Archives of Psychiatry and Psychotherapy, 2008; 1 : 37–47

Psychopathology and creativity

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Summary

The process of creativity may be connected with psychopathological features of mood disorders, mainly bipolar, and psychosis-like thought abnormalities. Patients with bipolar affective illness and members of their families exhibit similarities to creative persons, as to increased indexes of creativity and such temperamental features as cyclothymia, neuroticism and openness. An association was also found between the dimension of "psychoticism", schizotypal features and the measures of creativity. A neurobiological model of generating ideas and creative drive assumes a dominant role of the frontal lobes, temporal lobes and the mesolimbic system. The dopaminergic system neurotransmission, especially its mesolimbic and cortical pathways are mostly connected with elevated mood and psychotic thinking. Neurobiological, molecular-genetic and pharmacological evidence has been accumulated pointing to an involvement of these pathways in motivational, emotional and cognitive processes, and indirectly, in the processes of creativity.

creativity / bipolar affective illness / psychosis

Psychopathology and creativity

Creativity can be defined as the generation of ideas and behaviours, both original and useful, and implementing them in life. In a narrower sense, it is understood as the ability to create new, socially useful or influential ideas, and is related to the creative activity of prominent writers, philosophers, or scientists. From a broader perspective, this term can be understood as a set of cognitive abilities which enable creative thinking. In this particular meaning creativity manifests itself in various artistic forms, but also in everyday activities, for instance while looking for solutions to various problems. Creativity has evolved in the course of evolution of the brain of Homo sapiens and in specific circumstances it may promote a reproductive success.

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The authors thank Dr Karolina Rataj for editing of the English text.

Creative people are often distinguished by broad interests, fascination with complex problems, great vigour, independent views, autonomy, intuition, self-confidence, and the capacity to resolve contradictions. The internal motivational processes connected with personality traits, which enable the generation of ideas independent of external factors are also of great importance for creativity. Cognitive features connected with creativity include such intellectual skills as divergent thinking or a long attention span. The process of creative thinking is also influenced by external factors present mainly in the culture, family or environment [1].

Researchers have for a long time been fascinated with the possibility of co-occurrence of outstanding creativity and psychopathological changes within a person. The oldest reflections on the presence of mental disorders among prominent individuals were presented by Aristotle in one of his works entitled *Problemata*, and were related to a frequent occurrence of melancholia in prominent people living in those days [2]. The first researcher to examine the relations

between outstanding gifts and mental disorders was an Italian psychiatrist, anthropologist and criminologist, Cesare Lombroso [3]. His conclusions, based on the analysis of famous people's biographies, pointed to the fact that genius, various psychiatric defects, and addictions tend to co-occur. He also reported that mental illnesses and alcoholism are often present in the families of prominent people.

The present article proposes a view formulated on the basis of results obtained in various studies, which postulates that creative processes may be linked with mood disorders, most often of the bipolar type, and with thought disorder similar to psychotic thinking. In psychiatry, mood disorders are present most frequently in affective disorders, while psychotic thinking in disorders of the schizophrenia type.

Biographic and family research on creativity in affective disorders

One of the methods used to examine the connection between creativity and psychopathology is the analysis of prominent people's biographies and the evaluation of the frequency of occurrence of mental disorders in those people and their families. The results of research in this area seem to corroborate the hypothesis that affective disorders are frequently observed in creative people. On the basis of a fifteen-year long prospective observation of thirty writers, Andreasen [4] concluded that 80% of them suffered from symptoms of affective disorders, and 43% of them suffered from bipolar affective disorder. Ludwig [5] examined a group of 59 female writers and showed that depression episodes occurred in 56% of them, manic states in 19%, which is much more frequent when compared to a control group (14% and 3%, respectively). A post-mortem analysis of biographies of renowned scientists, politicians and artists carried out by Post [6] showed the presence of depression in 72% of writers, and alcohol addiction in 28% of writers and 29% of artists. The same author focused his further research on biographies of 100 writers, poets and playwrights and confirmed the occurrence of affective disorders (82%) and alcohol abuse or addiction (40%) [7]. A similar method was used by Ludwig [8] for the analysis of biographies of prominent people whose names were published in a literary supplement to *The New York Times.* Affective disorders were observed more frequently in creative professions (artists, writers, musicians) than in politicians, military men and scientists. For instance, depression occurred much more frequently amongst poets (54-66%) than military men (5%).

