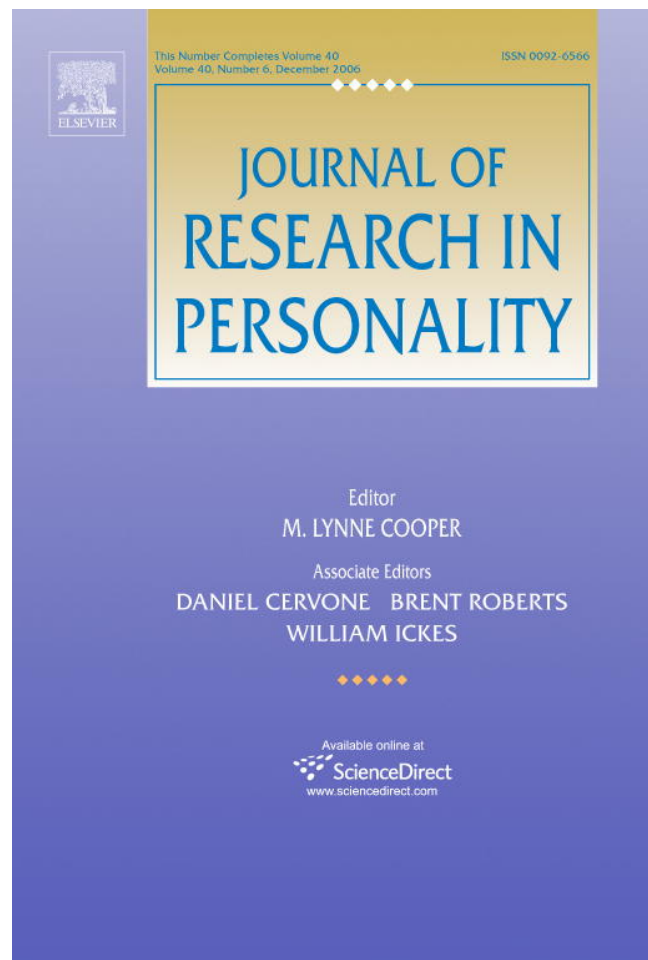


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Schizotypy and mental health amongst poets, visual artists, and mathematicians

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Abstract

Many researchers have found evidence of an association between creativity and the predisposition to mental illness. However, a number of questions remain unanswered. First, it is not clear whether healthy creatives have a milder loading on schizotypal traits than people who suffer serious psychopathology, or whether they have an equal loading, but other mediating characteristics. Second, most of the existing research has concentrated on artistic creativity, and the position of other creative domains is not yet clear. The present study compares schizotypy profiles using the O-LIFE inventory in a large sample of poets, artists, mathematicians, the general population, and psychiatric patients. Poets and artists have levels of unusual experiences that are higher than controls, and as high as schizophrenia patients. However, they are relatively low on the dimension of introvertive anhedonia. Mathematicians are lower than controls on unusual experiences. The results suggest that artistic creatives and psychiatric patients share a tendency to unusual ideas and experiences, but creative groups are distinguished by the absence of anhedonia and avolition. Moreover, different domains of creativity require different cognitive profiles, with poetry and art associated with divergent thinking, schizophrenia and affective disorder, and mathematics associated with convergent thinking and autism.

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1. Introduction

Notions of an association between creativity and mental illness have a long history (Jamison, 1993; Nettle, 2001). Moreover, contemporary research has provided consider-

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able support to traditional speculations. The evidence comes from five different types of studies. First, biographical and survey studies have found high levels of psychopathology, especially, depression and bipolar disorder, in eminent individuals in the fields of literature and the arts (Andreasen, 1987; Andreasen & Canter, 1974; Jamison, 1989, 1993; Ludwig, 1995; Post, 1994). Second, family studies have produced evidence of creative interests and aptitudes in close relatives of psychiatric patients, including biological relatives separated by adoption (Heston, 1966; Karlson, 1970; McNeil, 1971; Richards, Kinney, & Lunde, 1988). Such studies are suggestive of an inherited personality or cognitive trait that has both creativity and mental illness in its range of effects.

Studies of the third type have shown that psychiatric patients, usually with a diagnosis of schizophrenia, have enhanced performance relative to control participants on tasks of divergent thinking (Andreasen & Powers, 1975; Hasenpus & Magaro, 1976; Keefe & Magaro, 1980). Such tasks have been taken to be good measures of creativity. For example, Keefe and Magaro (1980) found that a schizophrenia patient group scored higher than controls on the alternate uses task (Guilford, Christensen, Merrifield, & Wilson, 1978), in which the participant has to generate unusual uses for a banal object. The logic behind such studies is the observation that divergent thinking, the capacity argued to underlie creativity, is very similar in definition to thought disorder, which is a feature of psychotic conditions (Guilford, 1967; Hasenpus & Magaro, 1976).

