Mental illness, suicide and creativity: 40-Year prospective total population study

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ABSTRACT

We previously demonstrated that patients with schizophrenia or bipolar disorder and their relatives are overrepresented in creative occupations. Here, we use a new dataset with a considerably larger sample of patients ($n = 1,173,763$) to survey other psychiatric diagnoses and to validate previous findings. The specific aims of this study were to i) investigate if creativity is associated with all psychiatric disorders or restricted to those with psychotic features, and ii) to specifically investigate authors in relationship to psychopathology. We conducted a nested case–control study using longitudinal Swedish total population registries, where the occurrence of creative occupations in patients and their non-diagnosed relatives was compared to that of matched population controls. Diagnoses included were schizophrenia, schizoaffective disorder, bipolar disorder, unipolar depression, anxiety disorders, alcohol abuse, drug abuse, autism, ADHD, anorexia nervosa, and completed suicide. Creative professions were defined as scientific and artistic occupations. Data were analyzed using conditional logistic regression. Except for bipolar disorder, individuals with overall creative professions were not more likely to suffer from investigated psychiatric disorders than controls. However, being an author was specifically associated with increased likelihood of schizophrenia, bipolar disorder, unipolar depression, anxiety disorders, substance abuse, and suicide. In addition, we found an association between creative professions and first-degree relatives of patients with schizophrenia, bipolar disorder, anorexia nervosa, and for siblings of patients with autism. We discuss the findings in relationship to some of the major components of creativity.

1. Objectives of the study

The ancient issue of genius and madness has prompted long-standing public and clinical interest. Although geniality has other components than creativity (e.g., intelligence) and is rooted in a social context, it is difficult to imagine an un-creative genius (Eysenck, 1995). Creativity consisting of both novelty and impact is thus central for geniality (Cropley, 2010).

The idea of an association between creativity and mental ill-health has mainly been upheld by occasional anecdotes or biographies of great artists who struggled with depression or alcohol abuse (Beveridge and Yorston, 1999). Previous studies primarily focusing on schizophrenia and bipolar disorder have provided some empirical evidence for a relationship between creativity and psychopathology (Andreasen, 1987; Jamison, 1996; Karlsson, 1970;

Kinney et al., 2000; Kyaga et al., 2011; Richards et al., 1988; Sass, 1998). We recently found that patients with schizophrenia or bipolar disorder and their non-diagnosed relatives are over-represented in creative occupations (i.e., scientific and artistic occupations) compared to controls (Kyaga et al., 2011). This association was not found for unipolar depression.

Although few studies have addressed *other psychopathologies* than schizophrenia and bipolar disorder regarding creativity, there is some support for an association. For example, Lange-Eichbaum argued in his study of 800 "geniuses" that most geniuses were never psychotic, but suffered from "nervous tensions" and were "given to drink or drug-habits" (Lange-Eichbaum and Paul, 1931). Juda investigated 294 artists and scientists born in German-speaking countries 1650–1900 (Juda, 1949) and found a clear increase of minor psychiatric disturbances among artists, whereas bipolar disorder was exclusively found in scientists. Another study using reviews of biographies published in the New York Times Book Review 1960–1990 found an increase of bipolar disorder,

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schizophrenia-like psychosis, depression, pathological anxiety, substance abuse, and suicide among creative arts professionals (Ludwig, 1992). A survey of 291 world-famous men born in the 19th and 20th centuries concluded that they were emotionally warm with a gift for friendship and sociability, but were often afflicted with depression and alcoholism (Post, 1994). These findings were especially evident in playwrights and prose writers in a follow-up study (Post, 1996).

Indeed, studies demonstrating increased psychopathology in eminent creative individuals have often investigated prominent authors (Andreasen, 1987; Jamison, 1989). This is not least evident in Andreasen's hallmark study of authors in the Iowa Writers' Workshop, which is the most widely known creative writing program in the United States. The study demonstrated a clear overrepresentation of affective disorders in authors and their first-degree relatives (Andreasen, 1987, 2005).

Although a number of researchers have published impressive work on the putative association between creativity and psychopathology, previous studies are generally hampered by small cohorts, lack of standardized tools to assess creativity, or the use of retrospective biographies to establish diagnoses. In addition, an "inverted-U" model of the relationship between psychopathology and creativity has been proposed, where increased symptom severity results in increased creativity to a certain point beyond which it starts to diminish (Richards et al., 1988). Hence, to be conclusive studies on the association between creativity and psychopathology should also address relatives of patients (presumably with lower symptom severity) (Richards et al., 1988). However, this study design has rarely been available.

Our primary aim was to investigate the proposed hypothesis of an association between creative occupations and different psychiatric disorders. Second, considering previous studies suggesting a high prevalence of psychopathology specifically in authors (Andreasen, 1987; Jamison, 1989; Post, 1996), we investigated authors separately. Third, we attempted to validate previous findings of a familial association for creative professions with schizophrenia and bipolar disorder by using a larger dataset (Kyaga et al., 2011).

