

It has been mathematically proven that if there is individual variation in traits or variants of traits, heritability such that offspring resemble their parents more than the parents of others, and differential fitness such that individual reproduce differentially, then the proportion of the population with a trait or variant on a trait will alter over time. That is simply to say that if those three conditions obtain, then evolution by natural selection will occur. These three conditions are not only thought to be sufficient for evolution by natural selection, however, they are also thought to be necessary, or *defining of what evolution by natural selection is*. As such, individual difference is a precondition for evolution by natural selection².

Genetic mutation is the mechanism that produces variation³. While most mutations are deleterious to the organism, occasionally mutations result in what Dennett refers to as a 'Very Good Trick', or adaptation⁴. The most plausible version of the thought is that a trait or variant on a trait might give such an advantage to the organisms that possess it that the trait or variant can be driven into fixation in the population. Language seems to be like that for *Homo Sapiens* in the sense that language is very robustly acquired by almost all across a diverse range of environments. It is important to note that adaptations are doubly relative, however. Firstly, what has highest fitness in one environment might have lowest fitness in another. Secondly, what trait or variant has highest fitness in a population is dependent on what other traits or variants are found in the population⁵.

Some have conceptualized evolution by natural selection as a mechanism that can *produce* diversity rather than being a mechanism that produces homogeneity (by way of fixation) by operating over diversity. The clearest example of this between species is thought to be the role of evolution by natural selection in speciation. Our best biological taxonomy of species distinguishes them according to lineage and thus interbreeding is more important for delineating species membership than morphological or behavioral characteristics. Evolution by natural selection is thought to operate on populations where populations are collections of interbreeding individuals. In order for speciation to occur a population needs to be subdivided into sub-populations where there isn't interbreeding between the sub-populations. The lack of interbreeding prevents heritability operating between the sub-populations and thus variations that arise in one population can't be driven into fixation across both sub-populations unless the variation independently arises in both groups. What variations arise in the sub-populations are likely to vary. What variations are adaptive in the sub-populations are thus also going to vary - both as a function of the different variants present in the sub-population and as a function of the different niche affordances of the two sub-populations - since the main mechanism for producing sub-populations is going to be geographical separation. A variety of extra-evolutionary mechanisms referred to as 'drift' (e.g., meteor strike, falling trees etc) are thought to be responsible for dividing populations into sub-populations. Once we have sub-populations then evolution by natural selection can (over time) result in the sub-populations being *unable* to interbreed for genetic or morphological rather than merely geographic reasons. While there is controversy, I think that in the case of speciation extra-evolutionary processes are responsible

¹I'm going to argue largely from the principles of evolution by natural selection as I think the implications are often misunderstood - often with concerning consequences for social policy.

²It is worth distinguishing the claim that those three properties are instantiated in the world from the stronger (and probably false) claim that evolution by natural selection is the main mechanism for speciation. The intelligent designers are correct that there is much debate over the latter. It is unfortunate that these two distinct issues are often conflated.

³There is controversy over the units that natural selection operates on. Some candidates are: genes, morphological or behavioral characteristics, sub-populations or groups within a species, species, memes. It isn't quite clear what would play the role of genetic mutation for these other units. It is understood that there is a gap between genes and the expression of genes in morphological or behavioral characteristics, however.

⁴The 'Adaptationist Assumption' has come under a lot of fire recently, so it is possible that Darwin didn't go there for very good reason.

⁵Darwin was very clear in maintaining that it was senseless to attempt to rank different traits for their adaptive value *between species*. This is because different species occupy different ecological niches (e.g., is it better to have gills or lungs?). Despite this, we might think that we can rank different species with respect to how adapted they are to their own environmental niche. In particular, it would seem that species that are close to extinction aren't particularly adapted. Ants probably outperform *Homo Sapiens* with respect to diversity of environments that they occupy and prevalence around the globe. Now we have a decision: We can accept this or we can say that we aren't much interested in adaptation after all (because it doesn't seem to be working to justify our intuition that we are better somehow). Not a lot follows from being better adapted (unless extinction is imminent), however. In particular: Ants are not busily evolving to be more like us, and we are not busily evolving to be more like ants.

for the variation that is generated within a population and for the heritability of those variants (where geographical isolation prevents that). Speciation thus doesn't undermine the notion that evolution by natural selection operates over diversity to produce homogeneity⁶.

