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Can the concept of discords help us find the causes of mental diseases?

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SUMMARY

The high prevalence of mental disorders has become a primary concern for health authorities. This paper asks whether the concept of discords, as based on an evolutionary perspective to medicine, can play a role in the discovery of possible environmental factors contributing to mental problems. Briefly, the term mismatches has been used to describe the differences between the environment humans are genetically adapted to and the present living conditions. Although, most mismatches may be beneficial, some have a potential negative impact on human health. The latter can be referred to as discords. The brain appears to be more susceptible to discords than other organs, and certain modules of the brain are particularly vulnerable, including the fear response and circuits involved in generating mood. Discords affecting these modules may contribute considerably to the pervasiveness of mental problems. If so, concomitant changes in the environment, including changes in present cultural practices, should improve mental health. However, the relevant discords may not be discovered without utilizing the suggested evolutionary perspective.

Introduction

There has been a growing interest in applying the evolutionary perspective to problems of health in general [1], mental health in particular [2,3], as well as to the question of well-being or quality of life [4]. In this perspective, occasionally referred to as "Darwinian medicine", a variety of medical problems are related to an environment at odds with the inherent characteristics of our species. Although, all aspects of health may gain from this type of evolutionary analysis, many of the more novel, and applicable, ideas concern mental health.

The concept of environment of evolutionary adaptation (EEA), as the environment we are genetically adapted to, plays a central role in Darwinian medicine [5]. The differences between the human EEA and present ways of living are referred to as mismatches. As far as health is concerned, mismatches can be highly beneficial (such as the use of antibiotics), somewhat beneficial while at the same time having a negative impact, or all detrimental. The word *discord* will here be used for mismatches that can be deleterious to human health; i.e., a discord imposes a measure of stress or strain on the individual caused by a suboptimal environment. Gross deprivations, such as not offering infants proper parenting, cause increased susceptibility to psychological problems, and are thus obvious discords in the present terminology. However, a range of more obscure discords, in the form of more subtle environmental factors, have been suggested to impact on mental health [3,6].

The brain may be particularly vulnerable to discords, as suggested by the following arguments: It is a highly complex organ, it requires substantial development after birth, and it is moulded to a large extent by interactions with the environment. Thus, the presence of discords may help explain the high prevalence of mental suffering in modern societies. Consequently, defining discords impacting on the brain may be particularly relevant for the purpose of improving mental health.

The present text is an attempt to examine the current framework for this evolutionary perspective. The main purpose of such a framework is to discover possible causes of mental disorders that would otherwise remain unrecognized. The question of particularly vulnerable brain functions will be discussed, and examples of possible discords suggested.

The concept of discord

In order to identify possible discords, we need to make some assumptions regarding the nature of the human EEA. The general idea is to look at the Palaeolithic way of life during the period starting with the emergence of modern humans, some 200,000 years ago, and ending with the increase in population density and invention of agriculture 10,000 years ago.

Besides the obvious problem that we only have indirect evidence as to how people lived in the Palaeolithic, there are at least two important obstacles concerning the concept of EEA: one, human genes were not shaped in a particular environment, but rather

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over millions of years of interaction with variable conditions. Thus, our emotions and propensities did not suddenly appear 200,000 years ago, but gradually developed in the brains of our animal ancestors, starting more than a 100 million years ago. As subsequent adaptation was constrained by the general rules of evolution, it follows that our mental constitution is not necessarily designed for any particular setting. Two, discord situations troubled our Palaeolithic ancestors as well, for instance when a natural catastrophe ruined the local environment, or when a child was orphaned. Thus discord conditions should be defined in terms of deviations from ideal conditions, rather than as a dislocation from a particular habitat.

Even in the light of the above constraints, it seems to be a practical approximation to assume the existence of an optimal EEA; and when it comes to identifying features that act as discords, a closer look at possible mismatches, using presumed life in the Palaeolithic as a reference, should offer meaningful clues.

