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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and even stated offspring sex preferences of higher-status Maasai. Their difficulties in convincing anyone that they are real Maasai makes sense in light of signaling theory. Signals, including ones about ethnicity, are believable only if there is some guarantee of their truthfulness. One way to provide such a guarantee is to make a signal difficult to fake, and ethnic signals generally have that quality. Mukogodo awareness of this is shown by the fact that they chose to emulate the Maasai, who were removed from the area by the British in the early twentieth century, rather than the remaining high-status Maa speakers in the region, the Samburu. Whereas no Maasai were left to challenge Mukogodo claims to Maasai identity, any claims to Samburu identity could easily have been dismissed by the Samburu themselves. Other applications of signaling theory to human affairs include studies of fishing (Sosis 2000), hunting (Bliege Bird et al. 2001), dancing (Brown et al. 2005), cosmetics (Cronk et al. 2002), engagement rings (Cronk & Dunham 2003), political rhetoric (Johnson 1986; 1987; 1989; Salmon 1998), kin terms (Chagnon 1988; 2000), religion (Cronk 1994; Irons 1996; Sosis & Alcorta 2003), and interpersonal communication (Gerkey & Cronk 2005).

Signaling, which generally occurs at very short timescales, clearly belongs in the category of microevolutionary processes. The question arises, therefore, of how to relate it to other microevolutionary process and to cultural macroevolution. One approach to this problem is to emphasize the aspects of signaling theory that focus on receiver psychology (Guilford & Dawkins 1991). The basic idea is simple: Signals, whether they are designed by natural selection or by advertising executives, should be designed to fit the psychology of the intended receiver. Similarly, cultural traits may be more successful in persisting in the minds of individuals and in being replicated if they are memorable and attention-grabbing (e.g., Boyer 1994 on religious concepts). In this way, evolved human psychology becomes the link between the short life of an individual signal and the long life of a cultural tradition, and intentionality can be given the role it deserves in the unified science of cultural evolution outlined by Mesoudi et al.

A continuum of mindfulness

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Abstract: Mesoudi et al. overlook an illuminating parallel between cultural and biological evolution, namely, the existence in each realm of a continuum from intelligent, *mindful* evolution through to oblivious, *mindless* evolution. In addition, they underplay the independence of cultural fitness from biological fitness. The assumption that successful cultural traits enhance genetic fitness must be sidelined, as must the assumption that such traits will at least be considered worth having.

Mesoudi et al. provide a valuable survey of the parallels between biological and cultural evolution, but they ignore or underestimate several other parallels that go some way to explaining the intensity of the distaste with which many researchers in the humanities and social sciences view *any* attempt to introduce Darwinian thinking into their domains. When Darwin first proposed sexual selection as a significant factor in biological evolution, it was greeted with both dismay and delight: To some it was an ominous backslide from the mindless purity of natural selection, whereas to others it was a welcome relief, restoring cherished elements of "mind" into evolution (Cronin 1991; Dennett 1995). But Darwin had already shown us the continuum from foresighted attempts to redesign nature through to utter mindlessness in his trio of *methodological* selection (in deliberate breeding and crossing), *unconscious* selection (in early domestication – which we might call domestication *without intent*), and *natural* selection proper, which invokes no minds or cognitive discriminations at all. It is important to avoid the common misconstrual that views methodical and unconscious selection as *alternatives* to natural selection, rather than as special *varieties* of natural selection, in which the selection pressure is focused through events in the nervous systems of the domesticating species. There is nothing counter-Darwinian, of course, in either phenomenon; intelligence *did* evolve by natural selection "proper" and thereupon became a potent selective force in the environment. Early domestication was thus an interspecific variation on sexual selection, in which the (cognitive) eye of the selector plays a crucial – but, of course, non-miraculous – role (Miller 2000). Neither the choosy females nor the early keepers of animals needed to understand their role in the "improvement of the breed." To these selective phenomena we can add the more recent and still more mind-requiring tinkerings of genetic engineering. The processes of generate-and-test that yield the would-be replicators come in all varieties of intelligence, but in the end, as Crick reminds us, Orgel's Second Rule applies: Evolution is cleverer than you are (Dennett 1995).

What many thinkers in the humanities and social sciences find abhorrent in evolutionary perspectives is the imagined implication that any such model will replace the traditional freedom of will, rational authorship, and artistic genius imputed in their disciplines with mindless random mutation and mechanical selection. And indeed, in cultural evolution, as Mesoudi et al. make abundantly clear, there are undeniable cases of cultural features that evolve by Darwinian processes without any need to invoke authors, designers, or other intelligent creators. Most obviously, languages – words and pronunciations and grammatical features – evolve without any *need* for grammarians, deliberate coiners, or other foresighted guardians of these cultural items. But what Mesoudi et al. never properly acknowledge is that the traditional perspective of the humanities, in which intelligent authorship, foresighted, purposeful reasoning, and artistic judgment occupy center stage, also has a place in the evolutionary picture, so the dread of the humanists is misplaced. Again, there is a continuum, with many different levels of mindfulness or rational engagement to be discerned. There is unconscious selection (as Darwin would say) of musical styles, for instance, methodical selection (with much planning and debate) of political arrangements and elements of religious dogma, for example, and attempts at *memetic* engineering by advertisers and even scientists seeking the best – most vivid and unforgettable – acronym for their novel theory or investigative method. And here, as before, Orgel's Second Rule applies. No matter how intelligent, foresighted, and purposeful the local process may be, most of the brainchildren of human cultural vectors fail to found long-lived lineages.

Another point that is underplayed in the target article is the extent to which cultural traits can flourish or perish independently of their effects on our genetic fitness. Because cultural evolution can occur in orders of magnitude faster than genetic evolution, many of its prominent patterns must be stabilized by forces that are only weakly related, at best, to the reproductive success of their vectors. The default presumption that all cultural traits that do evolve will be fitness-enhancing needs to be firmly set aside. Mesoudi et al. are right that this assumption is not uniformly made, but it is often tacitly implied or suggested by the way people write about cultural evolution. For example, the fact that some form of religion is found in every human group that has ever been studied leads many to conclude that religion *must* be enhancing to either individual or group fitness, but this is a serious non sequitur; the common cold also is found wherever there are people, but presumably it is not fitness-enhancing at all. It has evolved because it could evolve.

One may, of course, treat these shifting features of human culture as mere "noisy" variation around the few cultural traits

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