In the already mentioned work by Andreasen [4], a higher rate of psychopathology (especially depression) as well as more prominent achievements in areas requiring creativity (20%) were observed in first degree relatives of writers as compared to relatives of the control group (8%). Moreover, in a study conducted by Coryell et al. [9], greater educational and professional achievements were reported in first degree relatives of patients suffering from bipolar affective disorder, as compared to a control group.

The mechanism of relations between affective disorder, especially of the bipolar type, and creativity is still subject to investigation. Most researchers believe that there exist common elements of a genetic predisposition to bipolar affective disorder and creative activity. Also, such factors as family background, which may shape the transmission of such predispositions, may have some influence. Moreover, the impact of particular episodes of the illness on creative activity remains to be investigated.

Hypomanic states seem to be conducive to creativity. According to McDermott [10], a prominent American poet Emily Dickinson wrote a significantly larger number of poems in the spring and summer periods than in the fall and winter. Such seasonal creativity as well as the content of the poet's letters, in which she described her emotional states, may suggest the presence of bipolar mood swings. A similar correlation was found in the analysis of Robert Schumann's artistic creativity. Most of his works were composed in hypomanic states [11].

Schildkraut et al. [12] analysed the presence of psychopathological changes in 15 expressionist painters of the New York School, who created their art in the mid-20th century. Over half of them showed depression symptoms, concentration on death issues and alcohol abuse. Six of them were psychiatrically treated, of whom three were hospitalized. Two committed suicide,

and two had fathers who did so. Seven artists from this group died before they reached the age of 60. Authors of this research indicate that depression-like experiences could significantly shape the works of these artists.

An analysis of Virginia Woolf's biography has shown that this prominent writer was extremely productive between 1915 and 1951, when she experienced mild mood swings, while she did not create much during severe episodes of her illness, though some novels are probably based on her experiences gathered during these periods [13].

Biographical and family research on creativity in schizophrenia

In most people, schizophrenia is a factor limiting artistic creativity, and a significant majority of schizophrenics do not show any outstanding talents. It is known, however, that schizophrenia has been diagnosed among the relatives of prominent creative persons, for example in James Joyce's daughter, as well as in Bertrand Russell's or Albert Einstein's sons. Thus, it may be assumed that in families of people suffering from schizophrenia some talents are hereditary.

Heston's research [14] was devoted to the evaluation of various manifestations of creativity in people related to schizophrenics. It has revealed that adopted children of mothers suffering from schizophrenia frequently show creative interests. The opposite relation was not found in research conducted by Post [6], who showed that among 291 creative men, only 14 had relatives suffering from schizophrenia. Moreover, no differences were found in the domain of artistic talents in children of schizophrenic parents and adopted children whose parents were mentally healthy.

Also educational achievements of people suffering from schizophrenia were evaluated. Isohanni et al. [15] conducted a cohort study of 11 070 people born in 1966 in Finland. 58 participants were diagnosed with schizophrenia between the ages of 16 and 28. Among them, 11% showed excellent progress in education in the pre-illness period, which constitutes a significantly bigger number when compared to a control group of healthy people (3%).

The aim of the research carried out by Karlsson in Iceland [16] was to compare the frequency of obtaining a high school diploma in the group of people hospitalized due to psychosis and in a population of healthy people. The study used data obtained from 171,000 people. Those hospitalized due to psychosis obtained a high school diploma more frequently and among their close relatives there were more people listed in the '*Who's who?*' publication, when compared to the relatives of healthy people. Further research on the same population [17] showed that psychotic disorders occur more often among the relatives of people with outstanding mathematical talents than in the relatives of people talented in the area of humanities, among which the frequency of occurrence of disorders did not differ from the average in Iceland. The hospitalization due to psychosis index was significantly higher for these people than it had been expected, particularly in relation to men (3.3% vs. 0.8%). Moreover, in their siblings, the percentage of persons hospitalized was reported to be higher (7%) than in the whole population (1.6%).