The fourth group of studies demonstrates that performance on tests of creativity among the general population correlates with scores on scales designed to assess the liability to psychopathology (Fisher et al., 2004; Schulberg, 1988, 1990, 2000; Woody & Claridge, 1977). Schulberg has shown that there are moderate correlations between tests of creative performance or self-rated creativity, and scales which assess liability to psychiatric symptoms. In particular, psychopathological dimensions relating to either positive psychotic symptoms or hypomania associate positively with creativity, whereas dimensions related to anhedonia or flattened affect related negatively to creative performance. In related work, it has been shown that individuals who score highly on scales related to positive but not negative psychotic symptoms make broader semantic associations between stimuli (Mohr, Graves, Gianotti, Pizzagalli, & Brugger, 2001), and score highly on a divergent thinking battery (Green & Williams, 1999).

The fifth and final approach to the link between psychiatric disorder and creativity has been psychometric assessment of individuals in creative pursuits (Barron, 1969; Eysenck, 1993). Eysenck argued that elevated scores on the P or Psychoticism dimension were typical of such individuals. However, the P dimension has been criticised in terms of validity and specificity, and moreover, despite its name, it has no clear relationship to psychosis in terms of item content or predictive power (Chapman, Chapman, & Kwapil, 1994; Claridge, 1983). Subsequent psychometric work has therefore adopted one of two strategies. Some studies have used the five factor model of personality, which has no single dimension corresponding to Psychoticism, and found that creative individuals and bipolar patients share high levels of the personality traits neuroticism and openness to experience (Nowakowska, Strong, Santosa, Wang, & Ketter, 2004). Such a profile is similar to that of those vulnerable to affective disorders. Other studies have turned instead to a dimension with direct theoretical and empirical connections to psychosis, namely schizotypy (Claridge, 1997; Claridge et al., 1996; Mason, Claridge, & Jackson, 1995).

The concept of schizotypy, and its component structure, are derived inductively from the traits and symptoms found in schizophrenia, and schizotypal and borderline

personality disorders (Mason et al., 1995). Factor analysis of these traits reliably produces four factors (Claridge et al., 1996; Mason et al., 1995). The first, unusual experiences, contains perceptual aberration, hallucinatory, and magical thinking items consonant with the positive symptoms (i.e., hallucinations, delusions and thought disorder) of psychotic illness. The second, cognitive disorganisation, describes difficulties of attention and concentration together with a sense of purposelessness and moodiness. The third, introvertive anhedonia describes a lack of enjoyment, and is congruent with the anhedonia component of the negative symptoms of schizophrenia. The fourth factor, impulsive nonconformity, contains items referring to violent, reckless and self-abusive behaviours. The O-LIFE schizotypy scales (Mason et al., 1995), which are the best validated and most widely used measures of schizotypy, contain 104 items selected from previous scales and inventories of candidate traits to give adequate psychometric properties in general populations.

The four dimensions measured by the O-LIFE are not completely orthogonal in a large general population sample (Mason et al., 1995). Cognitive disorganisation correlates with all of the other three, with r values in the range .25–.42. Unusual experiences is also correlated with impulsive nonconformity ($r = .46$). The scales have not been directly tested for criterion validity against groups diagnosed with relevant psychopathology. However, the magical thinking and perceptual aberration scales, which correlate with, and were incorporated into the production of, unusual experiences, have been found to be predictors of the onset of psychosis in a 10-year longitudinal study (Chapman, Chapman, Kwapił, Eckblad, & Zinser, 1994). However, it is also clear that there are many high scorers on unusual experiences who do not suffer from psychopathology (Jackson, 1997), and that several of the schizotypy dimensions are related to creativity (Brod, 1997).

Two major questions remain about the creativity–psychopathology linkage. First, there is the question of the determinants of creative versus illness outcomes. Full-blown symptoms are detrimental to any kind of creativity. One suggestion that has been made in the literature is that the relationship between schizotypy and creativity is an inverted U shape, with creativity first increasing with increasing schizotypy, and then decreasing as psychopathology begins to take its toll (Akiskal & Akiskal, 1988; Richards et al., 1988). Evidence for such a model includes the fact that although there is evidence of creative functioning in bipolar patients, their non-ill relatives are even more creative (Richards et al., 1988), and creativity is often found in relatives of psychiatric patients, relatives who may have a lower load of the shared trait (Heston, 1966; Karlson, 1970). Many cases of illness can be found amongst artistic creators (Ludwig, 1995). However, such illness is often episodic, and usually of a less severe and unremitting nature than, for example, schizophrenia. The prediction of this inverted U-shaped model would be that individuals in creative professions would tend to score more highly than the general population on schizotypy scales, but not as highly as schizophrenia patients.

