

The Power of Memes

Behaviors and ideas copied from person to person by imitation - memes - may have forced human genes to make us what we are today

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Human beings are strange animals. Although evolutionary theory has brilliantly accounted for the features we share with other creatures—from the genetic code that directs the construction of our bodies to the details of how our muscles and neurons work—we still stand out in countless ways. Our brains are exceptionally large, we alone have truly grammatical language, and we alone compose symphonies, drive cars, eat spaghetti with a fork and wonder about the origins of the universe.

The problem is that these abilities seem surplus to requirements, going well beyond what we need to survive. As Steven Pinker of the Massachusetts Institute of Technology points out in *How the Mind Works*, "As far as biological cause and effect are concerned, music is useless." We might say the same of art, chess and pure mathematics.

Classical (Darwinian) evolutionary theory, which focuses on inheritable traits of organisms, cannot directly justify such riches. Expressed in modern terms, this theory holds that genes control the traits of organisms; over the course of many generations, genes that give their bearers a survival advantage and that favor production of many offspring (who will inherit the genes) tend to proliferate at the expense of others. The genes, then, essentially compete against one another, and those that are most proficient at being passed to the next generation gradually prosper.

Few scientists would want to abandon Darwinian theory. But if it does not clarify why we humans have come to apportion so much of our resources to so many abilities that are superfluous to the central biological task of further propagating our genes, where else can we look?

The answer, I suggest, lies in memes. Memes are stories, songs, habits, skills, inventions and ways of doing things that we copy from person to person by imitation. Human nature can be explained by evolutionary theory, but only when we consider evolving memes as well as genes.

It is tempting to consider memes as simply "ideas," but more properly memes are a form of information. (Genes, too, are information: instructions, written in DNA, for building proteins.) Thus, the meme for, say, the first eight notes of the *Twilight Zone* theme can be recorded not only in the neurons of a person (who will recognize the notes when she hears them) but also in magnetic patterns on a videocassette or in ink markings on a page of sheet music.

The Birth of Memes

The notion that memes exist and evolve has been around for almost 25 years, but only recently has it gained attention as a powerful force in human evolution. Richard Dawkins of the University of Oxford coined the word in 1976, in his best-selling book *The Selfish Gene*. There he described the basic principle of Darwinian evolution in terms of three

general processes—when information is copied again and again, with variations and with selection of some variants over others, you must get evolution. That is, over many iterations of this cycle, the population of surviving copies will gradually acquire new properties that tend to make them better suited to succeeding in the ongoing competition to produce progeny. Although the cycle is mindless, it generates design out of chaos.

Dawkins called the information that gets copied the "replicator" and pointed out that the most familiar replicator is the gene. But he wanted to emphasize that evolution can be based on any replicator, and so, as an example, he invented the idea of the meme. The copying of memes from one person to another is imperfect, just as the copying of genes from parent to child is sometimes inaccurate. We may embellish a story, forget a word of the song, adapt an old technology or concoct a new theory out of old ideas. Of all these variations, some go on to be copied many times, whereas others die out. Memes are thus true replicators, possessing all three properties—replication, variation, selection—needed to spawn a new Darwinian evolutionary process.

Dawkins says that he had modest intentions for his new term—to prevent his readers from thinking that the gene was the "be-all and end-all of evolution, the fundamental unit of selection"—but in fact his idea is dynamite. If memes are replicators, then they, like genes, compete to get copied for their own sake. This conclusion contradicts the assumption, held by most evolutionary psychologists, that the ultimate function of human culture is to serve the genes by aiding their survival. The founder of sociobiology, E. O. Wilson, famously said that the genes hold culture on a leash. Culture might temporarily develop in some direction that is counterproductive to spreading the genes, but in the long run it is brought back in line by gene-based natural selection, like a straying dog curbed by its owner. In this view, memes would be slaves to the genes that built the brains that copy them, prospering only by helping those genes to proliferate. But if Dawkins is right and memes are replicators, then memes serve their own selfish ends, replicating whenever they can. They sculpt our minds and cultures as they go—whatever their effect on the genes.

