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Common misunderstandings of memes (and genes):

The promise and the limits of the genetic analogy to cultural transmission processes

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Abstract: Memetics suffers from conceptual confusion and not enough empirical work. This paper will argue that, although memes are not, in fact, selfish replicators, they can and should be analyzed with Darwinian models. The selfish meme conception does more to distort than enlighten our understanding of cultural processes.

I. Introduction

There is now a vigorous debate on how Darwinism should be applied to culture (see Aunger 2000). Following Dawkins (1989[1975]), many now refer to units of cultural transmission and evolution as 'memes', regard 'replicators' as essential for a Darwinian process, assume 'selfish memes', and adopt a 'meme's eye view'. Analogies and borrowed yardsticks are often useful for a new field, but may also cause misunderstanding. I will argue that Dawkins' legacy for cultural Darwinism has not only given rise to confusion but itself results from misconstruals of Darwinian theory.

I will not define a 'meme' as a *selfish replicator* [1] but will adopt the broad Oxford English Dictionary's definition—"an element of culture that may be considered to be passed down by non-genetic means".[2] Selfish replication, then, is a

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[1] Nor do many others, including several authors in Aunger 2000 (e.g. see chapters by Plotkin, and Laland & Odling-Smee).

[2] Unlike Sperber (2000:163) I do not think this definition is trivial. Nor do I think that it corresponds to the way anthropologists have always thought about culture, as he claims. Implicit in this definition is the idea that memes are units, that they are materially stored, and that they are subject to selection. These intuitions open the way to a completely different form of cultural analysis from that which we anthropologists have traditionally contemplated. As Sperber

hypothesis about the behavior of the stuff that gets transmitted through non-genetic means. The relevant questions, then, are:

1) Does this stuff behave like a selfish replicator?;
2) If not, does this make Darwinian analyses of culture impossible?
3) If not, is it impossible to find the boundaries of memes?
4) Can we simply appropriate the 'selfish gene' idea from biology?

I will answer "no" to each but will still call what is culturally transmitted 'memes'.

II. What is required for cumulative genetic evolution?

Darwinian processes are simple, and blindly algorithmic, but they gradually accumulate purposeful design (often very complex). They have three main requirements: information must leave descendant copies (*inheritance*), new information should be routinely generated (*mutation*), and some items of information should reliably leave more descendants than others (*selection*).

Genes meet these requirements. They are inherited through reproduction; new genes are routinely created because of occasional copying mistakes, or mutations, during DNA duplication; and a gene's effects on its carriers affect the probability that it will leave more copies. Thanks to selection and inheritance, genes that cause increased reproductive success in their average carrier leave more copies, and the gene's relative frequency in the population increases (absent frequency dependent effects, eventually the whole population will have it). Thanks to mutation, new alternative genes get generated which occasionally amount to improvements, allowing the population to continue to evolve.

Cumulative genetic adaptations are possible because (1) genetic mutations typically introduce incremental rather than massive changes, and (2) the mutation rate for genes is low. An over-emphasis on these two properties of genetic transmission is responsible for the mistaken intuition that replication—perfect copying—is required for cumulative evolution. For this reason, I give it further attention.

(1996) has emphasized, anthropologists have tended to mystical approaches to culture that put it 'out there' in the ether somewhere rather than in people's brains, and have failed to examine the processes of transmission in phenomenal and cognitive detail. By contrast, the idea of memes in any of its forms makes units of cultural transmission analogous to genes. This produces an entirely new perspective—a revolution of sorts.

We should expect organic evolution to consist of small incremental changes. The space of worse designs is vast relative to the space of better ones, and since mutations are random, they are unlikely to result in better designs. If a monkey types a character at random as I write this essay, he is unlikely to improve it. But if a monkey presses a key launching a program to rearrange at random *all* the letters in my essay, he is infinitely *less* likely to improve it. Given a selective force, a random novelty usually will not last longer than a geological instant unless it produces small changes. Thus design improvements, which result from atypically lucky random changes, are *incremental*.

Mutations must also be *infrequent* because cumulative evolution is impossible without relative stability of design across time. If the offspring of As are mostly non-As, then even if A reproduces better than competitors B and C, this will not increase the frequency of A-types, since the information in A is mostly lost after reproduction. When As instead typically beget other As, then their higher reproductive success will soon make everybody in the population an A (absent frequency-dependent effects). Later, if a rare mutation generates a slight improvement to the A design—call it the A° design—, these A° mutants will outreproduce mere As and the population changes again (but only slightly).

This covers the intuitive basics of genes. How similar are memes?

Memes also show inheritance, mutation, and selection. We learn from each other through social interaction so, in a broad sense, my information can create a descendant copy in you (*inheritance*). People often make mistakes when copying, and they can also have stupid or bright novel ideas, generating modified items of information (*mutation*). And some ideas are copied more, stored longer, and rebroadcast more often, leaving more descendants than competing ideas (*selection*). The properties of human social-learning psychology make some ideas more popular than others.

Many critics have focused on how similar must ancestor and descendant memes be for the analogy to hold. Some assert that selectionist approaches to culture cannot work because memes are not true replicators, making cumulative evolution impossible (Sperber 1996; Boyer 1994). Others disagree, and have built models of cultural change with fundamental assumptions quite similar to those of evolutionary genetics, but adapted for the idiosyncrasies of culture (e.g. Boyd & Richerson 1985; Lumsden & Wilson 1981; Cavalli Sforza & Feldman 1981; Castro & Toro 2002; for a review, see Feldman & Laland 1996). To adjudicate, we must examine whether it matters that memes are poor replicators.

III. Do memes mutate too much?

Genes *replicate* because they almost never make copying errors during duplication. Since relative stability of design over time is a requirement of cumulative evolution, genetic replication allows organic evolution to be cumulative.