According to Andreasen [4], the presence of schizophrenia in relatives of people widely acknowledged as prominent may suggest inheritance of such predispositions. Moreover, it has been postulated that due to this fact the index of prevalence of schizophrenia is stable (1%) although schizophrenics have fewer children. It has been assumed that genes associated with schizophrenia may in some people be phenotypically manifested in the form of special abilities and adaptive traits resulting in reproduction benefits, while in others may lead to the occurrence of illness [18].

Measures of creativity

One of the most influential researchers in the area of creativity was an American psychologist Joy Paul Guilford. In the theory of intellect proposed by him, he distinguished such intellectual attributes as fluency, flexibility of thinking, the ability to redefine concepts, originality, which he then labelled as divergent thinking [19]. Further research carried out by him as well as conducted by other researchers allowed for the formulation of a hypothesis linking creativity with

divergent thinking [20]. On the basis of this research, tests were prepared whose aim was to measure creative thinking. One of them is the Guilford's Alternative Uses Task created by him in 1967. The participant is asked to find as many uses of objects commonly used as possible (for example, a brick: to block the door, to defend against an attacker, or in self-defense). The following items are evaluated in this task: originality (compared to a group examined earlier), fluency (the number of proposed items), flexibility (variety of uses) and the ability to provide details for a particular use. Similar assumptions constitute the basis for the Torrance Tests of Creativity, which consist of a verbal form and a figural form. Also, an updated version of the Divergent Thinking Task has been developed. The participant's task is to find as many uses of objects presented to them as possible. In the first part, these are well known objects (a needle and thread, tools used in carpentry, an eraser), while in the second part – less known objects. If the participant was presented with several objects at once, then he or she is expected to come up with the uses for each of the objects as well as for the whole group.

The creativity scale drawn up by Frank Barron, a psychologist from the University of California at Berkeley, and based on the psychoanalytic hypotheses has been popular to date (Barron-Welsh Art Scale). In one of the versions of this scale, the participant is asked to draw pictures. Based on the analysis of these pictures, the way in which the participant's ego and libidinal drive function is described, for example the use of symbols and substitutions. In the second version, the participant is presented with 62 pictures previously evaluated by artists who were asked to determine whether they liked the pictures or not. Then the participants of the study were asked to say whether they liked the pictures or not. Finally, the ultimate results are obtained by the comparison of the preferences of the artists and the participants of the test [21].

Another method of creativity assessment is the use of questionnaires whose aim is to obtain the information about previous creative activities and achievements in the examined population. One such recently published questionnaire is the Creative Achievement Questionnaire developed by Shelley Carson et al. [22]. Moreover, biographical inventories have been developed, in which participants are asked about their educational background, way of spending their free time, as well as creative interests in a number of areas (mathematics and physics, arts, writing etc.). The interpretation of results is based on the assumption that creativity is a consequence of previous life experience. This group comprises also the Lifetime Creativity Scale (LCS) and the Creative Achievement Scale [23].

Creativity research on bipolar affective disorder

A number of studies using various psychometric instruments have investigated the phenomenon of creativity in patients with bipolar affective disorder and their families. Richards et al. [24] measured the so called everyday creativity using the Lifetime Creativity Scale, which estimates creative achievements based on both professional and non-professional activities. They reported that adults with cyclothymia and first degree relatives of patients with bipolar affective disorder (but not the patients themselves) obtained results significantly higher on LCS when compared to a control group. In the study carried out by Ludwig [8], except for a more frequent occurrence of affective disorders in known artists, the results obtained for them on the Creative Achievement Scale were higher than in representatives of other professions.