An alternative possibility comes from the two-factor approach of Frank Barron. Barron (1972) argued that successful creativity combines deviant and psychopathological traits with high scores on measures of ‘ego strength’. Ego strength includes resilience, ability to cope with stress, self-control and high levels of experienced well-being. Ego strength is thus a mediating factor that determines whether schizotypy is translated into damaging symptoms or healthy creative output. Schulberg’s (1990) work is relevant to this model, finding as it does that scales based on positive symptoms correlate positively with creativity scores, whereas scales based on negative symptoms correlate negatively. Thus, a lack of negative symptoms would appear to be equivalent to high ‘ego strength’ in Barron’s terms. The prediction in

terms of the O-LIFE dimensions would therefore be that creativity would be associated positively with unusual experiences but negatively with introvertive anhedonia.

The first purpose of this study is therefore to investigate these alternatives by administering the O-LIFE schizotypy scales (Mason et al., 1995) to a general population, psychiatric patients, and groups of creative individuals. The psychiatric patients serve both as a validity check for the O-LIFE scales, and a comparison against the creative groups.

The second question regarding the relationship between creativity and psychopathology concerns the differences between creative domains. Existing studies have tended to concentrate on artistic creativity. Where natural scientists have been considered, they appear to have much lower rates of mental illness (Ludwig, 1995). More recently, it has been argued that scientists, mathematicians and engineers are likely to have profiles related to autism-spectrum disorders (Baron-Cohen, Richler, Bisarya, Gurunathan, & Wheelwright, 2003; Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001). Autistic traits are in many ways the converse of the unusual experiences component of schizotypy. Whereas schizotypal thought is characterised by often metaphorical leaps from domain to domain, remote associations, and broad attentional set, autism is characterised by narrow interests and literality, with occasionally highly developed abilities in tasks requiring systematic and convergent thinking.

To investigate possible differences, as well as two artistic groups, poets and visual artists, research mathematicians have been included in this study. In as much as mathematics (and perhaps other sciences, though these are beyond the scope of this paper) requires exceptional abilities in working convergently from a small number of postulates to all their entailments, it may actually be hindered by divergent thinking. If this view is correct, then mathematicians may show the converse pattern to that expected of the artistic groups—low in unusual experiences, and potentially high in introvertive anhedonia.

2. Methods

To investigate these questions, a comprehensive questionnaire including the O-LIFE schizotypy scales (Mason et al., 1995) was administered to a composite sample which contained a mixture of control participants, poets, visual artists, mathematicians, and individuals with a history of serious psychiatric disorder. No claim is implied that such a sample is representative of the general population, but it allows all the comparisons required for investigation of the research questions.

2.1. Participants

A multi-pronged sampling effort was mounted to ensure representation of all the relevant groups in the sample. First, questionnaires were dropped through letter boxes in a socio-economically mixed neighbourhood of a town in Southern England. Second, the study was advertised on an internet local events site for the same city. Third, students attending residential schools in Psychology at the Open University were given the option of taking a questionnaire pack away with them. In all cases, the questionnaire pack contained a postage-paid envelope for return of the questionnaire to the researchers, and a voucher to obtain a small honorarium in the form of a gift certificate from a major retail outlet. These initiatives yielded 239 individuals (82 door to door, 107 from the website, 50 Open University).

Further participants were recruited through a local mental health support charity. This organization provides day care facilities, information on treatment, and other support and services to people with serious mental health problems, their families and carers. Participants recruited in this way had the option of having a donation made to the charity instead of their honorarium. The 64 participants recruited this way included both patients, who were generally in remission and living in the community, and carers. A number of additional participants heard about the study by word of mouth from this source.

The creative professions were targeted in the following ways. An advertisement was placed in a magazine aimed at the visual art community (yielding 60 responses). A call for participants was placed on the website of a leading poetry organization (16 responses). In addition, successful published British poets who placed their office addresses in their entries in *Who's Who In Poetry* (2003) were written to directly offering them the questionnaire pack (20 responses). Finally, an advertisement was placed in the newsletter of Great Britain's leading mathematical society (26 responses). All of these initiatives also yielded a few additional participants by word of mouth.

2.2. Grouping of the sample

Participants have been assigned to groups on the basis of their history of psychopathology, and also on the basis of their involvement in any of the creative domains. In all cases, group assignment was made on the basis of questionnaire responses and without regard to how the participant had become involved in the study.

