On natural selection and culture

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The "monolithic theory" claims that there is only one process of evolution: natural selection among alternative genetic alleles. Plotkin & Odling-Smee (P & 0) criticize this theory on the grounds that environmental variations during the lifetimes of organisms necessitate instructions that respond more rapidly than genes, and that evolution must hence occur through other processes, and at other levels, than genetic *ones.* In other words, they argue that genes cannot be the only instructions (behaving structures) involved in evolution; enzymes, contractile proteins, neurons, genetically programmed neural instructions, learned neural instructions, and culturally acquired neural instructions also evolve, each through its own process. Nevertheless, it could be argued that genes are the only self-replicating instructions, and thus the only ones actually capable of evolving.

It seems logically possible, for instance, that the neural instructions carried by a highly complicated organism, say a human being, could all be entirely genetically programmed, their *presence* having required only an *environment* normal

for ontogeny. Each such neural instruction would behave only in a particular cue-context, of course, so the animal would have a complete repertory of adaptive responses to varying conditions. For a sociobiologist to view a learned neural instruction (and/or its behavioral resultant) as just the expression, in a certain environment, of the set of genes that built the learning apparatus, is not illogical either. But it does not help us gain an understanding of the variations. I think, too, that it is fundamentally misleading: Because cultural instructions, too, are self-replicating (via observational learning and verbal tuition), they, too, evolve through exactly the same "monolithic process" as genes do, that is, through natural selection. I'm arguing, in other words, that only cultural and genetic instructions are in fact capable of evolving, because they are self-replicators; the other instructions mentioned above, and all other products of the behaviors of cultural and genetic instructions, do *appear* to evolve, but only because the self-replicators produce them anew in each "generation." There is just one process, natural selection, but it enables evolution of units of exactly two kinds.

To P & O's list of metaphors that are overused by sociobiologists, I would add the one wherein organisms adopt different reproductive strategies in attempting to maximize their inclusive fitnesses. That metaphor, of course, closely approximates the sociobiological idea, which is criticized by P & 0, that genes are adaptive for the organism - the opposite of the idea, which we seem to agree is correct, that the organism's features are, as a rule, mechanisms of adaptation for the genes. (Oddly enough, the "strategy" metaphor of the sociobiologists seems to be opposed to their monolithic theory as articulated by P & 0.)

P & O's distinction among types of sites of "information storage," that is, among types of instructions, is useful: a gene is not an enzyme, is not a contractile protein, is not a neural instruction, is not a habit, is not a culture-trait. P & O's recognition that instructions of various types interact to enable any given adaptation to occur is essential, as is their corollary that you can't look at an adaptation (or at any complicated feature, really) and declare that it's the product of instructions of just one particular type. But that leads to the further conclusion, I think, that equating the distinction among instruction-types with a distinction among *"levels* of evolution" is a mistake.

Genes are stored, properly speaking, in individuals' genomes; and cultural and other neural instructions are stored in individuals' nervous systems (especially their brains) - not in pools. "Pool" is a useful abstraction, but not in the context of storage.

Getting back to "levels" proper, no one can deny that epigenesis depends on genes, phenotypes on epigenesis, learning on phenotypes, and culture on learning (Cloak 1980, pp. 329-40). What P & 0 leave out is the *nature* of that dependency. The dependency is not mysteriously rooted in history; rather, it results from the fact that (just to choose the "bottom" and "top" levels) any cultural instruction must repeatedly get itself selected in its here-and-now environment, which includes its carrying organism, the carrying organism's structural and behavioral features, and the genes that enable and operate all of the above. If the instruction fails to get itself selected via that environment, it will not propagate or even maintain itself in the cultural pool (sic).

The converse of that is also true: as culture evolves, cultural instructions and products become ever more salient environmental features, enabling the selection of *genes* and cultural instructions. For example, selective adaptation to the newly-evolved cultural environment has often been invoked to explain the dramatic expansion of the human cranium during the Pleistocene. P & O's hierarchical view seems incapable of comprehending the ecological complexity of selective interactions among instructions of different levels.

P & 0 employ "natural selection" in two somewhat different senses, and have thus missed an opportunity to contribute to a unified theory of cultural and genetic evolution.

When they discuss the monolithic theory, they treat natural selection as "selection among alternative alleles." The advantage of this treatment is that, in the final analysis, the units that are selected are microinstructions, the genes - "It is genes that end up being selected and not genotypes, or phenotypes, or phenotypic traits." So treated, natural selection is a *creative* process, indeed *the* creative process, of evolution - rather than a mere culler of the unfit from populations of organisms mysteriously provided.

This treatment has two serious disadvantages, however: first, it recognizes only genes as self-replicating instructions capable of selection and, thus, of evolution; second, it defines selection in terms of competition, that is, of alleles competing for chromosome-loci, and thus prevents consideration of natural selection as a process underlying evolution and adaptation in noncompetitive situations. (Again, the monolithic theory now appears somewhat less monolithic, since we now need another process to account for noncompetitive evolution.)