Researchers from Stanford University evaluated the phenomenon of creativity in bipolar affective illness with the Barron-Welsh Art Scale (BWAS) [25]. 40 people suffering from this illness and their offspring participated in the study: 20 persons with bipolar disorder and 20 with attention deficit hyperactivity disorder (ADHD), as well as a control group of healthy persons: 18 adults and their children. Adult patients with bipolar affective disorder obtained significantly higher scores on the BWAS subscale "I do not like it" (120% higher) when compared with the control group of healthy adults, as well as a slightly higher score for the whole scale (32% higher). Moreover, the offspring of these patients also obtained higher scores on the BWAS subscale "I do not like it" (children with bipolar disorder – 107% higher, children with ADHD – 91% higher) when compared with the

control group of healthy children. For the whole scale, this difference amounted to 67% for children with bipolar disorder and 40% for children with ADHD, however, when age was taken into account, these results failed to reach statistical significance.

It seems important to notice the presence of a negative correlation of the scores obtained by children with bipolar disorder on BWAS with illness duration, which indicates that the longer the illness is present, the smaller creativity is observed. This study was the first one to show that children with bipolar disorder who at the same time come from families with a history of this illness are more creative on BWAS than their healthy peers. These differences, in both children and adults, are connected with greater ability to experience and express the unwillingness to choose simple and symmetrical forms on BWAS. They may also stem from such emotional traits as neuroticism, cyclothymia, dysthymia, and irritability, which may provide creative energy, but also contribute to worse interpersonal relationships and susceptibility to depression. The results obtained seem to indicate that there is a connection between creative traits and bipolar affective disorder, as well as that these may be transmitted in families.

A study by Nowakowska et al. carried out in the same research centre [26], investigated the temperamental traits in patients with affective disorders in remission as compared with a control group of healthy people with high and average creativity. 49 patients with bipolar affective disorder being in euthymia, 25 patients with the unipolar disorder, 32 students of arts, and a control group of 47 healthy people were examined. The following research methods were used: the NEO PI-R Personality Inventory, the Temperament and Character Inventory (TCI), and the Temperament Evaluation of the Memphis Pisa Paris and San Diego Auto-questionnaire (TEMPS-A).

The results showed that patients with bipolar and unipolar affective disorders in remission and students of arts were more cyclothymic, dysthymic and irritable on the TEMPS-A scale when compared to the control group of healthy people. Moreover, patients with bipolar disorder were reported to be more cyclothymic than patients with unipolar disorder. On the NEO PI-R Personality Inventory, patients with bipolar and unipolar disorder in remission and students of arts were more neurotic and less conscientious than the control group. Patients with bipolar disorder and students of creative arts showed more "openness to experience" as compared to patients with unipolar affective disorder and the control group of healthy people. On the TCI scale, patients with bipolar and unipolar disorder as well as students of creative specializations showed more proneness to seek novelty and avoid harm when compared with healthy people.

Although most students of schools of arts were not professional artists and represented various fields of arts, the results obtained reveal a similarity between them and patients with bipolar disorder in remission in the area of temperamental features. The similarity in the intensity of cyclothymia, as well as in traits such as novelty seeking and openness to new experience is particularly noteworthy. Moreover, the results indicate the presence of a correlation between temperamental features characteristic for bipolar disorder and the manifestation of artistic creativity.

Creativity and psychotic thinking features

Reflection on psychotic thinking is frequently connected with research on schizotypy. Schizotypy is a disorder classified within the range of schizophrenia and including among others: proneness to eccentricity, magical thinking, and unusual experiences; however, this state does not prevent a person from control over his or her own cognitive processes. Hans Eysenck, a prominent psychologist, proposed a theory concerned with the relationship between psychoticism, creativity and disorders of the schizophrenia type. He believed that psychoticism, conditioned by the reduction in cognitive inhibition, is a common feature of creativity and of disorders of the schizophrenia type. In research which used the Eysenck Personality Questionnaire, a positive correlation was found between psychotic features and creativity. In a study which examined 100 students, a significant correlation was found between the intensity of psychotic features and such creativity measures as divergent

thinking tests [27]. In another study, which examined 62 students, the intensity of psychoticism also showed a significant positive correlation with the results of BWAS subscale "I do not like it" [28]. 625 students participated in a study conducted by Schuldberg [29] which revealed a significant correlation between the intensity of psychotic features and the results of the *How do You Think* tests, which measure creativity,and Perceptual Aberrations related to schizothymia, including hypomanic features.