We therefore extended our previous population-based study on schizophrenia, bipolar disorder, and unipolar depression by including schizoaffective disorder, anxiety disorders, alcohol abuse, drug abuse, autism, ADHD, anorexia nervosa, and completed suicide; estimating the occurrence of creative occupations in these patients and their first-, second-, and third-degree relatives compared to non-diagnosed controls. We also investigate if the proposed association is mediated or moderated by IQ.

2. Materials and methods

2.1. National registers

We performed a nested case–control study using longitudinal Swedish total population registers. The primary key for register linkage was the unique personal identification number assigned to each Swedish citizen. The National Patient Register (NPR, National Board of Health and Welfare) provided discharge diagnoses for all inpatient treatment episodes in Sweden 1973–2009, and partial coverage of outpatient specialist physician (other than general practitioners) treatment episodes in 2001–2009. The Cause of Death Register (CDR, National Board of Health and Welfare) provided data on completed suicides in Sweden 1952–2009. The Multi-Generation Register (MGR, Statistics Sweden) enabled identification of biological relatives of an index person, including all individuals born in Sweden since 1932 and registered as living in Sweden after 1960. National censuses based on mandatory self-report questionnaires completed by all adult citizens in 1960, 1970, 1975, 1980, 1985, 1990 and a national register (LISA, Statistics Sweden) from 2001 to 2009 provided information on professions in the entire Swedish population. Information on IQ (men only) was collected from the Military Service Conscription Register (MSCR, Swedish Defence Recruitment Agency), based on compulsory conscription for essentially all men. This information included IQ test results for all 18–19 year-old men between 1969 and 2009 ($n = 1,875,142$).

2.2. Disease classifications

Diagnoses were coded according to the 8th, 9th, and 10th editions of the ICD (1969–1986, 1987–1996, 1997–). Information was available on individuals treated both in inpatient and outpatient (only from 2001 an onwards) facilities. A hierarchical approach was assigned to differentiate between schizophrenia, bipolar disorder, unipolar depression, and anxiety disorders. Any individual with an NPR episode with one of the schizophrenia diagnoses (ICD8: 295.0–295.6, 295.8, 295.9; ICD9: 295A–295G, 295W, 295X; ICD10: F20) was coded as having schizophrenia. Individuals with any diagnosis of bipolar disorder (ICD8: 296.1, 296.3, 296.8, 296.9; ICD9: 296A, 296C, 296D, 296E, 296W, 296X; ICD10: F30, F31), but not schizophrenia, were regarded as having bipolar disorder. Individuals with an episode of unipolar depression (ICD8: 296.2, 300.4; ICD9: 296B, 300E, 311; ICD10: F32–F39), but neither schizophrenia nor bipolar disorder, was coded as having unipolar depression. Individuals with an episode of anxiety disorder (ICD8: 300 except 300.4; ICD9: 300 except 300E; ICD10: F40–F42, F44–F45, F48) but without schizophrenia, bipolar disorder, or unipolar depression were coded as having anxiety disorder. Regardless of other diagnoses, individuals with any of the following disorders were coded accordingly: schizoaffective disorder (ICD8: 295.7; ICD9: 295H; ICD10: F25), alcohol abuse (ICD8: 303; ICD9: 303,305A; ICD10: F10 except x.5), drug abuse (ICD8: 304; ICD9: 304, 305X; ICD10: F11–F19 except x.5), autism (ICD8: N/A; ICD9: 299A; ICD10: F84.0, F84.1), ADHD (ICD8: N/A; ICD9: 314; ICD10: F90), anorexia nervosa (ICD8: 306.5; ICD9: 307B; ICD10: F50.0), and completed suicide (ICD6: E970–E979; ICD7: E970–E979; ICD8: E950–E959; ICD9: E950–E959; ICD10: X60–X84). Relatives of patients and control individuals with any event of the particular diagnosis investigated were excluded from the respective analysis.

The use of registers in psychiatric research is well established (Byrne et al., 2005). The general validity of both somatic and psychiatric diagnoses in the Swedish National Patient Register (NPR) was recently reviewed with an estimated positive predictive value of 85–95% (Ludvigsson et al., 2011). Inpatient schizophrenia diagnoses have good to excellent validity, with 94% agreement when compared to research diagnoses based on semi-structured interviews and medical records (Ekholm et al., 2005). The validity of NPR schizoaffective disorder diagnoses has not been investigated; however, one study found that 86% (i.e., 6 of 7 patients) of those with an ICD8 diagnosis of schizoaffective disorder (295.70) did not fulfill DSM-III criteria for schizophrenia based on a review of medical records (Kristjansson et al., 1987). The validity of NPR bipolar disorder diagnoses has recently been addressed, with a positive predictive value of 0.81–0.92 relative to diagnostic status based on patients' medical records (Sellgren et al., 2011). The validity of a single depressive episode in the Danish national psychiatric register has demonstrated sufficient precision with improved validity with increasing severity (65–83%) (Bock et al., 2009). To our knowledge, no studies have been published so far on the validity of unipolar depression, anxiety diagnoses, anorexia nervosa, or ADHD in the Swedish NPR. Autism was investigated in the Finnish Hospital Discharge Register, suggesting that 96% of subjects

with register diagnoses of childhood autism fulfilled criteria based on the ADI-R inventory (Lampi et al., 2010). The validity of alcohol abuse diagnoses was also addressed in the Finnish Hospital Discharge Register suggesting 98% accuracy compared to medical records (Keskimäki and Aro, 1991). Official data of suicide and attempted suicide has often been used in major studies, however, also questioned (Nordentoft, 2007; Tidemalm et al., 2008).

