MEMETIC ENGINEERING AND CULTURAL EVOLUTION

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Contents

Summary

The current status of "memetics" and the meaning of "memetic engineering" are considered. A set of artificial society models are summarised which attempt to capture in abstracted form certain memetic processes. The main qualitative results gained from these models are discussed. The problematic nature of artificial society methodology and the application of results to the real world are explored. It is concluded that both meme theory and artificial society modeling are at an early stage, but as a possible route to increased understanding of the social world, and the benefits that this may bring the area, they show promise. Much more work needs to be done.

1. What is Memetics?

Since the invention of the word "meme" by Richard Dawkins as a cultural analogy to the gene, a loose speculative and unproven area of enquiry termed "memetics" began to emerge. The meme is to culture as the gene is to biology. A meme can be conceived as a cultural unit of imitation. Within such a broad definition examples of memes might be stories, hairstyles, religious beliefs or popular songs. Indeed anything that is passed from individual to individual via some form of cultural imitation or learning may be seen to replicate over space and time. Spurred on by popular science writers such as

Daniel Dennett terminology from genetics has been applied to cultural phenomena usually in a highly speculative and metaphorical way.

2. The State and Status of Memetics

The scientific status of memetics is still at this current time (mid 1999) a matter of intense debate and has been dismissed by some (notably Steven Jay Gould) as no more than an empty analogy failing to put forward falsifiable hypotheses and detailed empirical or theoretical work. A recurring problem within memetics is the ontological status of the meme itself. Some writers like Dennett conceive of memes as self-replicating entities which through their own self-interested propagation become the building blocks which form the "virtual serial machines" and "mental operating systems" of the conscious human mind. Such approaches have been termed "internalist" memetics since they attempt to construct a theory of mind within a memetic framework. Other researchers have taken a different emphasis, conceiving of memes from a behaviorist and functional position. Here memes are seen as behavioral rules that propagate through and shape a population. From this approach the detailed cognitive and ontological status of memes is not addressed and it has been argued that such a position is no more than "social contagion theory" (an existing empirically based area of social psychology) dressed-up in new nomenclature borrowed from genetics.

3. Memetic Engineering in Human Societies

The concept of memetic engineering (by analogy with genetic engineering) has been used to address the question of purposeful and planned generations of memes to serve some end. In the wider context of daily life the conception of memetic engineering generally signifies no more than any planned activity that produces cultural units that may be imitated. At this level of generality the term may be no more than a scientific sounding phrase applicable to most human activity. However the phrase has found some application in the advertising and management constancy industries when applied to planned and controlled attempts to change and influence human behavior.

4. Memetic Engineering and Artificial Societies

In the context of this article artificial societies will be described which address issues of culture change from a memetic perspective. Their implications (if any) for real human societies will be discussed at the end of the article. It must be noted that at present (1999) such models are limited and have limited input into the theorising that goes on at the general level in memetics. It has been claimed by some that one possible future direction for the formation and testing of new memetic theory is via construction, comparison and experimentation with computational models. However, methodology and practice within the field of artificial societies is also young and it is currently unclear as to how highly abstracted, theoretical computational models can be validated or even communicated to the satisfaction of sociological disciplines. Some have argued that increasingly computationally aware practitioners within the social sciences will come to embrace these techniques. Others have argued that a more grounded terminology and strict verification process is required and needs to be developed. In their weakest sense artificial societies of memetic processes and cultural change offer no

more than computational thought experiments. These are complex "what-if" questions that are answered via empirical analysis of the output of computer programs. Minimally they give an "existence proof" of what certain stated assumptions can support. More importantly other researchers can attempt to reproduce, compare and merge models to verify results and test for compatibility (so called "docking experiments"). It would seem that such methods may begin to offer the social sciences at least some of the tools and techniques traditionally only available to hard sciences such as the possibility of a repeatable experimental method, the ability to exchange models of social phenomena within a formal language (computer programs) and to make real progress in the acceptance via existence proofs that certain assumptions do indeed support certain conclusion.

5. What Are Artificial Societies?

Computational modeling and simulation of social systems has a history of almost 40 years. Recently a speculative and exploratory form of social modeling has emerged. Termed "Artificial Societies", such models address "possible societies", their general processes, dynamics, and emergent properties. In the same way that Artificial Intelligence is not limited to the accurate modeling of physiological brain processes so artificial societies research does not start from some given scenario or particular social system. The aim is to model features and processes that characterise societies in general such as co-operation, specialisation, group formation, and hierarchy.

Artificial Society work does not strive for superficial realism or direct correspondence with existing societies but for abstract logical relationships that characterise whole categories of phenomena. Generally such societies consist of multiple interacting agents. Each agent minimally consists of: internal state; sets of possible actions; percepts (or perceptual inputs); a shared environment and some form of decision process informing action selection. This latter component of an agent "architecture" may vary considerably. It may consist of simple hardwired rules (e.g. the Sugerscape, see the article within this topic for details), deliberative, planning and goal directed artificial intelligence systems; inductive learning (e.g. via connectionist models) or population level evolutionary methods (e.g. evolutionary game theory).

