

As indicated earlier, test–retest correlations over time in prior studies have cast reasonable doubt on the temporal stability of schizotypy personality. We caution however that these prior studies have not corrected for psychometric error variance. After such correction, we observed in the current study that the six year stability in total schizotypy scores moved from .41 to.58 – an increase that is not large, but also not trivial. Similarly, stability of the three individual factors on average moved from 0.29 ($d=0.61$) to 0.53 ($d=1.25$) after correction, a doubling of effect size. Furthermore, ROC analyses showed that groups on each factor at age 23 could be significantly identified by scores on the same factor at age 17. We nevertheless caution, as others have done, that continuity of schizotypy over time is not as strong as prior editions of DSM have argued (Lenzenweger, 2004). There is clearly considerable leeway for developmental change in schizotypy from adolescence to adulthood.

4.2. Theoretical considerations

Establishing the degree to which psychotic-like features persist or change is of significant importance in psychiatry. While the prevalence of sub-clinical psychotic features in the general population is not insubstantial, it has been argued that 75–90% of these experiences disappear over time (van Os et al., 2009). This would suggest major developmental change in schizotypal features. At a trait level however, there is clearly some degree of stability over time, as indicated in the present study even when using different instruments. The psychosis proneness – persistence – impairment model argues that persistence of psychotic-like experiences, produced by psychological and biological mechanisms, increase the probability of clinical impairment (van Os et al., 2009). The identification of individuals with stably high levels of psychosis-proneness in longitudinal community studies has the potential to shed light on the nature of these mechanisms. In this context the current findings establish the identification of such individuals as a fully feasible goal in a community context given the degree of

Table 4
Results of receiver operating characteristic (ROC) curve fitting for age 17 SAE factors predicting High (top 10%) versus Low (bottom 50%) scorers on same SPQ factors at age 23. Two columns on the right show sensitivity and specificity values at a 50% cut of the predictor $N=339$ for each sample.

Factor	AUC	SE	Sig	95% LB	95% UB	Sens	Spec
Test sample							
Cognitive–Perceptual	0.675	0.043	0.000	0.590	0.760	0.85	0.37
Interpersonal	0.731	0.051	0.000	0.631	0.831	0.71	0.71
Disorganized	0.769	0.040	0.000	0.691	0.848	0.94	0.45
Replication sample							
Cognitive–Perceptual	0.750	0.042	0.000	0.667	0.832	0.94	0.43
Interpersonal	0.710	0.041	0.000	0.630	0.791	0.63	0.67
Disorganized	0.775	0.047	0.000	0.682	0.868	0.93	0.39

AUC=area under curve
SE=standard error with significance level and 95% upper (UB) and lower (LB) bounds of AUC.

Table 5
Correlations between social and physical anhedonia at age 17 and the three factors of schizotypy at age 23 in the two independent samples from Mauritius, together with concurrent associations in the U.S. sample (far right). Cog–Percept=Cognitive–Perceptual.

	Test sample		Replication sample		U.S. sample	
Factor	Social anhedonia	Physical anhedonia	Social anhedonia	Physical anhedonia	Social anhedonia	Physical anhedonia
Cog–Percept	−0.09	−0.21**	−0.07	−0.07	0.14*	0.06
Interpersonal	−0.07	−0.06	−0.01	−0.01	0.35**	0.06
Disorganized	−0.10+	−0.11*	0.01	−0.01	−0.03	−0.02
Total score	−0.09+	−0.14*	−0.04	−0.04	0.23**	0.05

+ $p<0.01$.
* $p<0.05$.
** $p<0.001$.

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stability. They also provide another lens with which to view the extent of change in psychotic-like experiences over time, which has been argued to be large.

Items in the SAE at age 17 which were not associated with age 23 schizotypy factors consisted of social and physical anhedonia. While the lack of such relationships may be expected for physical anhedonia which bears no clear relationship to DSM-defined schizotypy, social anhedonia has been concurrently associated with the interpersonal factor of schizotypy (Wang et al., 2014). We confirmed this *concurrent* relationship ($r=0.35$) in a sample of adults from the U.S. using the same measures of social anhedonia and schizotypy as used in Mauritius. Consequently, the failure to observe a *longitudinal* relationship indicates developmental instability of social anhedonia in relation to interpersonal schizotypal features. This may not be surprising given changes in social relationships occurring from 17 to 23 years (e.g. leaving school, starting work, marriage, having children).

