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Schizotypy versus openness and intelligence as predictors of creativity

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Abstract

Schizophrenia-spectrum risk alleles may persist in the population, despite their reproductive costs in individuals with schizophrenia, through the possible creativity benefits of mild schizotypy in non-psychotic relatives. To assess this creativity-benefit model, we measured creativity (using 6 verbal and 8 drawing tasks), schizotypy, Big Five personality traits, and general intelligence in 225 University of New Mexico students. Multiple regression analyses showed that openness and intelligence, but not schizotypy, predicted reliable observer ratings of verbal and drawing creativity. Thus, the 'madness-creativity' link seems mediated by the personality trait of openness, and standard creativity-benefit models seem unlikely to explain schizophrenia's evolutionary persistence.
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1. Introduction

The evolutionary origins of schizophrenia spectrum disorders can illuminate their hidden adaptive costs and benefits, guide the search for genetic and environmental risk factors, and suggest new interventions (Keller and Miller, 2006; Shaner et al., 2004). Following millennia of controversy about the 'madness–creativity' link (see Becker, 2000; Lauronen et al., 2004; Sass, 2000), some current models (e.g. Andreasen, 1987; Crow, 2000; Eysenck, 1995; Nettle and Clegg, 2006) suggest that schizophrenia-spectrum risk alleles may persist in current human populations through the possible creativity (and hence reproductive) benefits of mild schizotypy in non-psychotic relatives, which may counterbalance their severe reproductive costs in individuals with schizophrenia (Avila et al., 2001; Haukka et al., 2003).

Many studies have shown positive relationships between schizotypy and creativity among creative professionals (Burch et al., 2006a; Merten and Fisher, 1999; Nettle and Clegg, 2006), normal young adults (Cox and Leon, 1999; Folley and Park, 2005; Rushton, 1990; Schuldberg, 2000; Tsakanikos and Claridge, 2005; Weinstein and Graves, 2002), and non-psychotic relatives of schizophrenics (Andreasen, 1987; Karlsson, 1984; Kinney et al., 2000). However, schizotypy might not predict creativity after controlling for other heritable traits that have better-established associations with creativity, such as general intelligence (Eysenck, 1995; Jensen, 1998; Kuncel et al., 2004; Rushton, 1990) and the personality trait of 'openness' from the Big Five model (Carson et al., 2005; Dollinger et al., 2004; King et al., 1996; McCrae, 1987; Wolfradt and Pretz, 2001;

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t1.1 Table 1
t1.2 SPQ subscale loadings on positive and negative schizotypy (from ML factor analysis pattern matrix)

t1.3 SPQ subscales	Positive schizotypy loading	Negative schizotypy loading
t1.4 *Unusual experiences*	+.87	−.13
t1.5 Magical ideation	+.66	−.23
t1.6 Ideas of reference	+.50	+.19
t1.7 Confusing/odd speech	+.47	+.29
t1.8 Odd behavior	+.41	+.24
t1.9 *Flat affect*	−.03	+.81
t1.10 No close friends	−.09	+.79
t1.11 Social anxiety	−.09	+.69
t1.12 Paranoid ideation	+.26	+.48

Zhang and Huang, 2001). To investigate the possible role of such confounds, we administered the SPQ measure of schizotypy (Raine, 1991), diverse verbal and drawing creativity tasks, and standard intelligence and personality measures to a diverse sample of normal young adults from a state college.

2. Methods

2.1. Participants and procedures

225 undergraduate students (163 women, 62 men; age mean 20.0 years, SD 2.7, range 18–33; 54% Caucasian, 41% Hispanic) from the University of New Mexico volunteered to participate in the study in partial fulfillment of psychology course credit requirements. Participants completed questionnaires under conditions of complete confidentiality and anonymity, in 2–3 h, sitting in groups of 9 to 95 students within UNM lecture rooms; to maximize privacy, they sat only in alternating rows, and alternating seats within each row. The work was carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans, and under UNM Institutional Review Board approval.

