Review article

GENES, HUMANS AND SOCIETY

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WHICH ARE THE PRINCIPLE CHARACTERISTICS OF THE HUMAN GENOME?

The majority of data on the organisation of the eukaryotic genomes and traits of certain types of nucleotide sequences have been obtained in recent times following the determination and publishing of a primary structure of several eukaryotic species. Hence, complete nucleotide sequences of baker's yeast (*Saccharomyces cerevisiae*), roundworm (nematode) (*Caenorhabditis elegans*) and fruit fly (*Drosophila melanogaster*) were completed in 1996, 1998 and 2000, respectively. The first, draft version of the primary structure of a human genome was published in 2001 and it is expected to be completed in 2003.

Today, 90% of sequences of euchromatic regions of the human chromosome are known. The size of the human genome is estimated to 3.2 Gb (i.e. 3.2 x 10^9 bases), while 2.95 out of these 3.2 Gb present euchromatine. Only 1.1-1.4% present nucleotide sequences that code proteins (it is about 5-28% of nucleotide sequences that are transcribed into RNA). More than 50% of DNA in human cells are various types of replicated nucleotide sequences: phylogenetically very old mobile elements comprise 45%, then 3% are repeat sequences, and 5% present recent duplicates of large DNA segments. It is estimated that 31,000 human genes code proteins (up to now the existence of 26,000 such genes has been confirmed).

On the other hand, approximately 6,000, 13,000, 18,000 and 26,000 genes, coding proteins, were detected in baker's yeast, platyhelminths, fruit fly and mouse-ear cress, respectively. Only 94 of 1278 (or 7.4%) of protein families are coded by human genes that are specific for vertebrates. It is estimated that 47 genes coding proteins were formed of mobile genetic elements, while 223 probably originated from bacteria, i.e. they are present in the human genome as a result of the horizontal evolution. Alternative intron excision is present in about 35% of genes. Genes coding proteins in humans have small exons (about 50 codons) and very long introns (length of some of them is up to 10 kb).

WHAT IS AN INNATE/ACQUIRED CONTROVERSY?

Many discussions have been taken in psychology in relation to the roles of biological ("innate") and cultural ("acquired") factors in the formation of human behaviour. There are four approaches to this problem. 1. **Biological determinism** is the belief that individual biological differences, such as those related to neuroanatomy, hormones and finally genes, are responsible for all types of human behaviour. 2. **Social constructivism** (syn. empiricism) on the other hand, emphasises the influences of cultural and social contexts in human behaviour. 3. **Interactionism** is believed to be a process of interaction of both biological and social factors that determine human behaviour. 4. **The theory of developmental systems** claims that any separation of innate from acquired is artificial, because all types of human behaviour are a result of a complex system within reactions whose parts cannot be treated as discrete units.

WHAT ARE INNATE TRAITS?

1. *In the context of genotype-phenotype relation* - for the majority of ethologists, psychologists and many geneticists the innateness of a certain trait is another term for the trait caused by genes. In other words, the trait is either "innate" or "acquired" if the development of the given organism is "closed" for environmental effects on the given trait. The innate or genetic traits are, according to this concept, "ontogenetically fixed", i.e. all pecies of information necessary for the development of the individual would be coded in its genotype. Many researchers, such as evolutionary physiologists and sociobiologists, who accept the concept of ontogenetic fixation are of the opinion that innate traits are always adaptations. Any modification of the "normal" environment (i.e. of the one for which adaptation is an innate trait) that would change the condition of the given trait would not represent a natural variability of a phenotype, i.e. phenotypic adaptability, but "abnormality" ("aberration" or "pathological condition"). Furthermore, according to a famous ethologist Konrad Lorenz and his followers who support the concept of ontogenetic fixation of innateness, if a trait "requires" an environmental stimulus for its "natural development" under *normal* conditions it means that that trait is not an innate one. Therefore, the innate trait is a trait which is entirely determined by genes under *normal* conditions. For instance, children who had misfortune to grow

up without a possibility to communicate with other people did not develop linguistic abilities (which indicates to the development of neurological components of the language and speech and to the fact that their functional conditions depend on stimuli coming form other people in early periods of the postnatal development); according to the concept of ontogenetic fixation, the language is not the innate trait in humans, although it is very clear that only they have genetically determined neural structures that establish the mode by which linguistic elements (such as words) are used to form rational sentences (syntax) regardless of the language itself. The concept of innateness based on ontogenetic fixation is in collision with the contemporary genetics, which has inevitably shown that *all* traits of an organism presented a result of interactions between genes and environments under which the development of the organism was conducted. In other words, both, genes and environments are causal factors for each trait of an organism.

2. *In the context of differences among population individuals* - the original and fundamental meaning of the term "innate" or "genetic" trait in the contemporary biology is: a trait is "innate" one if *phenotypic differences* among individuals in a given population can be explained by *genetic differences*.

WHICH ARE THE BASES OF THE CONTEMPORARY GENETIC DETERMINISM?

The belief of the contemporary genetic determinism is that evolutionary biological considerations have a crucial role in understanding of our own selves, our behaviour and validation systems. It is claimed that social policy, legislation and ethical systems of human societies have to be within frames provided by the genetics. Culture is an epiphenomenon; it is said that the crown of the genetics can be used to "hide a reality from us". The human being is described as a selfish, aggressive creature that functions the best within a group which permits him without any limitation set by modern societies, to express absolutely freely his own biological instincts. The ambition of sociobiology and evolutionary psychology is greater than the "explanation" of human nature; it is an attempt to develop a total explanatory system of the human social existence.

WHAT IS THE EVOLUTIONARY PSYCHOLOGY?

The majority of people encountering the term "evolutionary psychology" thinks of it as a discipline relating to studies on the evolution of cognitive abilities and behaviour. However, over the last ten years, the evolutionary psychology have been developing into a specific research programme based on very explicit nativistic and adaptive interpretations of evolutionary mechanisms exclusively related to human mental abilities and behaviour. There are several essential principles characteristic for this research programme. The majority of evolutionary psychologists and anthropologists believes that aspects of human behaviour, traditionally studied by the psychology and anthropology, can and have to be explained by numerous inner computer-like mechanisms whereby *each of them* presents an *adaptation* that

occurred due to effects of natural selection in environments that were inhabited by the first members of the genus *Homo*. Since the appropriate psychological adaptations permitted primitive humans to solve specific problems they were encountering in environments of that time, it is quite obvious to expect that "cognitive architecture" of modern humans comprises of numerous (perhaps of several thousands) special purposeful mechanisms ("specialised modules"). Considering that the appropriate selection regimes were present long ago in an environment often named the "environment of evolutionary adaptiveness" (EEA) and were dated as far as the Pleistocene (pertaining to the geologic epoch forming the earlier half of the Quaternary Period, beginning about two million years ago and ending ten thousand years ago) the majority of psychological mechanisms of today are not adaptive, if great changes in the environment of humans are considered. However, such traits would today be inherited or innate dispositions of humans. Numerous examples of such traits could be found in the recently published book *Genome* by Met Ridley (2001) that popularise principal ideas of the evolutionary psychology.

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