

## 6 From Typo to Thinko: When Evolution Graduated to Semantic Norms

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Natural selection edits with an eye only toward what the message says, not to what it means.

—Richard Powers, *The Gold Bug Variations*

### Darwinian Perspectives on Culture

Do we need a Darwinian theory of cultural evolution? In one sense, certainly. It is obvious that there are patterns of cultural change—evolution in the neutral sense—and any theory of cultural change worth more than a moment's consideration will have to be Darwinian in the minimal sense of being consistent with the theory of evolution by natural selection of *Homo sapiens*. Our species name is well chosen, and it is culture that makes us the knowing hominid, so a minimally Darwinian theory of culture must hold that the phenotypic traits that make cumulative culture possible—mainly, language and the habits of sociality—evolved by natural selection, unaided by what I call *skyhooks*: saltations in Design Space that could not be the outcome of standard evolutionary mechanisms (Dennett 1995). This minimal Darwinism is simply the denial of the hypothesis that culture is, as it were, a miracle, a gift from God.<sup>1</sup> It maintains in one way or another that natural selection eventually provided the foundations for culture, which then took off and elaborated itself under some regime that explains the patterns of cultural change, but that regime need not itself be Darwinian in any interesting sense.

For instance, the standard model is an economic one. The theorist says, in effect, if Darwin will give me *Homo economicus*, a social group of rational, self-interested individuals getting and spending, saving and making and trading, I can then use the intentional stance (Dennett 1971, 1987) as the explanatory framework for describing and accounting for the patterns of cultural evolution. This economic model is used not just by economists, of course; it is tacitly presupposed by historians and anthropologists and all the other theorists who treat culture as composed of goods, possessions of the people, who husband them in various ways, wisely or foolishly. People

carefully preserve their traditions of fire-lighting, house-building, speaking, counting, justice, etc. They trade cultural items as they trade other goods. And of course some cultural items (wagons, pasta, recipes for chocolate cake, etc.) are definitely goods, and so we can plot their trajectories using the tools of economics. It is clear from this perspective that highly prized cultural entities will be protected at the expense of less favored ones, and there will be a competitive market where agents both “buy” and “sell” cultural wares. If a new method of house-building or farming or a new style of music sweeps through the culture, it will be because people perceive advantages to these novelties and choose them. If Coca Cola bottles proliferate around the world, it is because more and more people prefer to buy a Coke. Advertising may fool them. Then we look to the advertisers, or those who have hired them, to find the relevant agents whose desires fix the values for our cost-benefit calculations. *Cui bono?* Who benefits? The purveyors of the goods and those they hire to help them, etc. In this way of thinking, then, the relative “replicative” power of various cultural goods—whether Coke bottles, building styles, or religious creeds—is measured in the marketplace of cost-benefit calculations performed, consciously or unconsciously, by the people.

Biologists, too, make good use of the economic model, explaining the evolution (in the neutral sense) of features of the natural world by treating them as goods belonging to various members of various species: one’s food, one’s nest, one’s burrow, one’s territory, one’s mates, one’s time and energy. Cost-benefit analyses shed light on the husbandry engaged in by the members of the different species inhabiting some shared environment.<sup>2</sup> Not every “possession” is considered a good, however. The dirt and grime that accumulates on one’s body, to say nothing of the accompanying flies and fleas, are of no value, or are of negative value, for instance. These hitchhikers are not normally considered as goods by biologists, except when the benefits derived from them are manifest.

