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Meme (French *mème*, German Mem), a term coined by Richard Dawkins in analogy to "gene", intended to designate pieces of culture ('units of cultural transmission' or 'units of imitation'; Dawkins 1976, p. 206) which are subject to a Darwinian process of evolution.

In *The Selfish Gene* (1976, ²1989), Dawkins tries among other things to give a general characterization of the phenomenon of evolution by natural selection. This characterization is intended to be general in the sense that it is independent of particular 'substrates' like, say, organic molecules or (populations of) organisms. Dawkins: Generalized theory of evolution

What is essential for the evolution of complex structures by natural selection, according to Dawkins, is the existence of 'replicators', i.e., objects which (in a suitable environment) generate copies of themselves. Replicators which are better able to multiply than others consequently spread more strongly than these do. In view of the resulting exponential growth (and the more so as the available resources of space, energy, materials etc. will ordinarily be limited) better replicators will, in the course of not too many copying-'generations', drive worse ones to numerical marginality or even obliteration. If such displacement of old variants by superior new ones takes place again and again over a protracted period of time, eventually replicators with extremely sophisticated mechanisms of action will hold the stage. In this manner, repeated variation and selection will lead to the emergence of unforeseeable, infinitely varied and highly complex phenomena, as presented by life (and culture) on earth. Replicators

In order for evolution to happen, the replicators must be stable enough to be technically able to persist for an indefinitely long time – in the form of successive tokens of the given type; that is, a replicator's structure must in general be retained over many 'generations'. Otherwise selection will not have enough time to lastingly affect the spectrum of different replicator types and to build cumulatively on the respective results. Specifically the replication process must be very faithful: a fire that passes from one object to others is not a replicator, because the character (temperature, color etc.) of the triggered fire is in every case owed solely to the respective burning object and need have nothing in common with that of the causative flame (alternatively, one might as well say that fire *is* a replicator, but an uninteresting one, because the structure that is replicated consists only in there being fire and thus is always exactly the same). Not even reproducing organisms are replicators, in Dawkins's Replication mistakes: rare, ...

opinion, since they do not, for example, pass on acquired traits to their offspring; those traits that are accurately passed on are ordinarily due exclusively to their genes.

... but not *too* rare

However, replication must not be perfectly faithful: while free neutrons in a reactor hitting the nuclei of uranium atoms, splitting them and thereby causing the release of further neutrons, can be considered replicators, they are not interesting ones, because all 'copies' are invariably of the exact same type. For evolution to happen, replication mistakes must sometimes occur, particularly ones such that the resulting copy, despite differing from the original, is still capable of self-replication, and even better suited to it than the original. Here, 'better' replication means that replicators of the new type replicate in larger numbers or in shorter intervals ("fecundity"), are more stable ("longevity") or incur fewer mistakes in their copying events ("copying fidelity"). (These three concepts are sometimes misinterpreted as necessary properties of replicators, or as marks of the concept of replicator. What they are really, however, is rather the abstract regards with respect to which replicator types can be *compared*, the dimensions of replicator fitness, as it were.)

Variation and selection

Copying mistakes engender variation among replicator types, and this variation constitutes the diversity that is then subject to selection: variants that are (in the respective environment, under the respective conditions) better disposed to replicate themselves (possibly because they impede the replication of other variants) displace others from the pool of replicators, in the sense that the relative frequency of tokens of the more replication-apt type increases at the expense of the other types. – This is not an empty tautology. It does not happen with logico-analytical necessity, just with very high probability; however, the smaller the number of tokens of a new type, the more its spreading will be influenced by contingencies. The impression of triviality can arise because for reasons of brevity – or for want of conscious differentiation – in writing about evolution usually phrases like "X spreads more strongly than Y" are employed instead of the more precise "X is better suited for spreading than Y".

Cumulative evolution and
'selfish' replicators

When this displacement process has repeated itself sufficiently often, the replicator pool will mostly contain types whose makeup and effects are optimized towards not being displaced by 'competitors' but rather, where possible, conversely displacing them. Such replicators are called "selfish" by Dawkins. – The point of this metaphor is that

the effects of replicators need not serve other sorts of entities, with whom they may be associated, but primarily serve the given replicator type itself. For example, genes are normally housed by an organism, which in turn is part of a family, a group, a population and a whole species. Where different variants – “alleles” – of a gene compete, those will succeed which are best suited to spreading their own type. This specialization of the gene – more generally: of the superordinate replicator type – towards particular alleles or more specific subtypes, respectively, can be considered as the ‘choice’ of certain behavioral ‘options’ by the gene, which choice is selfish in the sense that it is independent of whether it promotes the preservation of the species, or the welfare of the group or the organism.