Psychopathology was rated from answers to detailed questions about symptoms and treatment. Psychopathology was divided into four categories: None, non-psychotic affective conditions (overwhelmingly depression and anxiety disorders), schizophrenia (as evidenced by a diagnosis of schizophrenia and treatment with anti-psychotics), and bipolar disorder (as evidenced by a diagnosis of mania and treatment with lithium). To maximise reliability, participants were assigned to psychopathology groups only if they reported and specified having receive a medical treatment (drugs or psychotherapy) for that condition, not if they report being troubled by the symptom but having had no treatment for it.

For poetry and visual art, participants were assigned to four groups on the basis of their responses: non-participant, hobbyist, serious, and professional. Non-participants groups were not active producers in the domain (though they could be keen readers of poetry or viewers of art). Hobbyists rated their production 'as a hobby,' while the serious group described themselves as 'seriously involved' in the domain. Finally, the professional group made all or part of their living from the domain. For mathematicians, a simpler division was made into those who were active mathematical researchers and those who were not.

Note that membership of the different psychopathology and creative groups is independent, so one individual could simultaneously be in the non-mathematician group for mathematics, the hobby group for poetry, the professional group for visual art, and the affective group for psychopathology. This means that, for example, the non-poet group contained the visual artists among others. This system of analysis was favoured for several reasons. First, it is statistically conservative, in that demonstrating an increase in schizotypy in poets is actually made harder by having groups of artists and psychiatric patients amongst the non-poet comparison group. Second, excluding all the hobby-level practitioners of the arts would lead to a large reduction in sample size. Third, the clinical and professionally creative groups formed a small proportion of the total sample.

Table 1

Sample composition, broken down according to psychopathology and activity in the different creative domains

Whole sample	501 (319)			
Psychopathology	None	Affective	Schizophrenia	Bipolar
	309 (198)	168 (110)	13 (6)	11 (5)
Poetry	Non-poet	Hobbyist	Serious	Professional
	406 (267)	40 (24)	37 (17)	18 (11)
Visual art	Non-artist	Hobbyist	Serious	Professional
	362 (220)	63 (44)	36 (24)	50 (31)
Mathematics	Non-mathematician	Mathematician		
	466 (312)	35 (7)		

The numbers in parentheses are the numbers of females.

The composition of the sample classified into its various groups is shown in Table 1. Both sexes are evenly represented in all groups, except for a relative paucity of female mathematicians. The mean age of the whole sample was 42.64 years (standard deviation 15.23).

2.3. Questionnaires

The questionnaire instrument used contained the O-LIFE schizotypy scales (Mason et al., 1995). In addition, there was a series of questions on general life history, socio-economic and demographic information, and self-report assessments of creative behaviour. Finally, the questionnaire elicited detailed information on the respondent's personal and family history of psychopathology.

2.4. Analysis

In what follows, groups differences in schizotypy scores are investigated using analysis of variance, taking the four schizotypy scale scores as dependent variables. As age and sex are related to schizotypy (Mason et al., 1995), these are also included in the models. Age was categorized into three equal groups; under 33, 33–47, and 48 and over. Effect sizes (η_p^2) are reported for all significant results.

3. Results

3.1. Scale reliability and validity

Means (and standard deviations) for the four sub-scales of the O-LIFE were as follows: unusual experiences 9.03 (7.00), cognitive disorganisation 9.95 (6.16), introvertive anhedonia 6.36 (5.08), impulsive nonconformity 7.09 (3.17). Although the current sample was partially recruited from populations suspected to be high in schizotypy, overall means and standard deviations are very close to the norms for over-25s given by Mason et al. (1995). The inter-correlation of the different sub-scales (Table 2) is also very similar to the normative data in Mason et al. (1995). The scale reliabilities (Cronbach's α) were also acceptably high, as shown in Table 2.

The presence in the sample of individuals with a history of psychosis allows the external validity of the scales in relation to psychopathology to be verified. Table 3 shows mean

Table 2
Reliability (Cronbach's α) and inter-correlations of the four schizotypy scales

	α	CD	IA	IN
Unusual experiences	.86	.50*	-.01	.47*
Cognitive disorganisation	.87	—	.31*	.41*
Introverted anhedonia	.86	.31*	—	-.06
Impulsive nonconformity	.73	.41*	-.06	—

* $p < .05$.

