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Review Article

The Shamanistic Theory of Schizophrenia: The Evidence for Schizophrenia as a Vestigial Phenotypic Behavior Originating in Paleolithic Shamanism

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Abstract

Ever since the first detailed descriptions of shamans by pioneering anthropologists of the 19th century, researchers have pondered the similarities between shamanism and schizophrenia. Where some theorists have seen compelling parallels, others have dismissed such similarities as coincidence. This review draws upon the latest knowledge in medical genetics, evolutionary science, religious studies, psychology, anthropology and medical history, in order to catalogue all of the possible links between the institution of shamanism and the medical condition of schizophrenia. Major discrepancies between the two phenomena are also examined. It is concluded that schizophrenia could have possibly originated in Upper Paleolithic shamanism - a constitutional behavioral trait that may have once been adaptive for modern hominids.

Keywords: Schizophrenia; Shaman; Evolution; Religion; Psychosis; Divination

Introduction

In its simplest form, the shamanistic theory of schizophrenia proposes that the core features of schizophrenia are akin to the primary qualities of shamanism; and that psychosis provided certain evolutionary advantages to prehistoric hominid tribes. The idea that shamanism could be comparable to medical forms of insanity can be traced back to early academic expeditions assigned to explore the Siberian wilderness during the late 18th century [1]. There has since been an ongoing and unresolved debate between anthropologists, psychiatrists and other scientific experts as to the merits of the association. This review does not venerate shamanism or spirituality but simply reviews the possible phylogenetic history of psychosis, beginning with upper paleolithic shamanism, and ending with the emerging concept of schizophrenia during humankind's transformation to post-Rennaisaince secular societies. Moreover, this research agenda does not offer any obvious insights about the medical treatment of psychosis, which is usually needed due to the pronounced suffering so often associated with the condition [2-4].

Defining Shamanism

The term shaman is derived from a word meaning "to know in an ecstatic manner" in the language of the Evenki, an indigenous people of southern Siberia [5]. What these Siberian shamans knew was the landscape of the ethereal spirit world. Their functions were akin to spiritual practitioners from other traditional societies throughout the globe and referenced under such terms as medicine man, diviner, sorcerer, magician, juggler, witch doctor, exorcist or medium. Perhaps the most descriptively accurate term for a traditional spiritual leader is magico-religious practitioner, however, this expression is not as popular as shaman. The most unique attribute related to shamans is the perceived ability to possess spiritual powers allowing one to communicate with a world beyond the observable realm, often through trance-like states [6]. As a consequence of this special insight, shamans were expected to heal the sick or preside over rites of passage such as birth, coming of age, marriage and death. They typically led tribal rituals involving a community's procurement of food, such as rain dances or divining the movement of prey, as well as conducting ceremonies in anticipation of war. One interesting point about shamanism is that, just like mental illness, it was often perceived as something that overcame an individual. In South Africa, for example, the Thonga people divided medicine men into two groups, "ordinary" and a special group who suffered possession by the spirit bubabyi bya psikwembu, which literally means "the madness of the gods"

[7]. The idea that a young person, male or female, hearing voices or acting erratically must answer the call to become a shaman has been repeatedly described by pioneering anthropologists visiting traditional societies throughout the world.

Psychotic-Like Symptoms Have Been Repeatedly Described in Shamans

A recurrent pattern observed throughout the anthropological literature is that young adults were inevitably directed towards the social role of shaman (i.e., magico-religious practitioner) whenever they experienced auditory hallucinations, feelings of possession or irrational suspiciousness. Some of the earliest accounts of psychotic-like behaviors in shamans were detailed in the early 20th century by the anthropologist Vladimer Bogaraz who studied the traditional cultures of northern Russian peoples, such as the Chukchee, Yakuts and Evenki [8]. One of the first psychiatrists with anthropological skills was George Devereux who studied the Mohave people around the 1930s [9]. He was convinced that most shamans were "mentally deranged", and many were outright psychotic. Another psychiatrist, B.J. F. Laubscher, who practiced in rural South Africa during the early 20th century, was convinced that most of the South African tribal witch doctors were "psychotic persons in remissive phases" [10]. There are dozens more examples of psychotic-like behaviors ascribed to shamans in the anthropological literature [11], which are beyond the scope of such a review.