The current findings also bear on core issues that have been highlighted in revisions to DSM-IV. DSM V abandoned previous sub-types of schizophrenia on grounds of instability and unreliability, and also dropped paranoid (related to cognitive–perceptual features) and schizoid (related to interpersonal features) personality disorders (Nemeroff et al., 2013). Schizotypal personality disorder remains, although different factors of schizotypy have not been recognized in any version of DSM. Furthermore, a more dimensional approach to personality disorders was not incorporated into the main DSM manual but was instead placed in section III for further research (American Psychiatric Association, 2013). In contrast, research findings are increasingly documenting discrete dimensions making up the schizotypy construct in both community and clinical samples which can be reliably assessed (Raine, 2006). Prior work has shown that the three factor model is invariant to culture, gender, religious affiliation, social adversity, and psychopathology, findings which document its stability (Reynolds et al., 2000; Stefanis et al., 2013). The current findings add further support by showing reasonable stability (average $r=0.53$ after error correction) across instruments and a quite substantial six-year time period in a culture very different from that which generated the schizotypy construct. Taken together, it is becoming increasingly difficult to ignore subtype distinctions in schizotypal symptomatology given this growing literature, whether such distinctions are conceptualized as three factors as in this study, or as four factors, as in other studies (Stefanis et al., 2013).

In this context, while the current findings pertain to the three factor model, we emphasize that there are other viable factor structures to DSM schizotypy. A four-factor model of positive, negative, disorganized, and paranoid schizotypy has been postulated, with molecular genetic data importantly documenting distinctions across these factors (Stefanis et al., 2013). While we anticipate that future research will continue to refine the factor structure of DSM schizotypy, there is a broad and growing consensus that schizotypy is a dimensional construct that blends into psychosis (Nelson et al., 2013). There is also agreement that specific features of schizotypy (particularly interpersonal) are genetically related to schizophrenia (Chapman et al., 1994; Raine, 2006). As such, it is becoming increasingly harder to substantiate schizotypy as a unitary concept, but easier to recognize that a syndrome approach has some merit (Chapman et al., 1994; Venables et al., 1990b).

4.3. Limitations and clarifications

Limitations of the current study need to be acknowledged. First, the sample size at 678, while not small, is not large compared to other psychometric studies of schizotypy, although limited power did not preclude significant findings being obtained. Secondly, findings on the temporal stability of schizotypy cannot at this time be generalized from Mauritius to Western countries. Thirdly and importantly, other factor models of DSM schizotypy need to be considered in future studies, including but not limited to the four-factor model of Stefanis et al. (2006). This competing model could not be tested in the current study due to the lack of any paranoia items in the original SAE. Fourth, we were not able to separate time from instrumentation as both instruments were never administered at the same time. Fifth, because different instruments are used to assess schizotypy at the two ages, we under-estimate the true stability of schizotypy when using the same instrument. The counter-perspective is that the same schizotypal individual in clinical practice may well be assessed somewhat differently across a six-year time period by different clinicians. Consequently, the current study utilizing two different instruments can potentially provide a better estimate for clinical practice.

We should also clarify two further issues. First, the goal of this study was not to develop a new measure of the three schizotypy factors, or to test the robustness of the three factors across time and instrumentation. Instead our goal was to empirically generate a three factor structure to the SAE schizotypy assessment at age 17 that could be tested for developmental stability/instability in relation to a similar three factor structure at age 23 using the SPQ. Clearly, the brevity of the age 17 schizotypy measure results in low internal reliabilities for the three factors (see Table 3) which is a significant limitation, resulting in conservative estimates for longitudinal stability. This in turn suggests that even stronger support for stability would emerge using the same schizotypy measures across time – an assessment we were unable to conduct. Secondly, we re-iterate that DSM schizotypy may well consist of more than three factors. We recognize that future studies may usefully extend the current cross-cultural work in both clinical and community settings to develop more complex factor models of schizotypy. Thirdly, while it would have been advantageous to have the same instrument administered at both ages, when participants were aged 17 the SPQ had not been developed, and at age 23 we elected to use the SPQ as it had just been developed. At no time-point were both instruments administered.

