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## Creativity and mental disorders – is there a connection?

In this article the main goals are to evaluate the supposed connection between creativity and mental disorders and to discuss recent findings of brain research in this field. First, some aspects of creativity are presented, and then the recent research concerning the link between creativity and mental disorders is introduced. Especially the connection between mental disorders and creative writing is discussed, as well as the creativity of people who suffer from affective and psychotic disorders. Some interesting brain research results concerning these disorders and creativity are mentioned. Lastly, the writers expound how the creative process can be examined using imaging methods such as electroencephalogram (EEG), functional magnetic resonance imaging (fMRI) and positron emission tomography (PET).

As a conclusion, the writers propose that some evidence on the hypothesized connection between creative writing and affective disorders has been found. More research is needed to reveal the complex neurobiology behind creative actions.

## WHAT IS CREATIVITY?

It is difficult to define what creativity is. There are hundreds of definitions, that approach the phenomenon from different points of view. Creativity is useful when one needs to communicate ideas and values or to solve problems (Franken, 2001, 396). In order to be creative, one needs to be able to view things in new ways or from a different perspective and to generate new possibilities or new alternatives. The ability to generate possibilities or to see things uniquely does not occur by chance; it is linked to other qualities of thinking, such as tolerance of unpredictability, flexibility, and the enjoyment of new things. (Franken, 2001, 394.) Creative persons are often interesting, stimulating and bright, they experience the world in original ways. (Csikszentmihalyi 1996, 25–26.) Creative persons are widely known to be sensitive and independent, even rebellious. Creative individuals have found a balance between many things, e.g., hard work and rest, smartness and naivety, playfulness and discipline, humbleness and pride. They have also found a workable combination of responsibility and irresponsibility as well as imagination and a rooted sense of reality. (Csikszentmihalyi 1996, 58–73.) In other words, while creativity is linked with mental balance, it is not possible to be creative if one thinks in an ordinary way. Creative thinking is always somehow distinctive. Creative persons are often eccentric and have a vivid imagination. The difference between brain functions behind creative and normal, every-day cognitive tasks is unclear (Abraham 2013, 1–9). It has been said that different cognitive and emotional states may enhance the individual's creative potential.

Psychoanalytical theories have discussed creativity as a part of personality. D.W. Winnicott has suggested that creativity rises from individual's depressive traits as means to replace an irreplaceable loss with an imaginative fiction (Winnicott 1963, 230–241; and 1971, 53–85). Melanie Klein has proposed a similar fictional replacement to take place in anxiety and paranoid-schizoid phases, where the disrupted reality is replaced with a fictional one (Klein 1929, 436–444). In these theories, both the depressive and paranoid-schizoid phase are normal developmental states of the human psyche, thus timing the onset of the assumed connection between creativity and psychological instability to early childhood. Andreasen and Glick have also proposed that creativity is more connected with temperamental factors than with mental disorders (Andreasen & Glick 1988, 207–217).

Creative activity in the central nervous system (CNS) has been associated with anatomical changes such as alterations in both integrity and amount of both white and grey matter in frontal areas, including prefrontal and striatal parts of the forebrain (Jung et al. 2010, 1–20; Takeuchi et al. 2010a, 578–585; Takeuchi et al. 2010b, 11–18), as well as integration of the connective structure between hemispheres, corpus callosum, and association cortices (Takeuchi et al. 2010b, 11–18.). Frontal lobe activity has been found to play a significant role in creative tasks, enabling the formation of alternative strategies (Heilman et al. 2003, 369–379.). Functional alterations, such as pronounced frontal lobe activity, both bilateral and right hemisphere activity (Carlsson & al. 2000, 873–885; Bowden & Jung-Beeman 2003, 730–737), and pronounced alpha synchronization

(Fink et al. 2009, 734–748) have also been observed to occur during creative tasks.

