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EVOLUTION OF HUMAN INTELLIGENCE – HYPOTHESIS FOR THE CAUSES

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Absract
Most scientists agree that anatomically contemporaneous Homo sapiens derives from Africa. Its first representatives appeared likely 195,000 years ago. It is much harder to establish when Homo sapiens became contemporaneous intellectually. Based on archeological finds in Europe, many anthropologists claimed for many years that the cultural revolution occurred about 40,000 years ago, supposedly due to the sudden development of brain. However, the others thought that the cultural explosion in Europe started actually in Africa. Nowadays, more and more popular is the hypothesis which assumes that such sudden revolution never happened. Probably there was no delay in brain and body development in the course of human evolution. Some supporters of the hypothesis believe that this kind of intelligence, as is typical for Homo sapiens, characterized other species of Homo, for example Homo neanderthalensis. When we investigate the evolution of human intelligence it is not only important when the human-type brain appeared but also why it appeared.

Human-type brain
How can we observe the evolution of brain within *Homo* species? Fossil evidence displays size and some structures on the brain surface – ganglions and furrows. It is possible to investigate the brain size basing on cranium, even if the latter is not well preserved. Based on fossils, we can presume that the process of brain expansion started before *Australopithecus afarensis* appeared. Remarkably bigger brain evolved in *Homo* species, precisely *Homo hablilis/rudolfensis* (2.5–1.8 mln years ago), whose skull capacity was estimated at 650-800 cm^3. *Homo ergaster/erectus's* (1.8 mln – 300,000 years ago) skull capacity is estimated at about 850–1000 cm^3, but considering the bigger body, the expansion of brain was not big. Skull capacity of archaic *Homo sapiens* (and *H. neanderthalensis*) was between 1100 and 1400 cm^3, so it was bigger than modern *Homo sapiens's* brain size. To be more objective, we should use the encephalization quotient which takes into account the body size. The easiest way to study the brain evolution is concentration on one variable, namely brain size, which can be easily measured in both living and extinct mammals. There is a hypothesis about the existence of a "critical mass" of neurons as the necessity for the evolutionary "explosion" of intelligence. It means that below a certain number of neurons (or size of the brain), intelligence is highly limited and does not lead to invention, imagination, symbolic social communication. A number of converging evolutionary factors determined a sharp increase in the size and complexity of the brain of hominids and led to the first true *Homo* species. After attainment the critical mass only quantitative evolution occurred (Brown 2006).

The intelligence, defined as mental and behavioral flexibility, has evolved independently in different classes of vertebrates (e.g. birds and mammals), and in different orders of the same class (e.g. cetaceans and primates), as well as in different families of the same order. This speaks strongly against an 'orthogenetic' view of intelligence, a single evolutionary line culminating, for example, in *Homo sapiens* (Kamil 2004).

Humans are usually considered to be by far the most intelligent then others animals. However, it is unclear which brain properties might the differences in intelligence between animals. Furthermore, the question of whether properties such as a theory of mind, imitation or a syntactical language are uniquely found in humans is hotly debated. It is assumed that animals with bigger brains are more intelligent than those with smaller ones. However, monkeys possess brains that are much smaller than those of ungulates, but their higher cognitive and behavioral flexibility is undisputable. The ca. 1.5 kg brain of *Homo sapiens*, apparently the smartest creature on earth, is significantly exceeded in weight by the brains of elephants and some cetaceans. Thus, a larger brain alone does not necessarily assure greater intelligence. Among large mammals, humans have the relatively largest brain (2% of body mass), whereas shrews, the smallest mammals, who exhibit supposedly much less cognitive and behavioral flexibility, have brains of up to 10% of their body mass. The relationship between relative brain size and intelligence is therefore inconclusive (Roth, Dicke 2005). Perhaps the absolute or relative size of the cerebral cortex, as the assumed seat of higher cognitive abilities, might better predict intelligence. The cue is that cortical volume increases faster than brain volume as a power function with an exponent of 1.13. Consequently, human cortical volume is considerably exceeded by that of the elephants and large cetaceans, both in absolute and relative terms, although these taxa are considered less intelligent (Roth, Dicke 2005).