2.3. Creative occupations

Occupation data from the Censuses were coded according to the Nordic Classification of Occupations (NYK) and the Swedish Standard Classification of Occupations (SSYK) in LISA (1983, 1990, 1998). As suggested previously scientific and artistic occupations were defined as creative professions (Table S1) (Feist, 1998; Holland, 1997; Juda, 1949). Throughout this article, *creative professions* denotes the overall aggregated group of scientific and artistic occupations, while *creative occupations* is used for creative professions and for any of the subgroups (i.e., scientific and artistic). Individuals reporting a creative occupation in at least one of the mandatory Censuses were considered creative. Scientific occupations were defined as NYK code 051: University teachers, described by Statistics Sweden as individuals "conducting research and teaching at the university", including occupations that generally require active research or examination at the Ph.D. level, but excluding researchers only active outside the academic field. In line with Holland's widely used theory of vocational personalities and work environments, which considers accountants as one of the occupations with predominantly *conventional* qualities (Holland, 1997) we also defined a less creative group (accountants and auditors) to test the specificity of any associations found for creative occupations. Individuals without information on occupation (including those reporting no or unspecified occupation) were excluded from the analyses. Descriptive data for the different occupational groups are presented in Table S1. Authors could not be identified as a separate group in SSYK. Therefore, information on authors was gathered exclusively from the censuses. The Swedish term "författare" used in the census is not synonymous to "author" in English. The dictionary published by the Swedish Academy (the Swedish counterpart of the Oxford English Dictionary) defines "författare" as "a person known for writing, who more or less professionally engages in writing, without further specification, but especially in terms of literary writings." (1927).

Information on occupations in the census was based on mandatory (enforced by law) self-report questionnaires mailed to every household in Sweden 1960, 1970, 1975, 1980, 1985, 1990. The censuses are more than 99% complete (Norman et al., 2002). The validity of occupational information in the Swedish Censuses was investigated by comparing survey data from personal interviews in 1977 and 1979–1981 to 1980 Census data, suggesting good agreement between the two sources (i.e., NYK 1-digit level: ∼90%; 2-digit level: ∼80%; 3-digit level: ∼70%) (Wärneryd et al., 1991). The sources for LISA are annual total statistics from the public sector, and selected from 10,000 companies in the private sector including all, but not restricted to, companies with more than 500 employees (2011).

We compared non-response rates regarding occupation among cases and controls of patients and their non-diagnosed siblings. Patients had higher rates of missing data than their respective controls (schizophrenia: 47% vs. 12%; schizoaffective disorder: 27% vs. 7%; bipolar disorder: 19% vs. 12%; unipolar depression: 19% vs. 14%; anxiety disorders: 20% vs. 13%; alcohol abuse: 14% vs. 9%; drug abuse: 23% vs. 10%; autism: 88% vs. 44%; ADHD: 59% vs. 41%; anorexia nervosa: 29% vs. 21%; suicide: 22% vs. 11%), whereas healthy siblings of patients had similar rates of missing data compared to their respective controls (schizophrenia: 7% vs. 5%; schizoaffective disorder: 7% vs. 5%; bipolar disorder: 9% vs. 7%; unipolar depression: 11% vs. 9%; anxiety disorders: 13% vs. 11%; alcohol abuse: 10% vs. 9%; drug abuse: 12% vs. 9%; autism: 41% vs. 37%; ADHD: 36% vs. 33%; anorexia nervosa: 24% vs. 23%; suicide: 6% vs. 4%). To elucidate how missing data influenced associations, we compared the prevalence of creativity in siblings of patients with or without missing data on occupation. Siblings of schizophrenic patients (3.6% vs. 3.0%; $p = 0.001$) and siblings of persons with completed suicides (3.2% vs. 2.4%; $p = 0.0001$) with a missing value, had creative professions more often than siblings of patients with a valid occupation. The opposite, i.e., less often creative professions, was true for siblings of patients with bipolar disorder (2.5% vs. 3.1%; $p = 0.02$), unipolar depression (1.9% vs. 2.5%; $p < 0.0001$), anxiety disorders (1.5% vs. 2.4%; $p < 0.0001$), alcohol abuse (1.4% vs. 1.9%; $p < 0.0001$), drug abuse (1.4% vs. 1.9%; $p < 0.0001$), and ADHD (1.2% vs. 2.4%; $p < 0.0001$). No significant differences were found in siblings of patients with schizoaffective disorder, autism, or anorexia nervosa.