2.2. Individual differences measures

To measure schizotypy, we used Raine's (1991) 74-item SPQ scale. To measure personality, we used the NEO–FFI (Costa and McCrae, 1992), a 60-item measure of the Big Five personality traits: openness, conscientiousness, extraversion, agreeableness, and neuroticism. To measure intelligence, we used an 18-item version of Raven's Advanced Progressive Matrices (Raven et al., 1998). Participants also completed questionnaires regarding age, sex, ethnicity, family psychiatric history, self-reported creative abilities, and several other background variables.

2.3. Creativity tasks

Participants completed 6 verbal creativity tasks (Appendix A) and 8 drawing creativity tasks (Appendix B), and were explicitly instructed to be as creative as possible, as if trying to attract potential romantic partners. Previous research has shown that priming participants with mating-relevant cues boosts creative output (Griskevicius et al., 2006), and we wished to elicit peak creative performance from participants.

Examples of our 6 verbal creativity tasks include: "Imagine that all clouds had really long strings hanging from them — strings hundreds of feet long. What would be the implications of that fact for nature and society?" and "If you could experience what it's like to be a different kind of animal for a day, what kind of animal would you want to be, and why?" For the 8 drawing creativity tasks, participants were asked to create 4 abstract drawings (e.g. "Please draw an abstract symbol, pattern, or composition that represents the taste of pure, rich, dark chocolate"), and 4 representational drawings (e.g. "Please draw what an alien civilization might look like on a distant planet").

2.4. Creativity ratings

Following Amabile's (1982) Consensual Assessment Technique, each participant's 6 verbal responses were independently rated on a 1–5 creativity scale by four raters (the two authors of this study, plus two Ph.D. students). We did not define "creativity" for the raters; we assumed they would know it when they saw it, and inter-rater reliabilities would suffer if they did not. Each participant's 2 pages of abstract and representational drawings were rated on the same 1–5 creativity scale by four raters (the two authors of this study plus two undergraduate research assistants). All ratings were done independently, blindly, and without any knowledge of the participant's sex, intelligence, personality, schizotypy, or any other information.

3. Results

3.1. Schizotypy factors

Schizotypy responses on the 9 SPQ subscales were factor-analyzed in SPSS using maximum likelihood extraction, with promax rotation. In contrast to Raine's (1991) three factors, we obtained just two factors (see Table 1): a 'positive schizotypy' factor with strong

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positive loadings on the 5 subscales concerning unusual experiences, magical ideation, ideas of reference, confusing/odd speech, and odd behavior; and a 'negative schizotypy' factor with strong positive loadings on the 4 subscales concerning flat affect, having no close friends, social anxiety, and paranoid ideation. These two factors emerged robustly across different factor extraction and rotation methods, across both sexes, and from factoring the 74 SPQ items directly. Both schizotypy factors showed nearly normal distributions, with no floor effects, but with slight positive skew.

3.2. Creativity ratings

For the 6 verbal creativity tasks, inter-rater reliabilities (Cronbach's alphas) were: .90 (for V1: cloud-strings), .90 (V2: sex changes), .80 (V3: self-descriptions), .84 (V4: animal-day), .80 (V5: marriage) and .82 (V6: future). The 15 pairwise correlations across the 6 tasks ranged from +.23 to +.49, with an average correlation of +.35 (N=225, p=.000).

Thus, it seemed reasonable to form a composite "verbal creativity" score for each participant, based on the mean of all 24 rating variables (4 raters × 6 tasks). When verbal creativity task ratings were averaged all 6 tasks for each of the four raters, the Cronbach's alpha was .93. For the 8 drawing tasks, inter-rater reliabilities were: .89 for the 4 abstract drawings considered together, and .87 for the 4 representational drawings considered together. Since the abstract drawing ratings correlated +.61 (N=225, p=.000) with the representational drawing ratings, analogous calculations (means of 4 raters × 2 drawing pages rated) were used to yield composite "drawing creativity" scores.