In a 1967 paper entitled "Shamans and Acute Schizophrenia" [12], the psychiatrist Julian Silverman highlighted several parallels between shamanism and schizophrenia. He conjectured that the main difference between the two phenomena was that in "primitive" cultures, psychosis is respected as a form of "expanded consciousness" while Western cultures denigrate such experiences, and consequently intensify the natural anxieties associated with psychotic experiences. In 2002, my colleague Jeff Reiss and I examined whether such ideas could withstand the scrutiny of basic evolutionary theory, as well as the newest medical discoveries around schizophrenia [13]. Two years earlier, the pioneering evolutionary psychiatrists John Price and Anthony Stevens wrote an extensive treatise drawing parallels between prophets and schizotypal personalities [14]. Price and Stevens, however, later refined their formulation, acknowledging that historical prophets were likely a form of magico-religious practitioner [15]. A new crop of neuroscience researchers, perhaps more familiar with dimensional approaches to diagnosis, have argued that subclinical forms of schizophrenia (e.g., Schizotypal Personality Disorder) are better candidates for shamanism [16-19]. Such fine discrimination, however, may not be essential when one considers that psychosis in traditional societies appears to be less debilitating [19-21], while also acknowledging the most psychotic individuals (i.e., phenotypic extremes) would not necessarily have become shamans [22].

The Disparate Social Space Occupied by an Occupation (Shamanism) Versus a Medical Affliction (Schizophrenia):

Many shamans have had a negligible propensity towards psychosis, which requires explanation. It must be understood that shamanism is a social role (i.e., occupation) while schizophrenia is defined by a constellation of mostly involuntary motor behaviors and sensory experiences. Therefore, the two phenomena are not exactly equal. This situation is akin to comparing very tall individuals and basketball players. In one case, the individual is being defined by an easily definable trait (height) while the latter is a social role particularly fitting for tall persons. One fascinating feature of shamanism, with potentially monumental implications, is its universality despite the belief that cultural diffusion cannot adequately explain its widespread existence throughout every traditional society ever surveyed [23]. Such observations implicate a constitutional predisposition towards the social role of shamanism. Accordingly, the cultural institution of shamanism is akin to other identifiable cultural practices such as culinary traditions, sexual habits, and war rituals. The universality of such social practices is seemingly maintained by innate behavioral tendencies: hunger for culinary traditions, erotic feelings for sexual practices, and tribalism and aggression for war rituals. Without the constant presence of certain innate behavioral tendencies, each cultural practice would eventually fade and disappear. Therefore, it can be argued that the social role of shaman requires psychosis to be only episodically introduced into paleolithic tribes, and not necessarily to be present in every shaman.

Towards a Definition of Spirituality and Religion

There is no academic consensus on the definition of religion. In fact, textbooks on the psychology of religion have often sidestepped a distillation of the concept [24]. Nonetheless, one reasonable definition is that religion is "a system of beliefs in a divine or superhuman power, and practices of worship or other rituals directed toward such a power" [25]. The terms "divine and superhuman power" may, however, be better represented by the term "supernatural agent" [26]. Spirituality typically connotes an individual's intimate relationship to supernatural ideas while religion usually refers to any accompanying formalized systems.

Religion as a Form of Communication

To fully appreciate the role of shamans in religious practices, it may be useful to recognize that religion can be framed as a form of human communication [27,28]. Hominids communicate in a myriad of ways (e.g., language, facial expression, music, humor); and each form of communication is better suited to transmit different aspects of social information. Moreover, communication is

sometimes asymmetrical in the animal kingdom, (e.g., alarm calls, mating songs, courtship displays, musicians, comics) - meaning that some conspecifics constitutionally signal more often while others spend more time being the recipients of certain signals. Accordingly, shamans can be viewed as the propagators of religious discourse while the rest of the tribe receives the signal; and such a religious exchange may ultimately be evolutionarily adaptive.

The Potential Evolutionary Adaptiveness of Religion

Several books have been dedicated to demonstrating the potential evolutionary advantages of religiosity [29-35]. The eminent evolutionary psychiatrist John Price summated the evolutionary adaptations associated with religion as threefold:

a) Religion enforces altruistic behavior (i.e., Morality),

b) Magico-religious ideas often lead to divination practices, and

c) Spirituality enhances morale, which especially promotes success in warfare [11].