When a trait or a variant on a trait has been driven into fixation then we have a fairly clear case of adaptation or function for the trait or variant on the trait - in that species, in that environment. When variation remains and there isn't a clear shifting of the relative frequency of the trait or particular variants in subsequent populations then it would seem that we simply don't have a clear case of the trait or variant of the trait being more adaptive or functional than other traits or variants⁷. The persistence of difference in such things as IQ scores shows us that the differences aren't differences of evolutionary adaptation or function. Indeed, it is more surprising that people would think that they would be relevant as the evolutionary notion of adaptation or function has to do with the *relative number of offspring* and it is very clear that we aren't attempting to calibrate the findings of intelligence tests with relative number of offspring! Evolution by natural selection and the related notion of expected relative number of offspring thus doesn't seem to have anything to do with the diversity of intelligence found in intelligence tests. Finding diversity in intelligence with no clear shifting in the intelligence exhibited by subsequent generations shows us that individual differences in cognition aren't being subjected to evolution by natural selection since evolution by natural selection would result in greater homogeneity in scores rather than persisting diversity. Evolution by natural selection and the evolutionary notion of adaptation, function, and dysfunction are often misapplied. The misapplication seems most often to be based on a misunderstanding of the principles of natural selection.

A similar situation has arisen where theorists have maintained that the difference between a disorder or disease and a mere problem in living is that evolutionary dysfunction is necessary for disorder or disease. The thought is that science will discover whether a certain condition involves an evolutionary dysfunction or not and that whether a condition is a disorder or a disease is thus something to be discovered by science. There are two problems: Firstly, evolutionary function and dysfunction is not the relevant notion for bio-medicine. While there is near consensus on the 'disease' or 'disorder' status of conditions that threaten survival increasing expected reproductive fitness simply is not the aim. Fertility treatment is one of the most contested areas and we often care about disorders occurring after reproductive age. Secondly, the relevant notion of dysfunction isn't *discovered* it is simply *assumed*. We begin with the phenomena that is of interest. We then describe the causal processes involved in its production. If we have the intuition that the phenomena is a dysfunction then we describe the causal processes as dysfunctional. If we have the intuition that the phenomena is not a dysfunction then we describe the causal processes as mere differences. Whether the causal mechanisms involved in the production of homosexuality were regarded as dysfunctional or not depended on whether the morphology was regarded dysfunctional or not, for example. I am very concerned about our failure to realize that our values drive our judgements of function and dysfunction both in the natural sciences (outside of evolutionary biology) and in social policy. It strikes me that there is a similar failure to see the values that are behind our efforts to rank such things as adaptation or cognitive capacity. While there is an objective notion of evolutionary function and dysfunction this notion really doesn't seem relevant for our project of ranking individual difference in cognitive capacities either between species or within species. While *Homo Sapiens* really are 'very peculiar primates' in a number of respects (see, for instance, Sterelny), the project of ranking difference seems to have more to do with imposition of value than scientific discovery⁸.

⁶And thus extra-evolutionary processes are more significant for speciation than evolution by natural selection. The intention / mandate of an intelligent designer doesn't count as drift because the intention / mandate of an intelligent designer is not a scientific mechanism, however.

⁷There is a great deal of controversy over whether intelligence is increasing over time. How one wants to define intelligence seems to depend on where one is situated in life more than anything else. Is it more intelligent to be able to hunt fish in a kayak in freezing arctic conditions or to perform *modus ponens* on arguments where the premisses are false? Is it more intelligent to create bombs with the power to destroy the conditions ones species requires for life or to be able to survive such radical environmental change (e.g., cockroaches)?

⁸Fortunately this obsession with ranking individual difference in cognition seems largely restricted to individuals occupying a specific socio-economic niche in the USA and it doesn't really seem to have caught on elsewhere. While differences between species and within a species are interesting, I have immense difficulty with appeals to evolution by natural selection to justify rankings that are consistent with our values, especially when it seems to involve a misunderstanding of the principles of evolution by natural selection.