Table 3
Mean scores on the four schizotypy scales, by respondent's history of psychopathology

	None	Affective	Schizophrenia	Bipolar	F	η_p^2
Unusual experiences	7.94	10.25	12.31	17.36	11.58*	.07
Cognitive disorganisation	8.41	12.24	12.31	15.45	21.76*	.12
Introverted anhedonia	5.84	7.10	9.38	6.36	1.02	—
Impulsive nonconformity	6.47	7.96	7.62	10.55	14.37*	.08

* $p < .05$.

scores on the four scales by history of psychopathology (none, affective disorders, schizophrenia, bipolar disorder). There are highly significant group differences on all scales except introverted anhedonia, with the order of the means being no psychopathology < affective disorders < schizophrenia < bipolar disorder (except for impulsive nonconformity, where affective disorders slightly exceeds schizophrenia). As a visual illustration, mean and 95% confidence intervals by psychopathology group for unusual experiences are shown in Fig. 1. For the remaining scale, introverted anhedonia, the schizophrenia group has a significantly higher mean than the no psychopathology group ($t_{(320)} = 2.58, p < .05, d = .64$), but as the bipolar group have scores almost as low as the no psychopathology group, the overall effect is not significant.

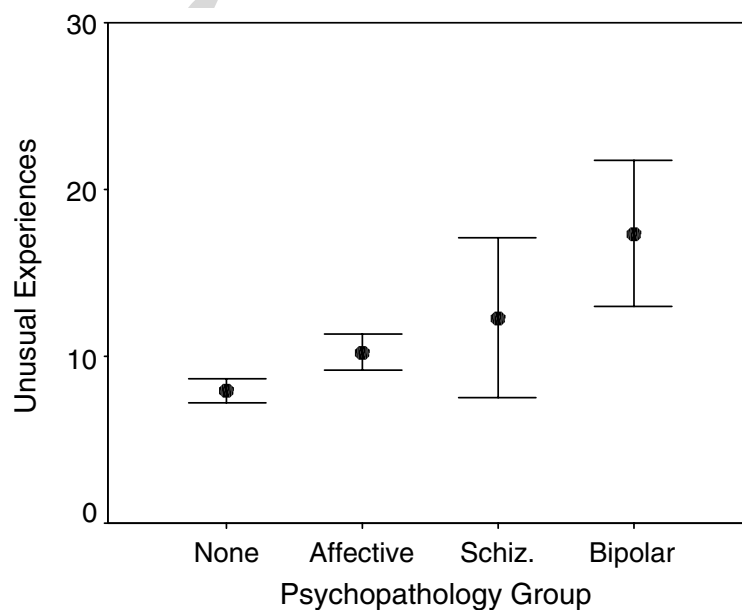


Fig. 1. Mean and 95% confidence interval for the mean for unusual experiences, by respondent's history of psychopathology.

3.2. Schizotypy in relation to poetry

When the sample is broken down by engagement with poetry, there are significant group differences in three of the four schizotypy scales (unusual experiences, cognitive disorganisation, and impulsive nonconformity; see Table 4). Fig. 2 illustrates the pattern for unusual experiences, which is similar in the other two scales: mean scores are

Table 4
Mean scores on the four schizotypy scales, by respondent's engagement in creative domains

Poetry	Non-poet	Hobbyist	Serious	Professional	<i>F</i>	η_p^2
Unusual experiences	8.16	12.43	13.92	11.28	11.81*	.07
Cognitive disorganisation	9.65	11.03	11.57	11.17	2.77*	.02
Introvertive anhedonia	6.56	6.27	6.11	5.00	1.44	—
Impulsive nonconformity	6.81	7.75	8.73	8.39	4.97*	.03
Visual arts	Non-artist	Hobbyist	Serious	Professional	<i>F</i>	η_p^2
Unusual experiences	8.00	9.75	13.58	12.12	7.15*	.04
Cognitive disorganisation	9.74	10.24	12.25	9.44	.71	—
Introvertive anhedonia	6.76	5.16	6.72	4.84	3.12*	.02
Impulsive nonconformity	6.63	7.94	8.86	7.92	3.43*	.02
Mathematics	Non-mathematician	Mathematician				
Unusual experiences	9.30	5.49			5.32*	.01
Cognitive disorganisation	10.15	7.29			4.50*	.01
Introvertive anhedonia	6.19	8.69			.75	—
Impulsive nonconformity	7.25	4.94			4.65*	.01

F values are from ANOVA with age group and sex included as independent variables.

* $p < .05$.