4.4. Conclusions

In conclusion, we find modest stability of schizotypy (error-corrected r of 0.58) from adolescence to adulthood, alongside replicable support for moderate stability of cognitive–perceptual ($r=0.53$), interpersonal ($r=0.57$), and disorganized factors ($r=0.49$). It is felt that there are several strengths to the current study which help form a substantive contribution to this field. The longitudinal nature of the study over a six year time period is not common. Unlike many single sample studies, we were able to replicate all findings on an independent sample, a methodological strength that places greater confidence in the findings. Perhaps more significantly, by correcting for measurement error we place the assessment of the stability of schizotypal personality on a firmer empirical background. Overall, findings on the multifactorial assessment of schizotypy provide a basis upon which further etiological and clinical work on schizotypy may build. The future clinical challenge lies in understanding what social and biological processes lead some individuals to remain stably schizotypal over time, while others change.

Contributors

Both authors contributed to the design of the study, data analyses and writing.

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Conflict of interest

None.

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References

American Psychiatric Association, 1987. Diagnostic and Statistical Manual of Mental Disorders, 3rd ed American Psychiatric Association, Washington.
American Psychiatric Association, 2013. Diagnostic and Statistical Manual of Psychiatric Disorders, 5th ed. American Psychiatric Publishing, Arlington VA.
Arbuckle, J.L., 2010. Amos 19 Users Guide. SPSS, Chicago.
Badcock, J.C., Dragović, M., 2006. Schizotypal personality in mature adults. Personality and Individual Differences 40, 77–85.
Belmont, R., 1979. The Belmont Report: Ethical Principles and Guidelines for the Protection of Human Subjects of Biomedical and Behavioral Research. US Dept of Health and Human Services, Washington, D.C.
Byrne, B.M., 2009. Structural equation modelling with AMOS, 2nd ed. Routledge, New York.
Cella, M., Serra, M., Lai, A., Mason, O.J., Sisti, D., Rocchi, M.B., Petretto, D.R., 2013. Schizotypal traits in adolescents: links to family history of psychosis and psychological distress. European Psychiatry 28, 247–253.
Chapman, L.J., Chapman, J.P., Kwapil, T.R., Eckblad, M., Zinser, M.C., 1994. Putatively psychosis-prone subjects 10 years later. Journal of Abnormal Psychology 103, 171–183.
Chapman, L.J., Chapman, J.P., Raulin, M.L., 1976. Scales for physical and social anhedonia. Journal of Abnormal Psychology 85, 374–382.
Chapman, L.J., Chapman, J.P., Raulin, M.L., 1978. Body-image aberration in schizophrenia. Journal of Abnormal Psychology 87, 399–407.
Chapman, L.J., Edell, W.S., Chapman, J.P., 1980. Physical anhedonia, perceptual aberration and psychosis proneness. Schizophrenia Bulletin 6, 639–654.
Ericson, M., Tuvblad, C., Raine, A., Young-Wolff, K., Baker, L.A., 2011. Heritability and longitudinal stability of schizotypal traits during adolescence. Behavioral Genetics 41, 499–511.
Faraone, S.V., Althoff, R.R., Hudziak, J.J., Monuteaux, M., Biederman, J., 2005. The CBCL predicts DSM bipolar disorder in children: a receiver operating characteristic curve analysis. Bipolar Disorders 7, 518–524.
Fossati, A., Raine, A., Carretta, H., Leonardi, B., Maffei, C., 2003. The three-factor model of schizotypal personality: invariance across age and gender. Personality and Individual Differences 35, 1007–1019.
Hu, L., Bentler, P.M., 1999. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. Structural Equation Modeling 6, 1–55.
Kendler, K.S., Hewitt, J., 1992. The structure of self-report schizotypy in twins. Journal of Personality Disorders 6, 1–17.
Lenzenweger, M.F., 2004. Consideration of the challenges, complications, and pitfalls of taxometric analysis. Journal of Abnormal Psychology 113, 10–23.