These economic models of culture are consistent with Darwinism but are not more specifically Darwinian. Darwinian evolution provides organisms whose ultimate goal is self-replication, and who then track the rational if myopic trajectory to that end; the interactions of such rational agents determine which features of the shared environment will proliferate, which will be contested, which despoiled, and so forth. In these models, cultural traits, however they arise, spread as fitness enhancers, at least locally considered. Agriculture, cooking, clothing, the wheel, writing, the bow and arrow—all these cultural innovations are plausibly viewed as improvements that need not arise from gene mutation and recombination and need not be transmitted genetically. They are, one might say, infectious phenotypic features. These features, it is presumed, pass some sort of quality-control test administered by the agents themselves. They are chosen by evolved organisms and put to use, and if they didn’t “pay for themselves” in a fitness boost (or at least an apparent fitness boost, myopically con-

sidered) they would soon die out, just like genetically transmitted phenotypic variations. The idea is that if innovations are randomly distributed around neutrality, the pernicious innovations will hasten the demise (or mating failure) of those who adopt them; the enhancements will do the opposite, and over the not very long haul the enhancers will proliferate. This vision allows the possibility, as relatively rare outliers, of mistakes: either good tricks abandoned by mistake or pernicious tricks persisted in thanks to some local illusion.

More ambitious models (Feldman and Cavalli-Sforza 1981; Boyd and Richerson 1985) then address the opportunities for coevolution, for interaction between the items that come to be present or dominant in the cultural marketplace and the genetically transmitted phenotypes of the persons transmitting and preserving those items. Clothes do make the man, at least to the extent of diverting selection pressures for weather-hardiness, so the cultural transmission of clothing sends ripples through the evolution of human physiology. Similarly, new practices of food gathering and preparation can reflexively change the fitness landscape for digestive capability. Lactose tolerance in adults descended from people who herded dairy animals is a well-studied case. These models are Darwinian in a more than minimal sense because they extend the perspective of population genetics, the replicator dynamics, to these nongenetically transmitted phenotypic features, exploring the effects of horizontal and oblique transmission, for instance. However, they also maintain the basic economic presupposition of rational agents: Cultural traits are adopted because they are deemed worth having, because they are supposed, rightly or wrongly, to contribute somehow to the achievement of one's more ulterior ends, whatever they may be.

When a rational agent or intentional system makes a decision about which is the best course of action, all things considered, we need to know from whose perspective this optimality is being judged. Here things begin to get messy. In nature, genes are the ultimate units of "self"-interest. That is to say, adaptations in plants and animals (and simpler life forms) are, by definition, features that further the *summum bonum* of gene replication, directly or indirectly. Are cultural innovations adaptations in this narrow, genetic sense? It is obvious that many cultural features are deemed by the populace to be beneficial, functional, adaptive, useful, life-enhancing, or enabling. It is less clear that these esteemed features play a discernible role in enhancing genetic fitness, as contrasted with, say, human happiness, the pursuit of which is curiously orthogonal to genetic fitness. One of the striking trends in human evolution, going back thousands of years, is the gradual diminution in the proportion of human effort devoted in any clearly discernible way to the achievement of the fundamental goals we share with animals: avoiding pain, hunger, and predation, and seeking comfort, security, and mating opportunities. Even if the peculiar human *desiderata* of prestige, power, wealth, beautiful surroundings, recreation, music, toys, and so forth, have discernible instrumental rationales (improving one's profile in the contest for mates,

enlarging one's harem, one's territory, one's margin of error), they have more or less detached themselves from these inaugural foundations and become ends in themselves. The young man bought the guitar in order to attract young women, but now he has become a guitarist who would rather make music than love. As Cavalli-Sforza and Feldman note,

There are people determined to risk their life to reach the top of Mt. Everest, and others that spend their life accumulating money, or attempting artistic or scientific creations, or simply trying to do as little as possible. It is difficult to subsume all of these choices under a common schedule admitting no individual variation. (1981: 342)

As they put it,

Control is delegated to a system of poorly understood internal drives and rewards that direct the activity of the individual. . . . Our very inadequate knowledge of this steering system prevents us from making finer statements, but it is probably true that the system's overall activity is directed towards maximizing self satisfaction of the individual. Important complications arise because we can satisfy ourselves in many different, competing ways, many of which demand careful advance planning. (1981: 364)

Feldman and Cavalli-Sforza thus adopt the default assumption, at least in the Western world, and especially among economists, of treating the agent as a sort of punctate, Cartesian locus of well-being. What's in it for *me*? Rational *self*-interest. However, while there has to be something in the role of the self—something that defines the answer to the *cui bono* question for the decision maker under examination, there is no necessity in this default treatment, common as it is. A self-as-ultimate-beneficiary can in principle be indefinitely distributed. I can care for others, or for a larger social structure, for instance. There is nothing that restricts me to a *me* as contrasted to an *us*. I can still take my task to be looking out for number one while including, under number one, not just myself, but my family, the Chicago Bulls, Oxfam, the flourishing of mid-twentieth-century acoustic guitar finger-picking techniques—indeed anything human ingenuity can define and become attached to, making its welfare definitive of the decision maker's "happiness."