Dan Sperber compares memes ('representations') to viruses that infest brains in successive epidemics. But he sees an important difference:

> . . .whereas pathogenic agents such as viruses and bacteria reproduce in the process of transmission and undergo a mutation only occasionally, representations are transformed almost every time they are transmitted. . .
> …Memory and communication transform information.
> (Sperber 1996: 25, 31)

For example, no one ever retells a story *exactly.*

> In the case of genes, a typical rate of mutation might be one mutation per million replications. With such low rates of mutation, even a very small selection bias is enough to have, with time, major cumulative effects. If, on the other hand, in the case of culture there may be, as Dawkins [1976] acknowledges, 'a certain "mutational" element in every copying event,' then the very possibility of cumulative effects of selection is open to question. (Sperber 1996: 102-103)

G.C. Williams' (1966) famously defines an 'evolutionary gene' as "any hereditary information for which there is a favorable or unfavorable selection bias equal to several or many times its rate of endogenous change." Dawkins' conception of memes applies the same standard, as stated clearly by Wilkins:

> A meme is the least unit of sociocultural information relative to a selection process that has favorable or unfavorable selection bias that exceeds its endogenous tendency to change. (Wilkins 1998:8)

Sperber accepts this move by assuming that: (1) replicators are the things to look for; (2) Dawkins' interpretation of Williams gives the *universal* definition of a replicator, and (3) Darwinian analyses will apply to memes *only if* they can satisfy this definition. Sperber regards any other conceptualization of memes as trivial (Sperber 2000:163).

Since Sperber argues that memes mutate in *every transmission event*, he concludes that cultural selection cannot conceivably act fast enough: the meme's dizzying

rate of endogenous change creates a ceiling effect (see also Atran 2001). Thus, not selection but cognitive processes of information storage and retrieval cause mutations in particular and systematic directions. By understanding how, we can build (orthomemetic?) models of directed mutation, as opposed to selectionist models of cumulative change (Sperber 1996:52-53, 82-83; 110-112).

Hull (2000:47) cites Wilkins' definition approvingly for a science of memetics that he optimistically believes *possible*, despite expecting "howls of derision" from critics who find this definition insufficiently "operational." Ironically, the opposite has happened: Sperber, a prominent critic of selectionist approaches to culture, has employed this definition to argue that selectionist approaches to culture are *impossible*.

Hull and Sperber agree on the standard Darwinian processes must meet, but disagree on whether culture satisfies it. Who is wrong? I suggest both are, since they have agreed on the wrong standard. Genetic replication is only one possible Darwinian processes; this particular solution is not necessary.

I accept Sperber's claims that memes mutate in every transmission event and in ways that are often systematically biased. But what matters, I will argue, is how big the mutations are, and how strongly biased in particular directions.

IV. Terminological clarification.

Replication means producing copies "exact in all details."[3] Though Dawkins recognized that copying mistakes are essential to Darwinian evolution, he dubbed genes 'replicators' because they are "astonishingly faithful" copiers that only "occasionally make mistakes" (Dawkins 1989: 16-17). Only after rehearsing this point did he introduce memes as hitherto unrecognized potential 'replicators' (Dawkins 1989:191-192), and argued that cultural transmission is Darwinian, *only if* memes are replicators. For him, if, as it seems, "meme transmission is subject to continuous mutation, and also to blending" this was a problem. Hence, he argued against it: "It is possible that this appearance…is illusory, and that the analogy with genes does not break down" (Dawkins 1989:194-195)

In his introduction to Blackmore 1999, Dawkins now dispenses with these worries: memes are definitely subject to Darwinian processes. This conclusion follows logically only if one decides a) that memes *are* replicators, or else b) that replication was not necessary. Dawkins, however uses examples of

[3] Merriam Webster's Collegiate Dictionary.

*non*replicating memes and yet he keeps the replication standard, as if these memes had met it.[4] Dennet (1995) and Blackmore do the same. "As long as we accept that…information of some kind [my emphasis] is passed on…then, by definition, memes exist," Blackmore says (2000:25). Since she also says that "memes are replicators" (p.26), by her definition replication is passing any information on. Aunger (2002:3) likewise defines replication as "the recurrence of. . .features."

Meanings have been turned upside down. We started with replication, defined as near-perfect copying fidelity, as *the* requirement for Darwinian processes. But these writers now ask first whether a unit is Darwinian, and if it is, they call it a 'replicator', whatever its copying fidelity! As a result of this extra-scientific semantic flip, the view that replication is a requirement of Darwinian processes has become entrenched.

Aunger recognizes that replication is not necessary for Darwinian processes (2002:ch.2), but he argues that 1) cultural 'replicators' are rampant and – perhaps because both coinages originate with Dawkins – that 2) replication entails a 'selfish meme' viral perspective on cultural change with humans as mere hosts.

> "It is only when information *replicates* that an additional causal force becomes involved. This is the very essence of the meme hypothesis…there is an information-bearing replicator underlying communication…a puppeteer pulling invisible strings…This puppeteer is the information packet itself, evolved to manipulate its carriers for its own ends." Aunger (2002:12-13; original emphasis)

I will argue, by contrast, that mapping the biases involved in social learning shows that only some rather specialized kinds of memes are really 'selfish.'

We should avoid the direct analogizing from biology to culture. However, we can still view culture in Darwinian terms.

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[4] Dawkins' argument is that, because humans keep trying to copy accurately, in the long developmental run meme-copying is close enough to replication to justify the application of Darwinian tools of thought. However, this repeatedly refined copying is far from being replication. even so one can apply Darwinian tools to culture, as demonstrated further below in the text. .

V. Replication is a red herring

Sperber's argument, though intuitively appealing, fails. Even meme-copying that is always imperfect can support cumulative adaptation.