The most obvious examples of this phenomenon are "viral" memes. Chain letters (both hard-copy and e-mail) consist of little bits of written information, including a "copy-me" instruction backed up with threats (if you break the chain you will suffer bad luck) or promises (you'll receive money and you can help your friends). It does not matter that the threats and promises are empty and your effort in copying the letters is wasted. These memes have an internal structure that ensures their own propagation.

The same can be said, Dawkins argues, of the great religions of the world. Of all the myriad small cults with charismatic leaders that have sprung up in human history, only a few had what it took to survive—copy-me instructions backed up with threats and promises. In religions the threats are of death or eternal damnation, and the promises are of everlasting bliss. The costs are a proportion of one's income, a lifetime devoted to propagating the word, or resources spent on building magnificent mosques and cathedrals that further promote the memes. The genes may even suffer directly at the hands of the memes—as occurs with a celibate priesthood.

Of course, not every cult (or chain letter) with the appropriate viral structure will actually succeed. Some threats and promises are more effective, or virulent, than others, and all compete for the limited resource of human attention in the face of experience and skepticism (which, in the viral metaphor, act as a kind of immune system).

Arguably, religions are not entirely viral; for example, they provide comfort and a sense of belonging. In any case, we must not make the mistake of thinking that all memes are viruses. The vast majority make up the very stuff of our lives, including languages, political systems, financial institutions, education, science and technology. All these are memes (or conglomerations of memes), because they are copied from person to person

and vie for survival in the limited space of human memories and culture.

Thinking memetically gives rise to a new vision of the world, one that, when you "get" it, transforms everything. From the meme's-eye view, every human is a machine for making more memes—a vehicle for propagation, an opportunity for replication and a resource to compete for. We are neither the slaves of our genes nor rational free agents creating culture, art, science and technology for our own happiness. Instead we are part of a vast evolutionary process in which memes are the evolving replicators and we are the meme machines.

This new vision is stunning and scary: stunning because now one simple theory encompasses all of human culture and creativity as well as biological evolution; scary because it seems to reduce great swathes of our humanity, of our activities and our intellectual lives, to a mindless phenomenon. But is this vision true? Can memetics help us to understand ourselves? Can it lead to testable predictions or do any real scientific work? If it cannot, memetics is worthless.

I believe that the idea of the meme as replicator is what has been missing from our theories of human evolution and that memetics will prove immensely useful for explaining our unique attributes and the rise of our elaborate cultures and societies. We are different from all other animals because we alone, at some time in our far past, became capable of widespread generalized imitation. This let loose new replicators—memes—which then began to propagate, using us as their copying machinery much as genes use the copying machinery inside cells. From then on, this one species has been designed by two replicators, not one. This is why we are different from the millions of other species on the planet. This is how we got our big brains, our language and all our other peculiar "surplus" abilities.

Big Brains for Memes

Memetics neatly resolves the mystery of the human brain's vastness. The human brain is about as big as the genes can make it—three times bigger, relative to body weight, than the brains of our closest relatives, the great apes. It is expensive to build and maintain, and many mothers and babies die through childbirth complications caused by the size of the head. Why has evolution allowed the brain to grow so hazardously large? Traditional theories look to genetic advantage, in improved hunting or foraging skills or the ability to sustain larger cooperating groups with complex social skills. Memetics provides a completely different explanation.

The critical transition for hominids was the dawn of imitation, perhaps two and a half million years ago, before the advent of stone tools and expanding brains. True imitation means copying a novel behavior or skill from another animal. It is difficult to do, requires a lot of brainpower and is correspondingly rare in the animal kingdom. Although many birds copy songs, and whales and dolphins can imitate sounds and actions, most species cannot. Often animal "imitation," such as learning to respond to a new predator, involves merely the use of an innate behavior in a new situation. Even chimpanzees' imitation is limited to a small range of behaviors, such as methods of fishing for termites. In contrast, generalized imitation of almost any activity seen—as seems to come naturally to humans—is a much more difficult and correspondingly more valuable trick, letting the imitator reap the benefits of someone else's learning or ingenuity as often as possible. For example, in experiments conducted in 1995 at the Yerkes Regional Primate Research Center in Georgia, when the same problems were presented to orangutans and human children, only the humans readily used imitation to solve the problems.