Morality is a notoriously vague term that is perhaps better represented by the evolutionary concept of altruism. Therefore, from an evolutionary perspective, morality can be framed as an ad hoc collection of pro-social attitudes used to reinforce altruistic behaviors. Both polytheistic and monotheistic religions include mechanisms that reinforce social contracts and formalize expectations of altruism (i.e., morality) - sometimes through formal rituals. For example, many hunting and gathering societies believe in ghosts or spirits that impose deific retribution for social infractions [36]. Moreover, such incorporeal spirits supposedly have the ability to continuously monitor any individual in a tribe. In other words, a moral adjudicating entity could be watching your every action. Divining practices, in their various forms (e.g., water witching, throwing stones or scapulimancy) are nearly universal in hunting and gathering societies [37-39]. Shamans are typically urged to divine when tribes are faced with bewildering problems, such as where to find game when there are no hints, or whether a neighboring tribe will attack. The prophesied results are unwittingly derived by chance but supported by supernatural authority. Divination allows an entire tribe to back an arbitrary decision (since it is often better to roll the dice and do something than not do anything at all). In the case of water witching, for example, divination provides the tribe with a rallying point so that everyone digs for water, together, at the same location [40].

In an explicitly titled article, "The Capacity for Religious Experience is an Evolutionary Adaptation to Warfare", Allen D. MacNeill straightforwardly connects the evolutionary purpose of religion to warfare [41]. MacNeill makes a cogent argument that religion has adaptive qualities in traditional societies. He makes the following proposal: "By making possible the belief that a supernatural entity knows the outcome of all actions and can influence such outcomes, that one's 'self' (i.e., 'soul') is not tied to one's physical body, and that if one is killed in battle, one's essential self (i.e., soul) will go to a better 'place' (e.g., heaven, Valhalla, etc.) the capacity for religious experience can tip the balance toward participation in warfare." Surveys of ancient burial sites indicate as many as 20-30% of prehistoric deaths resulted from war-related trauma, suggesting tremendous evolutionary pressures to adapt to the exigencies of intertribal conflict [42- 44]. Anthropological accounts have repeatedly shown that shamans tend to be fixated with the intangible threat of neighboring tribes [11], and persecutory delusions commonly associated with schizophrenia may be a vestigial remnant of such adaptive paleolithic cognitive processes. One problem in the evolutionary study of behaviors is that there is often a failure to separate incidental actions from evolutionary effective activities. For example, not every manifestation of anger is evolutionarily advantageous, but, on average, the sum of all angry expressions provides phenotypic advantage. Similarly, not every shamanistic endeavor would have necessarily been evolutionarily advantageous. It is also possible that the more sporadic shamanistic activities may have been more evolutionarily impactful (i.e., divining, out-group suspiciousness) compared with some of the more conspicuous shamanistic practices (spiritual healing, weather prophesies), which may simply have been incidental behaviors tolerated by evolutionary processes.

The Cognitive Structure of Religion (and Its Similarity to Psychosis)

In the acclaimed book Religion Explained, Pascal Boyer proposed that religious ideas possess a specific cognitive structure [26]. Boyer's theory begins with the proposition that hominids organize the world through five fundamental ontological categories: person, plant, animal, natural object and man-made object. For an idea to be considered religious, it must always contain at least one feature that specifically contradicts (or violates) a defining characteristic of the respective ontological category. For example, a ghost may have the form of a person, but lacks physical matter, which is an essential quality of the corresponding ontological category (i.e., persons). Another example are curses, which can be viewed as "action at a distance", which is typically considered an impossibility for persons but normal for certain natural objects, such as gravity, wind, and the tides. The mythology of traditional societies is filled with countless examples of such magico-religious fodder, such as animals that talk, stones that alter luck, volcanoes that eat people and witches that supposedly leave their bodies [11]. Humankind may therefore possess a subtle constitutional predisposition to superstitiously believe in intangible supernatural agents existing inside other-worldly systems, and the markers unique to this world may be cognitively differentiated by Boyer's violated ontological categories.