2.4. IQ

In Sweden, conscription and associated assessment of cognitive ability measured as IQ was compulsory for men up until 2009, but individuals with known severe medical or psychological handicaps or living in institutions were excluded (approximately 2% in the early 1990s; B. Carlstedt, personal communication, 2011). Two tests were used during the study period. The first test (1969–1994) was based on written questionnaires, and the second (1994 and onwards) was computer-based. Both tests addressed four dimensions of the intelligence construct (logical/inductive, verbal, spatial/visual, and theoretical/technical) and included 160 questions (40 for each dimension) (Mårdberg and Carlstedt, 1998). Results were presented as Stanine scores ranging from 1 to 9, standardized against the entire male conscript population with a mean of 5 and a SD of 2. Higher scores indicate greater cognitive capacity.

2.5. Statistical analysis

We used a nested case–control strategy to study associations between having a creative occupation and being diagnosed with any of the included diagnoses or being a first-, second- or third-degree relative of these patients. First-degree relatives share on average half their genes with the patient and included parents, siblings, and offspring. Second-degree relatives share on average 25% of the genes with the patient and included parents' siblings, half siblings, and sibling offspring. Third-degree relatives share on average 12.5% of their genes with the patient and included first-cousins. Ten control subjects matched on sex and birth year were randomly selected from the MGR for each patient and each of their relatives. Controls had to be alive, residing within the country, and without any inpatient episode for the studied disorder at the date of the first hospitalization or completed suicide of the patient (incidence density sampling). This method avoids bias due to the complication that individuals in the population registers enter the study at different times (i.e., left truncation) and allows equal follow-up time of relatives of patients and controls (Lichtenstein et al., 2009). To assess the association between a creative occupation across each class of patients and relatives, we estimated odds ratios using conditional logistic regression in PROC PHREG in SAS software, Version 9.3 of the SAS System for Windows. Copyright© 2010 SAS Institute Inc. SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc., Cary, NC, USA. Since several correlated pairs of relatives from a family could be included in an analysis, a robust

sandwich estimator was used to adjust for the correlated data structure when calculating confidence intervals.

The study was carried out in accordance with the latest version of the Declaration of Helsinki (2008) and approved by the Regional Ethics Committee at the Karolinska Institutet (2009/939-31/5). Informed consent was not required since data were anonymized immediately after merging by Statistics Sweden.

3. Results

We identified 65,589 patients (35,819 men and 29,770 women) with schizophrenia, 14,905 individuals (6145 men and 8760 women) with schizoaffective disorder, 68,915 (27,199 men and 41,716 women) with bipolar disorder, and 438,372 patients (170,781 men and 267,591 women) with unipolar depression. Further, 212,758 patients (84,087 men and 128,671 women) were diagnosed with anxiety disorders, 340,784 (246,905 men and 93,879 women) with alcohol abuse/dependence, 136,490 (80,303 men and 56,187 women) with drug abuse/dependence, 11,802 (8281 men and 3521 women) with autism, 48,024 (32,973 men and 15,051 women) with ADHD, 17,276 (2384 men and 14,442 women) with anorexia nervosa, and 73,766 persons (52,516 men and 21,250 women) that died from completed suicide. Since data in the registries are longitudinal and truncated, descriptive data are presented only for patients born in 1958 (1987 for autism and ADHD later because a diagnosis was either not available in ICD8 or seldom used; Table 1). The total number of patients, controls, and relatives in the different creative occupations are presented in Table S2. We did not detect any apparent gender differences in our analyses, and since prior comparisons of gender in schizophrenia, bipolar disorder, and unipolar depression did not reveal any significant differences, only pooled results are presented (Kyaga et al., 2011).

3.1. Creative professions

The main findings of associations between creative professions and psychiatric disorders are shown in Fig. 1 and Table 2; the full results are presented in Table S3.

We found no positive association between psychopathology and overall creative professions except for bipolar disorder. Rather, individuals holding creative professions had a significantly reduced likelihood of being diagnosed with schizophrenia, schizoaffective disorder, unipolar depression, anxiety disorders, alcohol abuse, drug abuse, autism, ADHD, or of committing suicide.

3.2. Authors

Authors suffered from schizophrenia and bipolar disorder more than twice as often as controls. Authors were also more likely to be diagnosed with unipolar depression, anxiety disorders, alcohol abuse, drug abuse, and to commit suicide. The finding of increased risk for suicide in authors might be secondary to other psychopathology. To investigate this further, we omitted all authors with any psychiatric diagnosis in the NPR (ICD-8: 290–315, ICD-9: 290–319, ICD-10: F00–F99). There was still a trend for authors without diagnosed psychopathology to commit suicide more frequent than controls (OR 1.45, 95% CI 0.97–2.16; $p = 0.07$). Thus, regardless of psychopathology, being an author seemed to increase suicide risk.

3.3. Accountants and auditors

In general, being an accountant or a relative to an accountant meant negative or no association to the psychopathologies investigated in this study (Table S3).

3.4. IQ

IQ (available for men only) was generally higher in people with creative occupations, but lower in patients with the psychiatric disorders studied and their respective relatives compared to people without these diagnoses (Table S4). To determine if IQ mediated the association between creativity and psychopathology, IQ was included as a continuous covariate in the regression model. However, this resulted in that the crude overrepresentations were generally strengthened rather than attenuated (Table S3). No significant interaction effects between IQ and creative occupations were found (data not shown).