To explain why, I begin with a few preliminaries. A genetic locus is the physical location on a chromosome where a gene is found. The eye-color locus, for example, contains information developmentally resulting in a brown eye or a blue eye. What is the memetic analogue? Imagine a tennis-serve locus with whatever is necessary to produce a certain behavior when it is your turn to serve in tennis. Anything could be in it. Waving hello to your mom, or baking a bread, would be ruled illegal by the judges, but in principle this information may be stored at the tennis-serve locus (similarly, a useless sequence of nucleotides could, in principle, be stored at the eye-color locus).

Cultural transmission does not require exactly duplicated neuronal structures, analogous to the duplication of exact nucleotide sequences in DNA, for Darwinian analyses to apply. Cognitively, the cultural locus is a *tag plus retrieval function*—a matter of categorization rather than physical location in the brain. What I retrieve as I begin a tennis point is information tagged 'tennis serve.' Waving to my mom or baking a cake have not been tagged this way (even though, in principle, they *could* be). The true alleles of my current serve, therefore, are other behaviors which I—and others—also tag as 'tennis serves' because some individuals in the population perform them when beginning a point in tennis. I may choose to acquire one of these later, replacing what is currently at my tennis serve locus. This gives the cultural locus all the requisite *functional* similarity to the genetic case.

A. The right mix of stability and variation

Suppose Bob's tennis serve is *the* most attractive, and watching Bob induces people to modify the information in their own tennis-serve loci. In principle, anything can result in the continuum bounded by the following two extremes:

1) Replication: people acquire information to reproduce Bob's serve exactly;
2) Random Changes: people rewrite the information at their locus such that they produce behaviors typically bearing zero resemblance to Bob's serve.[5]

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[5] For a mathematical demonstration of the central argument of this section, see Henrich and Boyd 2002. Note that I am not here tracking information in the brain, although it is necessary for the process. Rather, I am tracking actual behaviors, and ignoring what particular information content in the brain may be

Consider first the causation of random changes. As silly as it sounds, suppose that my admiration for Bob's top-spin serve motivates me to put random information in my tennis serve locus, say, 'wave at mom.' You put randomly different, but typically equally dissimilar, information in your own tennis serve locus (say, 'scratch the left knee').

What happens? We are assuming it is the content (the sequence of motions, plus their relative success in winning points) that make Bob's serve attractive. But because the changes observers make in their own loci are random, the 'tennis serves' of copiers look nothing like Bob's, so they are not admired and cause no further changes in others. Bob's serve therefore does not become more common, nor does the mean serve in the population move in the direction of Bob's. Since evolution is about statistical changes in a population, and since Bob does not pull the population mean towards his serve, design improvements will not accumulate under these assumptions.

Now consider the other extreme assumption. This sounds silly too. Here, watching Bob's serve produces information changes in observers' loci such that the resulting behaviors are replicas—perfect copies—of Bob's. There are no mutations, of any size.

What happens? All those who copied Bob's serve in turn become models for other people, who in turn copy it. Bob's serve spreads until everybody serves identically. Again, selection cannot lead to cumulative design changes because the serves have all become identical to Bob's. Nobody ever makes mistakes, so the future will be a world where everyone serves exactly like Bob—forever.

Thus, neither the extreme of random changes nor that of replication (100% copying fidelity), allows accumulation of adaptive design. That occurs only in the middle, where descendant changes are relatively similar to the parent stimulus, but somewhat different. This can happen in two ways.

> (1) *Small copying mistakes, only once in a long while.* Descendant copies are replicas of parent serves, with a tiny probability of replication failure. Rare random modifications typically make Bob's serve less effective, because a tennis serve is a complex behavior where many variables must be kept within narrow ranges to ensure success. Since only effective serves are attractive, most random changes produce less attractive serves. But very

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causing them. The latter is not always unimportant (Gil-White 2002a), but it is irrelevant to my present points. 'Replication failure' here means failure of the copier to *perform* a serve that is identical to Bob's.

occasionally a random copying mistake begets a more effective—and therefore more attractive—serve, which then displaces Bob's as people begin replicating the improved version. Many iterations of this cycle lead to ever better serves.

This case is exactly parallel to genetics. Sperber (1996) claims that cultural transmission must be like this in order to allow cumulative adaptations. But let us take a look at a rather different process.

(2) *Copying always involves mistakes, but closely hugging an average of perfect accuracy* (see Figure 1). Everybody's *goal* is to copy Bob's serve exactly, but there is always some error. Yet errors are relatively small, so that Bob's serve remains the template for all descendant serves. The population's *mean serve* is still Bob's, since errors cancel out around the mean. From the modest variations introduced by copying errors, a serve superior to Bob's emerges, and this becomes the new template for us all to imitate and thus the new mean of the population, with a cloud of error around it.

If we focus on the population mean, it is clear that, despite the absence of replication, adaptive design accumulates under selective pressure. Moreover, the process is faster than natural selection because mutants are produced in every copying attempt).

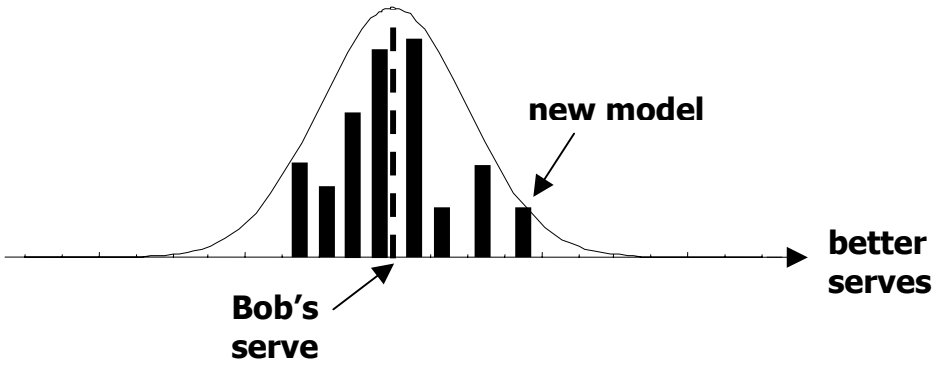

Figure 1. Copying with modest errors. Units in the X-axis are small, so that all serves produced are minor deviations from Bob's target serve. The height of the curve above any point is the idealized probability of getting serves that far away from Bob's. (Since serves are not unidimensional, this is a simplification.)