Although the DSM-V criteria for schizophrenia have eschewed terms such as bizarre delusions or Scneiderian symptoms due to their supposed lack of diagnostic specificity, such concepts have

nevertheless possessed some descriptive utility. It is interesting how classic Schneiderian first-rank symptoms fit so nicely into Boyer's concept of a religious idea. In the 1930s, Kurt Schneider proposed the following first-rank symptoms to distinguish schizophrenic psychosis from other types of insanity: audible thoughts, voices arguing, voices commenting on one's actions, the belief that bodily organs drive behavior, thought withdrawal or insertion enigmatically controlled by some external force, and thought broadcasting [45]. Auditory hallucinations, for example, can be viewed as a religious concept by the implication that hallucinations infer a disembodied person (the lack of physical matter is a violation of an essential quality of being a person) or perhaps hallucinations can be framed as a magical action-at-a-distance phenomenon. It should be highlighted that mere strangeness does not result in a religious idea. A peculiar or randomly put-together idea (e.g., a green man hanging two fish from his ears, or a forty-pound mosquito flying upside-down) will not, in theory, generate a spiritual feeling unless it takes on Boyer's specific cognitive form.

Is religion observed in the psychosis of schizophrenia?

When examining the frequency of religious delusions in schizophrenia, studies have typically shown that about 60% of delusions and hallucinations contain outright religious themes [46-49]. However, if one broadens the conventional definition of religiosity and tallies magico-religious themes, the frequency turns out to be much higher. Our research team, for example, provided the raw data from discussions with 26 individuals with schizophrenia and found that all but one possessed plausible magico-religious themes inside their delusions and hallucinations [11].

This formulation may also explain why

a) Paranormal phenomena,

b) Possession states,

c) Hallucinogenic experiences and

d) Cults have been generally perceived as being either on the fringe of psychosis or religious experience.

Paranormal phenomena represent a hodgepodge of experiences supposedly outside the domain of scientific understanding. Some examples of paranormal phenomena are extrasensory perception (ESP), telepathy, clairvoyance, astral projection, out-of-body experiences, telekinesis, reincarnation, reincarnation, ghosts, witchcraft, UFOs and belief in cryptids (e.g., Bigfoot, Loch Ness Monster). Most of these examples fulfill Boyer's definition of a religious concept. Some studies have noted schizotypal tendencies among persons with dedicated paranormal beliefs [50-52]. It has also been theorized that deriving meaning in unrelated items is a cognitive trait shared by paranormal believers, psychotic individuals and creative people [53]. The idea that demonic spirits or other spiritual entities can possess a person's soul has a very long history, having been observed in most ancient societies throughout the world, including numerous accounts from traditional societies [54]. Through a modern lens, most historical accounts of possession states would probably have been attributed to either hysterical reactions or psychosis.

Hallucinogens have been used by most traditional societies throughout the world. There is a great multitude of hallucinogenic substances in nature such as mushrooms containing Amanita muscaria (Chukchee tribes), mushrooms containing psilocybin (southern Mexico), ayahuasca (Amazonian tribes), peyote (Mexico and the southwest U.S.), to name a few. In traditional societies, substance-induced hallucinations were generally interpreted as spirit visitations, which allowed for religious prognostication. Shamans were the primary users although ordinary adult males sometimes participated.

New religious movements (cults) are constantly being born. The anthropologist and pioneering expert in aboriginal religions Weston La Barre once wrote, "Every religion, in historical fact, began in one man's "revelation" his dream or fugue or ecstatic trance" [55] and such revelations almost always resemble psychosis. It is not heretical to suggest that during the height of their revelatory experiences both Jesus and Mohammad would have probably been anachronistically admitted to a modern-day psychiatry facility (accordingly, both Christianity and Islam were considered to be upstart cults by the prevailing authorities of their time). Where there are reasonable written records, we typically find evidence of mild psychosis in the life history of almost every founder of new religion: George Fox (Quakers), Mother Ann Lee (Shakers), Ellen White (Seventh-day Adventists) Mary Baker Eddy (Christian Science), Joseph Smith (Mormons), L. Ron Hubbard (Scientology). There are numerous other smaller cults such as Heaven's Gate, the "UFO Cult", Order of the Solar Temple whose leaders appeared to have demonstrated frank psychosis. Other famous figures who led cult-like movements like Joan of Arc, Louis Riel, and Pythagoras also appear to have struggled with psychotic experiences. It has even been suggested that Adolph Hitler had schizotypal personality traits, which would explain the cult-like characteristics of the Nazi regime [14].