2. When treating of culture traits, however, P & 0 see only their "ultimate evaluation by natural selection," because "natural selection . . . is only sensitive to whether an animal as a whole is fit." In brief, natural selection is now viewed as but a culler of the unfit.

These two conflicting treatments of natural selection can be reconciled, I think, if we simply accept the idea that cultural instructions are self-replicating microinstructions, like genes. Then we immediately recognize that natural selection is the creative process underlying the evolution of cultural, as well as biogenetic, features. By "evaluating" cultural traits, natural selection actually shapes the cultural pool just as it shapes the gene pool.

The following brief formulation of natural selection allows it to be studied as the "monolithic" and creative process by which all biotic evolution - genetic and cultural - takes place, in both competitive and noncompetitive contexts:

> Natural selection is the class of processes, in each of which a behavior of an instruction *enables an occurrence* of that instruction or of an instruction interchangeable with it.

Ascertaining the environmental conditions under which a given instruction is thus "selected" is strictly a matter of empirical inquiry. By logic, however, a behavior can *enable* neither (1) an "occurrence" that doesn't happen, nor (2) an occurrence that would have happened anyway. An instance of natural selection, in other words, requires both an environmental "opportunity" and an environmental "challenge"; in the lower Pleistocene, to build on a previous example, some genes whose behaviors enabled the brains of their carriers to expand were thereby selected, but only because there was culture available to be stored in the additional cells (environmental "opportunity"), and only because certain conditions prevailed there and then such that some further occurrences of those genes were contingent upon that culture being stored there (environmental "challenge").

The concept of enabling, including its element of contingency, strongly supports two assertions of P & 0. First: evolutionary history (or, as I would say, the present environment, which is in part an outcome of evolutionary history) does not determine, in the absolute sense, the next evolutionary event. Second, a corollary to the first: evolution is inherently unpredictable. The latter fact requires us to develop new scientific standards for testing explanatory hypotheses about evolution.

By the above formulation, it is not logically necessary that natural selection "operate" only via whole animals or Mendelian populations thereof: anything an instruction

happens to do that enables it to occur is an instance of natural selection and, if repeated often (which is likely only if it is a self-replicator), will result in its propagation or maintenance and the propagation or maintenance of whatever macrofeature(s) it enables - in other words, in the evolutionary change and adaptation of (a) the set(s) of instructions of which it is a part and (b) the behavioral products thereof.

Moreover, it is not factually true that natural selection "operates" only via whole animals and populations. There are genes - for example, the T-allele in the house-mouse - that enable their own occurrences and thus propagate, even though, on balance, they are lethal to their carriers. And cultural instructions that enable pain, death, and even reproductive suicide of their carriers to occur have been known to propagate and maintain themselves. In other words, a cultural instruction or a gene may enable its own recurrence via an environmental route other than organism survival or reproduction. Ascertaining which route a given instruction employs is a matter of empirical research and thought, not a matter of a priori reasoning (Cloak 1976; 1977).

P & O's explication of "adaptation" is not very satisfactory - the definiens (in terms of "relevance") is more opaque than the definiendum. Nor is the linking of adaptation to "information" helpful. (At one point they substitute "instruction" for "information"; I wish they had stuck to it, it is much more precise.) I think an adaptation is anything that an organism or a gene or other instruction regularly has or does that enables its subsequent occurrence, or the occurrence of another entity like itself, (i.e., whatever "gets it selected"). The link to environment, then, is that the thing the organism or instruction has or does enables its occurrence only in the presence of some particular environmental "opportunity" and "challenge"; in an environment lacking either of those conditions, the behavior may occur but it is not an adaptation.

P & 0 should more explicitly decouple cultural acquisition from individual learning. A cultural instruction may have originated through an individual conditioning of some cultural ancestor, but that is quite irrelevant to its present selection and replication. It is a fact that people (and possibly members of other culture-bearing species) acquire certain cultural instructions, and act on them, and continue to act on them, even though the outcomes of those actions are very painful (i.e. negatively reinforced) (Cloak 1976, pp. 219-28). Moreover, such instructions are often maintained and even propagated over generations, so they must be enabling their own recurrence despite the pain they cause.

In fact, there is no logical reason why a cultural instruction must originate in individual learning. For example, a novel cultural instruction might originate in a misperception, of a (perhaps complicated) behavior by an animal engaged in observational learning (cultural acquisition); if the behavior of this "mutant" cultural instruction subsequently enables occurrences of it or similar instructions (natural selection), it may become commonplace in the cultural pool without ever having been learned in the sense of P & O's "third level." The important thing for cultural evolution is the Darwinian mechanism of change or continuity, not the "Lamarckian" mechanism of origin.