3.3. Bivariate correlations among traits

Table 2 shows the bivariate correlations among verbal creativity, drawing creativity, positive schizotypy, negative schizotypy, intelligence, openness, conscientiousness, agreeableness, extraversion, and neuroticism. None of these traits showed any significant nonlinear relationships with each other, according to quadratic and cubic curve estimations. In particular, moderate levels of schizotypy did not predict higher creativity than low or high levels of schizotypy, as would be predicted by standard heterozygote-advantage creativity-benefit models.

3.4. Verbal creativity multiple regression

As predictors of verbal creativity, we entered 8 variables: intelligence (RAPM-18 score), the Big Five personality traits (openness, conscientiousness, extraversion, agreeableness, neuroticism), positive schizotypy, and negative schizotypy. Table 3 (left column) shows the resulting standardized beta weights and significance levels. Only intelligence and openness consistently predict verbal creativity. No other Big Five

t2.1 Table 2
t2.2 Correlations among key variables, with exact p-values

t2.3		Verbal creativity	Drawing creativity	Positive schizotypy	Negative schizotypy	IQ	O	C	E	A	N
t2.4	Verbal creativity	1									
t2.5	Drawing creativity	.47**	1								
t2.6		.000									
t2.7	Positive schizotypy	.16*	.16*	1							
		.018	.014								
t2.8	Negative schizotypy	−.04	.08	.47**	1						
		ns	ns	.000							
t2.9	Intelligence (IQ)	.35**	.29**	.07	.03	1					
		.000	.000	ns	ns						
t2.10	Openness (O)	.34**	.46**	.29**	−.01	.30**	1				
		.000	.000	.000	ns	.000					
t2.11	Conscientiousness (C)	−.17*	−.18*	−.26*	−.25**	−.17*	−.14*	1			
		.012	.008	.000	.000	.011	.041				
t2.12	Extraversion (E)	.07	−.13	−.05	−.50**	−.03	−.03	.19**	1		
		ns	.058	ns	.000	ns	ns	.004			
t2.13	Agreeableness (A)	−.06	−.02	−.30**	−.38**	−.09	.01	.21**	.17*	1	
		ns	ns	.000	.000	ns	ns	.002	.012		
t2.14	Neuroticism (N)	.06	.19**	.31**	.51**	.07	.09	−.26**	−.28**	−.35**	1
		ns	.004	.000	.000	ns	ns	.000	.000	.000	

t2.15 * Significant at p<.05.
t2.16 ** Significant at p<.01.

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t3.1 Table 3
t3.2 Predictors of verbal and drawing creativity in multiple regression

t3.3 Predictor trait	Verbal creativity	Drawing creativity
t3.4 Intelligence	+.26 (.000)	+.15 (.014)
t3.5 Openness	+.23 (.000)	+.38 (.000)
t3.6 Conscientiousness	−.10 (ns)	−.06 (ns)
t3.7 Extraversion	+.07 (ns)	−.09 (ns)
t3.8 Agreeableness	−.03 (ns)	+.05 (ns)
t3.9 Neuroticism	+.02 (ns)	+.14 (.051)
t3.10 Positive schizotypy	+.08 (ns)	+.01 (ns)
t3.11 Negative schizotypy	−.09 (ns)	−.04 (ns)

t3.12 Standardized beta weights (and significance levels).

trait, nor either schizotypy trait, predicts verbal creativity when controlling for all other variables. Schizotypy's failure to predict verbal creativity holds even when Raine's original 3 factors are used in this multiple regression instead of our two factors. Even in a simpler multiple regression model including just intelligence, openness, positive schizotypy, and negative schizotypy as predictors, only intelligence and openness show significant beta weights. Nested model comparisons showed that, given a full model with intelligence, openness, and positive schizotypy predicting verbal creativity, the model fit is not significantly worse if positive schizotypy is eliminated ($F(1220) = 1.08$, $p > .05$), whereas the model fit is significantly worse if intelligence ($F(1, 220) = 18.9$, $p < .001$) or openness ($F(1, 220) = 12.7$, $p < .001$) are eliminated.

