and offering an inspirational glimpse into a very new kind of social science that may exist in the future. Our only concern is that readers may run with the ideas without thinking carefully about each step.

Evolutionary theory and the riddle of the universe

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Abstract: An effective restructuring of the social sciences around the evolutionary model requires that evolutionary theory has explanatory power with respect to the spread of cultural traits: The causal mechanisms involved should be structurally analogous to those of biological evolution. I argue that this is implausible because phenotypical consequences of cultural traits are not causally relevant to their chances of "survival."

That there exists a certain likeness between the evolution of species and the manner in which cultural traits are propagated, stands beyond doubt. Before we jump to conclusions and start remodeling the social sciences according to the evolutionary blueprint that biology provides, however, it is important to have a clear indication that the evolution of cultural traits is not merely similar to biological evolution, but structurally analogous to it. Therefore, the important question is not whether models based on evolutionary theory are roughly *descriptive* of the spread of cultural traits, but whether the evolutionary model has *explanatory power* with respect to the process by which that spread occurs. And for this to be the case, the model has to get the causal mechanisms of the process right.

In the story "The Riddle of the Universe and Its Solution," Czerniak (1981) describes a situation that would allow for a positive verdict on this score. It is useful to examine this situation, because it rather glaringly differs from the situation that we find ourselves in with respect to the propagation of ideas and other cultural traits. Czerniak imagines that, for humans, there exists an idea analogous to a Gödel sentence for computers. People who have this idea go into a catatonic state from which they are unable to recover. The propagation of such an idea (or rather, the process by which it goes extinct) would be truly analogous to biological evolution. The reason for this is that the causal system at work would be structurally analogous to selection of genes by biological evolution: A phenotypical consequence of having the Gödel idea (namely, going into catatonic state) is itself responsible for its lower chances of being propagated – just as the phenotypical properties associated with genes may cause their bearers to go extinct.

The fact that this story strikes us as science fiction suggests that, in reality, it does not work like this. At least on the face of it, the propagation of ideas and other cultural traits does not involve selection on their phenotypical properties (if that term is at all well defined). Ideas, artifacts, and other cultural traits are subject to changing levels of popularity, sometimes as a result of their becoming more or less useful over time, sometimes because of other factors. But surely the decline in popularity of, say, Dixieland music is not due to any phenotypical consequences of liking Dixieland music. In point of fact, liking Dixieland music does not prevent one from giving away Dixieland records for free, however much the decline in popularity of such records in the human population may resemble the evolutionary process by which genes become infrequent in a population of animals. In contrast, such a connection does exist between having a gene and being able to propagate it (namely, if the gene is bad for you, you die before you get the chance to propagate).

Mesoudi et al. attempt to anticipate the problem of identifying such causal mechanisms by stating that "just as Darwin formulated his theory of evolution with little understanding of genes or Mendelian inheritance, a theory of cultural evolution likewise does not necessarily have to rest on the existence of memes or particulate cultural transmission" (sect. 1, para. 12). But this confuses an ontological condition with an epistemological one. The relevant issue here is not whether Darwin *knew* about the mechanisms of inheritance via genetics; the relevant issue is that such mechanisms *exist* and are *causally relevant* to the biological phenomena that we want to explain. In other words, what convinces us of the usefulness of the evolutionary framework in biology has nothing to do with the epistemological position Darwin was in when working out the principles of evolutionary theory; it has to do with the fact that his theory, by and large, appears to be true.

The biological sciences are organized around evolutionary theory because evolution has causal relevance for each of the disciplines involved. For a similar organization of the social sciences to be an effective restructuring, rather than a case of plastic surgery, it is important to show that such causal relevance also exists for the various disciplines that make up the social sciences. Hence, the mechanisms by which cultural traits are propagated cannot be sidestepped as easily as Mesoudi et al. suggest, and they would, therefore, do well to offer some convincing arguments for the existence of such mechanisms. Otherwise our restructured social science, modeled after the biological plan, will be like a toy model of a Boeing 747. It will look just the same, but it won't fly.

It is not evolutionary models, but models in general that social science needs

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Abstract: Mathematical models are potentially as useful for culture as for evolution, but cultural models must have different designs from genetic models. Social sciences must borrow from biology the idea of modeling, rather than the structure of models, because copying the product is fundamentally different from copying the design. Transfer of most cultural information from brains to artificial media increases the differences between cultural and biological information.

Mesoudi et al. make a plea for the use of evolutionary models, developed for analyzing genetic evolution, in analyzing cultural influence and change. Indeed, they provide many illuminating examples of the usefulness of modeling in social sciences, but the connection to mathematical models of biological evolution is often indirect, sometimes only metaphorical. For example, in section 2.1.2 the authors cite Mace and Pagel (1994), who treat cultural traits as equivalent to biological characters, with independent instances of cultural change occurring when a cultural trait is invented, acquired from another culture, changed, or lost. This situation is very different from biological evolution, though, where "acquired" is not a possibility. Further, cultural traits are not like Mendelian units, independent of one another – they influence one another, they have different sizes and different nestings, and, as Mesoudi et al. note, they are frustratingly difficult to define.

Under these conditions, it is surprising that models developed to analyze biological evolution are also useful for looking at cultural development. But the value of the models may stem not so much from their link to evolutionary theory as from the way that they force investigators to define terms, use consistent categories, and in general discipline their data. Mathematical

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models are also useful to identify ill-defined concepts or relationships, and to find unsuspected relationships among variables.