Even modern pop music has elements akin to shamanism through its stream-of-consciousness lyrical style, which seems to mimic psychotic ramblings and arguably results in enhancing the spiritual grandeur of songs. Bob Dylan, with such lines as, "The dead will arise and burst out of your clothes", was one of the earliest adopters of this literary style. The Beatles were especially prolific at intuitively violating Boyer's ontological categories with such lyrics as, "Images of broken light which dance before me like a million eyes" (Across the Universe) or "I am he, as you are he, and you are me, and we are all together" (I am the Walrus). The Beatle song "Hey Jude" was originally given the drab title "Hey Jules", which lacks transcendent impact-even to nonbelievers. This may because the emotional (i.e., aesthetic) ability to sense spirituality and its associated grandeur does not necessarily require explicit religious belief - similar to how one can feel anger yet recognize its potential irrationality.

Is schizophrenia under evolutionary constraints?

The field of evolutionary psychiatry came into existence a little over fifty years ago with the publication of a seminal paper by Julian Huxley, Ernst Mayr, Humphry Osmond and Abram Hoffer (Huxley et al. 1964). They reasoned that basic evolutionary principles applied to the concept of schizophrenia because the condition was a discrete biological phenomenon demonstrating intergenerational heredity. More simply, the authors questioned how schizophrenia, a condition with an appreciable heritable component, persists if those afflicted consistently have fewer progenies?

Now known as the schizophrenia paradox, the question implied that there could be a beneficial aspect to schizophrenia-otherwise, how would natural selection support it? Upon closer examination, the schizophrenia paradox contains a number of implicit suppositions although none that are obviously unreasonable:

a) Schizophrenia is heritable.

b) The incidence of schizophrenia has been relatively stable through history and its age is measured on evolutionary timescales (e.g., Thousands of years).

c) Schizophrenia is associated with reduced fecundity.

d) Schizophrenia is a categorical rather than a dimensional psychiatric diagnosis.

e) The incidence of schizophrenia exceeds its mutation rate, and

f) Individual selection is the only applicable evolutionary model (i.e., Multi-level selection had not been considered as a possible solution).

The schizophrenia paradox implies that one or more of these suppositions could be false. At the very least, it should give pause to unquestionably assume schizophrenia represents a disease state.

The heritability of schizophrenia has been estimated to be in the 40-80% range [56-59]. The concordance rate for schizophrenia in identical twins is about 50% but may be higher if one extends the diagnosis to subclinical states such as schizotypal personality disorder [60,61]. Hence, there appears to be a missing heritable component, probably explained by environmental or epigenetic factors [62,63]. The candidate genetic loci associated with schizophrenia are mostly common variants with only a very small percentage of rare variants or de novo mutations-a finding that disfavors sinister pathology [64,65]. A number of studies have suggested that schizophrenia-associated loci are a function of positive selection in the hominid lineage, although there is less agreement about possible timescales [66-69]. There are several lines of evidence suggesting that schizophrenia is a very old phenomenon, but tracing its ancient history has its hurdles. Jeste and others [70] put forward a list of possible explanations for the shortage of unequivocal cases of schizophrenia in the historical record, such as ambiguous ancient medical terms, the historical trend to underreport the lives of ordinary people, and the tendency to interpret aberrant behaviors as spiritual or magical doings. Nevertheless, there is a peppering of psychotic-like incidents scattered throughout the historical record. It has been argued that a convergence of four social factors created the "epidemic" of schizophrenia in the late 18th century:

a) Secularization,

b) Industrialization,

c) Greater government accountability and

d) Improved record keeping [71,11].

The presence of schizophrenia in indigenous Australians, a population that seems to have been genetically isolated for about 50,000 years [72], could perhaps provide a minimum age for schizophrenia [13].

Reduced fecundity, particularly in males with schizophrenia, is a reliable finding in Western societies and is undoubtedly due to fewer conjugal relationships [73,74]; however, this does not necessarily apply to traditional societies. Although schizophrenia is treated as a categorical diagnosis in the DSM-V, there may be extant dimensional properties through schizophrenia's affiliation with milder but genetically related cluster A personality disorders such as schizotypal, schizoid and paranoid personality disorders [75-78]. Even so, it is not known whether a dimensional framework to schizophrenia would solve the paradox. Last, there seems to be no compelling evidence to suggest that schizophrenia's mutation rate exceeds its incidence. Examining the six major suppositions of the schizophrenia paradox for possible errors leads to the possibility that multi-level selection could be a solution, and this option will be examined more closely in a later section.