It has previously been claimed that the PFC is exceptionally large in humans, although recent studies contend that the human frontal or prefrontal cortex is not improportionally large as compared with other primates and may be exceeded by that of elephants and cetaceans. However, these discrepancies might result from the difficulty, among others, of exactly defining the prefrontal cortex in different mammals (Roth, Dicke 2005).

Another much discussed general factor to estimate the brain evolution is an encephalization. This is expressed by an 'encephalization quotient', which indicates the extent to which the brain size of a given species deviates from the expected brain size, based on a 'standard' species of the same taxon. The EQ is also not the optimal predictor for intelligence due to some New World capuchin monkeys have higher EQs than chimpanzees and gorillas despite their lower intelligence (Roth, Dicke 2005).

One of the main problems in discussion about the evolution of intelligence is that there is no universal definition of animal intelligence, nor procedure to measure it. Intelligence may be defined and measured by the speed and success of how animals, including humans, solve problems to survive in their natural and social environments (Roth, Dicke 2005). These include problems related to feeding, spatial orientation, social relationships and intraspecific communication. Several comparative and evolutionary psychologists and cognitive ecologists consider that the mental or behavioral flexibility is a good measure of intelligence, which resulted in the appearance of novel solutions that are not part of the animal's normal repertoire (Roth, Dicke 2005).

There is a long tradition to ascribe to humans properties that are supposedly not found in other animals. Among the most cited are: understanding of mechanisms of tool use, tool-making, syntactical–grammatical language, consciousness, self-awareness, imitation, deception and theory of mind (Subiaul et al. after Roth, Dickie 2005). There is evidence, however, of showing understanding of the mechanisms of tool use and tool-making by great apes and even corvids. Deception has been widely observed among monkeys. Great apes and cetaceans show mirror self-recognition, and there is evidence of possessing by great apes at least some states of consciousness typical for humans. Rhesus monkeys are capable of imitation by copying an expert's use of a rule rather than just copying a certain motor behavior which evidence widens the discussion about imitation in non-human primates (Subiaul et al. after Roth, Dickie 2005).

It is debatable whether non-human primates possess a theory of mind (ToM), that is, the ability to understand another individual's mental state and to take it into account in one's own behavior. In humans, ToM and the understanding that a person can hold a false belief develops between the ages of 3–4 years and becomes fully developed only at the age of 5. In a study on false belief, chimpanzees, a group of autistic children (assumed characteristically to lack ToM) and children of ages between 3 and 6 years were tested non-verbally by O'Connell and Dunbar. They proved that the chimpanzees performed better than the autistic children and the 3-year-old normal children, because they were equal to 4–5-year-old children and inferior to the 6-year-old ones. This would corroborate the idea that chimpanzees exhibit at least some aspects of ToM (O'Connel, Dunbar after Roth, Dicke 2005).

The most cited example for a unique human ability is a syntactical–grammatical language.

Kanzi, the 8-year-old bonobo chimp, who was raised in a language environment similar to that of human children, showed linguistic capabilities including signs of grammar and syntax typical of a 2-year-old girl. However, Kanzi did not go beyond these abilities despite his long training period. It is known that the Wernicke's speech area located in the superior temporal and inferior parietal lobe is apparently not unique to humans, and the existence of precursors of the Broca's area in the frontal lobe in non-human primates is disputed. The monkey F5 'mirror neurons' are believed to be partially homologous to the Broca's area, particularly because this area in humans is also active during movements of the hand and mouth, as is the case with the mirror neurons (Roth, Dicke 2005).

Basing on endocranial casting, while investigating the general brain structure, we can distinguish between the typical apish brain organization and the typical human brain organization. A brain, in which parietal and temporal lobes are the biggest, is human. In the apish brain, these parts are remarkably smaller. What is more, the human frontal lobe is more wrinkled. The organization of brain and the number of neural connections are more important rather than brain size. Deliberations on origin of human intelligence are also complicated by the lack of certainty which feature is actually the most important. Most scientists consider that the most important feature is the ability of symbolic thinking and language using. For the measure of the evolution of intelligence within *Homo,* scientists use tools and others ways of finding the food. Even the earliest hominids had better cognitive abilities than contemporary chimps (Lewin 1999).