## CREATIVITY, WRITING AND MENTAL DISORDERS

Creativity and mental disorders are often considered to be linked with each other. Some researchers consider this link to be nothing but a myth (see Aukeantaus 2010, 68–72). Artistic traits are easily associated with a common assumption of underlying psychological pathology, leading to the prejudicial idea of a "mad artist". Artists often tend to present unconventional behavior which a layman could easily mistake for that of individuals affected with mental disorders. However, what is considered as a healthy, normal psyche has a broad range of varieties. It is therefore important to note that creativity does not necessarily demand any underlying psychological pathology, though researchers have speculated that some similarities in the central nervous system functions between creativity and mental disorders do exist. Frosch reminds us that creative furor differs significantly from mania. Although it might be reminiscent of an affective disorder episode, it is structured and capable of producing a product. (Frosch 1996, 506–508.)

Researchers of the Karolinska Institutet have made some observations concerning the connection between creativity and affective disorders. They examined the medical records of about 1.2 million Swedish patients in order to find out if creativity was associated with mental disorders. They also combed through the records of the patients' relatives. They discovered that bipolar disorder was the only mental condi-

tion people in most “creative” professions were more likely to suffer from than the control patients. Then again, the researchers noticed that creative professionals were more likely to have relatives who were diagnosed with schizophrenia, bipolar disorder, anorexia and autism than the relatives of the control patients. (Kyaga et al. 2013, 83–90.)

Many famous creative people, such as authors, are known to have problems with mental health. Authors most typically suffer from a bipolar or unipolar depression, but there are also many writers who have been diagnosed with schizophrenia. However, it is essential to remember the importance of both historical and social contexts when interpreting the works of an artist in this sense (Frosch 1996, 506–508). The sociocultural environment of the era defines the limits of behavior that can be considered as normal. The definitions of mental disorders can, and have varied, over time and in different cultural environments. Historical context may also greatly influence our understanding of the connection between mental disorders and creativity, since diagnostics and reporting may vary substantially. Furthermore, it is very difficult to deduce posthumously from the works or letters whether or not a historical writer or some other creative characters actually suffered from a mental disorder. Broadly speaking, the definition of a mental disorder includes behavior that causes significant distress to the affected individual and/or their surroundings, and is therefore considered as a risk for the individual’s health. These limits permit a quite large variety of behavior that can thereby be considered as normal.

According to Kyaga’s study, creative individuals themselves do not have more mental disorders (excluding bipo-

lar disorder) than so-called ordinary people. The findings included one interesting exception: creative writing. Being an author is, according to the study, associated with increased likelihood of not only bipolar disorder but schizophrenia, depression, anxiety disorders, substance abuse and suicide. (Kyaga et al. 2013, 83–90). Why is that? There are many competing explanations. Writing may be a form of self-care for the authors. Could it be that people with mental problems find writing to make them feel better? Without writing their disorders might be more severe. Or maybe professional writing is, for some reason, a cause for mental illness? The third possibility is that the ability and desire to write arises from the same source as mental illnesses.

It has been suggested that mental disorders, such as major depressive disorder (MDD) and bipolar disorder, may give a sufficient ground to further develop ideas and therefore increase the creative actions of an individual. This could perhaps happen through a so-called incubation period a depressive phase may create (Holm-Hadulla 2013, 266–274; Simone & Dijksterhuis 2014, 1–34). Also, different social and individual experiences related to mental disorders may broaden the understanding of life and the human existence of an individual by raising questions and attempts to solve the problems in a novel way. Then again, social environment may even enhance and reward the signs of connection between creative, especially artistic, traits and mental disorders by setting social norms that expect unconventional behavior from those with high creative properties. Interestingly enough, especially with respect to writing, it has been suggested that instead of the

active phases of an affective disorder, the actual source of most active creative and artistic periods are the euthymic phases caused by proper medication (Andreasen & Glick 1988, 207–217). This suggests that the periods of mental disorder could act as brain storming periods, while the true creative potential is used during the phases when mental disorders do not drastically affect the normal, every-day life of an individual.

From a general perspective, mental disorders tend to have a deteriorating effect on an individual's life, even shortening their estimated life expectancy. It has been suggested that hypomanic and depressive episodes might also deteriorate the quality of creative work. The benefits of psychological instability have also been questioned. Yet for a person to be creative, they need to have a pronounced trait of openness of personality. Openness to new experiences is often connected with simultaneous psychological vulnerability. Psychological risk factors, such as psychic vulnerability, can predispose an individual for developing mental disorders, such as depression or a psychotic disorder, later in life. Recent neuroscientific research has revealed some perplexing observations concerning possible common neural processes behind creativity and mental disorders. We will discuss those observations in more detail in the following sections.