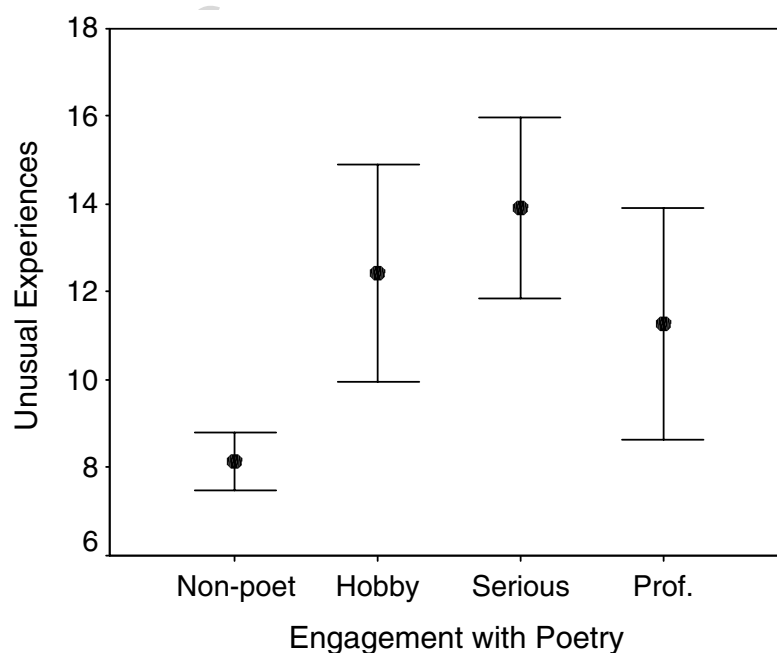


Fig. 2. Mean and 95% confidence interval of unusual experiences scores as a function of engagement with poetry.

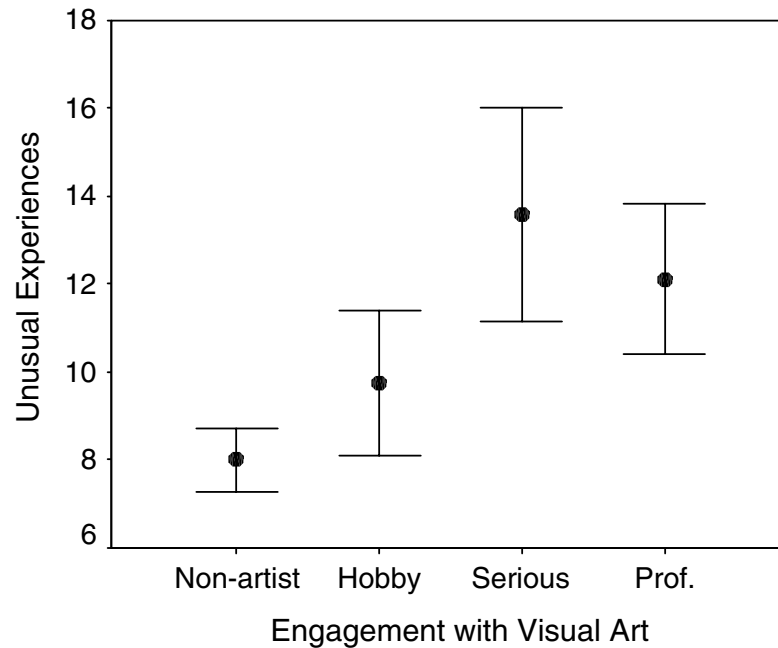


Fig. 3. Mean and 95% confidence intervals of unusual experiences scores as a function of engagement with visual art.

lowest in the non-poets, increase through the hobby to the serious poets, and are slightly lower in the professional poets. Post hoc Tukey tests show that for unusual experiences, the hobby and serious groups of poets have significantly higher scores than the non-poets ($p < .05$), but the professional poets do not differ significantly from either the controls or the other two groups. For cognitive disorganisation, no groups differ significantly by Tukey tests, although the overall effect is significant. For impulsive nonconformity, the serious poet group differs significantly from the non-poet group ($p < .05$). For the fourth schizotypy dimension, introvertive anhedonia, there is a non-significant trend for mean scores to decrease with engagement with poetry.

3.3. Schizotypy in relation to visual arts

When engagement with visual arts is examined, there are again significant group differences in three of the four schizotypy scales, this time unusual experiences, introvertive anhedonia, and impulsive nonconformity (see Table 4). The pattern for unusual experiences and impulsive nonconformity (and the non-significant trend for cognitive disorganisation) is similar to that found for poetry, with scores lowest in non-artists, highest in serious artists and slightly reduced in professional artists (see Fig. 3 for unusual experiences). Post hoc Tukey tests show that for unusual experiences, the serious and professional groups of artists have significantly higher scores than the non-artists ($p < .05$). For impulsive nonconformity, the hobby and serious groups differ significantly from the non-artists ($p < .05$), but the professional group mean is not significantly different from any other. For introvertive anhedonia, means decrease with increasing engagement with visual art, this time significantly, with Tukey tests finding the professional artist group significantly lower than the non-artists.