The fact that human is the most intelligent creature is accepted as obviousness. We can investigate the ways of evolution and search for the features that have made us so unique on the Earth. Nevertheless, it is also very interesting why we became so intelligent. The causes of the evolution of human brain are not so obvious. Human brain is an exceedingly costly organ. Although the brain is only 2% of the total body weight in humans, it consumes 18% of energy, which is totally uneconomical (Lewin 1999). With the cat as a 'standard' for mammals, humans have the highest EQ of 7.4–7.8, which indicates that the human brain is 7–8 times larger than expected. This can be related to an extremely rapid increase in the brain size during hominid evolution, which in turn required substantial reorganization of the digestive system and feeding behavior. It is really fascinating why the evolution allowed this to happen and promoted such a costly organ (Roth, Dicke 2005).

Hypothesis on the evolution of human brain

During last 160 years scientists have been thinking that the primates' brain evolved in response to some ecological factors. In the 50th of the last century, the man was called "Man the tool maker", suggesting that the evolution of human intelligence was strictly connected with tool production. Few years later, man was proclaimed "Man the hunter", suggesting that the most important factor were more and more complicated methods of hunting. It would be, however, completely against the model of parsimony, which is the basic rule of evolution. The brain is exceedingly expensive both to evolve and to maintain and it could hardly evolve just to process information of ecological relevance. It is difficult to justify the claim that primates, and especially humans, need larger brains than other species merely to do the same ecological job (Dunbar 1998). Four main hypotheses have been put forward to explain the evolution of the primate's brain: epiphenomenal, developmental, ecological, and social.

Ecological Hypothesis. The ecological hypothesis emphasizes the relation between diet and size and structural complication of brain. There are few versions of this hypothesis, each concerns different aspects of a diet. The first version assumes that primates need bigger brains because they are frugivorous. It is presumed that fruitvores need the better cognitive abilities than follivores because fruits are more ephemeral and patchy in their distribution than leaves are, and hence require more memory to find. The second version stresses the need of creation of mental maps and assumes that the size of brain forces the size of mental map. The primates need larger brains because of the greater memory requirements of large-scale mental maps. This means that bigger brains are necessary for controlling the bigger territory where the food is being found and for longer daily activity. The last version is related to kinds of food – is it easy or more complicated to obtain food of certain kind. It convinces that the diet forces primates to extract resources from a matrix in which they are embedded (e.g., they must remove fruit pulp from a case, stimulate gum flow from a tree, extract termites from a termitarium, or hunt species that are cryptic or behave evasively).

Epiphenomenal Hypothesis. This hypothesis bases on the assumption that evolution of the brain (or parts of it) is not a consequence of the external selection pressures but rather simply a consequence of the biological growth. It argues that the brain evolution is a byproduct of the body size evolution, and that the size of brain parts is a byproduct of the total brain evolution. The big body needs the big brain to manage such a machine. This hypothesis does cannot be verified because the size of brain evolves very early in ontogenesis and it seems to be stable in comparing with other systems. We can use the body size hypothesis only when it comes to the differences in body size such as mouse and elephant (Jerison after Dunbar 1998). Large brains will evolve only when the selection factor in their favor is sufficient to overcome the steep cost gradient. Developmental constraints are undoubtedly important, but rather than being causal their role is that of a constraint that must be overcome if larger brains are to evolve. But this does not explain why brains actually evolved as they did. They may tell us that if you want to evolve a large brain, then you must evolve a large body in order to carry the energetic costs of doing so or a diet that ensures sufficient energy to provide for fetal brain development. Shifts to more energy-rich or more easily processed diets may be essential precursors of significant increases in brain or brain part size. This would explain why frugivores have larger brains than folivores and why hominids have larger brains than great apes.