It is not obvious that any other organism strives for its own happiness or anything like it. If human happiness is our *summum bonum* (or at least a *bonum* against which we do in fact often attempt to measure costs and benefits), how did it arise? It is here that the prospect of a still more radically Darwinian theory of cultural evolution becomes attractive. Could the unique varieties of human evaluation that are so distantly and indirectly anchored to any plausible litmus test of genetic fitness be accounted for by supposing that human beings have evolved into a condition where they have become the vectors, the hosts, of a new order of symbionts—competing cultural replicators whose own fitness, defined in standard Darwinian terms of relative replicative success, has constituted a new sort of entity? An enculturated human being,

according to this proposal, is as important a novelty on the evolutionary front as the eukaryotic cell was at its debut: a unification of distinct replicators into a synthetic organization with a displaced goal or *summum bonum*. It is no longer just an organism bent on self-replication, but a *person* bent on furthering the particular goals and ideals with which that person identifies. Has our guitarist unwittingly become part of a guitar's way of making another guitar? This is a tantalizingly attractive idea, but for such a perspective to anchor itself firmly in evolutionary theory, we must take seriously Dawkins's concept of a meme, and there are reasons to doubt that we should do that.

### **Cultural Replicators: A Central or a Peripheral Phenomenon?**

In some neighborhoods, ball bearings outnumber rabbit turds; in other neighborhoods this imbalance is reversed; and in yet other neighborhoods no entities of either variety are to be found. These differential production patterns change over time, and there are reasons for them, but they are not, in the main, Darwinian reasons. Not all production is replication, and not all distribution is emigration. Variety and similarity are also found among cultural items, and the question is whether any (or many) of the reasons for patterns in changing "populations" of cultural items are Darwinian.

Dan Sperber (2000) notes that the dictionary definition of "memes" is too bland to be of much interest: "an element of culture that may be considered to be passed on by non-genetic means," while a more radical definition, more faithful to Dawkins's arresting proposal, "cultural replicators propagated through imitation," is far from obvious. Indeed, it is in need of defense against two objections. The "simplest and most serious objection" is that the copying of cultural items is in general too low fidelity to permit natural selection to get a purchase. Compare memes with viruses. Viruses travel light and carry no copying machines, so they reproduce by entering cells and tricking the cell's proprietary copying machines into making spurious copies of them instead of copying their usual and proper fare, the cell's own DNA. If memes are like viruses, as Dawkins and other would-be memeticists have claimed, it is because they reproduce by exploiting the copying machinery resident in the brains of human beings. How well does this parallel hold? How good is that machinery? Not good enough, it seems. We human beings are actually rather bad at the sorts of "mindless" copying that cells excel at.

Following Williams (1966), Sperber notes that although higher selection biases can tolerate lower fidelity, it still appears that "mutation" rates among memes would be so great that any description of the emerging patterns in terms of descent with modification, as Darwin put it, would be lip service only. "For memetics to be a reasonable research program, it should be the case that copying, and differential success in causing the multiplication of copies, over-whelmingly plays the major role in shaping

all or at least most of the contents of culture” (Sperber 2000: 172). If we are not inveterate and talented copyists, we will make poor hosts for our cultural viruses, and Darwinian descent with (relatively rare) modification will seldom occur. We will need to look elsewhere to explain the patterns of culture.