3.5. Drawing creativity multiple regression

As predictors of drawing creativity, we entered the same 8 variables as above; results are shown in Table 3 (right column). Openness predicts drawing creativity even more strongly than it predicts verbal creativity, whereas intelligence predicts drawing creativity less strongly than it predicts verbal creativity. Neither schizotypy trait (nor Raine's 3 factors) predicted drawing creativity. Nested model comparisons showed that, given a full model with intelligence, openness, and positive schizotypy predicting drawing creativity, the model fit is not significantly worse if positive schizotypy is eliminated ($F(1, 220) = .29$, $p > .05$), whereas the model fit is significantly worse if openness ($F(1, 220) = 37.7$, $p < .001$) or intelligence ($F(1, 220) = 7.4$, $p < .05$) are eliminated.

3.6. Effects of self-reported creativity

Self-reported capacities to be creative, inventive, imaginative, interesting, entertaining, funny, and witty were slightly correlated with positive schizotypy, but were correlated with expressed (other-rated) creativity only very weakly at best (no correlations above .25; most non-significant) — and not at all after controlling for intelligence and openness. Thus, schizotypy better predicts self-reported creativity than other-rated creativity.

3.7. Effects of family psychiatric history

Family psychiatric history was assessed by participants checking presence or absence of 25 possible DSM-IV-TR mental illnesses "that you know have affected any members of your family". Maximum likelihood factor analysis of responses with promax rotation yielded 3 factors, reflecting mood/anxiety/personality disorders, schizophrenia spectrum disorders, and impulse control disorders (drug and alcohol abuse, gambling, ADHD). The mood/anxiety/personality disorders factor correlated positively with verbal creativity ($r(223) = +.16$, $p = .015$) and drawing creativity ($r(223) = +.24$, $p = .000$). The family schizophrenia spectrum disorder factor did not correlate with either creativity trait, though it did correlate with the family mood/anxiety/personality disorders factor ($r(223) = +.39$, $p = .000$)), and with individual schizotypy scores, both positive ($r(223) = +.31$, $p = .000$) and negative ($r(223) = +.19$, $p = .001$). In multiple regression analyses with the 8 previous variables (Big Five, intelligence, positive and negative schizotypy) plus the 3 family psychiatric disorders factors predicting verbal or drawing creativity, no family psychiatric disorder factor predicted verbal creativity, but drawing creativity was positively predicted by the family mood/anxiety/personality disorders factor ($\beta = +.22$, $p = .007$), and negatively predicted by the family impulse control disorders factor ($\beta = -.19$, $p = .010$). In each of these regression analyses, intelligence and openness still predicted creativity, and positive and negative schizotypy did not. Further item-level analyses suggested that, within the mood/anxiety/personality disorders factor, avoidant and obsessive–compulsive disorders – not bipolar disorder (cf. Jamison, 1993) – were most positively predictive of drawing creativity.

4. Discussion

Our findings are consistent with previous research showing a spectrum of schizotypy symptoms in normal young adults (Verdoux and van Os, 2002), which is differentiated into two factors: positive schizotypy (unusual perceptual experiences, ideas of reference, magical thinking, odd speech, and odd behavior) and negative schizotypy (no close friends, constricted affect,

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social anxiety, paranoid ideation) (Dinn et al., 2002; Linney et al., 2003). At first glance, our findings also seem consistent with previous research showing that positive schizotypy is associated with higher creativity (Burch et al., 2006a, Folley and Park, 2005; Kinney et al., 2000; Nettle and Clegg, 2006, Schuldberg, 2000; Tsakanikos and Claridge, 2005; Weinstein and Graves, 2002): our positive schizotypy factor shows modest positive correlations with both verbal creativity ($r(225)=+.16$, $p=.018$) and drawing creativity ($r(225)=+.16$, $p=.014$) in this sample of 225 college students.