The second case reflects the basic assumptions in many selectionist models pioneered by Boyd & Richerson (1985). Contra Sperber, cumulative cultural adaptation is possible under these assumptions. Replication itself is a red herring. Cumulative adaptation requires (1) sufficient copying inaccuracy that superior variants occasionally emerge; and (2) sufficient accuracy that there is directional change at the populational level (the mean) (cf. Boyd & Richerson 2000).

B. Mutations may have consistent biases

What about directed mutation? If a psychological bias creates an attractor, copying mistakes will be made in its direction. This is still not a problem, at least not in principle. The attractor could be anywhere, but we can get our bearings by once again considering the two extremes.

(1) *The mutation attractor is the optimally effective serve* (Figure 2). Most of us try to copy Bob's serve exactly, but fail within a cloud of error with mean zero. A few, however, can see modifications that will make Bob's serve even better, and attempt these. This skews the mean 'error' for the whole population in the direction of the optimal serve. Does this prevent cumulative adaptive design? No. Rather, it speeds up movement to the optimum, since mutations in this direction are slightly more likely. Design changes are cumulative because foresight does not extend to the optimal serve itself, merely to slight modifications of observable serves that take them in that direction.

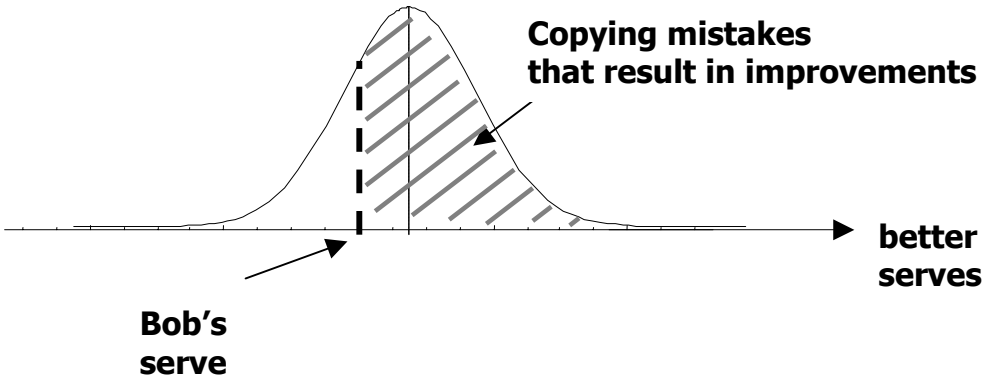

Figure 2. Adaptive mutation bias. In this case the population mean is closer to the optimum, after copying, than Bob's serve is.

(2) *The mutation attractor is in a direction opposite to the optimal serve* (Figure 3). If a good serve is a somewhat unnatural movement, errors will tend away from the optimal serve, so the mean copy is inferior to Bob's serve. But so long as 'errors' in the other direction (towards optimality) are not too unlikely, *some* descendant serves are better than Bob's and displace him as the model. The new distribution of copies again has a mean that lags the target serve, *but it is better than the previous population mean.* Hence, the population mean makes gradual progress towards the optimum despite always lagging its current target.

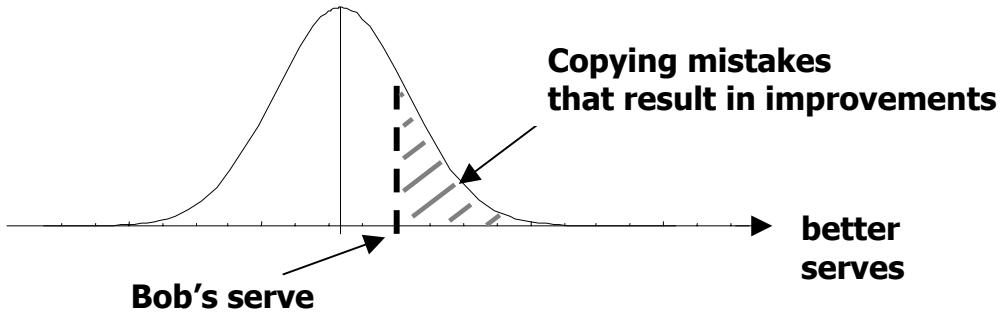

Figure 3. Maladaptive mutation bias. In this case the population mean is further away from the optimum, after copying, than is Bob's serve. However, some copiers make 'mistakes' to the right of Bob, yielding a better serve that becomes the model for the next generation.

Only when variants better than Bob's are *very* unlikely, because the maladaptive attractor is too strong, will this prevent the emergence of cumulative design (Figure 4).

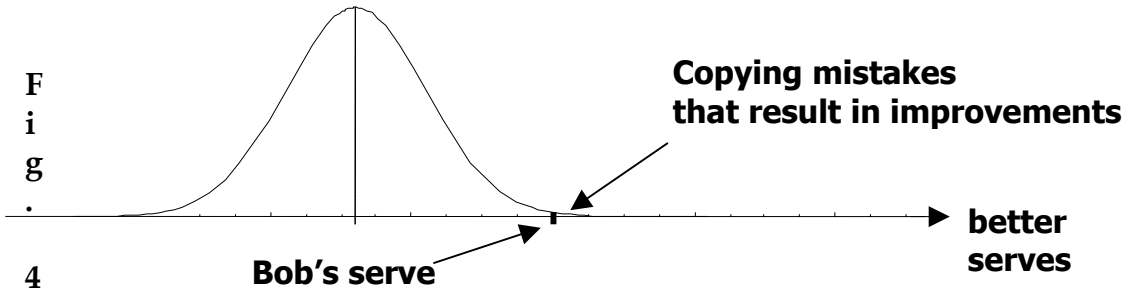

Figure 4. Overly strong maladaptive bias. A strong mutation attractor produces a population mean so far away from Bob's serve in a maladaptive direction that better serves practically never appear.