The interactive process of development

Two examples of putative discords, concerning functions outside the brain, serve to illustrate the problems of identifying the pitfalls of modern living.

The increased incidence of myopia observed in industrialised societies [7] may be due to environmental factors. Both the tendency of infants to spend long periods focusing at a fixed, close range [8], and the exposure to light during night-time early in life (keeping the lights on in the bedroom) [9], have been suggested as possible culprits. Stimuli, such as incoming light and the use of focusing muscles, apparently affect postnatal eye-growth. When the stimuli are different from what the genes are ''expecting'', the process is more likely to end up out of balance.

The other example involves the apparent increase in immunological disorders, such as allergies and asthma, observed in affluent societies. The immune system is designed to mature by constant interaction with microbes. Evolution made this process appropriate to the life style of our Palaeolithic ancestors, but today the interactions between humans and germs are different. Infants are, for example, less likely to be exposed to the mostly harmless flora of microbes found in the soil. Apparently, unless activated by foreign antigens, immune cells are prone to attack self-components; which is why one attempts to use ''vaccines'', containing innocuous bacteria, to combat autoimmune disease [10]. Thus, the surge in adverse immunological conditions may be partly related to excessive cleanliness. There is evidence in support of this hygiene hypothesis, as well as models to help explain the putative connection [11].

The above examples illustrate two important points: mismatches may be detrimental even if, as in the case of night-light or cleanliness, there are no obvious reasons to classify them as discords; and they may be detrimental to some individuals even if the majority of the population is not troubled.

For the purpose of describing discords that may affect our mental constitution, knowledge on the following topics is essential: One, the evolution of human mental capacities; two, the various mental problems that trouble present societies; three, the development and operation of the brain; and four, the social and emotional environment associated with the EEA.

We are beginning to elucidate the neurological correlates of emotions [12]. One emerging issue is the existence of a considerable neuronal plasticity in the circuits involved. We are born neither as a *tabula rasa*, nor with a brain predestined to function in a particular way, but rather with the capacity to develop mental functions given the right environmental stimuli. In other words, our behavioural and mental competence requires complex and extensive interactions with a variety of environmental factors in order to ensure proper maturation. Presumably the combination of complex assignments and the need for proper environmental interaction, make the eye, the immune system, and the emotional system particularly vulnerable to discord conditions.

Mental problems

According to recent estimates, 31–50% of the population of industrialised nations suffers from a mental disorder at some point in life, whereas 17–33% has had a diagnosable condition during the last 12 months [13,14]. Moreover, diagnosable mental diseases are presumably only the tip of the iceberg as to mental agony and suboptimal quality of life [3].

It seems unlikely that the above data reflect the default state of the human mind, as many of the mental conditions would be expected to be under considerable negative selection in a tribal, hunter–gatherer setting. A reasonable interpretation is that the high prevalence is due to the combination of two factors: brain modules (or functions) that are sensitive to discords, and the presence of discords affecting these modules. This interpretation is in line with the idea that the brain is the most complex human organ, and an organ that requires substantial environmental input for proper maturation due to its relatively immature release at birth.

Obviously there is also a genetic factor involved. In certain forms of mental disorders, such as Huntington's disease, genetic constitution may explain more or less all the symptoms. But in case of the more complex mental problems, the environment (i.e., putative discords) is typically assumed to be responsible for at least half the problem [2].

Depression and anxiety related disorders tend to top the lists of mental diseases, and environmental factors are presumably an important part of their aetiology. Anxiety is related to inappropriate triggering of fear, while depression is associated with excessive activity of a low mood module. Moreover, some of the other mental problems listed may be secondary consequences of disturbances in the fear and mood functions. Certain sleep problems are, for example, caused by anxiety; and misuse of drugs and alcohol may be related to a low mood. It therefore seems likely that mood and fear represent brain modules that are particularly vulnerable to discords.