However, positive schizotypy is significantly correlated ($r(225)=+.29$, $p=.000$) with the Big Five personality trait of 'openness to experience', and multiple regression analyses show that it is really openness, not positive schizotypy, that predicts verbal and drawing creativity. Moreover, contrary to standard creativity-benefit models, self-reported family history of schizophrenia spectrum disorders did not predict creativity. Thus, the only major predictors of creativity in this sample were intelligence and openness; schizotypy played no significant role after these two traits were considered.

Differences in scale reliability cannot explain these results, since openness, intelligence, and positive schizotypy had very similar internal consistency reliabilities of .77, .78, and .74, respectively. Differences in motivation, effort, and time spent per task are also unlikely to explain the results, since conscientiousness (normally a strong predictor of effort — Judge and Ilies, 2002) did not predict rated verbal or drawing creativity, or the raw number of responses produced in each creativity task.

These results are consistent with findings of a positive association between openness and creativity (Carson et al., 2005; Dollinger et al., 2004; King et al., 1996; McCrae, 1987; Wolfradt and Pretz, 2001; Zhang and Huang, 2001), and with some previous findings that schizotypy is not directly predictive of creativity (e.g. Burch et al., 2006b; Green and Williams, 1999; O'Reilly et al., 2001; Stavridou and Furnham, 1996). Thus, creativity is best predicted by positive responses to openness questions (e.g. "I am intrigued by the patterns I find in art and nature", "I have a lot of intellectual curiosity", "Sometimes when I am reading poetry or looking at a work of art, I feel a chill or wave of excitement"), rather than schizotypy questions (e.g. "I believe in telepathy", "Parts of my body sometimes seem unreal or disconnected", "Sometimes my thoughts are so strong I can almost hear them").

An alternative interpretation might be that positive schizotypy is an extreme version of openness (see Markon et al., 2005; Nettle and Clegg, 2006), with openness reflecting socially valued manifestations of the trait (e.g. cultural interests), and schizotypy symptoms reflecting more extreme, socially devalued manifestations (e.g. hallucinations). In this view, openness is what really mediates the 'madness–creativity' link, and schizotypy is incidentally correlated with openness, as found in several other studies (see (e.g. Gurrera et al., 2005; Rawlings and Freeman, 1997) Soldz and Vaillant, 1999). We are sympathetic to this view, but two findings in our data argue against an integrated openness/schizotypy construct predicting creativity. First, if schizotypy reflects extreme openness, then schizotypy should increase as a concave-upwards function of openness, but it does not, according to quadratic and cubic curve estimation analyses. Second, if all 12 openness and 40 positive schizotypy items are entered into one big factor analysis, they do not form an integrated factor, but fractionate clearly into openness and positive schizotypy factors, with the resulting openness factor still predicting creativity and positive schizotypy not.

In summary, our results do not seem consistent with a narrow interpretation of current creativity-benefit models (e.g. Crow, 2000; Eysenck, 1995; Nettle and Clegg, 2006) that posit social or sexual payoffs for schizotypy, mediated by creativity-payoffs that might offset the reproductive costs of schizophrenia, thereby maintaining schizophrenia-spectrum risk alleles in current human populations. Rather, in light of the present findings, future research might investigate the possibility that human creativity is a sexually-selected fitness indicator that reliably reveals heritable genetic quality and general intelligence (Griskevicius et al., 2006; Haselton and Miller, 2006; Miller, 2000). If so, then openness, and perhaps positive schizotypy, or a new construct subsuming both, may act as 'amplifier traits' that increase the manifest variance in creativity across individuals (Shaner et al., 2004) — much as a peacock's tail amplifies the visible variance in quality between males trying to attract female mates.

5. Contributors

Geoffrey Miller designed the study. Ilanit Tal supervised data collection and entry. Miller and Tal did the statistical analysis, and Miller wrote the first draft of the manuscript. All authors contributed to and have approved the final manuscript.

6. Uncited references

Arthur and Day, 1994
Randall, 1998
Yeo et al., 1999

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Appendix A. Verbal Creativity Tasks

"In the next four pages, we will ask you to do some writing tasks.