Is it so clear that our copying is too low fidelity to work? Dawkins (1999) has responded to this objection with his example of the origami model of a Chinese junk, which people learn to make by following a canonical set of simple “self-normalizing” instructions, but Sperber finds this misleading, since “the normalisation of the instructions results precisely from the fact that something other than copying is taking place” (2000: 169). Sperber lays down three conditions for “true replication”:

For B to be a replication of A,

1. B must be caused by A (together with background conditions).
2. B must be similar in relevant respects to A.
3. The process that generates B must obtain the information that makes B similar to A from A.

It is condition (3), Sperber claims, that is seldom met by cultural transmissions. Infectious laughter is his excellent example of a transmission event that meets (1) and (2) and fails (3), and he extends his analysis of this case by the fanciful example of ten sound recorders that trigger each other, but whose productions, in one case, do not consist of replications, but rather of recognitions, followed by re-productions. Triggered production of this sort is distinct from copying or replication in the one way that matters for Darwin, according to Sperber. It does not slavishly copy the original; instead it is inspired by the original to make another of the same sort—but without any systematic attempt or disposition to reproduce any idiosyncracies of the original. It normalizes its production to an independent ideal, discarding or not even noticing any mutations, good or bad, in the original.

Sperber illustrates this point with another fine example, the contrast between a nonsense scribble and a five-pointed star. The nonsense scribble would degenerate quickly in any series of attempted replications because people are not good copiers of such productions, while the five-pointed star would be “copied” with high fidelity, just as Dawkins says. However, Sperber maintains, the succession of stars would not really be copies of their predecessors, since the “copyists” would normalize to the recipe for the drawing procedure, ignoring the details of the individual productions. Is Sperber looking at the right level of fineness? Dawkins’s point is that a finite repertoire of such triggered productions is not just a good trick for human beings who want to heighten their transmission fidelity, it is a Good Trick discovered several billion years ago by natural selection. Sperber distinguishes copying from merely triggering the production of a similar effect, but a repertoire of such triggers, called an alphabet, is what makes high-fidelity copying possible, both in cells and in human culture.

Suppose Tommy writes the letters “SePERaTE” on the blackboard, and Billy “copies” it by writing “seperate.” Is this copying or triggered reproduction? The normalization to all lower case letters shows that Billy is not slavishly copying Tommy’s chalk marks but rather is being triggered to execute a series of canonical, normalized acts: *make an “s”*; *make an “e,”* etc. It is thanks to these letter norms that Billy can “copy” Tommy’s word at all. And he does copy Tommy’s spelling error, unlike Molly, who “copies” Tommy by writing “separate,” responding to a higher norm, at the level of word spelling. Sally then goes a step higher, “copying” the phrase “separate butt equal”—all words in good standing in the dictionary—as “separate but equal,” responding to a recognized norm at the phrase level. Can we go higher? Of course. Anybody who, when “copying” the line in a recipe “Separate three eggs and beat the yolks until they form stiff white cones,” would replace “yolks” with “whites,” knows enough about cooking to recognize the error and correct it. Above spelling and syntactic norms are a host of semantic norms as well.

DNA has an alphabet—the famous ACGT—and words, the three-letter codons that “spell” the twenty amino acids. In fact, the high fidelity of genetic transmission depends on the subcellular machinery being triggered to “recognize” and “re-produce” a small repertoire of types, whose idiosyncracies, if any, are ignored, not slavishly copied: “*make a cytosine,*” “*make a guanine,*” etc. There are error-correcting enzymes as well, but they don’t ascend (as far as we know!) above the level of a spell checker, correcting “typos” by brute template matching against the original.<sup>3</sup>

Does the human capacity (and irresistible disposition) to respond to higher, semantic norms—our capacity to correct not only typos but what hackers call *thinkos*—rule out cultural transmission as a candidate for natural selection? Sperber seems to think it does. “Contrary to what Dawkins writes,” he claims, “the instructions are not ‘self-normalizing.’ It is the process of attribution of intentions that normalizes the implicit instructions that participants infer from what they observe” (Sperber 2000: 171). Sperber is partly right; the attribution of intentions is the key difference between this sort of human transmission and genetic replication. The point comes out even more clearly if we mutate Sperber’s example slightly, adding a point to his star. Consider the fact that there are two distinct recipes (and many other less obvious ones) for making a regular six-pointed star:

1. Make a regular hexagon and put equilateral triangle points on each side.
2. Make an equilateral triangle and superimpose on it another one, upside-down.