Therefore, any plausible directed mutation effects should be modeled together with selection, and the algebraic sum of the forces will determine the direction of the system. We do not have to decide between mutation and selection in our modeling exercises. Sperber is correct that constant directed mutation can prevent cumulative adaptation, but if and only if such mutation is (1) not towards the optimum and, (2) of sufficient strength. Whether these conditions are met is an empirical question; they may be met for some domains and not for others. The answer will not be found from an armchair.

What is the evidence? Do we have empirical examples of cumulative cultural adaptations through selection? Yes. Consider technological items, such as tennis racquets: design has accumulated gradually. Even here, Sperber's dictum that replication is a limiting case rather than the norm is correct (except in the case of very modern manufacturing techniques).

Or one could point to institutions, which are always imperfectly copied (consider that the Mexican political constitution is—on paper—almost a replica of the American). And yet institutions accrete cumulative adaptive changes, as evidenced by how the institutions of complex societies have outcompeted those of simple ones (McNeil 1963, Landes 1998, Diamond 1997, Wright 2000).

Technology and institutions include much of what is important in cultural evolution, and therefore selectionist approaches will be significant to historical explanations.

VI. Imitation is another red herring

Blackmore regards imitation as the mechanism of memetic evolution. Yet she considers a narrative, which is not transmitted by imitation, a 'meme.'

> Dawkins said that memes jump from 'brain to brain via a process which, in the broad sense, can be called imitation' (1976:192). I will also use the term 'imitation' in the broad sense. So if, for example, a friend tells you a story and you remember the gist and pass it on to someone else then that counts as imitation. (Blackmore 1999:6)

This definition of 'imitation' is much too loose. We need a handle on the social-learning cognitive mechanisms which, in combination with individual-learning processes, are responsible for affecting the distribution of memes (cf. Plotkin 2000; Laland & Odling Smee 2000). Imitation is important, but some domains depend on other processes.

> The imitation of a motor act, the acquisition of a native language, and learning one's culture-specific social constructions have different

> developmental trajectories. . .Each is based on different psychological mechanisms. It is almost certainly the case that the characteristics each displays in terms of fecundity, longevity, and fidelity of copying are also different in each case, and different precisely because each is based on different mechanisms. The suggestion that "we stick to defining the [sic] meme as that which is passed on by imitation" (Blackmore 1998), if taken literally, is an impoverishment of memetics for reasons of wanting to maintain copying fidelity. (Plotkin 2000:76)

Blackmore apparently requires imitation because it suggests replication, which she regards as a requirement of Darwinian processes. Critics again agree with the standard but reach the opposite conclusion: In a section title, Atran (2001) says, "No Replication without Imitation; Therefore, No Replication" (because there is no real imitation), and hence no Darwinian processes in culture. But this is the wrong litmus test; advocacy or skepticism about a Darwinian approach does not turn on imitation.

True, some cultural transmission scholars have stressed the importance of imitation, but their concern is the human/non-human comparison (Boyd & Richerson 1985, 1996, 2000; Tomasello *et al.* 1993). Though the appearance of imitation initially set humans along the path of cumulative cultural change, other tricks have since become possible. For example, I have recently argued that language became possible when imitation led to the emergence of prestige hierarchies (Gil-White 2002). But language now makes non-imitative processes possible, such as prestige-biased influence (Henrich & Gil-White 2001). Another example: narratives can accrue cumulative changes through selection but do not spread through imitation, even if the evolution of imitation was necessary for the emergence of language, which is indispensable for narrative. The phylogenetic indispensability of imitation should be distinguished from its current importance in cultural transmission.

VII. Platonic inferences

I have so far ignored an interesting problem. Individuals cannot replicate memes, though they do try. But what is their target? No two serves by Bob are ever replicas of each other; Bob's performance is itself a cloud of error around a mean. So copiers must be abstracting an 'ideal Bob serve' from Bob's performances, which they try to copy. Sperber dismisses this as 'a Platonist approach', claiming that formal properties cannot be causal (1996:62-63).

I disagree. We must infer an 'ideal' serve as Bob's goal, and strive for that. Evolution could not design our social-learning psychology otherwise, given that the performances of the people we copy are statistical clouds (cf. Dennett

1995:358; Dawkins 1999:x-xii; Blackmore 1999:51-52; Boyd & Richerson 2000). Selectionist models may therefore define 'the meme' as Bob's ideal goal, and track the population mean. Whether the simplification is legitimate depends on the problem being modeled.

However, there is no question that cognitive psychology and anthropology must study how the brain parses reality into important or irrelevant material. Understanding such cognitive filters will tell us what the memes are for a particular domain. But our presented limited understanding of these filters is no obstacle to current selectionist models (*pace* Atran 2002, ch.10). These models concern the formal, emergent properties of Darwinian systems that, by assumption, are capable of cumulative adaptation, rather than the histories of specific memes (for a review, see Feldman & Laland 1996). They teach us about the general properties of cultural evolutionary systems, and the results that emerge from the interdependence between two systems of inheritance: genetic and cultural.