The paradigmatic replicators are the genes; according to Dawkins, what underlies biological evolution is mainly *their* differing aptness for self-replication. Dawkins claims that besides genes there is a further kind of replicators: ideas and modes of behavior, which spread among people by means of imitation in the broadest sense. For these he coins the generic term “meme”, as a short form of “mimeme”, which is derived from the Greek μίμημα (“that which is imitated”). Examples of memes are melodies, phrases, clothes fashions, dietary rules, works of art, architectural styles, customs, laws, technologies, scientific theorems and religious dogmas. Dawkins proposes that the development of human culture might be considered as a process of evolution by natural selection among memes and ‘coadapted meme complexes’ ([coadapted] meme complexes are groups of memes which further each other’s spreading, like symphonies and novels, ideologies, scientific theories or even entire languages). Thus culture would become wholly or in part amenable to scientific-mechanistic modes of explanation.

Memes as other replicators besides genes

Memes and meme complexes are replicated by being passed on from person to person via imitation or, more generally, social learning (also mediated by artifacts, especially teaching materials). One important direction of meme transfer is from parents to their children, but people acquire memes from a variety of sources: parents adopt some ideas and behaviors from their children, people learn from other relatives, from friends, strangers and the media. Cultural ‘inheritance’ and biological inheritance therefore proceed by no means entirely in parallel.

Meme replication

Variation arises by the creation of new memes thanks to individual learning, by mistakes in transferral (slips of the

Variation among memes

tongue, misinterpretations and the like) as well as by modification and recombination of memes by the bearer subjects (intentionally or because of, say, incorrect recollection).

Selection by meme fitness

The reservoir of potential human bearers and their capacity for picking up, storing and passing on memes are limited. Therefore a process of selection among meme variants happens: memes that are better at spreading among people in the mentioned manner will tend to displace others. Such 'memetic fitness' can take various shapes: *ceteris paribus*, those memes will be fitter (1) that draw more attention to themselves (for example, by a sense of urgency or an element of surprise), (2) that are psychologically attractive (for example, by targeting in an appropriate manner strong, quasi-universal motives of people, e.g., their self-interest, their curiosity, their fascination by sex and violence or their desires for safety, for peace of mind and for the reduction of cognitive dissonance), (3) that tend to stick well in memory (for example, by a simple but nontrivial structure) and (4) that strongly stir their bearers into action (for example, by the prospect of reward or punishment).

The meme perspective on culture

While on the usual approach to cultural change the focus lies on the subjects who create new memes (or meme complexes), and it is presupposed that new memes will ordinarily spread in accordance with the interests of the candidate bearers, from the 'meme's-eye view' the ideas themselves are regarded like agents. Their origins are disregarded, and it is assumed that from among several competing memes, in general those will prevail whose makeup and effects are (given the psychological nature and the preexisting meme store of the potential bearers) most conducive to their own spreading. In the process, even behaviors may spread which are detrimental to both welfare and genetic fitness of the person carrying them out – for instance, because they are (for certain personality types) psychologically attractive. For example, teenage suicides or people running amok generate, due to their tragic or dramatic quality, intensive coverage by the media, which in turn encourages the appearance of imitators who subliminally wish for a similar attention to their person (the 'Werther Effect'). These would be memes which compensate the ephemerality of their tokens by sufficient fecundity.

Meme–gene coevolution

While memetic evolution is not derived from biological evolution, neither is it independent of it. Memetic evolution presupposes biological evolution insofar as without beings capable of imitation or social learning it couldn't start in the first place. Furthermore, biological evolution affects

memetic evolution insofar as it determines wholly or in part the psychological nature of the meme bearers and thus the most important part of the memes' environment. On this it crucially depends which memes are fitter and which ones less so. The influence between the two kinds of evolution need not be one-way, however. As soon as memes exist and can be passed on they may by their very presence change the environmental conditions and selection pressures for the genes, particularly for those which influence the meme bearers' learning ability. This is because memes constitute an additional environmental resource, from which those agents will profit most who can best detect and adopt the useful ones among them. Thus it is plausible to assume that the presence of memes has exerted a selection pressure towards better social learning. If as a result it is not only the general capability for learning that is enhanced but also a disposition to preferentially adopt memes with particular characteristics as the supposedly most useful ones then this biological development changes in turn the selection criteria for memes, and so on. It is such meme-gene co-evolution to which Susan Blackmore (*The Meme Machine*, 1999) traces back, among other things, the evolution of the disproportionate size of the human brain (relative to body weight, compared with other animals, even primates).