3.5. Relatives

Compared to our previous study (Kyaga et al., 2011), the inclusion of additional patients and data on creative occupations did not change the familial association between schizophrenia and bipolar disorder and creative professions. Patients' first-degree relatives were still significantly overrepresented in these professions. In addition, we found associations between creative professions and being a sibling of individuals with autism and being parent or sibling of individuals diagnosed with anorexia nervosa.

Table 1
Descriptive data for patients.

Diagnosis	Men	Women	Age at first diagnosis	No. of discharges	Residential area	
					Rural	Urban
					Year 1990/2005	Year 1990/2005
	n (%)	n (%)	(Mean; median)	(Mean; median)	(n)	(n)
Schizophrenia[a]	627 (62.3)	380 (37.7)	34.0; 33.0	11.8; 6	65/32	840/822
Schizoaffective disorder[a]	114 (36.2)	201 (63.8)	40.7; 41.9	10.9; 5	38/8	259/281
Bipolar disorder[a]	384 (40.6)	561 (59.4)	40.9; 44.7	7.9; 4	128/32	767/841
Unipolar depression[a]	2236 (42.3)	3051 (57.7)	42.7; 46.1	3.8; 2	671/198	4064/4810
Anxiety disorder[a]	1218 (40.2)	1810 (59.8)	41.6; 45.9	2.7; 1	382/107	2399/2778
Alcohol abuse[a]	3142 (71.2)	1274 (28.8)	38.2; 40.1	6.7; 2	487/172	3693/3647
Drug abuse[a]	1668 (62.3)	1008 (37.7)	36.4; 37.7	5.8; 2	238/82	2260/2185
Autism[b]	215 (67.4)	104 (32.6)	14.3; 15.8	3.9; 2	54/14	248/300
ADHD[b]	941 (65.8)	490 (34.2)	17.8; 18.6	4.7; 3	215/59	1159/1367
Anorexia nervosa[a]	10 (8.1)	114 (91.9)	26.1; 24.3	3.4; 2	16/2	101/106
Suicide[a]	497 (71.9)	194 (28.1)	34.3; 33.6	1.0; 1	71/7	294/58

[a] Born 1958.
[b] Born 1987.

Relation to proband	Creative professions OR (95% CI)
Schizophrenia	
Proband	0.75 (0.70-0.82)
Parent	1.51 (1.42-1.60)
Sibling	1.26 (1.19-1.33)
Offspring	0.92 (0.86-1.00)
Schizoaffective disorder	
Proband	0.68 (0.59-0.78)
Parent	1.45 (1.30-1.61)
Sibling	1.24 (1.12-1.36)
Offspring	0.96 (0.84-1.09)
Bipolar disorder	
Proband	1.08 (1.02-1.14)
Parent	1.33 (1.27-1.40)
Sibling	1.20 (1.14-1.27)
Offspring	1.11 (1.06-1.16)
Unipolar depression	
Proband	0.92 (0.90-0.94)
Parent	1.11 (1.09-1.14)
Sibling	0.98 (0.95-1.00)
Offspring	0.96 (0.94-0.98)
Anxiety disorders	
Proband	0.90 (0.87-0.94)
Parent	1.05 (1.02-1.08)
Sibling	0.91 (0.88-0.95)
Offspring	0.93 (0.90-0.97)
Alcohol abuse	
Proband	0.70 (0.68-0.72)
Parent	0.95 (0.92-0.98)
Sibling	0.75 (0.73-0.78)
Offspring	0.79 (0.77-0.81)
Drug abuse	
Proband	0.57 (0.54-0.60)
Parent	0.99 (0.96-1.03)
Sibling	0.74 (0.71-0.78)
Offspring	0.82 (0.79-0.86)
Autism	
Proband	0.59 (0.31-1.13)
Parent	0.92 (0.84-1.01)
Sibling	1.39 (1.16-1.66)
Offspring	0.58 (0.25-1.37)
ADHD	
Proband	0.57 (0.49-0.67)
Parent	0.86 (0.82-0.90)
Sibling	0.87 (0.79-0.96)
Offspring	1.21 (0.92-1.59)
Anorexia nervosa	
Proband	1.10 (0.98-1.25)
Parent	1.21 (1.13-1.29)
Sibling	1.21 (1.10-1.34)
Offspring	1.03 (0.77-1.38)
Suicide	
Proband	0.74 (0.69-0.79)
Parent	1.10 (1.01-1.19)
Sibling	0.98 (0.91-1.06)
Offspring	1.00 (0.95-1.04)