Schizophrenia - disease or complex phenotype?

Differentiating disease from phenotype, especially for psychiatric disorders, is not straightforward [79-81]. For example, the sickle-cell anemia balanced polymorphism model (through heterozygote advantage) is one popular example of how a condition can possess both disease (i.e., anemia) and phenotypic qualities (i.e. protection from malaria) [82]. It is acknowledged that disease models of schizophrenia cannot be easily discounted; however, there are also reasons to caution against viewing schizophrenia as a simple brain defect. The last century has generated thousands of scientific papers demonstrating a number of compelling differences in schizophrenia, especially when population means are compared; however, no universal pathognomonic signal has been found. The conspicuous absence of disease markers has given schizophrenia the epithet "the graveyard of neuropathologists". Gliosis, a form of cellular damage, widely recognized as a marker of degenerative neuropathology, is notably absent.

Despite intensive histological research, only slight phenotypic variations have been identified in schizophrenia. For example,

there are a series of studies suggesting minor variations in the neuronal densities of astrocytes in certain cerebral regions [83,84]. Similarly, neuroimaging studies have implied altered network functions or perhaps atrophy of certain cerebral regions [85-87]. However, cerebral atrophy in schizophrenia may be aggravated by factors that are only incidentally associated with the condition such as poor nutrition [88,89], alcohol [90], lack of exercise [91], and antipsychotic medication [92,93]. Differences in neurocognition have also been widely reported in schizophrenia [94-96]. Some authors have cautioned that secondary factors such as poor motivation and anxiety may be the predominant explanation for such differences [97,98]; however, it cannot be easily discounted that certain tests tend to have greater effect sizes (i.e., executive function, attentional deficits, continuous performance, social acumen) compared to other conventional neurocognitive tests [99]. Nevertheless, effect sizes in cognitive performance are normally small; and typically, one-third of schizophrenia patients will outperform the median control performance [95].

Psychosis can sometimes be associated with delirium, dementia, epileptic syndromes, 22q11.2 deletion syndrome and birth complications, all of which are unequivocal pathological syndromes. On the surface, this would seem to imply that schizophrenia represents a disease process, however, there is certainly room for alternate explanations. Delusions in dementia, for example, are rarely as bizarre as those found in schizophrenia, but instead, tend to reflect suspiciousness or "misidentification" of familiar experiences [100]. Similarly, 22q11.2 deletion syndrome is associated with psychosis in about one-quarter of affected individuals, but Daniel Weinberger suggested: "there is reason to question whether the psychosis in these cases is a primary phenomenon based directly on the genetic variant or a secondary associated feature often observed in individuals with intellectual deficits" [65]. In sum, the case can be made that the term psychosis represents an overly general behavioral description, and that there may be several varied expressions dependent on specific etiologies. Psychotic symptoms are experienced by about 5% of epileptic patients [101]. Although frontal lobe seizures can produce psychosis [102,103], temporal lobe epilepsy appears to have a stronger association with psychosis [104,105]. Two points are worthy of consideration:

a) A seizure often represents an abnormal triggering of ordinary motor or sensory neural pathways and

b) Epileptic psychosis may have its own unique expression different from schizophrenic psychosis.

Interestingly, religious experiences are quite commonly associated with seizures, particularly with temporal lobe epilepsy [106], an association known since ancient times. Studying this matter directly, Brewerton reported on a sample of ten patients deemed to have psychotic symptoms secondary to complex partial seizure disorders and found that seven of the ten had religious delusions or hallucinations [107]. The presence of a spiritual experience during a seizure could implicate the existence of assigned neural circuits supporting religious ideation-an idea proffered by some neuroscientists studying the neurophysiology of religion [108]. In an intriguing article by Malur and others [109], the authors identified five case reports of delirium caused by medical illness in patients with schizophrenia or bipolar disorder coinciding with a reduction of psychotic symptoms. They argued that a number of historical treatments for psychosis (i.e., insulin coma treatment, electroconvulsive therapy) produced their therapeutic benefits through inducing delirium. In a similar vein, Bhugra and Potts reported two cases where protracted psychosis remitted after significant burn injuries [110]. The implication is that schizophrenic psychosis may require a certain minimal brain function.