Developmental hypothesis. It claims that the size of brain is correlated with maternal energetic reserves, which are crucial in brain development. Most of brain growth in mammals occurs prenatally. Maternal metabolic input is the critical factor influencing brain development. In fact, it seems that the brain development in mammals is almost complete before the birth, with little postnatal growth is finish by the time an infant is weaned. From this, the conclusion is drawn that brain evolution must be constrained by the spare energy, over and above her basal metabolic requirements, that the mother has to channel into fetal development.

Frugivorous primates have larger adult brains relative to body size than folivorous primates. This has been interpreted as implying that frugivores have a richer diet than folivores do and thus have more spare energy to divert into fetal growth. Large brains are thus seen as a kind of emergent epigenetic effect of spare capacity in the system. There are two main hypotheses on expansion of anthropoids' brain. First one says that the brain size depend on mother's metabolism pace – the faster (higher) pace the bigger brain. The second hypothesis says that the most important factor is duration of gestation and the litter size. It is really difficult to say which of the two is more probable. Both emphasize that the high energy food sources and lack of predators are essential for the brain to evolve (Dunbar 1998). Both kinds of explanations suffer from disregard a fundamental principle of evolutionary theory, which is that evolution is the outcome of the balance between costs and benefits. Because the cost of maintaining a large brain is so great, it is really unlikely that large brains will evolve merely because they can. Large brains will evolve only when the selection factor in their favor is sufficient to overcome the steep cost gradient. Developmental constraints are undoubtedly important, but rather than being causal their role is that of a constraint that must be overcome if larger brains are to evolve.

The social brain hypothesis. The social brain hypothesis, proposed in 1980, names human "Man the social animal". It implies that constraints on group size arise from the information-processing capacity of the primate brain, and that the neocortex plays a major role in this. Primate social systems are more complex than those of other species. Such a big brain, like human's, brings changes in parameters of life strategy. Although the body size of mature human and ape are similar, human newborns are bigger and have bigger brain than apish newborns. Human brain develops very fast, not only in the uterus, like other mammals, but also 12 months after delivery. Human newborn is much more helpless than apish young. This elongated period of child care strongly influenced human social life. The adherents of this hypothesis say that more complicated relationships in primate groups demanded some behaviors such as tactical deception and coalition-formation to acquire the evolutionary success (which is to survive and to have fertile offspring with the best mate). Because of this, the suggestion was rapidly proclaimed the Machiavellian intelligence hypothesis, although nowadays there is a preference to name it the social brain hypothesis (Dunbar 1998).

First of all it is important to realize that the brain does not evolve as a unity but it is rather a mosaic. The changes in brain are caused by changes in its parts. The scientists say that for determinating the evolution of intelligence, it is more important to analyze the development of neocortex, which is responsible for thinking and deduction, than the whole brain. Because of the size of neocortex in primates (50% to 80% of total brain volume), changes in the volume of the neocortex have a large effect on apparent change in brain volume that may be quite unrelated to changes in other brain components. Thus, the neocortex size is an exponential function of the brain size, whereas other brain components are not (Dunbar 1998).

The social brain hypothesis was tested by Robin Dunbar, using the social group size as a simple measure of social complexity and comparing with size of the neocortex among the primate species. Primate social groups are structured in different ways to those of other species. They are based on intense social bonds and the formation of long-term coalitions, which are founded on deep social knowledge of the past behavior and, perhaps, strategic interests of other individuals (Dunbar 1998). Due to the complexity of relations between members of the group, we can expect that the information-processing demands will increase with the number of relationships. As the neocortex is generally regarded as being responsible for those cognitive processes associated with reasoning and consciousness, it can be expected to be under the most intense selection due to the need to increase or improve the effectiveness of these processes (Dunbar 1998). Previous researches showed that neocortex size does not correlate with any index of the ecological hypothesis but it correlate with the social group size. Sawaguchi and Kudo (Sawaguchi and Kudo after Dunbar 1998) found that neocortex size correlates with mating system in primates. Additionally it was shown that while relative neocortex volume correlates with group size but not the size of the ranging area, the reverse is true of relative hippocampus size. A correlation between the ranging area and hippocampus sizes is to be expected because of hippocampal involvement in spatial memory (Dunbar 1998).