A series of six-pointed star “replications” might be created by a random alternation between these two recipes with no loss of fidelity. Which recipe did various individual copyists follow? It wouldn’t matter, because what is being copied is not the recipe but the result understood as an intended object having certain features.<sup>4</sup>

Sperber thinks that this reliance on attribution of intentions on the part of the copyists disqualifies cultural transmission as a Darwinian process of natural selection. He supposes that this invocation of intelligent, semantically sensitive, intention-attributing agents in the purported replication process flies in the face of a fundamental requirement of Darwinian processes: mindless, purposeless mechanistic. He is almost right. To see the force of this interesting objection, imagine a creationist variant on standard neo-Darwinian genetic evolution. It postulates that God watches over each moment of DNA replication and whenever He sees some copying that is “wrong” (relative to God’s great plan), he undoes it. Thus when He chooses, he lets mutations flourish, and when He does not, those mutations get corrected by a gentle miraculous nudge of the error-correcting enzymes. Here Intelligence is playing a guiding role in evolution—just the sort of role that orthodox (devout, “fundamentalist”) Darwinians abjure. As Richard Powers has observed, “Natural selection edits with an eye only toward what the message says, not to what it means” (1992: 546). Clever human beings, in contrast, edit with an eye toward meaning. If such clever editors are inserted into the process of cultural transmission and revision, what would be left of a Darwinian theory of culture?

This worry ignores the fact that *Homo sapiens* is not itself a miracle, a skyhook, but something that has evolved by nonmiraculous natural selection. Its capacity to respond to semantic norms is itself something that has evolved under a regime that could not respond to semantic norms. Before there could be eyes, good for distal perception, there had to be mere photosensitive responders to proximal stimulation, out of which eyes could gradually be built. Before there could be minds, good for semantic discrimination, there had to be copying machinery that could only discriminate alphabet letters. Put otherwise, DNA error-correcting enzymes have always responded to semantic norms, but just local or proximal semantic norms—*make a G*—as contrasted to more distal semantic norms—*make a codon for asparagine* or *make some lysozyme* or *make a protein that blocks serotonin uptake*, or even *make something that will fight off infection*.

Why shouldn’t evolution go right on working once the copying machinery graduates to less myopic norms? Even our lowest-level mindless copying avails itself of correction to a norm. Is there a “highest permissible” level of normalization in any Darwinian process? Darwin (and Fisher, and Williams, and others) saw the need for a sufficiently “strong principle of inheritance” to keep evolution going, but nothing has been said about how that fidelity is to be maintained mechanically. Let there be copyists that take themselves to be responding to semantic norms; there will still be a suitably long-distance evolutionary perspective from which their copying efforts, for all their editorial work, will appear myopic and unwitting, oblivious to—and hence unresponsive to—the larger-scale pattern of differential replication that ensures that a Darwinian process is occurring.



In “Pierre Menard, Author of the *Quixote*,” Jorge Luis Borges (1962) tells the fanciful tale of a literary theorist who sets out to *compose* (not copy, not write from memory) Cervantes’ great work anew in the twentieth century. This will be an act of bizarre self-control, since Menard is a Cervantes scholar who no doubt has at least large portions of the text of *Don Quixote* committed to memory, but Menard is determined to bracket that memory and create, with his own authorial intentions, all of Cervantes’ sentences anew, like an experienced wheelwright setting out to reinvent the wheel! He succeeds (though how can he tell?), and Borges tells us: “Cervantes’ text and Menard’s are verbally identical, but the second is almost infinitely richer” (1962: 42). In one sense, Menard did not copy or memorize Cervantes’ text, but in another sense, he did, in spite of his virtuoso self-control, his obsessive act of re-creation. He did, because, as Sperber puts it, “(3) The process that generates B must obtain the information that makes B similar to A from A” (2000: 169) and surely Menard’s prior study of Cervantes’ text is an essential part of the scholarship that permits him to “compose” *Don Quixote* anew. Of course Menard has used a lot of other information as well; the surplus is presumably what permits him, unlike an ordinary reader, to claim to have re-composed, not written down from brute memory, the work. But so what? According to Borges, the texts are “verbally identical,” so high-fidelity reproduction has occurred. Imagine a world in which Menards abound, devoting their lives to the re-composition of their favorite works. The transmission of texts will proceed just fine in such a world—as fine as if photocopying machines were the underlying machinery.