A recent article presents the results of a study conducted on 107 students and employees, of whom 53 came from a well known Department of Visual Arts at the University of London, and 54 from other university departments. A number of psychometric scales were used such as the O-LIFE schizotypy scale, the creative personality scale, the intelligence scale and the divergent thinking battery. The group of visual artists obtained significantly higher scores in three subscales of schizotypy, as well as in the measure of neuroticism, openness to experience and divergent thinking [30].

The results of research in which the Kings Schizotypy Questionnaire was applied, seem to indicate that the presence of bipolar affective disorder does not preclude the presence of schizotypy features. In a study carried out on 135 schizophrenia patients, 92 bipolar affective disorder patients and 263 healthy people, patients with bipolar affective disorder were significantly more schizotypal than healthy people, but less than patients with schizophrenia [31]. The authors of this research believe that this test may allow assessing propensity for psychotic behaviour. These results seem particularly interesting in the light of the relationship between creativity and psychoticism presented above.

Propensity for psychosis, as well as the tendency for higher creativity are related to a cognitive mechanism of latent inhibition (LI). It is connected with a failure to notice stimuli from the environment previously evaluated as insignificant. It has been reported that weaker LI is connected with the predisposition to schizophrenia [32]. Moreover, it has recently been assumed that a lower LI index is also related to such a trait of character as openness to experience, which in turn may be connected with divergent thinking and creativity [33]. This may account for the fact that creative people see things which remain unnoticeable to others, have access to a wide range of stimuli at the early stage of processing, and thus better chances for original thinking. Research recently carried out by Carson et al. [34] on a group of 86 students, which applied an experimental method of LI assessment, showed that highly creative people obtained significantly lower results in LI when compared to less creative people. These results can indicate that there is a neurobiological similarity between highly creative people and people with a predisposition to psychotic disorders. The authors of the study believe that a high intelligence quotient (IQ) may help to transform low LI into creative achievements.

Neurobiology of creativity

Creativity is undoubtedly related to an adequate organization of brain functions. A neurobiological theory of creativity formulated in the 1980's postulated its relationship with a specific lateralization of the brain hemispheres [35]. The right hemisphere (the so called non-dominant hemisphere) was believed to be involved in holistic processes and artistic experience, especially in such domains as painting or music. The weakness of this theory was, however, the underestimation of the importance of the left hemisphere responsible for linguistic processes, which constitute the basis of creative thinking. Moreover, the maximum integration of the functioning of both hemispheres seems to be more important for creative processes [36].

At present, it is believed that creativity requires the cooperation of cerebral structures involved in cognitive processes and those responsible for motivation for action. A model recently presented by Alice Flaherty [37] presupposes that three cerebral structures, frontal lobes, temporal lobes and the mesolimbic pathway play a dominant role in the generation of ideas and artistic drive. Some elements of the functioning of these structures related to creative processes may be similar to changes observed in mental disorders. These are mainly disorders of mood and motivation of the hypomanic type, as well as disorders of information processing of the psychotic thinking type.

The dopaminergic system is a neurotransmitter system strongly connected with mood elevation and psychotic thinking, which are believed to be involved in creativity. In particular, it concerns the functions of this system within the dopaminergic pathways in the mesolimbic system and cerebral cortex. There is both neurobiological and pharmacological evidence for the existence of a relation between these pathways and motivational and emotional processes as well as cognitive processes. Activity of the dopaminergic mesolimbic system results in the increase in motivation for action and in exploration of the environment, as well as in positive emotional experience (hedonia). An increase in the activity of this system was observed in manic and hypomanic episodes, as well as after taking psychostimulant substances (e.g. amphetamine). The mesolimbic system has structural and functional connections with the temporal lobe, responsible, among other things for linguistic processing. In such a connection, hyper-dopaminergy of the limbic system can constitute the basis of cognitive function disorders, especially in the area of perception and thinking. Dopamine causes the diminishing of the habituation processes and influences the sense of increased perception and salience of external stimuli [38]. It may also reduce the latent inhibition mechanism [39]. The increase in the dopaminergic activity may, thus, predispose to psychotic thinking on the one hand, and to increased creativity on the other. The pharmacological mechanism of the antipsychotic activity of neuroleptics seems to indicate a dominant role of dopamine receptors D2 in shaping these processes.