There are a few explanations why the group size would have to constraint the bigger brain. These are: the ability to recognize and interpret visual signals for identifying either individuals or their behavior, limitations on memory for faces, the ability to remember who has a relationship with whom, the ability to manipulate information about a set of relationships, and the capacity to process emotional information, particularly recognition and responding to other animals' emotional states.

Although visual mechanisms are likely to be important for social interaction, and may have been the initial impulse for the evolution of large brains in primates, it seems inherently unlikely that the crucial constraint of group size lies in the mechanisms of the visual system itself. The relationship between the relative size of the visual cortex and group size in anthropoid primates is much gentler than that between the nonvisual neocortex and group size. The volume of the lateral geniculate nucleus, a major subcortical way station in visual processing, does not correlate with group size at all, indicating that recognition per se is unlikely to be the most important for the evolution of intelligence. It seems equally unlikely that the problem lies with a pure memory constraint, though memory capacity obviously must impose some kind of the upper limit on the number of relationships that an animal can have. In humans at least, memory for faces is larger than the predicted cognitive group size. Humans are said to be able to attach names to around 2,000 faces but have a cognitive group size of only about 150 (Dunbar 1998). What is more, there is no intrinsic reason to suppose that memory per se is the issue. The social brain hypothesis bases on the capability to manipulate information, not simply to remember it. Additionally memories appear to be stored mainly in the temporal lobes, whereas recent studies implicate the prefrontal neocortex, notably Brodman area 8, as the area for social skills and, specifically, theory of mind.

It does not seem possible that emotional responses are the substantive constraint of the group size. Although the correct emission and interpretation of emotional cues is of singular importance in the management of social relationships, there is little evidence that the subcortical areas principally associated with emotional cuing (for example, the amygdala in the limbic system) correlate in any way with social group size. Indeed there has been progressive reduction in the relative sizes of the ‘‘emotional’’ centers in the brain (the hypothalamus and septum) in favor of the ‘‘executive’’ centers (the neocortex and striate cortex) during primate evolution. It can be interpreted in terms of a shift away from emotional control of behavior to more conscious, deliberate control (Dunbar 1998).

The last alternative is that the mechanism involved in limitation of group size is the ability to manipulate information about social relationships themselves. We can distinct different grades of group size and different grades of neocortex volume even within the anthropoid primates. Apes seem to lie on a separate grade from the monkeys, which lie on a separate grade from the prosimians (Dunbar 1998). According to social brain hypothesis it is because apes require more computing power to manage the same number of relationships that monkeys do, and monkeys require more than prosimians do. This gradation corresponds closely to the real scale of social complexity. What is more, the neocortex size correlate with frequency of use tactical deception. Species with large neocortex ratios make significantly more use of tactical deception, even when the differential frequencies with which these large-brained species have been studied are taken into account. Pawłowski, Dunbar, and Lowen have shown that among polygamous primates the male rank correlation with mating success is negatively related to neocortex size (Pawłowski, Dunbar, Lowen 1997 after Dunbar 1998). That means that the lower ranking males of species with larger neocortices seem to be able to use their greater computational capacities to deploy more sophisticated social skills, such as the use of coalitions and capitalizing on female mate choice, to undermine or circumvent the power-based strategies of the dominant animals. Additionally the adult neocortex size in primates correlates with the length of the juvenile period, but not with the length of gestation, lactation, or the reproductive life span, even though total brain size in mammals correlates with the length of the gestation period. This suggests that the most important in the development of a large neocortex in primates is not the embryological development of brain tissue, which is associated primarily with gestation length, but rather the ‘‘software programming’’ that occurs during the period of social learning between weaning and adulthood (Dunbar 1998).