Almost everything about the meme hypothesis is contentious: What exactly are memes? Are they brain structures, ways of thinking and behaving, or dispositions toward, or the products of, such? Do memes even exist? Are they really replicators and, if so, in what manner exactly are they replicated? Are there smallest memetic units, atoms of culture, as it were? Are memes sufficiently long-lived and faithfully copied to sustain a Darwinian selection process? What, if anything, are the memetic analogues of biological organisms and phenotypes (i. e., the observable effects of genes: traits or behaviors of organisms)? How far does the explanatory power of the meme hypothesis reach?

The objection against Dawkins that memes (or genes), being abstract types, cannot be causally efficacious (McLaughlin 2008) misses the mark: What is meant by talk about the effects of a meme is of course the effects of (the presence and distribution of) tokens of that meme. Otherwise one shouldn't be allowed to say, for example, that Darwin's *On the Origin of Species* (1859) was an influential book, because the book, considered as pure text, is an abstract type too. – Below, six further common objections against the meme hypothesis will be considered.

Points of contention

Objections:
Abstracta are not causes

Identity conditions? (1) While genes have, in the form of DNA sequences, well-defined physical correlates with clear identity conditions, for memes no such correlates are in sight. Thus one can never be sure whether one is dealing with the same or a different meme. Therefore “meme” is not a viable scientific concept. – The idea that identities and nonidentities between memes are hard to determine stems from the identification of memes with the neuronal structures which represent them in brains. Memes thus conceived, though, are militated against by worries concerning the multiple realizability of meme representations. In actuality, many memes are straightforwardly identifiable (albeit with a certain measure of vagueness): it is easily decidable whether someone is wearing his baseball cap backwards on his head, or whether a given passage in a Ph.D. thesis is a plagiarism, that is, the unacknowledged copy of another author’s meme complex. There are of course meme complexes which are harder to identify, e.g., the personal style of a certain painter or composer. Nevertheless, even here adepts are able to imitate the style concerned, and experts, to grade such imitations as more or less successful.

Imitation is not copying (2) Whereas genes are replicated by splitting and two-fold reconstitution of the DNA double helix, the transfer of memes is not a process that could be considered as copying or replication. Rather, in adopting a meme by imitation or social learning, the underlying intentions of the meme’s producer and the function of the respective behavior or artifact must be figured out. Hence the transfer of memes is no ‘mechanical’ replication but rather a cognitively demanding reconstruction process. Therefore memes, unlike genes, are not replicators. – The condition that propagation of replicators happen in a somehow mechanical manner is however not part of the characterization of replicators. “Copying” and “replication” are merely the technical terms Dawkins introduces as labels for the multiplication process. What matters is not their colloquial meanings and connotations but only that the corresponding process happens with sufficient regularity among the entities in question, and is ordinarily structure-preserving, never mind how it is realized.

Imitation is low in fidelity (3) Memes are modified in almost every transfer; hence they do not have enough copying-fidelity to support a Darwinian evolution process. – This is a fallacy engendered by the characterization of memes as ‘units’ of cultural transmission. Against it, one can argue that most salient ‘memes’ are really meme *complexes* (candidates for ‘atomic’ memes

may be musical intervals, linguistic morphemes and logical connectives). That the specific structure of a meme-complex token is partially lost in transmission is compatible with there being a more or less large structural core that is preserved intact over countless transfers: Whereas a (for the respective listener) meaningless sequence of sounds will be distorted beyond recognition in the course of a few imitation steps, a joke that is retold has a certain core which it retains in (almost) all transmission steps; without it, it would cease to be funny and would not be passed on. A joke (or, more precisely, that part of its content that makes it funny) is a comparatively fit meme complex: even though in most transfers some amount of modification occurs, this variation happens, so to speak, at the surface. Meme complexes for which the 'surface details' matter too, but where these are difficult to store by human brains (e.g., novels, symphonies or YouTube videos), have been passed on by means of recording media since the invention of letters, for example, via books, records, CDs or electronic storage media. This in turn could be interpreted as indicating that meme complexes are increasingly 'offloaded' from brains, and that the human role in their replication is then reduced to the passing on of 'pointers' leading to these meme complexes (one might even argue that already the quotidian 'linguistic division of labor' is such a case; this happens when the precise extension of a predicate like "elm" is known only to certain experts, while ordinary speakers rely, in using it, on the discriminatory capabilities of the experts). In the case of complicated application programs, for instance, the underlying source code is managed only by some few programmers, and even of those none handle it as a whole. Computer-generated proofs, finally (like for the Four-Color Theorem), are generated entirely by machines, and for most of their extent aren't read by people at all anymore.