Another noticeable problem with simple disease models of schizophrenia is that there are several lines of evidence suggesting specific positive phenotypic traits associated with either having psychosis or in relatives of individuals with primary psychotic disorders-a situation that seems conspicuously absent for other conventional medical diseases. Superior academic performance in relatives of individuals with primary psychotic disorders has been a consistent finding over the last few decades [111-115]. Another set of studies has shown that individuals with schizophrenia perform better in a few narrow - and arguably unusual - cognitive tasks, such as certain perceptual tests where individuals with schizophrenia appear to be less fooled by certain optical illusions or counter-intuitive syllogisms [116,117]. It has been argued that an inability to properly use contextual information allows such superior performance in these cases [118,119], although it does not appear that similar paradoxes have been found in other supposed deficit states like Intellectual Disorder or dementia. The association between creativity and psychotic disorders has been surmised since ancient times and supported by a variety of different experimental protocols [120-126]. Accordingly, there appears to be a long list of accomplished historical figures who have very likely struggled with psychotic symptoms at some juncture in their lives, such as Isaac Newton, Bobby Fischer, Socrates, John Nash, Michael Faraday, Ludwig van Beethoven and Vincent van Gogh.

Group Selection Could Explain the Existence of Low-Frequency Phenotypes (Polymorphisms)

The shamanistic formulation of schizophrenia suggests that only a subset of the population (i.e., shamans) possess certain adaptive behavioral traits, and this idea could perhaps be in conflict with basic evolutionary principles of individual selection. In other words, a genotypic trait must be either adaptive, disadvantageous or neutral and accordingly, a conspicuous phenotypic trait should either fully populate a species or become extinct (absolute neutrality is unlikely for a dramatically deviant phenotype). The science of genotypic and phenotypic variation is indeed complex, but it does allow for the existence of low-frequency phenotypes (polymorphisms) through such evolutionary mechanisms as negative frequency-dependent selection, heterozygote advantage and perhaps antagonistic pleiotropy and each of these mechanisms

could theoretically explain the epidemiology of schizophrenia [127]. The existence of disadvantageous phenotypic traits that simultaneously appear to serve group functions can be framed as altruistic behavior. Altruism is conspicuously present in animals that compete as groups such eusocial insects, naked mole rats, wolfpacks and primates, and accordingly, such individually disadvantageous behavior could be maintained by the evolutionary mechanism of group selection (i.e., multi-level selection). Altruistic behaviors include sharing, honest communication, mobbing, organized warfare, and task specialization. In hominids, shamanism could hypothetically reflect a form of task specialization where the personal disadvantages of episodic psychosis are perfectly countervailed by the group advantage of maintaining religiosity in the tribe.

Conclusion

The other well-known psychiatric condition most similar to schizophrenia is bipolar disorder. It appears that the frequency and intensity of delusions (including religious delusions) is slightly lessened in bipolar disorder, almost as if adding emotional affect to the equation is somehow protective. I have previously speculated that unidimensional models of psychosis [128] could have greater merit than previously supposed because assortative mating may be distorting the characteristics of psychosis. In other words, the fuzzy distinction between schizophrenia and bipolar disorder could have been caused by centuries of assortative mating along certain personality lines, which may be less obvious in non-psychotic individuals who are better able to conform to social norms. Several studies have shown that individuals tend to marry along certain diagnostic lines, with bipolar disorder and schizophrenia showing greater assortative mating compared to other psychiatric diagnoses [129-135].

There are only a handful of studies examining assortative mating by personality in the general population, without any consistent or definitive results, however, it is conceivable that high versus low affect assortative mating in the general population could perhaps interact with psychosis in complex ways, which may explain how unidimensional models of psychosis and Kraepelin's dichotomy both have merit.

Where schizophrenia is common, magico-religious healers are not; and where shamans practice, unusual experiences become spiritual. Comparative studies in such disparate fields as medical history, anthropology, genetics, evolutionary science, religious studies and psychology all seem to show varying degrees of likeness between ancient shamanism and modern psychosis. The manifold semblances between shamanism and schizophrenia could perhaps be due to a shared phylogenetic history.

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