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Feature Review

Cultural Evolutionary Perspectives on Creativity and Human Innovation

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Cultural traits originate through creative or innovative processes, which might be crucial to understanding how culture evolves and accumulates. However, because of its complexity and apparent subjectivity, creativity has remained largely unexplored as the dynamic underpinning of cultural evolution. Here, we explore the approach to innovation commonly taken in theoretical studies of cultural evolution and discuss its limitations. Drawing insights from cognitive science, psychology, archeology, and even animal behavior, it is possible to generate a formal description of creativity and to incorporate a dynamic theory of creativity into models of cultural evolution. We discuss the implications of such models for our understanding of the archaeological record and the history of hominid culture.

Trends

Creative and innovative processes are of central importance to our understanding of how culture evolves and accumulates.

Using the perspectives of cognitive science and other fields to inform a formal definition of creativity, it is possible to include a dynamic theory of creativity in models of cultural evolution.

This may help to answer important questions about human cultural evolution and generate deeper insights into the rate of cultural evolution and accumulation over time.

Culture and Creativity

The complexity and ubiquity of human ritual, language, and material culture is unparalleled in the animal kingdom and, while there has been some success in describing how cultural traits spread in human and nonhuman populations, little theory has addressed the origins of these traits. Creativity represents the starting point of the cultural evolutionary process. Thus, to fully understand complex cultural abilities, the evolution of these abilities, and what sets human culture apart from that of other animals, we must first understand what circumstances lead to innovation, what is unique about human creativity, and what drives humans alone to create art on cave walls or design increasingly sophisticated technologies.

Although early creativity research often focused on uniquely creative individuals, such as Einstein, Mozart, or Poincaré [1,2], in fact, each human creates novel solutions to problems and thinks novel thoughts every day [3]. This 'everyday creativity' is especially pertinent to cultural evolution, because most cultural innovations are thought to be incremental but important [3]. Such novelty can, in turn, be altered and built upon by others, leading to an elaborate and heritable system of culture.

Similarly, definitions of creativity range from those that invoke extraordinary ideas generated by exceptional individuals to those that stress the capacity for innovative problem solving by any individual. To study the role of creativity in cultural evolution, a definition of creativity must incorporate 'everyday creativity' as well as its cultural and social context. Therefore, here we define a creative idea as 'one that is both novel and useful in a particular social setting' [4–6]. This definition, with its specification that creativity involves both novelty and utility, is widely accepted in cognitive science and psychology (e.g., [3–9]), and the idea that novelty and usefulness depend on social context is relevant to archaeology, anthropology, and cultural evolution. Although the terms 'innovation', 'creativity', and 'invention' are often used interchangeably in cultural evolutionary theory, important distinctions exist between these concepts in some fields,

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Box 1. Creativity, Innovation, Invention, and Their Subdivisions: Avoiding a Terminological Quagmire

In much of the literature dealing with nonhuman animals, 'innovation' is taken to mean either 'a new or modified behavior pattern' or 'a process that results in a new or modified behavior' [94,95]. These definitions include the invention of a new behavioral pattern, which we have labeled 'creativity', as well as the introduction of new behaviors into a population through noncreative processes, such as borrowing or immigration. Thus, in studying creativity, we are interested in just a subset of the processes underlying animal innovation, as outlined by Reader and Laland [94], and in our review of the literature related to nonhuman creativity, innovation is defined as it is used in each cited study.

A further important terminological distinction also exists between what economists and others term 'invention' and what they term 'innovation' [68,96]. The former refers to the production of a novel behavior or idea, and the latter refers to its spread through the population. Similarly, in management science, the term 'creativity' refers to the process of developing a new product, whereas an 'innovation' is the end point of creativity: a finished, valuable product that can be marketed [97].

These differ somewhat from the definitions used by Reader and Laland [94], and those in the social learning literature more generally, and the distinction is important. Here, we suggest that much of cultural evolutionary theory deals with 'innovation,' or the spread, but not 'invention,' or the production, of ideas. Both of these concepts have clear importance in understanding cultural dynamics. In the archeological record, for example, researchers interested in creativity necessarily consider only tools or artifacts that have spread in a population to a detectable frequency. Thus, they sample traits that have been favored culturally in some way. In this respect, archeologists often confront the definitional issues discussed here and must consider 'innovations' not 'inventions', and caution is needed when attempting to link novel artifacts in the archeological record to rates of creativity and invention on an individual or population level.

The scientific literature includes a large number of subdivisions of creativity, many of which are broadly similar (Table 1, main text). For example, some researchers attempt to separate creative outputs by assessing the extent of their novelty or usefulness. This tendency is reflected in P-creativity and H-creativity, definitions proposed by Boden [3] to describe psychological creativity, the creation of something that is new to the creator, and historical creativity, or the creation of something that is new to human history, respectively (see also Table 1, main text). Of course, these are fuzzy concepts. For example, calculus was discovered (or invented, depending on your philosophical bent) twice, once by Leibniz and once by Newton. Strictly, one of these discoveries should be regarded as P-creativity only, but both are treated as H-creativity. Somewhat similar to P- and H-creativity are the concepts of Big-C and little-c creativity, often used to separate studies of the works of great creators (Big-C) and studies of everyday creativity (little-c), with further subdivisions also suggested (Table 1, main text). However, models of cultural evolution must make some assumptions about H- and P-creativity, which might not always be recognized as such. Any models based, for instance, on the infinite sites model in population genetics (e.g., [27,28]) or on that proposed by Henrich [23,24] assume (in different ways, the former explicitly and the latter implicitly) that each cultural trait can be innovated only once. Thus, in these models, only H-creativity is possible. However, repeated innovations of similar or identical ideas or artifacts could change the cultural evolutionary dynamics by increasing the probability that a particular cultural trait is copied. We can see the importance of this assumption for Oldowan stone tool sites, where the distribution of the sites, as well as the relative simplicity of the method of production of the tools, calls into question the idea of a single invention of the method of stone tool production and might point instead to multiple inventions each with limited spread [98]. To discern the difference in patterns expected under these conditions, we must use models that allow P-creativity.

It might also be important to ask whether differences in outcome described by such divisions as P-creativity and H-creativity, or Big-C and little-c creativity, reflect real differences in how the brain works, or if the divisions merely reflect useful and observable ways to share the load of investigating creativity. In other words, these divisions might be useful in the study of creative outputs, but are they useful in the study of creativity itself? Indeed, the usefulness of the dichotomy between Big-C and little-c creativity has more recently been called into question [99]. Critics suggest that such divisions are not useful and could, in fact, be harmful to progress in the study of creativity. They claim that there is, in reality, no mechanistic difference in the creative processes involved these two types of creativity (or, one assumes, in further subdivisions along similar lines [100]). Therefore, in attempting to use categorizations to inform models useful to cultural evolution, we advocate reliance on differences in the processes of creativity, such as those proposed by Dietrich [47] and others in the cognitive sciences, and by Amabile [46] and others in psychology. In contrast to a sharp division between high- and low-level creativity, Amabile's model of the creative process assumes that there is a continuum from low-level everyday creativity to higher-level historical creativity and assumes that two creative acts by the same person, say, could fall on different points along this continuum.

such as animal behavior, economics, and archeology. These and other terminological distinctions are discussed in Box 1.

Using the above definition of creativity, and focusing on cultural evolution, in this review (i) we discuss what features would make a useful and realistic model of creativity; for example, does the rate of creativity increase in risky, harsh, or unpredictable environments? Are different