A particularly useful function of modeling is to uncover hidden assumptions in a discipline. A ground assumption of cultural anthropology, for example, might be that cultures are coherent, independent entities, and that a given person belongs to only one of them. Perhaps it was inevitable that many anthropologists came to think in this way, because our evolved capabilities for social reasoning revolve around individual people who have distinct traits and personalities; we use this capability to assign characteristics to groups, using the mental machinery that evolved in us to understand individuals (Bridgeman 2003, pp. 178–79). The pioneering modeling of Boyd and Richerson (1985), done without the concept of culture as a critical variable, showed the value of modeling social interactions but also showed how different the resulting models were from mathematical descriptions of biological evolution. In short, what social sciences must borrow from biology is not the models themselves, but a commitment to mathematical description of phenomena and modeling of the processes in which they engage.

The studies of cultural selection reviewed in section 3.3.3 highlight the structural differences between models of biological evolution and models of cultural change. The "selection" of cultural traits is different from selection of genes in a way that Susan Blackmore (1999) colorfully and effectively explained in her example of copying a pumpkin soup. I can ask for the recipe, and reproduce the soup according to a constant set of instructions, so that the similarity of my soup to hers is limited only by the similarity of available ingredients (the environment). If I change the soup, most of the recipe remains the same. Copying the recipe is analogous to genetic inheritance. Alternatively, I could go home and try to reproduce the soup by guessing at the ingredients, basing my guesses on the flavor and texture of the soup that I had experienced. This copy-the-product strategy is the pattern of cultural inheritance, which Blackmore points out is fundamentally different from copy-the-plan structures.

Another questionable assumption about the informational contents of culture appears in section 3.5.3, where Mesoudi et al. assume that cultural information is represented primarily in the brain. Merlin Donald (1991) has pointed out that this was once the case, before reading and writing made it possible to store information outside the brain. Today not only books but a vast array of technical aids store information and move it around the world, making much of the content of our culture so accessible that it is no longer necessary or even advantageous to store content in the head. Our minds are filled largely with pointers to the information we need, rather than the information itself. The transfer of cultural information to film, video, books, and other media vastly increases the richness and magnitude as well as the accessibility of the information, potentially enhancing cultural change even while making brain-based models of it obsolete.

In conclusion, I will stick with Plotkin (2002a): Differences between genetic evolution and cultural change are fundamental. They follow different rules and should be kept distinct even while both are modeled mathematically.

Intelligent design in cultural evolution

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Abstract: Intelligent design, though unnecessary in the study of biological evolution, is essential to the study of cultural evolution. However, the intelligent designers in question are not deities or aliens but rather humans going about their lives. The role of intentionality in cultural evolution can be elucidated through the addition of signaling theory to the framework outlined in the target article.

Darwinian aspects of cultural evolution were first identified long ago (e.g., Schleicher 1863). Mesoudi et al. update this analogy and make a convincing case for a unified science of cultural evolution that parallels the science of evolutionary biology. However, as Mesoudi et al. acknowledge, such a science must differ from evolutionary biology in a number of ways. One important difference, which they deal with quickly, is the active, often intentional role that humans play in cultural transmission and, thus, in cultural evolution. Although the notion of intelligent design is unnecessary in the study of biological evolution, it is essential to the study of cultural evolution. The intelligent designers in question, however, are not deities or aliens but rather humans going about their lives.

When they do address the active role that individuals play in cultural transmission, Mesoudi et al.'s interest in long-term cultural evolutionary trends leads them to focus on technological innovation and creativity. They are correct that the impact of human intentionality on long-term cultural change in those realms is an empirical question and that recognition of intentionality does not undermine the approach they advocate. But those of us who live, work, and study in the here-and-now, minute-by-minute, day-by-day, down-and-dirty, nitty-gritty reality of everyday human social life are constantly faced with the fact that the cultural pools in which we swim are at least stirred, if not created, by human intentions. When we study cultural change and other human phenomena on the short timescales of everyday life, grand analogies between biological and cultural evolution tend to become less interesting than the question of how our evolved psychological and behavioral propensities play themselves out in the things we say and do.

Furthermore, even very drastic cultural change is possible on short timescales, and even if such episodes can be phrased in the language of cultural evolution, it is not clear what is gained by doing so. For example, I have documented a brief episode of extreme culture change among the Mukogodo of Kenya (Cronk 1989; 2002; 2004). In the space of little more than a decade, the Mukogodo shifted from speaking a language called Yaaku, living in caves, hunting, and keeping bees to speaking Maa, living in houses, and keeping livestock. This was surely an instance in which a particular meme pool was drained and refilled in short order, but pointing that out seems much less interesting than exploring the reasons why Mukogodo individuals chose to make such a swift and radical change. Those reasons certainly do involve the question of what memes they had available to them – they adopted those of their new neighbors rather than inventing entirely new ones or adopting those of some more distant group – but they also concern the strategies Mukogodo individuals employed to obtain food, find mates, communicate, keep warm at night, stay dry when it rained, gain respect, and so on.

One interpretation of this argument might be that even if cultural evolutionary theories like those described by Mesoudi et al. are relevant to long timescales, human phenomena at shorter timescales are best studied using non-evolutionary methods. I reject that interpretation and seek instead a way to remain within an evolutionary framework while focusing on phenomena that people experience in their everyday lives. Elsewhere (Cronk 1991; 1994; 1995; 1999; 2005) I have argued that this can be accomplished by using animal signaling theory to study signals that humans construct primarily out of the cultural raw materials they have at hand.

With signaling theory, one can simultaneously acknowledge the role of intentionality in human affairs, remain within an evolutionary framework, and study human culture. Mukogodo ethnic signaling, for example, is better understood through an application of signaling theory (Cronk 2004). Since the early twentieth century, the Mukogodo have had limited success in raising their status by adopting the language, clothing, subsistence, religion,

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