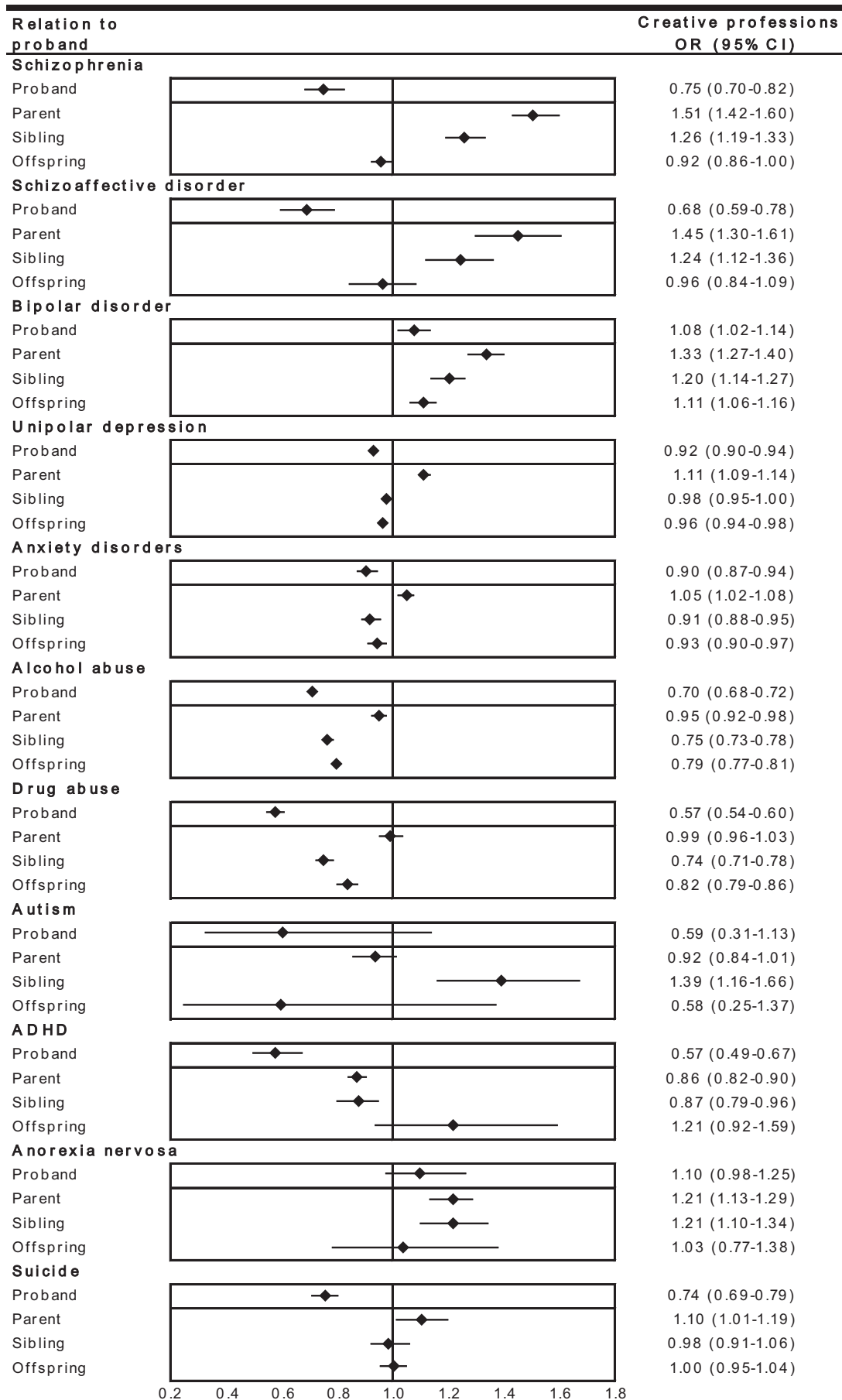Axis: 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8

Fig. 1. Associations between diagnoses and creative professions.

4. Discussion

This Swedish total population study suggests, except for an increase in bipolar disorder, that individuals with overall creative professions are not more likely than controls to suffer from psychiatric disorders in general. Further, the results indicate a familial association with overall creative professions for schizophrenia, bipolar disorder, anorexia nervosa, and possibly autism. By also investigating healthy relatives of patients with psychiatric disorders, we could address the "inverted-U" model proposed for the association between psychopathology and creativity (Richards et al., 1988). Importantly, differences in IQ (available for men only) does not account for any of the associations suggested.

Although we find few associations between creative professions overall and being diagnosed with a psychiatric disorder, professional authors were prominent in having increased risk for most of the studied disorders. Hence, authors were moderately more often (odds ratios 2.1–2.2) diagnosed with schizophrenia and bipolar disorder (Table 2). These findings are interesting in light of Crow's proposal for psychosis resulting from the evolution of language (Crow, 2008). Additionally, the increased risk of suicide among authors corroborates Ludwig's findings of highest increased suicide rates in poets (Ludwig, 1995).

The definition of creativity used by us differed from that of many previous investigations of the association between creativity and psychopathology. These studies often relied on third parties defining the creative output (e.g., being mentioned in *Who's who*, receiving reviews in the *New York Times Book Review* or through the judgment of experts (Karlsson, 1970; Ludwig, 1992; McKinnon, 1962)). This approach largely taps into eminent creativity ("Big-C"), considered different from everyday creativity ("little-c") often addressed in studies of creativity. Still, our use of occupation as a proxy for creativity does not completely fit with either Big-C or little-c. This problem was previously addressed by Kaufman and Beghetto, suggesting the term Pro-c for "individuals who are professional creators, but have not reached eminent status" (Kaufman and Beghetto, 2009). These authors also argue that the addition of Pro-c better represents the developmental trajectory of creativity in a person's life. They also point to the weakness of using expert opinion, considering the many examples in history of now-obscure artists, inventors, and scientists, that were once seen as the future of a field. While the creative occupations included by us correspond closely to Pro-c, the increase in artistic occupations (including authors) among patients could reflect that people with severe mental disorder often have difficulties in finding and maintaining a job. One solution for such individuals would be to

Table 2
Associations between proband psychiatric morbidity and a creative occupation in proband and first-degree relatives.