The prefrontal cortex is a part of the brain which is strongly connected with creative processes. Dorsolateral prefrontal cortex (DLPC) manages complex operations of information processing, such as working memory and executive functions. Ventromedial prefrontal cortex is involved in the coordination of emotional and motivational processes, concerned mainly with decision making. Prefrontal cortex functions depend to a large degree on the optimal activity of the dopaminergic system and activation of dopamine receptors DRD1 [41]. The role of other neurotransmitter systems like the serotonergic system, glutamatergic system and substances from the neurotrophin group (mainly the brain derived neurotropic factor - BDNF) is also significant.

The dysfunction of the prefrontal cortex and decrease activity of the dopaminergic system in this brain region result in the impairment of cognitive functions, including generation of creative ideas. It is reflected in various pathological conditions in which both dysfunction indices of this structure and significant changes in creativity are observed. Depression serves a good example here. In a number of neuroimaging and neuropsychological studies it has been observed that glucose metabolism in frontal lobes is impaired (known as hypofrontality) in patients suffering from depression [42], while mental efficiency including creative thinking is poorer, and decision making is more difficult. These are the most frequent complaints raised by patients during acute episodes of depression. In manic episodes, especially hypomania, both creativity and the facility of decision making may increase. Nevertheless, with a progressive intensification of manic symptoms patients lose control over their behaviour and become less creative.

The results of neuroimaging studies point to the significant role of the prefrontal cortex in creativity. Carlsson et al. [43] measured regional cerebral blood flow (rCBF) in the brains of people who obtained either high or low scores on the creativity test. The participants were completing psychological tests, including the divergent thinking test, while their rCBF was measured. The results revealed that the creative group used frontal lobes bilaterally while the low in creativity group used them unilaterally. Similar results have recently been reported by Folley and Park [44] from a study in which the activity of the prefrontal cortex was measured by the use of a near-infrared optical imaging method while the participants were doing the divergent thinking test. The study was carried out on 17 people suffering from schizophrenia, 17 people with schizotypy features, and 17 healthy people. People with schizotypy features obtained significantly higher results in the divergent thinking task when compared to the remaining groups. The neuroimaging study on schizotypal people revealed a significantly higher bilateral activation of the prefrontal cortex, higher on the right side, when compared to the remaining groups. Results of both studies seem to confirm the im-

portance of the integration of both hemispheres for creative activity.

An example of a pathological creative drive is the phenomenon of hypergraphia observed in the disorders of left temporal lobe functions, e.g. in temporal lobe epilepsy. It occurs predominantly when the epileptic seizure is located in the right hemisphere because, as a result, the activity of the left hemisphere connected with verbal processes becomes disinhibited. In such pathological changes frequent mood swings are observed, including manic states and psychotic disorders. Experimental research reported by Japanese authors revealed an increase in the dopaminergic activity in the animal model of temporal lobe epilepsy [45].

Progress in the molecular-genetic research revealed a number of remarkable results related to the genetic background of creative processing connected with mood changes of the bipolar type and psychotic disorders. Particularly interesting are the results obtained in the case of some genes connected with the dopaminergic system.

The dopamine receptor D2 (DRD2) is connected with the mechanism of antipsychotic action of neuroleptic drugs [40]. These drugs, especially new generation neuroleptic drugs, are used in treatment of both schizophrenia and manic states. In some research, an association of the polymorphism of DRD2 gene with schizophrenia and bipolar affective disorder was reported [46, 47]. Serretti et al. [48] found an association of the DRD2 gene with delusion symptoms and thinking disorganization, and Blum et al. [49] found such an association with schizotypal features. In a recent study carried out on healthy people, Reuter et al. [50] found an association between DRD2 gene and verbal creativity.