(4) Memes are not replicators, because, unlike genes, they don't form lineages: the acquisition of a meme via social learning is in general not based upon a single template, as is gene replication, but on many; the resulting meme is a (possibly weighted) mixture of these templates. In the process, advantageous variation will usually be leveled again. Thus social learning does not promote the conservation of advantageous variation; cumulative cultural evolution is due to other processes. – However, for cumulative evolution by natural selection among replicators to happen it is only required that replicator tokens replicate in a ratio

Replication isn't one-one

that allows for exponential growth (at least as long as the environmental conditions do not change). Where a replicator is able to replicate not only in the ratio one–one but also in many–one or many–many ratios, that does not impede its spreading. The putative mixing or watering-down of the replicator type again happens – for memes that are passably fit – mostly at the ‘surface’. – Like many another argument against the meme hypothesis this one stems from the belief that the thesis implies far-reaching analogies between biological and cultural evolution and particularly between genes and memes. However, the thesis only says that certain structural conditions (the presence of entities of whatever kind that multiply in some sense or other such that variation occurs very rarely, but still every so often) are sufficient for cumulative evolution and thus for the emergence of arbitrarily complex adaptive mechanisms, and that in the arena of culture these conditions are met in the manner specified.

No alleles

(5) In contrast to genes, for memes there is no clearly demarcated spectrum of alleles, of variants of a type that compete at displacing each other. But when it isn't even clear who takes part in the race then no predictions are possible about who is going to win it. Therefore the meme hypothesis must stay empirically barren. – On the one hand, there are in fact many cases where a quite well-delimited group of meme variants compete among themselves, for instance, for occupying a particular ‘place’ in a more comprehensive meme complex (e.g., formulations employable at a specific place in a given text, the footwear to be chosen for a given suit or the shaping of a specific facet of a religious doctrine – say, what is the exact relationship between Jesus and God?) or for filling a particular bit of leeway in a given person's life, uniquely or permanently (what headgear? what salutation behavior? what language to write in? which writing implement?). On the other hand, when the question is more generally what occupation someone should spend his time and energy on from moment to moment in the first place then apparently the competition involves all memes at once. This, however, just parallels the situation of the first replicator molecules in the ‘primordial soup’, which hadn't yet combined in coadapted groups, not to mention the formation of organisms. Insofar as the most promising candidates can be surveyed sufficiently well, predictions are again conceivable.

Creative achievements by individuals

(6) The mechanism of the selective passing on of memes among persons leaves important parts of cultural evolution

unexplained: major creative achievements by individual persons, e. g., a Beethoven symphony or Einstein's theory of relativity, did not arise by the variantly successful spreading of rawer, but successively more refined, preliminary versions among people, but were developed by their creators in mostly 'isolated' labor. If the biological analog of this were to happen, namely, adaptive macromutations, the biological theory of evolution would be put in doubt. – Elaborate meme complexes due mostly to the creativity of single individuals do indeed constitute counterexamples to the ordinary meme hypothesis. For it to be salvaged, it must be augmented by a theory that reduces the creativity of individuals to processes of Darwinian evolution as well: say, by explaining creativity via a mechanism in the brain where in a pool of already available meme complexes (or representations of such) the generation of undirected variation is repeatedly followed by a form of natural selection. Proposals for this exist (e. g., Gerald M. Edelman's hypothesis of neuronal group selection) but are likewise contentious.

Many or even most memetic explanations may be replaceable by explanations which get by without the terminology of memes. Nevertheless, in principle the meme hypothesis has the potential to furnish a unified explanatory framework for the entire profusion of cultural phenomena. Should this be the case, and should the meme hypothesis moreover provide surprising generalizations and predictions, then 'memetics' could gain the status of a science.

Usefulness of the meme concept?

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