	Proband OR (95% CI)	Parent OR (95% CI)	Sibling OR (95% CI)	Offspring OR (95% CI)
Schizophrenia				
Scientific occupations	0.49 (0.42–0.56)	1.43 (1.29–1.58)	1.31 (1.21–1.42)	0.76 (0.68–0.86)
Artistic occupations	0.95 (0.86–1.04)	1.54 (1.43–1.65)	1.24 (1.15–1.33)	1.08 (0.98–1.18)
Authors only	2.09 (1.35–3.23)	1.64 (1.19–2.25)	1.87 (1.13–3.10)	0.93 (0.39–2.24)
Schizoaffective disorder				
Scientific occupations	0.42 (0.32–0.56)	1.44 (1.21–1.71)	1.23 (1.07–1.41)	0.99 (0.83–1.18)
Artistic occupations	0.86 (0.72–1.02)	1.44 (1.27–1.64)	1.23 (1.09–1.40)	0.92 (0.77–1.10)
Authors only	1.37 (0.54–3.51)	2.28 (1.41–3.67)	1.46 (0.69–3.08)	–
Bipolar disorder				
Scientific occupations	0.90 (0.82–0.98)	1.39 (1.28–1.50)	1.30 (1.21–1.40)	1.12 (1.05–1.19)
Artistic occupations	1.21 (1.13–1.30)	1.29 (1.20–1.37)	1.12 (1.04–1.20)	1.09 (1.03–1.17)
Authors only	2.21 (1.50–3.26)	1.82 (1.37–2.42)	1.09 (0.64–1.86)	0.86 (0.46–1.60)
Unipolar depression				
Scientific occupations	0.73 (0.70–0.76)	1.04 (1.00–1.08)	0.92 (0.88–0.95)	0.91 (0.88–0.93)
Artistic occupations	1.07 (1.04–1.10)	1.16 (1.13–1.19)	1.03 (1.00–1.07)	1.01 (0.99–1.04)
Authors only	1.54 (1.30–1.81)	1.23 (1.05–1.43)	1.19 (0.92–1.53)	1.09 (0.88–1.35)
Anxiety disorders				
Scientific occupations	0.67 (0.63–0.71)	0.93 (0.89–0.97)	0.83 (0.79–0.88)	0.83 (0.79–0.87)
Artistic occupations	1.12 (1.07–1.17)	1.13 (1.09–1.17)	0.99 (0.95–1.03)	1.04 (0.99–1.08)
Authors only	1.38 (1.03–1.86)	1.12 (0.91–1.38)	1.00 (0.66–1.51)	2.00 (1.46–2.74)
Alcohol abuse				
Scientific occupations	0.34 (0.32–0.36)	0.75 (0.71–0.79)	0.61 (0.58–0.64)	0.62 (0.59–0.64)
Artistic occupations	0.98 (0.95–1.01)	1.07 (1.04–1.11)	0.88 (0.85–0.92)	0.96 (0.93–0.99)
Authors only	1.47 (1.25–1.74)	0.93 (0.78–1.12)	0.93 (0.70–1.24)	0.95 (0.69–1.32)
Drug abuse				
Scientific occupations	0.25 (0.23–0.28)	0.68 (0.63–0.73)	0.59 (0.55–0.63)	0.71 (0.67–0.76)
Artistic occupations	0.84 (0.79–0.89)	1.18 (1.13–1.23)	0.88 (0.84–0.93)	0.94 (0.89–0.99)
Authors only	1.53 (1.09–2.16)	1.40 (1.13–1.72)	0.73 (0.47–1.16)	0.50 (0.21–1.17)
Autism				
Scientific occupations	0.49 (0.18–1.34)	0.88 (0.78–1.00)	1.48 (1.17–1.89)	0.48 (0.12–1.96)
Artistic occupations	0.68 (0.30–1.58)	0.98 (0.88–1.11)	1.30 (1.00–1.69)	0.69 (0.22–2.10)
Authors only	–	2.10 (1.06–4.18)	–	–
ADHD				
Scientific occupations	0.33 (0.26–0.43)	0.67 (0.61–0.72)	0.84 (0.73–0.97)	1.19 (0.80–1.77)
Artistic occupations	0.85 (0.71–1.01)	1.02 (0.96–1.08)	0.91 (0.79–1.04)	1.21 (0.83–1.76)
Authors only	2.45 (0.27–21.90)	1.39 (0.94–2.05)	3.34 (0.44–25.04)	–
Anorexia nervosa				
Scientific occupations	1.16 (0.97–1.37)	1.19 (1.08–1.31)	1.35 (1.19–1.54)	0.89 (0.58–1.37)
Artistic occupations	1.06 (0.89–1.26)	1.23 (1.13–1.34)	1.04 (0.89–1.21)	1.18 (0.79–1.76)
Authors only	1.41 (0.17–11.46)	1.11 (0.62–1.98)	0.88 (0.13–6.06)	–
Suicide				
Scientific occupations	0.42 (0.36–0.48)	1.16 (1.01–1.33)	0.94 (0.85–1.05)	0.94 (0.89–1.01)
Artistic occupations	0.93 (0.86–1.01)	1.08 (0.98–1.20)	1.03 (0.93–1.13)	1.05 (0.99–1.12)
Authors only	1.49 (1.08–2.05)	1.18 (0.77–1.82)	1.59 (0.87–2.89)	1.11 (0.71–1.74)