## BIPOLAR DISORDER AND CREATIVITY

Especially mood disorders have been observed in connection with creative traits. In a study concerning writers at the Iowa University the researchers found that writers, as well as their first-degree relatives, were at greater risk of suffering from mood disorders than the members of the control group. The prevalence of mood disorders among writers was 80%, whereas in the control groups it was merely 30%. Furthermore, Andreasen found that also the first-degree relatives of writers had a pronounced prevalence for affective disorders in comparison to the members of the control group, and that the relatives of writers were more likely to be successful in some other field requiring creative cognitive skills, such as in arts or science (Andreasen 1987, 1288–1292). Kyaga has also observed connections between writing as a profession and bipolar disorder, as well as in being an author and having mental disorders, most typically affective disorders. In line with the previously mentioned study, Kyaga found a pronounced prevalence of different affective disorders among the relatives of writers (Kyaga et al. 2012, 83–90). The notions propose a connection between affective disorders and creative writing skills. It has also been suggested that there could be a common form of creativity expressing itself through various media or subtypes. Could creativity in both sciences and arts have a common origin, or do the different creative tasks demand different functional alterations in ways of creative cognition? (Andreasen & Ramchandran 2012, 49–54).

Language is commonly associated with left hemisphere functional activity, whereas abstract and practical thoughts



are associated with right hemisphere activity. It has been suggested that individuals suffering from bipolar disorder might have an atypical localization for language and praxis in the brain. Right hemisphere lateralization has been suggested to occur as a natural variant for language processing (Knecht & al. 2003, 917–927). Differences have been observed concerning the anatomical structure, such as white matter integrity, and functionality of the brain, e.g., the connectivity of subgenual cingulate and amygdalo-hippocampal complex, in the brain of patients suffering from bipolar disorder. Left-sided lateralization was also observed in this study (Houenou & al. 2007, 1001–1010). The probable differences in lateralization and the functional properties of the brain of the individuals with certain types of bipolar disorder and schizophrenia may have benefited the individuals by facilitating some more developed cognitive abilities, such as creativity or artistic traits and even the writing itself. Therefore it has been suggested that these otherwise detrimental changes might have produced a selection favor (Berrittini 2006, 235–247; Nettle & Clegg 2006, 611–615), which doubles as a hypothesis for the fairly constant rates at which mental disorders tend to occur worldwide. In addition to the findings on bilateral activity during tasks that demand creativity, it has been reported that artists who have suffered an otherwise debilitating brain damage have continued their artistic work afterwards. This suggests that creative abilities aren't fixed to certain brain areas, but might form a network-like functional pattern that activates during creative tasks (Zaidel 2005, 177–183).

Damage to central nervous system (CNS), capable of

producing anatomical changes in the brain, has been observed to be sometimes related to increased artistic traits. In relation to that, serious cognitive disabilities, such as neurological disorders, have been perceived to affect artistic traits later than other cognitive abilities demanding higher cognitive functions (Miller & al. 1996, 1744–5; Drago et al. 2006, 3011–3015; Cummings et al. 2008, 1–20). According to the aforementioned studies, anatomical and functional differences, whether caused by a natural variety or a disease affecting CNS, can be occasionally observed together with distinct creative abilities.

## PSYCHOTIC DISORDERS AND CREATIVITY

Psychotic range of mental disorders, mainly schizophrenia, have been associated with unusually active and atypical formation of connections within the so-called default network, a network of brain areas that activates during rest (Whitfiel-Gabrieli et al. 2009, 1279–84). Default network activity has been observed to be most prominent during resting states and reduce during target-oriented cognitive functions. It has been located in brain regions such as the medial prefrontal cortex (MPFC) and posterior cingulate cortex/precuneus. The reason why default network activity is in focus in this article rises from the hypothetical connection between creativity and mental disorders. Creativity has been suggested to be connected with the so-called incubation periods or periods of diminished creative action, e.g., idle or depressive phases, during which thoughts, though not actively processed, are observed, selected and

further developed for the active creative phases. Also, creativity is characterized by the recurrence of unconscious thoughts and other unconscious cognitive processes which are often described by the creative persons themselves as the very sources of their creative potential (Andreasen & Ramchandran 2012, 49–54). It has been suggested that a heightened resting state activity might be present during those aforementioned periods of diminished creative activity, and therefore, by enabling the unconscious processes, connected with an overall higher rate of creative thought production.