Kudo, Lowen, and Dunbar have shown that grooming clique size, a surrogate variable that indexes alliance size, correlates rather tightly with relative neocortex and social group size in primates, including humans. The human data derive from two samples: hair-care networks among female Bushmen and support cliques among adults in the United Kingdom. What is remarkable is how closely the human data fit with the data from other primate species (Dunbar 1998). Grooming cliques of this kind function as coalitions in primate groups. Coalitions are essentials to individuals within these groups because they enable the animals to minimize the levels of persecution and competition that they inevitably suffer when living in close proximity to others. Coalitions essentially allow primates to manage a fine balancing act between keeping other individuals off their backs while at the same time avoiding driving them away altogether and thereby losing the benefits for which the groups formed in the first place (Dunbar 1998).

The correlation between cortex size and social group size can probably be interpreted as a direct cognitive limitation on the number of individuals with which an animal can simultaneously maintain a relationship of sufficient depth that they can be relied on to provide unstinting mutual support when one of them is under attack. Because this is the core process that gives primate social groups their internal structure and coherence, this can be seen as a crucial basis for primate sociality (Dunbar 1998).

There are the evidences that the neocortex and striate cortex, areas of the primate brain that are responsible for the executive function, are under maternally rather than paternally imprinted genes (i.e., genes that ‘‘know’’ which parent they came from). It is also proved that the converse is true for the limbic system, those parts of the brain most closely associated with the emotional behavior. It can be interpreted in relation to the cognitive demands of the more intense social life of females in matrilineal female-bonded society (Dunbar 1998).

Identifying the relevant level of grouping (as a grooming clique) to measure the size of group in humans is difficult because most humans live in a series of hierarchically inclusive groups (Dunbar 1998). Limited census data on such societies suggest that there is indeed consistent group size in the region of 150 individuals. Among Australian aboriginals, for example, the relevant group is the clan, which meets from time to time in jamborees where they enact the rituals (marriages and rites of passage) and rehear tales of the old times, which remind everyone who they are and why they hold a particular relationship to each other. Indeed, this indisputably seems to be the largest group of people who know everyone in the group as an individual at the level of personal relationships (Dunbar 1998). A more extensive investigation in human groups in other contexts shows that groupings of this size are widespread and typical for all human social systems, being present in structures that range from business organizations to the arrangement of farming communities.

It is assumed that social evolution in primates is driven by different processes in males and females. It is because that if the female reproductive success is linked to the acquisition of resources and protection from predators, then males gain from monopolizing access to females. Thus, it would be expected that if relative neocortex size limits group size, the female group size should be more limited than the male group size, simply because there are more females than males in primate groups (Dunbar 1998). If the increased social complexity selects for a larger relative neocortex, the selection should be highest in the sex where the value of keeping tracks of social interactions is higher. It is assumed that those are females because most haplorhine primates are matrilocal and where females stay in the social network where they were born whereas males migrate to new social groups upon reaching adulthood. Secondly, about two-thirds of haplorhine primates are polygynous, where intrasexual interactions between males to a large degree consist of competing with other males over access to females (Lindenfors 2005). That not means that males have no social interactions or that social interactions are unimportant to males, but only that the value of social interactions, and of keeping track of them, is most probably higher in primate females than in males (Lindenfors 2005). Basing on the analysis of behavior of baboons, it was found that a composite index of sociality based on three measures (spatial proximity to other adults, being groomed by others, and grooming others) was highly correlated with infant survival. Females who were more social had more infants that survived the first year of life, the most dangerous time for these infant monkeys. Clearly, highly social females had higher reproductive success than less social females (Kamil 2004). Baboons appear to possess complex, hierarchically organized information about social status and relationships and sociality itself has major consequences for fitness. If the ability to make sophisticated judgments about relationships between individuals contributes to social success, then it links social cognition to biological success (Kamil 2004).

Sexual selection and evolution of human intelligence

Defining intelligence, however, is a highly problematic issue. An operational definition, which is used here, attributes the primary component of intelligence to flexible problem solving and the ability to cope with novel situations. What is obvious to most cognitive scientists it is better to be smart than stupid, informed than not informed, it is not obvious, however, to evolutionary biologists. There is a very high cost to maintain the brain tissue that makes cognition possible. The benefits, therefore, must be substantial (Kamil 2004). This is why Geoffrey Miller (2002) suggested in his book ‘The Mating Mind’ that the main motor of the evolution and development of human intelligence is the sexual selection. He suggested that our brains are not only survival machines but also courtship machines. Miller compares human brain to peacock’s tail, which is the most famous example for mechanism of sexual selection. Peahens prefer bigger and more colorful tails in peacocks even if the big tail is an obstacle for males.