Relatives to all patients were not allowed to have any event of the disorder of the patient.

seek self-employment, e.g., in artistic occupations. Artistic occupations would then be the result of social drift rather than a creative propensity. While difficult to completely rule out, the same could not be said about scientific occupations, since these generally require the passing of a series of professional "gates".

The findings of familial associations between creative professions and schizophrenia, bipolar disorder and possibly autism as suggested here, could have some bearing on three of the major components identified in creativity research. First, divergent thinking or the capacity for broad associative thinking has since long been considered fundamental to creativity (Kaufman and Sternberg, 2010). Divergent thinking involves different, partly correlated, indices (e.g., *fluency* or quantity of ideas, *flexibility* or categories of ideas, and *originality* or the unusualness of ideas). While the thought disorder in schizophrenia or more moderate schizotypy is not identical to divergent thinking, there are similarities regarding the tendency to over-inclusive thinking (e.g., delusions) (Eysenck, 1995). Second, creativity research has also acknowledged the importance of personal engagement and motivation (Kaufman and Sternberg, 2010). Lack of motivation and personal ambition, also when concomitant with extreme intelligence, has repeatedly been seen as detrimental for personal success (Eysenck, 1995). In light of this fundamental importance of motivation, Spielberger et al's findings of remitted bipolar patients' appraisal of personal success compared to healthy controls is suggestive (Spielberger et al., 1963). More than 93% of those with a history of mania endorsed that "I nearly always strive hard for personal achievement" compared to 60% in non-psychiatric controls. Third, extensive research suggests the importance of determination in genius and creativity (Simonton, 1999). There is a clear association between the time spent in a task, increased knowledge, concomitant cognitive and physiological changes, and exceptional achievement (Ericsson et al., 2007). Restrictive and intense interests are one of the core features of autism and Baron-Cohen has proposed that autistic traits are associated with a hyper-systemizing cognitive style leading to talent in scientific endeavors (Baron-Cohen et al., 2009). This opens up for a common denominator in autism spectrum disorders, creativity, and exceptional achievement (Vital et al., 2009).

Another important issue related to the association of creativity and psychopathology, is if it could help explain the decreased fertility found in severe psychiatric disorder, the high heritabilities, and the paradoxical stable prevalence of these disorders (Uher, 2009). One frame of explanation is provided by the *balancing selection hypothesis*, which assumes that alleles associated with mental disorder in patients and their relatives also hold adaptive advantages that increase fitness (Huxley et al., 1964). This is congruent with the "inverted-U" relationship between psychopathology and creativity mentioned earlier (Richards et al., 1988), and the present results where associations to creativity peak in first-degree relatives of patients with schizophrenia, bipolar disorder, anorexia nervosa or autism, rather than in the patients themselves.

Major strengths of this study include the prospective total population study design with information also on healthy relatives of affected patients, thus reducing selection bias for both patients and individuals with creative occupations, while providing substantial statistical power and a wide range of psychiatric diagnoses. Limitations include the use of scientific and artistic occupations as a proxy for creativity, patients having higher rates of missing data than their respective controls, different diagnostic systems throughout the study, the narrow definition of scientific occupations as those active solely within the academic arena, and artistic occupations possibly reflecting social drift rather than creativity.

In conclusion, these results substantially expands on our prior findings of familial co-segregation of creativity with schizophrenia and bipolar disorder. The present data suggest that this familial aggregation is confined to mental disorders with psychotic features, anorexia nervosa and possibly autism, and not generalizable to all psychiatric disorders. In contrast, specifically professional authors had more often been diagnosed with a majority of the investigated psychopathologies.

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Contributors

SK contributed to the conception and design of the study, analysis and interpretation of the data, drafting of the manuscript, and critical revision of the manuscript for important intellectual content. ML contributed to the conception and design of the study, and critical revision of the manuscript for important intellectual content. MB contributed to analysis and interpretation of the data, and critical revision of the manuscript for important intellectual content. CH contributed to the conception and design of the study, and critical revision of the manuscript for important intellectual content. NL contributed to the conception and design of the study, and critical revision of the manuscript for important intellectual content. PL contributed to the conception and design of the study, and critical revision of the manuscript for important intellectual content.

Conflict of interest

We declare no conflict of interest.

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Appendix A. Supplementary material

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.jpsychires.2012.09.010.

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