In fact, of course, a pastel version of that fantasy is just what has happened in the transmission of ancient texts in our world, for seldom if ever have the scribes taking dictation been entirely uncomprehending of the words they were dutifully “copying,” and so they have willy-nilly “corrected” whatever they heard in the process of transcribing it. Their corrections have been governed by several levels of norms: orthographic or lexical, syntactic, and finally semantical. The imaginary Menard can be conceived to have “transcribed” the entire poem of Cervantes *modulo* the “semantic norm” of the whole text. Most of us lack that highly sophisticated norm; we tend to fall back on our sense of the gist of such a narrative, or when all else fails, rote memory or parroting (but even “parroting” is not like a parrot’s parroting—unless it is, as it very seldom is, a matter of reiterating formulas in a language we don’t understand).

When Sperber notes that in cultural transmission “the information provided by the stimulus is complemented with information already in the system” (2000: 171) he is right, but the same is true of DNA replication. The main difference, so far as I can see, is that unlike DNA replication, human cultural replication is accomplished by processes of highly variable semantic depth, responding to perceived (and misperceived) “copying” errors relative to norms at many levels. The alphabets of written languages provide us with the most vivid and best-understood system of such norms

of replication, but the phenomenon of semantic norms is not directly tied to language. Musical notation relies on the staff to digitalize the roughly inked spots, so that a musician can see at a glance that a chord is A-C#-E-G even though the A is written almost twice as far beneath the staff as it is “supposed” to be. A sketch of a new sort of axle for a wagon need not make the wheels exactly round; the user of the sketch will recognize those irregular closed curves as representations of wheels, which are to be round, of course. As we move through our various apprenticeships in life, we learn to perceive new families of categories—new alphabets, in an extended sense—from which to construct high-fidelity copies. Only a skilled potter can see at a glance what another potter is doing and copy it or teach it to others.

Consider a chef demonstrating the making of a sauce to an apprentice. The description in words might be “deglaze the pan, reduce the sauce, and thicken with cornstarch,” but the words aren’t really necessary if the apprentice appreciates the goal of each process. Here is a series of three analog processes, none of which could be exactly copied by the apprentice. The cook didn’t measure the water he sloshed into the pan, didn’t time the reduction period, and added cornstarch freehand until the sauce took on the desired consistency. The recipe can be transmitted faithfully all the same, thanks to the shared norms for these analog processes already inculcated in the apprentice.

If the error correction in the case of memes is semantically appreciative at many levels, doesn’t this show that cultural evolution is *not* a mindless algorithm but rather a system that must invoke high-level semantic comprehension at every juncture? The variable depth of semantic norms does guarantee that memeticists will have a problem providing identity conditions for memes that are more severe than the (already severe) problems afflicting the identity conditions for genes. If we consider that the meme ought to be understood to be the smallest unit of *information worth copying*, then we have already accumulated a wealth of understanding of just such problems, which arise in patent law and the law of copyright and trade secrets. How big is an idea? When is one idea an illicit copy of another idea? We have no single bedrock criterion for answering such questions, but we manage quite well with them in practice, counting on the costs of re-invention to stabilize our sense of what is worth copying in particular cases.<sup>5</sup>

It is undeniable that cultural transmission depends on comprehension at almost every juncture. We human beings are just not in the habit of copying formulas we don’t understand and then passing them mindlessly on to our neighbors. This in itself is not a fatal blow to the proposed Darwinian theory of cultural evolution because the intelligent agents active at these junctures are not miraculous. They are themselves products of earlier mindless evolution; cranes, not skyhooks. Moreover, the comprehension they exhibit, even in extreme cases, is typically insufficient to account for the cultural patterns their many attempts at copying and transmission eventually yield.