6. Memes in Artificial Societies

A number of researchers from various perspectives and backgrounds have implemented interpretations of memetic processes in artificial societies. Such models vary widely in their approach, abstraction level and focus of interest. Many may not explicitly utilise memetic terminology but all attempt to capture some form of cultural replication, variation and selection. Such models can be seen as a form of memetic engineering in which the questions: "In the given model which memes are successful?" and / or "In the given model which dynamics of memetic change occur?" are being asked. The results obtained from the models are obviously dependant on the set of assumptions which comprise the model. Those assumptions will be influenced by the particular perspective, focus and disciplinary background of the research. A more speculative form of memetic engineering is to reverse engineer specific pre-defined behaviors from the model via a

search over some space of assumptions. In such an instance the question "From a space of assumptions which are sufficient to produce some given behavior?" is being asked.

It is important to distinguish the following models from the sometime used computer science term "memetic algorithm" which refers to a class of general local search algorithms which are applicable to problems requiring the searching of large spaces of solutions for some optimal or reasonably optimal solution. Although this latter class of algorithms has some connection with cultural processes they are at a tangent to the current article and will not be discussed further.

7. Evolutionary Game Theory Models

The Economics and Biology heritage of evolutionary game theory means models within this class start with the assumption that agents are utility maximisers adhering to the assumptions of the replicator dynamics. Effectively this means that each individual meme or behavioral rule (generally termed a strategy within this paradigm) is reproduced over some time unit in proportion to the product of its frequency and cumulative fitness over the population.

The assumption within a cultural context is that memes (or strategies) are copied between agents when they are observed to be "better" (i.e. produce higher utility). Generally models within this tradition attempt to identify static or dynamic equilibrium states in which particular memes (or strategies) are stable within some strictly defined game.

Robert Axelrods' now classic computational tournaments between submitted programs implementing differing strategies in the two person "prisoners' dilemma" game were advanced at the time as evidence for particular organisational recommendations which could be used to foster co-operative interactions between agents. That is, the application of the "tit-for-tat"-strategy. This strategy states that one should copy the last move made in any previous encounter by one's opponent or cooperate if this is a first encounter. It should be noted that the usefulness of these conclusions have since been challenged by several game theoretic researchers notably Ken Binmore.

8. Memetic Models of Cultural Change

Those models which specifically use memetic terminology tend to break with the assumptions of the replicator dynamics in some way. Utility for example, is rarely explicitly represented within such models. Propagation of memes is generally modelled as a more passive process which does not necessarily entail utility comparisons between memes by agents.

Cultural transmission in the Sugarscape model is effectively an extension of the Axelrod Cultural Model (ACM) which can be compared to Social Impact Theory (SIT) models. These models are implemented within a cellular automata framework (a two-dimensional grid of agents interacting within some small spatial neighborhood). Sugarscape, ACM and SIT work on a passive representation of culture focusing on the spread of memes that are often termed "cultural attributes".

Cultural attributes in such models are equated with observable features such as language and clothes style. They are passive in the sense that they do not have direct behavioral impact but may have indirect effects via their recognition by other agents. In the Sugarscape for example, the presence or absence of certain designated attributes (represented as bit strings) attached to an agent may trigger an attacking action from another agent. In the ACM the distance between two agents (in differing attributes) affects the attribute propagation process itself. However it is important to note that the attributes themselves are not equated with behavioral rules. An interesting distinction can therefore be made between evolutionary game theoretic models, which focus on the spread of behavioral rules or strategies which determine the behavior of the agent possessing them, and the cultural attribute models, which focus on the spread of passive attributes, labels or tags. In the wider scope of memetics both can be described as memes. Behavioral rules or strategies are generally not visible to other agents but cultural attributes generally are. These may be termed "hidden memes" and "visible or surface memes" respectively.

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Biographical Sketch

David Hales is a research fellow working in the areas of Social Simulation and Artificial Societies. The general focus of his work involves modeling processes of cultural transmission and evolution in populations of agents. Use is made of the emerging Meme paradigm as a basis for computational modeling. The general thrust of the work is to explore those situations in which cultural evolutionary processes appear to be better than genetic evolution or individual rationality in sustaining pro-social behaviors. One specific area of focus centers on the emergence of "meme bundles" or "cultural packages". Such processes are of particular significance when "tags" or "cultural markers" are combined with behaviors that transport utility between individuals possessing similar markers. He received a BSc in Computer Science from Aston University and MSc in Artificial Intelligence from Essex University. He holds a PhD in Social Simulation (Essex University).