VIII. What are the boundaries of 'a meme'?

Memes have been criticized for lacking well-defined boundaries (Atran 2001). Maurice Bloch (2000) writes:

> As I look at the work of meme enthusiasts, I find a ragbag of proposals for candidate memes… At first, some seem convincing as discrete units: catchy tunes, folk tales, the taboo on shaving among Sikhs, Pythagoras's theorem, etc. However, on closer observation, even these more obvious 'units' lose their boundaries. Is it the whole tune or only a part of it which is the meme? The Sikh taboo is meaningless unless it is seen as part of Sikh religion and identity. Pythagoras' theorem is a part of geometry and could be divided into smaller units such as the concept of a triangle, angle, equivalence, etc.

But are the boundary problems any greater for memes than genes?

A Darwinian unit is of whatever size selection favors. For this reason, Dawkins (1983:87-89) is right not to view the gene as a *cistron* (from 'start' codon to 'stop' codon). Cistrons are more useful to molecular biologists. Is the meme the whole tune or only part of it? A tune, like a cistron, has a starting point and an ending point, which are a matter of *mechanical performance*, not selection: for the tune, a musical performance, and for the cistron, the construction of a polypeptide chain. In culture, our colloquial understandings tend to confuse the distinction between units of performance and units of information storage.

One cultural locus houses a finite number of competing beliefs about which piece should be played. Here, the meme 'Beethoven's 5th deserves to be played' has done well. A different locus houses competing beliefs about how much of a piece should be played. Here, the meme 'play a piece from beginning to end' has fared well. Because these two memes are successful in their respective loci, Beethoven's 5th is played often and in its entirety—not because the whole symphony is encoded in the heads of listeners! What listeners remember of the piece is stored in yet another locus, where tune-fragments compete to be remembered. For the most part, only the catchy opening theme to the 5th is encoded.

These loci are independent though related. Very catchy but tiresome pop-tune fragments are remembered so easily that the preference for the entire song *not* to be played will spread (at least after the song's initial success). So both the tune-fragment and the negative preference for the song can be simultaneously at high frequency (nobody can forget the Macarena and most of us prefer not to hear it). But for a tune-fragment to persist across generations it must be enduringly popular (my grandchildren will know Beethoven's 5th, but not the Macarena).

A meme cannot spread except in a favorable ecology of memes at other loci (for example, 'Beethoven's 5th deserves to be played'; the memes necessary to play a violin; the meme that violinists should be paid; and so on). Similarly, genes prosper only when surrounded by favorable ecology of genes at other loci in its own and other vehicles. If this does not undermine population analyses in biology, why is culture different? Yes, the Sikh shaving taboo will spread and stabilize if the existing religious memes are congruent, and yes, Pythagoras' theorem cannot be learned without first possessing the meme for triangles. But neither can a gene for reciprocity spread without genes for, say, social aggregation. There is no new difficulty here.

Finally, what is the appropriate level of abstraction? The details of a narrative, say, are apparently not stored in memory (Schank & Abelson 1995). Critics may pounce: "Aha! No stability!" But at what level? If the narrative *skeleton* is stable, radical variation in the details is as worrisome to cultural Darwinian analyses as silent mutations in DNA are to evolutionary genetics (i.e. not at all). One must keep track of story skeletons, and changes there will be the real mutations (Gil-White, in prep.).

IX. Meme content is not everything

Sperber makes a concession to the view that we make Platonic inferences, but he insists along Chomskian lines that these almost always depend on pre-existing

knowledge structures being *triggered* rather than new knowledge being *bootstrapped*: observation produces prepared 'inferences' (2000; see also Atran 2002, 2001, 1998; and Boyer 1998, 1994). For example, "language learners converge on similar meanings on the basis of weak evidence provided by words used in an endless diversity of contexts and with various degrees of literalness or figurativeness" (2000:171-172). There are no stable, discrete memes competing with each other under selective pressure. Rather, meme-content is edited by successive directed mutations into the shape favored by the innately given content-bias 'attractors.'

Sperber admits that at least some things are not merely triggered.: "Learning to tap dance involves more copying than learning to walk". But, he insists, "For memetics to be a reasonable research programme, it should be the case that copying [as opposed to triggering], and differential success in causing the multiplication of copies, overwhelmingly plays the major role in shaping all or at least most of the contents of culture." In his view, this is not the case. Rather, "the acquisition of cultural knowledge and know-how is made possible and partly shaped by evolved domain-specific competencies…" (Sperber 2000:172)

Sperber's requirement is not a proper test, for five reasons. First, he asks us to choose between complements rather than alternatives. Domain-specific competencies do not rule out selection-driven cumulative adaptations.

Second, for many domains, the way inferences are triggered supports a rather different point. Learning Bob's serve requires that we abstract his *goal* from the statistical cloud of his performances. This is an inference, but the "pre-existing knowledge" it relies on concerns the purpose of a serve in a game of tennis, which does not derive from an innate, domain-specific module prepared to trigger 'tennis.' Because the rules of tennis need to be understood before Bob's goal can be inferred, this is a form of cumulative developmental bootstrapping not reducible to the triggering of innate and specialized content domains.

Third, Sperber's linguistic example is not even apt for his purposes.. There is undoubtedly much innate knowledge dedicated to the bootstrapping of language, but a model that reduces historical linguistic processes to the triggering of innate knowledge cannot explain how Indo-European became Hindi in one place and Spanish in another.

Fourth, Sperber's requirement is asymmetric.
The mechanism he disfavores, the copying of knowledge, can only be significant if it is "overwhelmingly" dominant "in shaping all or at least most" of culture, while his favored innate mechanism need only be "partly" responsible.

Finally, even granting Sperber's assumptions that there are innate attractors for everything, his conclusion does not follow. Henrich & Boyd (2002) show that so long as more than one attractor can exert influence over a given meme, and the attractors are strong relative to other selection pressures, the dynamics quickly become a contest between the discrete alternatives favored by each attractor, engaged in a selective contest. So even here we find something close to particulate selection rather than a fuzzy morphing into the attractor.