It is easy to imagine that our early ancestors imitated useful new skills in making fire, hunting, and carrying and preparing food. As these early memes spread, the ability to acquire them became increasingly important for survival. In short, people who were better

at imitation thrived, and the genes that gave them the bigger brains required for it consequently spread in the gene pool. Everyone got better at imitation, intensifying the pressure to enlarge the brain still further in a kind of cerebral arms race.

Once everyone started imitating, the second replicator was let loose on the world, changing human evolution forever. The memes started to take control. Alongside useful skills, such as building fires, people copied less useful ones like fancy body decoration and downright costly ones such as energetic but futile rain dances. The genes faced a problem: how to ensure that their carriers copied only the useful behaviors. Newly arisen memes can spread through a population by imitation in a single generation, faster than genetic evolution can respond. By the time the genes could evolve a hardwired predilection for making fires and an aversion to performing rain dances, completely different fads could arise and hold sway. The genes can develop only broad, long-term strategies to try to make their bearers more discriminating about what they imitate.

A useful general heuristic that the genes could bestow might be a predisposition to copy the best imitators—the people most likely to have accurate versions of currently useful memes. (More familiar terms for "the best imitators" in modern life may be "trendsetters" or "role models.") In addition to their bag of useful tricks for survival, the best imitators would thereby acquire higher social status, further improving their survival chances and helping to propagate the genes that made them talented imitators—the genes that gave them big brains specialized at accurate generalized imitation.

The genes would continue to respond with improvements in people's innate preferences about what to imitate, but the genes' response, requiring generations of people to act on, would always lag far behind the memetic developments. I call the process by which memes control gene selection "memetic drive": memes compete among themselves and evolve rapidly in some direction, and genes must respond by improving selective imitation—increasing brain size and power along the way. Successful memes thus begin dictating which genes will be most successful. The memes take hold of the leash.

In a final twist, it would pay for people to mate with the most proficient imitators, because by and large, good imitators have the best survival skills. Through this effect, sexual selection, guided by memes, could have played a role in creating our big brains. By choosing the best imitator for a mate, women help propagate the genes needed to copy religious rituals, colorful clothes, singing, dancing, painting and so on. By this process, the legacy of past memetic evolution becomes embedded in the structures of our brains and we become musical, artistic and religious creatures. Our big brains are selective imitation devices built by and for the memes as much as for the genes.

Origin of Language

Language could have been another exquisite creation of this same process of meme-gene coevolution. Questions about the origins and function of language have been so contentious that in 1866 the Linguistic Society of Paris banned any more speculation on the issue. Even today scientists have reached no general consensus, but the most popular theories appeal to genetic advantage. For example, evolutionary psychologist Robin Dunbar of the University of Liverpool argues that language is a substitute for grooming in keeping large social groups together. Evolutionary anthropologist and neuroscientist Terrence Deacon of Boston University proposes that language made symbolic communication possible, which in turn allowed improved hunting skills, tighter social bonds and group defense.

In contrast, the theory of memetic drive explains language by its conferring survival advantages on memes. To understand how this works, we must ask which kinds of memes would have survived best and proliferated in the emerging meme pool of our early ancestors. The general answer for any replicator is those with high fecundity, fidelity

and longevity: ones that make many accurate and long-lived copies of themselves.

Sounds are more fecund than gestures, particularly sounds analogous to "hey!" or "look out!" Everyone within earshot can hear a shout, whether they happen to be looking at the speaker or not. Fidelity of spoken memes is higher for those built from discrete units of sound (phonemes) and divided into words—a kind of digitization that reduces errors in copying. As different actions and vocalizations competed in the prehistoric meme pool, such spoken words would prosper and displace less well adapted memes of communication. Then, stringing words together in different orders, and adding prefixes and inflections, would provide fertile niches for new, more sophisticated vocal memes. In sum, the highest-quality replicable sounds would crowd out the poorer ones.