The dopamine receptor D4 (DRD4) gene was the first gene to be reported to show a connection with such a personality trait as novelty seeking, which may be linked with increased creativity [51]. Moreover, in some research an association between polymorphism of the DRD4 gene and a predisposition to bipolar affective disorder was reported [52].

Catechol-O-methyl transferase (COMT) is an enzyme which regulates the breakdown of dopamine in the prefrontal cortex. Research on the Val/Met polymorphism of this gene indicated a possibility of its association with cognitive functions related to the prefrontal cortex both in healthy people and those suffering from schizophrenia [53]. However, recent research on healthy people showed no relation between polymorphism of this gene and creative features [50].

An important role of the serotonergic system in the mechanisms of cognitive functions was revealed in experiments with the tryptophan-free diet (tryptophan being the precursor for serotonin), in which a decline in cognitive functions was observed in healthy people after the introduction of this diet [54]. The importance of serotonin in creativity mechanisms was reported in a genetic and molecular study carried out on healthy people, in which an association of the polymorphism of the tryptohan hydroxylase gene with creativity in tasks with numbers and figures was observed [50].

Some implications for the connection between higher efficiency of the prefrontal cortex (which has been shown to play a crucial role in creative activity) and bipolar affective disorder may follow from our original research carried out on the Val/Met polymorphism of the BDNF gene. We found that in patients with bipolar affective disorder (but not in patients suffering from schizophrenia and healthy people) the Val allele correlates significantly with higher scores on tests assessing the activity of the prefrontal cortex [55]. Other studies have revealed that the Val allele correlates also with the predisposition to bipolar affective disorder [56]. These results can be interpreted as mechanisms of gaining evolutionary benefits in the area of cognitive functions in people suffering from bipolar affective disorder.

CONCLUSIONS

In recent years two papers have been published whose authors summarized the results of research conducted on the relationship between mental disorders and creativity. Based on a critical analysis of the results of 29 studies, Waddell [57] did not find sufficient evidence corroborating the hypothesis about the correlation between creativity and mental illness. Lauronen et al. [58] summed up the results of 13 studies devoted to creativity and mental disorders, each

of which comprised at least 100 participants. On the basis of the analysis of the results they concluded that the correlation between creativity and schizophrenia does not seem convincing because these conclusions are based on little research abundant in methodological faults. However, it does not preclude the possibility of occurrence of unusual creative abilities in families of people suffering from schizophrenia. According to them, research using widely recognized methods of creativity assessment indicate the existence of a correlation between creativity and affective disorders, mainly hypomanic states and cyclothymia.

Similar conclusions have been presented by Nancy Andreasen, the author of a recently published book *Creative Brain* [59]. She believes that there exists convincing evidence for the correlation between creativity, especially literary and artistic, and affective disorders. In schizophrenia, such a correlation could refer to scientific creativity, especially in the domain of sciences, but would be manifested predominantly in the relatives of people suffering from schizophrenia. The author intends to verify the hypothesis claiming that schizophrenia is more frequent in families of prominent scientists.

The view presented in this work does not presuppose a direct connection between a particular illness and creative features. Hypomanic states and cyclothymic personality, as well as a wide range of other temperamental features (novelty seeking, openness to experience) conducive to creative processes are more frequent in people suffering from bipolar affective disorder, which may render them more predisposed to artistic creativity. The propensity for psychotic thinking is more frequent in disorders of the schizophrenia type, especially in people with schizotypal features. Interesting results of research conducted by Heron et al. [31] indicate that schizotypal features are also stronger in bipolar affective disorder than in healthy people. Recently, Nettle and Clegg [60] analyzed the relationship between schizotypal features, creative activity, and finding a partner, in a big group of British poets, artists and other people. They concluded that two schizotypal features – the propensity for unusual experience and impulsive nonconformity – showed a correlation with the number of partners; however, in the first case the mediating factor was creative activity. This may corroborate the hypothesis put forward by Miller [61], which claims that artistic activity may be a factor attracting a sexual partner and thus, in the context of evolution, increasing the reproductive success.

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PSYCHIATRIA POLSKA
[POLISH PSYCHIATRY]
YEAR 2008 JANUARY–FEBRUARY, VOLUME XLII ISSUE 1

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