It has been suggested that of writers suspected of suffering from some form of a mental disorder within the psychotic range, such as Franz Kafka, may possibly have had alternating default network activity. Take for example the case of Franz Kafka: his letters reveal that he used sleep deprivation, solitude, and darkness as means in an attempt to obtain a state suitable for creative writing. This kind of a state is closely related to dissociative experiences. Hallucinative experiences feature prominently in Kafka's text (Mishara 2010, 1–37). Mishara suggests that the neuroscientific explanation for these experiences might lay in the activation of the social networks of the brain. Social networks are defined as neural networks which function in social cognition. They have been suggested to create imaginative fictional social realities to compensate the loss of signals for the CNS from the real life events. These networks might be related to the excessive functionality of the default network.

Cortical activity plays an important role in processes creating alternate states of consciousness, as well as in

processes demanding higher abstract cognitive skills, such as imagination and creative thinking. Hyperexcitability of cortical regions might lead to hallucinatory symptoms. In the CNS, a system of inhibitory neurotransmitters regulates the overall activity of the CNS with gamma-aminobutyric acid (GABA) being the leading inhibitory neurotransmitter. Postmortem studies have shown that patients suffering from schizophrenia have suffered from diminished GABA neurotransmission. Diminished neurotransmission of inhibitory signals might lead to cortical hyperexcitability, and since hallucinations are connected with cortical activity, it has been suggested that GABA could also be one of the possible agents causing hallucinatory symptoms. Furthermore, it has been observed that light deprivation reduces the amount of GABA, suggesting a neurobiochemical background for Kafka's method of seeking solitude and darkness in order to achieve a creative state of mind (Mishara 2010, 1–37).

Schizophrenia and psychotic states are also characterized with changes in dopamine, NMDA (N-methyl-D-aspartic acid), and AMPA ( $\alpha$ -amino-3-hydroxy-5-methyl-4-isoxazolepropionic acid) glutamate activities, e.g., receptor function.. Schizophrenia and other psychotic symptoms have been associated with alterations of dopamine levels in the CNS. Sleep deprivation has also been proposed to affect these pathways, suggesting a connection between sleep disturbances and the related short-term psychotic experiences (Mishara 2010, 1–37). Activation of the default network has been found to be connected with the simultaneous activation of noradrenergic transmitter system and the locus caeruleus. The activation of the noradrenergic transmitter

system leads to increased dopamine levels, a feature which has been observed to be connected with schizophrenia. Anatomically, these changes have been observed to occur in areas of the hippocampus and parahippocampal cortex, both of which also have a crucial role in memory assignments (Buckner 2013, 351–358).

## IMAGING THE CREATIVE PROCESS

Electroencephalogram (EEG) was one of the first technical applications to be used in the research on creativity and brain functions. It measures the electric activity of the CNS, presenting as graphic waves. Alterations in alpha wave activity and lateralization have been the most prominent findings in EEG studies concerning creativity (Abraham 2013, 1–9). By means of more sophisticated imaging methods, such as functional magnetic resonance imaging (fMRI), diffusion tensor imaging (DTI), and positron emission tomography (PET), both the anatomical features and the functional differences in central nervous system activity have been more easy for the scientists to reach.

Before fMRI, time posed a problem concerning the imaging of mental processes, since the processes measuring creativity are usually time-dependent and impossible to detect with techniques that only gather spatial information. With fMRI and PET, physical activities such as writing can be studied more closely (Richards et al. 2009, 967–83). Yet, questions have been elicited that need to be answered concerning the neurobiological measuring of a creative task, e.g., the duration of imaging, the varying amount of data,

and the definition of a creative task as well as the creative process, which are also hard to detect. The functionality and quality of experimental designs have been stressed as important subjects to be focused on in the future. It has also been noted that attention must be paid to the fact that the creative properties of an individual can vary over time in both degree and quality. (Abraham 2013, 1–9.) Furthermore, the interpretation of data and results also pose a challenge concerning whether or not the observed changes are directly connected with the phenomenon the research is interested in, or may there occur factors that affect the results via some indirect pathways.