A. Non-content biases and their importance

Sperber might reply that, even so, the contest is between innate attractors ('core memes'), so one cannot expect cumulative cultural evolution acting on *arbitrarily* varying memes (see also Atran 1998; Boyer 1998). A related view stresses that 'triggered inferences' result mainly from local non-cultural environments (e.g. Tooby & Cosmides 1992), so cultural differences can be explained by the environmental conditions surrounding various local populations. By contrast, others argue—not instead but *in addition*—for the importance of *non*-content biases allowing arbitrary variations to spread and remain stable (Boyd & Richerson 1985; Henrich & Boyd 1998; Henrich & Gil-White 2001; Gil-White 2001a, 2001b). Our social-learning cognitive biases support the latter view.

Suppose Bob is your hero because he is a great tennis player. Bob likes a Wilson racquet. So you buy a Wilson racquet. Bob wears leather trousers; you buy leather trousers. Or, suppose everybody in your high school class is getting leather trousers. So you get leather trousers; you want to fit in. In these examples you acquire the meme not because of its content, but because of contingently associated features: its source, or its relative frequency. The tradition begun by Boyd and Richerson (1985) – with its roots in cultural anthropological questions – focuses on non-content biases, such as conformity bias and prestige bias, which produce the accumulation of arbitrary differences between societies.

Research in social psychology suggests that humans have biases favoring memes that are common relative to competing memes at a particular cultural 'locus' (Miller and McFarland 1991; Kuran 1995; Asch 1956, 1963[1951]). Boyd and Richerson (1985, ch.7) and Henrich & Boyd (1998) explain the adaptiveness of informational conformism: it helps individuals pick up useful memes that others have already converged on. Gil-White (2001a) argues that interactional-norm conformism is adaptive because it maximizes the number of the conformist's potential interactants.

Boyd and Richerson, among others, have also speculated that prestigious individuals are copied more often than others. Henrich & Gil-White (2001) develop a lay model to explain the evolution of such a cognitive bias and review

evidence for it in the social-scientific literature. We argue that prestige-bias is adaptive because successful individuals (i.e. with better memes) tend to have prestige.

These two biases care nothing about content: conformity bias cares about relative frequency, and prestige bias about source. As far as these biases are concerned, the memes could be about anything at all. Thus, in domains without strong content biases, we should see the following effects. First, the memes of prestigious individuals will tend to become more common. These will be unpredictably different for people in different communities given that every individual—including prestigious ones—has an idiosyncratic life history (e.g., I, but not you, may fall off the horse after washing my feet in a stream, and conclude superstitiously that the stream was somehow directly responsible). Second, such differences will be larger between members of different communities (even if we both fall of our horses after washing in the stream, I am more likely to blame the stream if my local community already believes that streams have supernatural powers). This sort of process will engender arbitrary differences between societies, and a third effect—conformism—will keep the differences locally stable at high frequency. The fourth and last effect is historical: such stable differences between societies produce acquired content biases making future memes consistent with them more likely and other memes less likely. These effects set different societies on separate and distinct historical paths.

The conformist and prestige biases offer an appealing joint explanation for the different historical trajectories resulting in dramatic variation among the world's cultures. They can explain why two populations living in the same environment can become quite different, culturally—something that happens all the time.

B. Don't reduce everything to 'content'

Anthropologists are interested in cultural variability. This sometimes leads to the theoretical excess of cultural relativism, according to which human brains are blank slates upon which local cultures can inscribe anything. But some anthropologists now overreact by claiming that nothing about culture approximates a blank-slate.

> The picture of the human mind/brain as a blank slate on which different cultures freely inscribe their own world-view. . .[is] incompatible with our current understanding of biology and psychology.

> . . . the brain contains many sub-mechanisms, or 'modules', which evolved as adaptations to. . .[ancestral] environmental opportunities and challenges (Cosmides & Tooby 1987, 1994; Tooby and Cosmides 1989, 1992) [and]…are crucial factors in cultural attraction. They tend to fix a lot of cultural content in and around the cognitive domain the processing of which they specialize in. (Sperber 1996:113)

Other anthropologists in this tradition have expressed similar views in the course of explaining the widespread recurrence of certain memes – certain religious ideas (Boyer 1994); concepts of living-kinds (Atran 1998); ideas about so-called 'races' (Hirschfeld 1996) – in terms of universal and innate content biases. This approach is valuable, but these authors seem to think that such content biases refute the possibility of acquiring unconstrained memes (Boyer 1998), and thus also refute the possibility of stable, arbitrary differences between cultures (Hirschfeld 1996:21-22), which in turn implies that such nonexistent differences cannot support cultural group selection (Atran 2002:ch.10). However, the importance of content-driven versus arbitrary memes should be adjudicated domain by domain. In some domains the blank-slate assumption will be quite reasonable.

Blackmore (1999) and Dennett (1995) also argue for the primacy of content, but focus more on the meme as autonomous. Cultural evolution is viewed as selective process that makes memes increasingly better propagators. As Dennett (1995:362) writes,

> Dawkins (1976:214) points out that '…a cultural trait may have evolved in the way it has simply because it is advantageous to itself.' … The first rule of memes, as for genes, is that replication is not necessarily for the good of anything; replicators flourish that are good at…replicating—for whatever reason!

For Dennett and Dawkins, the only thing affecting a meme's spread is whether *the meme itself* is good at replicating. Selection will successively edit the meme's content, making it ever better at replicating. This is the 'meme's eye view': memes with content that 'looks' like what the brain 'wants' will spread even if they lack the effects that the brain is adaptively 'hoping for.' The argument is valid for some memes, but not, I would argue, for most.

