Eugenics—evolutionary nonsense?

In these pages, we are often confronted with the horrors of gene defects, although advances that may help attenuate their effects encourage us. We argue that it is undesirable to attempt to eradicate genetic causes of disease by modification of the germ line, prenatal selection or human cloning. The application of evolutionary principles has benefited medicine[1], but these same principles are conspicuously absent from discussions of ethical issues in human genetics. We believe these will be generally more intelligible and compelling than any ethical or philosophical considerations.

The process of evolution requires that genes mutate, individuals are selected and populations evolve. Without errors in the replication of genomes and the production of genetic variation among individuals, populations would not be able to respond to new environmental challenges (including infection and disease) and adaptation would not take place. In addition, a trait or strategy that is harmful in one situation may be favourable in another environmental setting. Evolution does not involve an active drive toward progress.

Just as evolution has no foresight, neither does *Homo sapiens* (although our highly developed central nervous system often deceives us into believing so). For our species, environmental and social conditions drastically change, even in the course of a few generations. And so eradication of traits that are considered undesirable today would be a vain, if not ill-fated, attempt to 'improve' the human race.

Two examples illustrate how the evolutionary value of alleles can change over time. Mutant alleles that give rise to hereditary haemochromatosis, a disorder involving excess iron in the blood, may have have been selected owing to their ability to compensate an iron-deficient diet[2]—a further reminder of how environmental factors, including diets, can determine the 'value' of a given allele[1]. Chemokines and their receptors are thought to be essential to inflammation, and so a deletion in a gene encoding a member of the chemokine receptor family might be expected to be deleterious or, at best, benign. In light of the AIDS epidemic, however, an inactive *CCR5* allele takes on new significance. Because the *CCR5* receptor is a co-receptor necessary for infection by macrophage-tropic HIV-1 strains, a deletion in this allele renders homozygous individuals relatively resistant to infection[3,4]. In fact, the value of a mutation can change across the spectrum of fitness values, from being devastatingly deleterious to strongly advantageous. We deceive ourselves if we think that we can sensibly draw the line regarding which mutations should be eliminated and which should be retained, given our inability to predict future environmental challenges.

Similar considerations should be applied to alleles inherited by individuals who, due to their genetic makeup, are driven to the fringes of society. Alleles that render individuals susceptible to alcoholism or drug abuse are problematic only because access to these toxins is easy today. On the other hand, because of their possible correlation with novelty seeking[5], these alleles may have been of tremendous benefit for human evolution. Can we be certain that these alleles do not spark technological advance or cultural achievement?

As another example, autism is a multigenic neurodevelopmental disorder whose effects can range from severe to subclinical. There is speculation that many outstanding personalities, including Albert Einstein[6], could be placed within the broader phenotype of the autism spectrum. With well-intended efforts to eliminate human suffering that goes hand in hand with severe forms of autism, should we risk eradicating alleles that may be over-represented in highly gifted individuals?

Familiarity with concepts of evolution and population genetics will make discussions on ethical issues that arise in the wake of advanced technologies much more productive. Counterselection of embryos and cloning of humans does not make evolutionary sense. In the new age of genomics, every individual or family will be confronted with a large number of so-called 'undesirable' alleles. Apart from the fact that a 'negative' allele may be neutral or even beneficial in a different genetic background, we should understand that our rating of alleles is biased, myopic and only relevant to the present. The evolutionary benefit of each individual's alleles can only be judged with hindsight by future generations.

It is not our intention to categorically deny individual parents the right to have a child free of a genetic disorder. Our hope is that the evolutionary considerations presented here will help to clarify the difficulties in individual decision-making and, especially when extensive genotyping becomes feasible, reduce the anticipated stigma of non-desired combinations of alleles. Perhaps simple evolutionary arguments will convince society as a whole to cherish its imperfections, in the certain understanding that human diversity not only protects us against social and cultural hegemony, but also immunizes us against the unpredictable future of our species.

Hence, the genetic variability of *H. sapiens* and the vast number of genotypes that sexual reproduction and recombination can produce should be recognized as one of our most valued assets. It makes no evolutionary sense to drive our species through a man-made bottleneck of genetic uniformity and thus further contribute to its premature extinction.

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