Due to female preferences peacocks evolved big, colorful, shiny tails which are supposed to attract females. Accordingly to the most amazing abilities of human brain are just the tools of mating system which evolved to attract the potential sexual partners. He points that human intelligence and creativity are more than just a machine which enables tactical deceptions. They are amazing sexually attractive features. According to the Zahavi's handicap hypothesis, the brain is a kind of handicap, the price which an individual has to pay for good advertising of its genes.

Due to the theory of sexual selection if the sexes are different in investment in reproduction the sex which invests more will be more fastidious in mating and the sex which invests less will fight for the access to the individuals of the opposite sex. It is obvious that in human that is the woman who has to pay higher price. It is because of the costs of long gestation and breastfeeding. That means that it is the man who has to show off quality of his genes to attract woman who will judge his performance. One of the fine ways to impress the woman is the creativity, knowledge, sense of humor, some artistic talents. All those merits lead to some great works of art, are essential in science and connected with all stunning products of human intelligence. Such good evidence of intelligence as some artistic creations, wittiness showed during the conversation are good and honest signals of possessing good genes. After the long conversation, learning, some intellectual effort we are hungry and really tired. That is because our brain is such an uneconomical energy consumer. According to Zahavi's theory better genes let the individual to develop some exaggerated features to attract the females. Miller argues that our brain is such an exaggerated trait.

The clue which lets intelligence and big brain perceive as the honest sings of good genes, is that the remarkably complicated human brain is prone to mutations and very costly to maintain. The more the brain is complicated the more easily it can brake. The point is that if the creative intelligence is a sexual attractive trait it could evolve not to help to survive but it can demonstrate the creature's mutations and disadvantages. Those who did not want to show the quality of genes were not chosen during courtships. Their small, closed, unwilling to risk, resistive to mutation brains died with them. In their place evolved our big, amazing, costly, sensitive open mind.

If the male brain was a sign of the quality of genes and woman was only a judge who has to choose the best possible partner, we could expect that the male would be much more intelligent than woman. Although this is not true for humankind, we can observe slightly greater variation in IQ among males than among females. The differences among the average of IQ for women and men are not statistically important, but there are some more men with IQ below 100 and with extremely high IQ than women.

This hypothesis would give the explanation for the patriarchality of our culture and why there are more male scientists, artists, painters than female. The men just have bigger motivation to show off their creativity. The most of work of art, in many human cultures, are made by males in the reproductive age. It explains many differences between both sexes, like the motivation to public performances. It is not necessary to have such a big and complicated organ just to find the food or just because we can have it. It must involve some extremely powerful mechanism which will promote such a waste of energy and will give something else in exchange. That can be the greater number of attractive females to mate with them.

Conclusion

The question how the human brain has evolved is very interesting. Many scientists focus on the moment in evolution when the human-type brain appeared. However the causes why such an amazing machine evolved are fascinating as well. How natural selection was able to produce such a marvel as the human brain and its capacities in such a short time. It is the question about the nature of our uniqueness among the animal kingdom, and why we are so today. Is intelligence unique to humans? Of course not. The current scientific view is that there are several degrees of complexity of intelligence present in mammals and that we share with them many features that we previously thought were unique to man (such as symbolic language, which has been proved to occur in apes). We know that independent lines of evolution have commonly led to larger brains (Kaas 2001). We also are sure that humans are the most intelligent animals on the Earth. Then why such an expensive and big organ had a chance to evolve? The ecological needs such as hunting and searching for food do not seem to be an adequate explanation. We are by far more intelligent than it would be necessarily for find and acquiring food. Because of that the Geoffrey Miller's (2002) hypothesis that our brain is just a sexual feature seems quite plausible. It is possible that the evolutionary psychology can be useful in explanation such a phenomena as the evolution of human intelligence.

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