A meme can be lucky. Through no merit of its content, it can find itself in the head of a prestigious person, or, thanks to prestige-bias bootstrapping (or even random drift processes), at high frequency. Since the meme's content takes a back seat, a meme may be favored *despite* its content. Prestige-biased and conformist transmission are excellent explanations of why some maladaptive

memes spread and stabilize, even when they are *not* good at replicating. Dennett's "first rule of memes" is not a rule at all (cf. Conte 2000:88; Laland & Odling Smee 2000:134; Boyd & Richerson 2000).

Concessions from the content camp suggest that the controversy is resolvable. Atran acknowledges that "from a cognitive standpoint, some cultural aspects are almost wholly arbitrary" (2002:ch.10). Boyer (1998) recognizes the importance of prestige bias, and Sperber (1996:90-91) explicitly recognizes its power to generate arbitrary differences between societies. Blackmore (1999:ch.6) postulates source biases that I doubt exist, such as 'imitate the good imitators', but which, as source biases, should undermine her view of meme selection as solely the result of meme content. Dawkins (1999:vii) introduces Blackmore's book by describing prestige bias. And Dennett and Dawkins are clearly aware of frequency-dependent effects such as conformism (Dennett 1995:352). The logical conclusions of these authors' own observations about non-content biases are that arbitrary differences between cultures are not only possible but likely, and that, to the extent they are widespread and stable, they generate selection pressures at the group level (Boyd & Richerson 1985:ch.7; Henrich & Boyd 1998).

Susan Blackmore (1999, 2000) has become an outspoken and pithy proponent of the view I criticize:

> …replicators are the ultimate beneficiaries of any evolutionary process. Dennett (1995) urges us always to ask *cui bono*? or who benefits? And the answer is the replicators… --(Blackmore 2000:26)

Evolutionary processes don't need replicators (cf. Boyd and Richerson, ch. 3; Henrich and Boyd 2002).Neither is it true that memes, even if they *were* replicators, would be "the ultimate beneficiaries" of cultural evolutionary processes. But this catchy argument is responsible for most of the attention given to the work of memeticists, and is the basis for Blackmore's arguments about brain evolution. I refute these next..

X. Memetic Drive

According to the 'selfish gene' perspective, a chicken is an egg's way of making another egg. Blackmore adopts a parallel 'selfish meme' perspective, according to which a brain is just a meme's way of making another meme. "We humans. . . have become just the physical 'hosts' needed for the memes to get around" (Blackmore 1999:8). This leads to what some (Aunger 2000:11) regard as her most radical idea, that of 'memetic drive':

> Memes are instructions for carrying out behavior, stored in brains (or other objects) and passed on by imitation. Their competition drives the evolution of the mind. (Blackmore 1999:17)

This claim is tautological if by 'mind' Blackmore means the set of interconnections that end up instantiated in the brain as the result of development. The tautology is not useless because 'meme' suggests Darwinian processes that have been hitherto neglected. But the point is better put thus: "short term cultural evolution results from competition among memes because a culture is a distribution of memes in people's heads." By the standards of cultural transmission theory, this is not a new or radical argument, notwithstanding Blackmore's view that she has advanced beyond it to a new, autonomous discipline (1999:15-17).

But Blackmore means also to explain the evolution of the 'brain' and argues that the 'interests' of memes select for genes coding for brains that prefer those same memes (1999, ch. 6). Runaway processes of this sort, she says, have selected for our inordinately big brains.

This *is* radical, but wrong. A meme can select for a gene only if it is widespread (meta-populationally) and stable (inter-generationally), and there are only two ways for these conditions to arise. First, the meme could be selected by an innate content bias in the brain's design, making it widespread in the species and stable across time. But this can't be Blackmore's 'memetic drive', because this meme fulfills the necessary conditions to select for a gene only because *the gene evolved first* – a Catch 22.

Second, a process such as group selection through conformist transmission could make a meme widespread and stable, even though there was no innate content bias favoring it (Boyd & Richerson 1985; Henrich & Boyd 1998; Boyd *et al.* 2003). For example, suppose group selection makes the meme for group-welfare altruism spread when groups with high frequencies of this meme outcompete others. If some of these groups also have a meme that says 'punish non-altruists in your group,' these groups will be the most competitive. Once such groups populate the world, it will become costly, everywhere, for individuals not to acquire the altruism meme quickly and reliably in early development. So genes coding for innate content biases favoring the acquisition of group-welfare memes will be selected, and Memes will have indeed selected for brain structure in a Baldwinian process.

Such a process could work, but the suggestion is not radical or new: the genesis of such Baldwinian arguments goes back to Boyd & Richerson 1985. Neither does this support Blackmore's claim that the interests of memes – in opposition to those of genes – are in the "driver's seat" in brain design.

The true claim that the replicative interests of memes affect *short-term* cultural evolution should not be confused with the false claim that the replicative interests of memes as against those of genes drive the *long-term* process of brain design. The brain cannot be designed against the interests of genes, because this design must be coded for by genes, which cannot spread without differential reproductive success in their favor.

When memes select for genes it will be *only because* the interests of memes and genes coincide. A culture-driven Baldwinian process is a very interesting way to generate this coincidence, but one still needs the coincidence. And a coincidence is just that—not, as Blackmore would have it, a radical turning of the tables on our understanding of what shapes brains.

XI. Conclusion

The morals I draw are:

First, we should avoid narrowly *genetic* Darwinian thinking, and instead think in terms of the properties of statistical populations capable of inheritance and subject to selection. Despite its heuristic horsepower, the gene/meme analogy should not be a litmus test.

Second, if psychological biases are the main selective forces acting on memes, then the existence and importance of non-content biases should be recognized. They do not detract from the importance of content biases, but merely add to the repertoire of relevant forces.

Third, psychologists and anthropologists should do more field and experimental work to trace the natural histories of particular memes in different domains and to explain the particular social learning biases responsible for such processes (see Gil-White, in progress; Henrich & Gil-White 2001). At this juncture, empirical work is sorely needed.

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