Mason, O., 1995. A confirmatory factor analysis of the structure of schizotypy. European Journal of Personality 9, 271–281.
Murphy, K.R., Davidshofer, C.O., 2004. Psychological Testing: Principles and Applications, 6th ed. Prentice Hall, New Jersey.
Nelson, M.T., Seal, M.L., Pantelis, C., Phillips, L.J., 2013. Evidence of a dimensional relationship between schizotypy and schizophrenia: a systematic review. Neuroscience and Biobehavioral Reviews 37, 317–327.
Nemeroff, C.B., Weinberger, D., Rutter, M., MacMillan, H.L., Bryant, R.A., Wessely, S., Lysaker, P., 2013. DSM-5: a collection of psychiatrist views on the changes, controversies, and future directions. BioMed Central Medicine 11, 202.
Nielsen, T.C., Petersen, K.E., 1976. Electrodermal correlates of extraversion, trait anxiety amd schizophrenism. Scandinavian Journal of Psychology 17, 73–80.
Raine, A., 1991. The SPQ: a scale for the assessment of Schizotypal Personality Disorder based on DSM-III-R criteria. Schizophrenia Bulletin 17, 555–564.
Raine, A., 2006. Schizotypal personality: neurodevelopmental and psychosocial trajectories. Annual Review of Clinical Psychology 2, 291–326.
Raine, A., Fung, A.L., Lam, B.Y.H., 2011. Peer victimization partially mediates the schizotypy–aggression relationship in children and adolescents. Schizophrenia Bulletin 37, 937–945.
Raine, A., Liu, J., Venables, P.H., Mednick, S.A., Dalais, C., 2010. Cohort profile: the Mauritius Child Health Project. International Journal of Epidemiology 39, 1441–1451.
Raine, A., Reynolds, C., Lencz, T., Scerbo, A., Triphon, N., Kim, D., 1994. Cognitive-perceptual, interpersonal, and disorganized features of schizotypal personality. Schizophrenia Bulletin 20, 191–201.
Reynolds, C.A., Raine, A., Mellingen, K., Venables, P.H., Mednick, S.A., 2000. Three-factor model of schizotypal personality: invariance across culture, gender, religious affiliation, family adversity, and psychopathology. Schizophrenia Bulletin 26, 603–618.
Schiffman, J., 2004. Schizotypal traits in a non-clinical sample from Hawai'i. Pacific Health Dialogue 11, 84–86.
Stefanis, N.C., Hatzimanolis, A., Avramopoulos, D., Smyrnis, N., Evdokimidis, I., Stefanis, C.N., Straub, R.E., 2013. Variation in psychosis gene ZNF804A is associated with a refined schizotypy phenotype but not neurocognitive performance in a large young male population. Schizophrneia Bulletin 39, 1252–1260.
Stefanis, N.C., Vitoratou, S., Ntzouufras, J., Smyrnis, N., Evdokimisdis, J., Stefanis, C.N., 2006. Psychometric properties of the greek version of the Schizotypal Personality Questionnaire (SPQ) in young male obligatory conscripts: a two year test-retest study. Personality and Individual Differences 41, 1275–1286.
van Os, J., Linscott, R., Myin-Germeys, I., Delespaul, P., Krabbendam, L., 2009. A systematic review and meta-analysis of the psychosis continuum: evidence for a psychosis proneness-persistence-impairment model of psychotic disorder. Psychological Medicine 39, 179–195.
Venables, P.H., 1990a. The measurement of schizotypy in Mauritius. Personality and Individual Differences 11, 965–971.
Venables, P.H., Bailes, K., 1994. The structure of schizotypy, its relation to subdiagnoses of schizophrenia and to sex and age. British Journal of Clinical Psychology 33, 277–294.
Venables, P.H., Wilkins, S., Mitchell, D.A., Raine, A., Bailes, K., 1990b. A scale for the measurement of schizotypy. Personality and Individual Differences 11, 481–495.
Wang, Y., Lui, S.S.Y., Zou, L.Q., Zhang, Q., Zhao, Q., Yan, C., Hong, X.H., Tan, S.P., Cheung, E.F.C., Chan, R.C.K., 2014. Individuals with psychometric schizotypy show similar social but not physical anhedonia to patients with schizophrenia. Psychiatry Research 216, 161–167.
Wuthrich, V.M., Bates, T.C., 2006. Confirmatory factor analysis of the three factor structure of the schizotypal personality questionnaire and the Chapman schizotypy scales. Journal of Personality Assessment 87, 292–304.

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