Whereas it is easy to diagnose suboptimal functioning of the eyes and the immune system, it is more difficult to understand a malfunctioning brain; and concomitantly more difficult to pinpoint relevant discords. Thus, modern societies most likely include a number of discord features that affect mental constitutions, but that are not yet identified. Uncovering these discords may help explain the present level of mental suffering – and, hopefully, help us find preventive measures to improve the situation.

Defence modules

Fear and low mood are inherent features of the human brain evolved to serve as warning or defence systems that help the individual avoid harm: Fear is part of the ''fight-or-flight'' response, while possible functions of low mood include eliciting help and preventing attack by a dominant individual [1,12].

For optimal performance, warning systems should rather be triggered too often than fail to react in times of real danger; simply because the latter alternative is likely to be more damaging. Thus, even in a perfect environment, humans are expected to suffer from unwarranted responses. Yet, the present levels of anxiety- and mood-related disorders seem to reflect excessive activity in the underlying circuits: the debilitating consequences are too severe

to be accounted for by evolutionary design operating in a natural environment.

Mood and fear are presumably designed to be strongly influenced by environmental input: We need to learn which features to be feared, as well as how to respond to aggressive or dominant individuals. The combination of environmental moulding and the presumed "low threshold" design may explain why these modules are particularly vulnerable to discords.

The neurological and endocrine mechanisms underlying fear is reasonably well understood [12,15]. Excessive stimulation of this function is known to result in hyperactivity of the hypothalamic–pituitary–adrenal axis. In addition to reducing the quality of life of the sufferer [16], the condition may lead to various secondary ailments, such as stress [17] and depression [18].

It is reasonable to assume that excessive stimulation early in life will be particularly detrimental, as this is the main period of brain development. The point has been demonstrated in rodents [19,20]. Thus, although, adult anxiety disorders may reflect both an expansion of the fear function during infancy, and the stress of adult life, it makes sense to be particularly concerned about the environment of children. Discords during the early period of brain development may lay the foundations for later problems. Moreover, it may prove more difficult for adults to avoid stress compared to giving infants an environment that does not cause unnecessary anxiety.

The way infants are typically handled in Western societies suggests some discords that may be related to anxiety, as previously reviewed [21]. Briefly, in the Palaeolithic, the infant would presumably always be close to an adult who would carry it around at daytime and sleep next to it at night – as tribal people tend to do today [22]. In modern societies the infant spends much time without a sensation of where the parents are, as exemplified by sleeping arrangements: We typically put the infant in a separate room, or at least in a separate crib. If children cry when put to bed, a dominant line of thought has been that it is best to ignore their crying in order to teach them to sleep alone [23]. Following this advice, the baby will eventually stop crying, but the situation may, over time, spur excessive development of the fear function.

Activation of fear, particularly of the type referred to as separation distress, may also follow as a consequence of other aspects of modern living, such as the use of day-care centres. It is important to note that the question is not whether the environments the babies are offered are hazardous, both day-care centres and modern housing may very well be safer than Palaeolithic camp sites. The point is that children presumably are prone to respond to the absence of parental proximity as a danger. Even in the Palaeolithic, the infant would most likely not worry about predators, because human biology dictates that its safety is in the hands of parents. Parents, on the other hand, tend to assume that as long as the home is secure, the infant should feel safe.

Another possible discord related to defence modules is the amount of skin to skin contact the infants receive. In the Palaeolithic there would be limited use of clothing, and more handling and carrying against the body [24]. In the absence of commercial substitutes, there was also more breastfeeding. Skin to skin contact is known to calm people [12]; thus a decrease in the dose of either nursing, or other forms of skin contact, is a likely discord.

The present social setting may also count as a discord. The close-knit tribal world of the Palaeolithic has been replaced with nuclear families, and most people experience numerous encounters with unrelated people. We lack the lifelong social network of the tribal world. The present situation is reflected in descriptions of loneliness, or lack of belonging, and may help explain a variety of mental problems.