Take about 2 min for each of the six tasks. Altogether, they should take about 12 min to complete.

For each task, imagine that you are single, and are trying to attract people who will be reading your responses on an internet dating site. Therefore, please try to be as creative, imaginative, and interesting as possible. Show off what makes you distinctive and intriguing as a person.

The quality of your verbal ideas is more important than the quantity of your writing. Don't worry about grammar, spelling, or punctuation. Just try to communicate your main verbal ideas clearly and creatively. There's no need to rush, or to fill up all the space provided.

Please try to write legibly! If your writing can't be read, your data will be useless for this experiment.

Don't take the tasks too seriously. Relax, have fun, be yourself, be funny if you want, but please don't write anything offensive."

V1 Cloud-strings: "Imagine that all clouds had really long strings hanging from them — strings hundreds of feet long. What would be the implications of that fact for nature and society? In the lines below, please list as many different implications as you can for strings hanging from clouds. Use a new line for each new idea, and take about 2 min for this task."

V2 Sex changes: "Imagine that every person could change their sex – male or female – whenever they wanted to, just by dreaming about it for one night. A person could wake up with an opposite-sex version of their own face and body, but would keep all their personality traits, skills, memories, and sense of personal identity. What would be the implications of that fact for society? In the lines below, please list as many different implications as you can for spontaneous sex changes. Use a new line for each new idea, and take about 2 min for this task."

V3 Self-descriptions: "Imagine that your internet dating agency lists people by brief self-descriptions — you can use just ten words to catch the attention of possible dates. In the lines below, please list the ten individual words that would describe you most creatively, and that would provoke the most interest from people you might want to meet. You don't have to be honest, just imaginative and intriguing. Take about 2 min for this task."

"Imagine that your internet dating agency asks everyone to write brief answers to the following questions. Please write brief, creative responses that would provoke the most interest from people you might want to meet. Take about 2 min per question, and about 6 min for this whole page."

V4 Animal-day: "If you could experience what it's like to be a different kind of animal for a day, what kind would of animal would you want to be, and why?"

V5 Marriage: "How would you keep a marriage exciting after the first couple of years?"

V6 Future: "What do you hope the world will be like in a hundred years?"

Appendix B. Drawing Creativity Tasks

"In the next two pages, we will ask you to make some drawings.

Take about 1 min per drawing. With four drawings per page, the two pages should take about 8 min total to complete.

For each task, imagine that you are single, and are trying to attract people who will be looking at your drawings on an internet dating site. Therefore, please try to be as creative, imaginative, and interesting as possible. Show off what makes you distinctive and intriguing as a person.

The quality of your visual ideas is more important than the technical skill of your drawing. Don't worry about detail, texture, shading, or background. Just try to communicate your main visual ideas clearly and creatively. There's no need to rush, or to fill up all the space provided.

Don't take the tasks too seriously. Relax, have fun, be yourself, be funny if you want, but please don't draw anything offensive."

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Page 1 (abstract drawings, 1/4 page each):

A1 Chocolate: "Please draw an abstract symbol, pattern, or composition that represents the taste of pure, rich, dark chocolate."
A2 Childhood: "Please draw an abstract symbol, pattern, or composition that represents your happiness as a child doing a favorite activity."
A3 Desire: "Please draw an abstract symbol, pattern, or composition that represents intense sexual desire and erotic yearning."
A4 Spirit: "Please draw an abstract symbol, pattern, or composition that represents your soul, spirit, or essence."

Page 2 (representational drawings, 1/4 page each):

R1 Animal-admired: "In the space below, please draw an animal that you admire for its strength, grace, speed, or beauty."
R2 Tree: "Please draw a tree that represents how you feel today."
R3 House: "Imagine that you are walking around a foreign city in the winter snow, and you see an intriguing house that must have been designed by a very imaginative architect. It looks warm inside, with candles glowing, and the sound of a happy dinner party. Please draw the house."
R4 Aliens: "Please draw what an alien civilization might look like, on a distant planet."

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