Furthermore, measuring creativity as a process can also be considered as a primarily social and cultural process, apart from the biological and neuroscientific approach presented in this article. The idea that creativity is the property of an individual, and that it can be measured through highly individualistic measurements focusing on certain observable, anatomical changes has been discussed in the context of whether creativity can be observed by means of traditional “hard sciences” such as biology and medicine. Creativity can also be considered to be a social process, where the relationships and co-operation between different individuals can be seen as conditions for the occurrence of creative activity. Perhaps the studies on creativity that utilize measuring tools offered by hard sciences, will find their place within the larger continuum of research concerning creativity, not just by striving to explain the phenomenon from a natural scientific point of view, but by providing a different perspective on the subject. After all, quantitative knowledge is only one part in the process of

establishing deeper knowledge on any given subject.

With writing as the focus, evidence has been found of the crucial part of the left inferior parietal cortex and the angular gyrus (AG) in word comprehension, both spoken and written (Geschwind 1965, 237–294, Mesulam 1998, 1013–1052). Writing and written word processing have been studied using PET scanning. As a result, increased activity in the frontal and temporal areas of the left hemisphere, as well as in the angular gyrus, were observed. Parietal cortex has also been observed to activate during the processes that involve writing (Brownsett & Wise 2010, 517–23; Rapp & Lipka 2011, 1180–97). In addition to left-sided lateralization, activation of left pre-and middle central gyri as well as left middle temporal gyrus and left anterior cingula have been noted, the two latter being connected also to the "theory of mind", that relates feelings and capability of social consciousness to certain patterns in CNS functioning (Ciaramelli et al. 2013, 1–54).

Contrary to the aforementioned studies that have observed changes in the left hemisphere with writing and written word processing, bilateral cortex activation has also been noted in a word-association test conducted with individuals with presumably high creative potential. Activation occurred also in visual cortices and other areas responsible for motor functions, suggesting broader network activation during creative word-association tasks. No difference was noted among the activation of different brain areas during the task when comparing the group of artists to the group of scientists, although their professions require different styles of creative expression. This suggests a similar way of origin for creative cognitive processes (Andreasen & Ram-

chandran 2012, 49–54). The aforementioned observations suggest that activity of the central nervous system during creative processes might arise from various areas of the brain and involve bilateral activation of the hemispheres. This would mean that creativity is not confined to simply just the left hemisphere commonly associated with linguistic phenomena, or the right hemisphere, connected with creative activity, as was already mentioned in the earlier paragraphs of this article.

Attention has been also paid to certain parts of ventral stream in the learning and development of language. Occipital areas, which process mainly visual information, have been observed to be connected with brain areas responsible for phonologic and linguistic abilities (Duffau 2008, 927–34; Sakai 2005, 815–19). This further supports the hypothesis that creative tasks activate more than one area in the brain, resulting in a network of activation in different CNS structures.

## CONCLUSION

As a conclusion it seems that some evidence has been found to support the presumed connection between creative writing and affective disorders. Also, in creative tasks the activity of the CNS is not solely linked to certain brain areas, but might form a network of brain regions associated with each other. Creativity has been seen as a means for an individual to cope with psychic stress. It seems that writing and creativity may share similar neuroanatomical pathways with the theory of mind, thus linking creative writing with



complex emotional processes and thereby possibly giving a neuroanatomical ground for the observations that creative writing can help solve problems related to emotional traumas. What remains to be answered in the future is how precisely the CNS functions during creative cognitive tasks, and are the presumable changes likewise in different processes demanding for different creative abilities. Also, if the hypothesized connection between mental disorders and creative writing is affirmed in the future, it can offer an explanation for the reason why creative writing has remained an enthralling and appealing activity throughout human history. It can also offer new ways for therapy concerning mental disorders.

We are just beginning to understand the varied processes behind creativity. Although questions arise, answers can be found through different research methods. More research is needed to reveal the complex neurobiology behind creative actions.

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