The low mood response is presumably related to social interactions. Frequent encounters with dominant individuals, for example teachers and bosses, but also in the form of strangers taking a dominant position, may lead to an abnormal development of the mood module, which again can translate into depression. The lack of a proper social network probably aggravates the problem.

It is well documented that stressful conditions for infants, such as abuse or separation from mother, can lead to anxiety- and mood-related disorders in both humans and animals [25–27]. However, the prevalence of these disorders in humans appears to be much higher than the prevalence of serious child abuse or neglect. Moreover, most patients do not appear to have that sort of background. Thus, even in the case of what is presently considered a normal upbringing, there is likely to be practices and cultural traditions that contribute to the decline of mental health.

Evaluating possible discords

The evolutionary perspective may help us describe candidate conditions affecting mental health, but further research is required for verification and to estimate their impact. Preventive measures rely on such data.

Direct testing of connections between putative discords and human mental health is difficult. It is, however, possible to obtain relevant data, for example, from cross-cultural comparisons. This strategy is complicated, both because of the problems related to assessing mental health across cultures, and because confounding factors rather than the assumed discord may be the key factor underlying differences. Moreover, although several cross-cultural comparisons of anxiety have been published [28,29], the cultures investigated tend to be industrialised, and therefore do not reflect the practices of Palaeolithic people. As to the rare tribal cultures that still might come close to such practice, most of them have been squeezed into marginal environments with concomitant stress factors. Yet, relevant data have been published, as exemplified by a comparison between the close-knit communities of Hutterites in Canada and the surrounding population, suggesting a reduced risk for psychoses in the Hutterites [30].

It is also feasible to compare individual child-care practices within a society with subsequent assessments of mental health, such as anxiety or depression, when the children come of age. The homogeneity of child caring practices within a single society (with the exception of gross deprivation or abuse) limits this approach. However, by obtaining long-term follow up of a large number of children, relevant correlations may still be obtained.

The author is presently involved in an attempt to use the latter, prospective strategy in other to find putative discords associated with mental disorders. The approach involves The Norwegian Mother and Child Cohort Study, which is designed to collect a variety of information, including health parameters, from before birth to adulthood of 100,000 infants [31]. The parents fill out forms that include questions related to a variety of possible discords, health assessment will be done as the children grow up.

Conclusion

The power of the human brain allows people to counteract the effects of discords, but unfortunately that does not change the fact that mental disorders are reaching epidemic proportions. The level of suffering implies that a major fraction of the population fail to counteract adequately.

Discords may act like sand in the human emotional machinery, i.e., a multitude of stress factors may add up to a propensity for mental problems. It is a question of disturbing a delicate balance, we are sufficiently versatile to survive when out of balance, but at a cost. Typical discords of modern societies may apply to a large fraction of the present world population. Thus, although, the

impact of each discord on a single individual may be limited, the combined effect on world health can be substantial.

It is generally agreed that the environment is important for mental health. It may be argued that renaming the relevant environmental parameters as discords does not change that position. However, although the more important environmental factors probably have been documented without the help of evolutionary theory, the concept of discords may help us identify features that would otherwise remain neglected. As pointed out in the present text, discords are not always easy to find. If we can correctly surmise the conditions of our Palaeolithic ancestors, we have a supplementary guiding principle.

It is neither realistic nor desirable to bring human society back to the tribal way of life. Our technological standard of living depends to a large extent on mismatches, many of them may prove to be discords. Yet, it may be possible to alleviate the concomitant strain within the general framework of an industrialised society; as exemplified by ecovillages [32]. That is, in some instances one may cater more to the nature of being human than what is the case today. While some mental agony is unavoidable, the evolutionary perspective should improve our prophylactic capacity.

Obviously, mental disorders were not absent in the Palaeolithic, although, the present discussion assumes that the prevalence is higher today. It is conceivable to create a society more fit to human mental health than any previous culture, and thus reduce the burden of mental disorders to below what was the case in the Palaeolithic. A concise understanding of how evolution has shaped the human brain to develop in interaction with the environment is highly relevant in this regard.

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