Table 5

Prevalences (percent) of any treated psychopathology in the whole sample stratified by respondent's level of engagement with the different creative domains

Poetry	Non-poet 36.2	Hobbyist 45.0	Serious 54.1	Professional 38.9
Visual arts	Non-artist 37.8	Hobbyist 41.3	Serious 47.2	Professional 32.0
Mathematics	Non-mathematician 39.7	Mathematician 20.0		

3.4. Schizotypy in relation to mathematics

As Table 4 shows, the mathematicians had significantly lower scores, controlling for age group and sex, than the non-mathematicians on unusual experiences, cognitive disorganisation, and impulsive nonconformity. The difference between mathematicians and non-mathematicians on introvertive anhedonia was not significant.

3.5. Prevalences of psychopathology

Since the recruitment of some parts of the sample was biased towards psychopathology, group comparisons of rates are strictly invalid. However, cross-tabulation against level of creative engagement is suggestive as an ancillary analysis. Table 5 shows the prevalences of any treated psychopathology, for the sample stratified according to their engagement in the three creative domains. Rates are highest in the serious poet and visual artist groups, though the differences in frequency of psychopathology considered across the four groups are not significant (Poetry: $\chi^2 = 5.40$, *ns*; Visual art: $\chi^2 = 2.33$, *ns*). However, when the serious poet group is compared to the non-poet group, there is a significant difference in frequency of psychopathology ($\chi^2 = 4.60$, $p < .05$, Odds ratio = 2.07). The mathematicians have a significantly reduced frequency of psychopathology compared to the non-mathematicians ($\chi^2 = 5.35$, $p < .05$, Odds ratio = .38).

The findings of increased scores on some schizotypy dimensions amongst the artists and poets could be simply due to a greater proportion of them experiencing psychopathology, with the concomitant increases in O-LIFE scores, or could be due to increases in scores amongst all of them, whether experiencing psychopathology or not. To disentangle this possibility, the significant analyses of variance for poetry and visual arts were rerun with psychopathology as an additional independent variable. Because of constraints of sample size, psychopathology could only be treated dichotomously for these analyses (any treated psychopathology versus none).

Including psychopathology in the analysis, the relationship between poetry group and unusual experiences remains significant ($F = 9.38$, $p < .05$), with η_p^2 reduced from .07 to .06, as does that with impulsive nonconformity ($F = 6.64$, $p < .05$), for which η_p^2 is unchanged. The association between cognitive disorganisation and poetry is no longer significant ($F = 1.42$, *ns*). The relationship between visual arts group and unusual experiences also remains significant ($F = 4.42$, $p < .05$), with η_p^2 slightly reduced from .04 to .03. The relationship between visual arts group and introvertive anhedonia is still significant with an unchanged η_p^2 ($F = 2.77$, $p < .05$, $\eta_p^2 = .02$), whilst that with impulsive nonconformity is no longer significant ($F = 2.29$, *ns*).

4. Discussion

4.1. Schizotypy and psychopathology

The results show that the four O-LIFE schizotypy scales are appropriately related to the participant's history of psychopathology. For three of the scales, the mean score increases consistently and significantly from those with no history of disorder, through (non-psychotic) affective disorders to schizophrenia and bipolar disorder. For the remaining scale, introvertive anhedonia, participants with a history of schizophrenia have significantly higher scores than controls, but participants with a history of bipolar disorder do not score especially highly. Given the particular associations of bipolar disorder with extraversion and euphoria, and the content of the introvertive anhedonia scale, this result is to be expected. Thus these findings suggest that the O-LIFE scales have good external validity as measures of psychosis-proneness, and moreover suggest an interesting dimensional continuity between the liabilities to psychotic illness and to non-psychotic affective disorders. Such a continuity has also been found by a variety of other investigations based on either familial coaggregation of disorders, or the predictive specificity of self-reported schizotypal traits (Somnath, Janardhan Reddy, & Jain, 2002; Van Os et al., 1999; Verdoux et al., 1999).

4.2. Schizotypy and artistic creativity

For both poets and visual artists, there was evidence of increased levels of some schizotypal traits relative to controls. Unusual Experiences was the scale producing the strongest effects. Means for the serious creators are in the same range as the schizophrenia patients (e.g., mean for schizophrenia patients 12.31, serious poets 13.92, serious visual artists 13.58), though not as high as the bipolar patients (17.36). However, the profile over the four sub-scales distinguishes the creatives from the patients; increasingly serious creative engagement is associated with a decrease in introvertive anhedonia, such that professional poets and artists actually have lower scores for this dimension than controls. The psychiatric group that is closest to this profile is the bipolar group, though their unusual experiences scores are even higher, and their introvertive anhedonia scores not quite as low. This may explain the observed special relationship between creativity and bipolar disorder (Jamison, 1989; Nowakowska et al., 2004.). Bipolar patients not only have the divergent thinking of schizotypy, but at least some of the time they avoid the inhibiting negative symptoms by a potentially productive flight into activity.