Now consider the effect of this on the genes. Once again the best imitators (the most articulate individuals) would acquire higher status, the best mates and the most offspring. In consequence, genes for the ability to imitate the winning sounds would increase in the gene pool. I suggest that by this process the successful sounds—the foundations of spoken language—gradually drove the genes into creating a brain that was not merely big but especially adept at copying those particular articulations. The result was the remarkable human capacity for language. It was designed by memetic competition and meme-gene coevolution.

The process of memetic driving is an example of replicators (memes) evolving concurrently with their copying machinery (brains). The appearance of memes is not the first time such concurrent evolution has occurred: something similar must have taken place in the earliest stages of life on earth, when the first replicating molecules developed in the primeval soup and evolved into DNA and all its associated cellular replication machinery. As with the evolution of that sophisticated gene-copying apparatus, we might expect better meme-copying machinery to have appeared—and it has. Written language provided a vast leap forward in longevity and fidelity; the printing press enhanced fecundity. From the telegraph to the cell phone, from "snail" mail to e-mail, from phonographs to DVDs and from computers to the Internet, copying machinery has been improving, spreading a growing multitude of memes farther and faster. Today's information explosion is just what we should expect of memetic evolution.

This memetic theory depends on a number of conjectures that can be tested, especially the assumption that imitation requires a lot of brainpower, even though it comes so easily to us. Brain-scan studies might compare people carrying out actions with others copying them. Contrary to common sense, this theory postulates that imitation is the harder part—and also that the evolutionarily newer parts of the brain should be especially implicated in carrying it out. In addition, within any group of related animal species, those with the most ability at imitation should have the largest brains. The scarcity of imitation in animals limits the amount of data available, but species of birds, whales and dolphins could be analyzed and compared with this prediction.

Experimental Tests

If language developed in humans as a result of meme-gene coevolution, linguists should find signs that grammar is optimized for transmitting memes with high fecundity, fidelity and longevity, rather than for conveying information on specific topics such as hunting or for forming social contracts. Social psychology experiments should show that people preferentially copy more articulate people and find them more sexually attractive than less eloquent people.

Other predictions can be tested by mathematical modeling and computer simulations, which many researchers have used to model evolutionary processes. The addition of a second, faster replicator to a system should introduce a dramatic change, analogous to the appearance of memes and the human brain's expansion. The second replicator

should also be able to control, and even stop, the evolution of the first. Such models might then be used to understand in greater detail the coevolution of memes and genes. In addition, the idea that language could spontaneously emerge in a population of imitating creatures could be tested with simulations of noisy imitating robots.

Memetics is a new science, struggling to find its place and with many critics. Some of these critics have simply failed to grasp the idea of a replicator. We need to remember that memes, like genes, are merely bits of information that either succeed in getting copied or do not. In this sense, but no other, memes can be said to be "selfish" and to have replicator power. Memes are not magical entities or free-floating Platonic ideals but information lodged in specific human memories, actions and artifacts. Nor are all mental contents memes, because not all of them were copied from someone else. If all your memes were removed, you would still have many perceptions, emotions, imaginings and learned skills that are yours alone, that you did not acquire from anyone else and that you can never share with another.

A common objection is that memes are very different from genes. And so they are. They suffer (or benefit) from much greater mutation rates, and they are not locked into a system as rigidly prescribed as DNA replication and protein synthesis. Memes are best thought about not by analogy with genes but as new replicators, with their own ways of surviving and getting copied. Memes can be copied all over the place, from speech to paper to book to computer, and to another person.

Yet many more potential criticisms remain, and much work is still to be done. In the end, memetics deserves to succeed only if it provides better explanations than rival theories and offers valid and testable predictions. Unlike religions, the great meme-complex of science includes methods for throwing out ideas that are vacuous, nonsensical or plain wrong. It is against these criteria that memetics, quite rightly, will be judged.

This article was accompanied by a brief editor's introduction and three 'counterpoints' written by Lee Alan Dugatkin, Robert Boyd and Peter Richerson, and Henry Plotkin. I do not have permission from Scientific American to post these here.