Just as genetic engineers, for all their foresight and insight into the innards of things, are still at the mercy of natural selection when it comes to the fate of their creations (that is why, after all, we are so cautious about letting them release their brainchildren on the outside world), so too the memetic engineer, no matter how sophisticated, still has to contend with the daunting task of winning the replication tournaments in the memosphere. One of the most sophisticated musical memetic engineers of the age, Leonard Bernstein, wryly noted this in a wonderful piece he published in 1955 in the *New York Times* entitled: “Why don’t you run upstairs and write a nice Gershwin tune?” Bernstein had credentials and academic honors aplenty in 1955, but no songs on the Hit Parade.

A few weeks ago a serious composer-friend and I . . . got boiling mad about it. Why shouldn’t we be able to come up with a hit, we said, if the standard is as low as it seems to be? We decided that all we had to do was to put ourselves into the mental state of an idiot and write a ridiculous hillbilly tune. (Bernstein 1959: 52)

They failed—and not for lack of trying. As Bernstein wistfully remarked, “It’s just that it would be nice to hear someone accidentally whistle something of mine, somewhere, just once” (1959: 54).

His wish came true, of course, a few years later in 1961, when *West Side Story* burst into the memosphere. Leonard Bernstein was a brilliant, comprehending, foresighted, ambitious creator of musical designs that he hoped would replicate like viruses in brains around the world. He succeeded in a few cases, but so did many musically ignorant, lackadaisical, inadvertent exuders of equally infectious melodies. Other unforgettable melodies have no identifiable composer at all, but have emerged from untold rounds of differential replication. A theory that can encompass, and ultimately explain, all such varieties of cultural production will need to track the differential ability of authorless and authored items to get people to harbor them and pass them on, with or without comprehension.

## Notes

1. The demands of this minimal Darwinism are far from trivial, and the ferocity with which Darwinian accounts of the evolution of language and sociality are attacked by some critics from the humanities and social sciences shows that mere consistency with evolutionary theory is not yet an accepted constraint in many quarters. This is a fact of life that we must deal with; fear of the thin edge of the wedge misleads many who hate the idea of a strong Darwinian theory of cultural evolution to resist conceding even consistency with evolutionary theory as the obvious requirement it is.

2. Such organisms need not be deemed to be making conscious decisions, of course, but the rationality, such as it is, of the “decisions” they make is typically anchored to the expected benefit to the individual organism. See, e.g., McFarland’s (1989) distinction between an organism’s goal function and its cost function, and Dennett (1989).

3. One might be tempted to treat the tolerance for variant “spellings” for proteins—e.g., there are over a hundred different ways of “spelling” lysozyme—as a sort of higher-level norm correction, but this is not strictly parallel since the copying at each locus is by local spelling, without ad lib interchange, except for mutations.

4. Following Sperber and Wilson’s (1986) reasoning in a different domain 1986 we can note that no complicated (“Gricean”) reasoning is required by the individual vectors in the series of transmissions, since they need not reconstruct the hidden recipe behind the production but simply use the optimality assumptions built into the intentional stance to home in on the intended production. It may often be difficult to reverse engineer the recipes for cultural products (styles of pottery, for instance) (Boyd and Richerson, 2000), but it is not typically necessary, since the intended properties of the result can be read off so readily.

5. There is considerable debate among memeticists about whether memes should be defined as brain structures or as behaviors, or as some other presumably well-anchored *concreta*, but I think the case is still overwhelming for defining memes abstractly, in terms of information worth copying (however embodied) since it is the information that determines how much design work or R and D does not have to be re-done. That is why a wagon with spoked wheels carries the idea of a wagon with spoked wheels as well as any mind or brain could carry it.

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