The increased levels of some schizotypal traits could not be mainly attributed to increased prevalences of clinical disorders amongst the poets and visual artists, since four of the six significant findings remained so when the presence of psychopathology was controlled for.

The findings provide some support for the two-factor model of Barron (1972). Creative groups are as high as patients on unusual experiences and cognitive disorganization, but lower than controls on introvertive anhedonia. Thus, artistic groups and psychiatric patients share divergent thought, but they differ in that the latter are troubled with negative symptoms such as avolition and anhedonia, whilst the former are unusually free of these traits. This is also congruent with Schuldberg's findings that creativity scores are positively correlated with scales of positive psychotic or hypomanic symptoms, and negatively

correlated with negative psychotic symptoms (i.e., anhedonia and avolition; [Schuldberg, 1990, 2000](#)).

There is less clear support for an inverted U-shaped model. For both poetry and visual arts, the maximum values of unusual experiences and cognitive disorganisation were observed not in the professional group but in those seriously involved but not making their living from their work. However, post hoc tests did not find this difference to be statistically significant. The prevalences of any treated psychopathology are also highest in the serious groups and relatively low in the professional creative groups. It is notable that the professional poetry and visual arts groups had the lowest means for introvertive anhedonia of any group, and these may be related to their apparently significant avoidance of debilitating psychopathology.

4.3. *Schizotypy and mathematics*

The mathematical researchers showed a significantly different pattern of schizotypy from other creative groups, and from controls. Their scores were significantly lower than controls on the positive symptom dimensions of unusual experiences and cognitive disorganization, as well as impulsive nonconformity. There was relatively little treated psychopathology in the mathematical group. There was a trend towards higher scores for mathematicians than controls on the negative symptom dimension of introvertive anhedonia.

This profile supports the picture of the mathematical mind as having opposite features to the artistic one, with a narrow range of associations (low unusual experiences), an interest in order (low cognitive disorganization), and in routine (low impulsive nonconformity). These findings are consonant with Baron-Cohen's work on systemising as a core feature of autistic spectrum disorders. Systemising is a cognitive style characterised by a drive for order and regularity, which is elevated in high-functioning autism and in mathematics and engineering ([Baron-Cohen et al., 2003](#); [Baron-Cohen et al., 2001](#)). The constellation of autism, systemising and science appears to be in many respects the opposite tail of the distribution to the constellation of arts, unusual experiences and affective and psychotic disorders explored in the present study.

5. Conclusions

The results here provide further confirmation of the link between vulnerability to psychopathology and artistic creativity. Artistically creative groups share the unusual and sometimes chaotic thought processes which typify both mild and severe psychopathology. Indeed, their scores on measures of these traits are essentially as high as patients with a diagnosis of schizophrenia. However, they lack the flattened affect and loss of volition that is typical of mental illnesses (with the possible exception of mania). Mathematicians present quite the opposite pattern, with unusually low levels of all aspects of schizotypy, with the exception of flattened affect and avolition. Thus mathematicians appear to be in the opposite tail of the population distribution to poets and visual artists. This is consonant with recent claims that mathematics and engineering tap cognitive styles closer to the autistic spectrum than to psychosis.

Further research is needed to determine which creative activities pattern with poetry and visual art, and which with mathematics. It is likely that fiction, drama and music

would show similar patterns to poetry (see for example, Ludwig, 1995). Physics would be likely to pattern with mathematics. However, it is not at all clear where biology or historical writing would fit, though these are undeniably creative activities.

It is also to be hoped that further research will shed light on the broader significance of these findings. It has often been suggested that enhanced creativity is the evolutionary benefit that keeps schizotypy in the human gene pool, despite the costs to individual fitness of psychotic illness (Nettle, 2001; O'Reilly, Dunbar, & Bentall, 2001). However, exactly how this would work is still to be determined. In Nettle (2001), a stabilizing selection model is proposed, whereby psychotic patients represent the upper extreme of the schizotypy distribution, whilst the lower extreme of the distribution is associated with low creativity. An intermediate level of schizotypy is thus selected for, and psychotic illness persists because of the scatter around the optimum. The present results are however suggestive of a slightly different interpretation, and highlight the importance of distinguishing between 'positive' schizotypy (i.e., unusual experiences) and 'negative' schizotypy (i.e., introverted anhedonia). Both high and low positive schizotypy are associated with creativity—artistic creativity in the former case, and mathematical in the latter. A high level of positive schizotypy is associated with illness in the presence of high introverted anhedonia, but creative output when introverted anhedonia is low. What factors moderate the development of introverted anhedonia, and whether they can be modified during life, is yet to be determined, but is obviously of the greatest interest in terms of the prevention of suffering and the enhancement of creativity.

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