DOSSIER

Evolutionary theory on the move: New perspectives on evolution in the cognitive science of religion

Teoria evolucionista em movimento: novas perspectivas sobre evolução na ciência cognitiva da religião

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ABSTRACT

This article discusses the use of evolutionary theory in the cognitive science of religion (CSR), with special attention to critical issues and new developments. In the first part of the article, I will discuss the definition of evolution and describe the Modern Synthesis (or neo-Darwinian theory). In the next part, I will consider various evolutionary perspectives in CSR, including evolutionary psychology, sexual selection, gene-culture co-evolution, and cultural evolution. In the final part, I will turn to the problems with the Modern Synthesis and present a new approach based on network theory, with potential applications to the study of biological and cultural systems.

Keywords: cognitive science of religion, evolution, modern synthesis, cultural evolution, gene regulatory networks, evo-devo, deep learning.

RESUMO

Este artigo discute o uso da teoria evolutiva na ciência cognitiva da religião (CCR), com especial atenção para questões críticas e novos desenvolvimentos. Na primeira parte do artigo, discutirei a definição de evolução e descreverei a Síntese Moderna (ou teoria neo-darwiniana). Em seguida, considerarei várias perspectivas evolucionárias em CCR, incluindo psicologia evolutiva, seleção sexual, co-evolução de cultura de genes e evolução cultural. Finalmente, abordarei os problemas da Síntese Moderna e apresentarei uma nova abordagem baseada na teoria das redes, com potenciais aplicações para o estudo de sistemas biológicos e culturais.

Palavras-chave: ciência cognitiva da religião, evolução, síntese moderna, evolução cultural, redes reguladoras de genes, evo-devo, aprendizagem profunda.

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What is evolution?

Evolutionary theory is on the move. Until about fifteen years ago, at least most biologists would have agreed on the main lines of what evolution was and how it worked. Apart from some controversial ideas (such as group selection, on which more below), the so-called neo-Darwinian synthesis (or Modern Synthesis) went mostly unchallenged. This is hardly the case any longer, with some of the basic tenets of the mid-twentieth century consensus being called into question. The purpose of this article is to discuss some of the recent developments in evolutionary theory with special attention to their (potential) applications in the study of religion. We will start by outlining some more traditional views and proceed toward innovative approaches.

Charles Darwin summarized the concept of evolution as "descent with modification over time" (Darwin, 1909, p. 132, 178, 380, etc). For a more extended formulation of the same basic idea, we can turn to a recent textbook definition (Moran, 2006, p. 1): "Evolution is a process that results in heritable changes in a population spread over many generations." It is important to recognize how broad the basic (Darwinian) definition of evolution is. Notwithstanding simplistic, popular understandings of evolution, such as the "survival of the fittest" (an expression coined by Herbert Spencer), evolution as defined above can take place by several mechanisms, such as drift, migration, mutation, and natural selection. Arguably, the most interesting and certainly the most intensely studied form of evolution is natural selection, which occurs when the frequency of a heritable trait that improves reproductive success increases in the population with time (Stearns and Hoekstra, 2005, p. 2).

Another notable aspect of the Darwinian notion is that it does not include genes. In fact, none of the definitions we have considered so far mentioned genes at all. If we now turn to the Modern Synthesis, which is what evolution really means for most biologists, genes become of central importance. It is not easy to give a straightforward definition of evolution in neo-Darwinian terms: one could say that the classical Darwinian concept was simple and elegant, while allowing for diverse applications, whereas the neo-Darwinian concept is more specific, yet cumbersome to define. Instead of a single definition, it is easier to think about neo-Darwinian evolution in terms of four different processes (Walsh and Huneman, 2017, p. 2):

(a) *Inheritance* is the transmission of replicated materials from parent to offspring.
(b) *Development* is the implementation of a program that exerts control over the phenotype.
(c) *Variation* arises from random changes introduced into the genetic code.
(d) *Adaptive population change* is the change in the relative frequency of replicated entities (genes) under the influence of natural selection (as described above), mediated by the environment.

As it appears, all four components of the Modern Synthesis have come under attack recently. Before looking at some of the suggested modifications and extensions, let us consider how classical evolutionary theorizing has influenced the cognitive science of religion (CSR).

Evolutionary psychology and the beginnings of the cognitive science of religion

Evolutionary psychology studies cognitive and behavioral adaptations to evolutionary pressures. More specifically, evolutionary psychologists focus on the evolved mental architecture of *Homo sapiens* that has been shaped by more or less consistent environmental conditions for tens of thousands of years, before humans started to live in large societies and invented agriculture. These conditions (associated with life on the African savannahs in the Pleistocene period, dated between 2.5 million and 12,000 years ago) provided evolutionary pressures that shaped the human mind in fairly consistent ways before *Homo sapiens* started to migrate out of Africa (traditionally dated to around 100,000 years ago, but potentially pushed back in time by recent archeological finds). Some of the implications of evolutionary psychology include the hypothesis of specialized systems of the mind that deal efficiently with salient problems, such as predation, mating, contagion, and various aspects of social life.

The theory of the modularity of mind has been especially influential in CSR. The astounding versatility and efficiency of the human mind begs explanation. Jerry Fodor (1983) suggested that the mind includes a number of modules that deal with different kinds of information. The modules are loosely related to the senses and are domain-specific, that is, they deal with some aspect of the world and process only information that is relevant to that aspect. Leda Cosmides and John Tooby (Cosmides and Tooby 1987, 1994; Tooby and Cosmides, 2000), together with a number of other scholars, reasoned that evolution created specialized cognitive systems in the human mind that coped with specific cognitive tasks in the environment of our ancestors. This version of modularity is called *massive modularity*, or the "Swiss army knife" model of the brain. While specialized cognitive modules are useful for dealing with specific tasks efficiently, they make it very difficult to learn, innovate, or develop a unified sense of self and consciousness that humans have. Steven Mithen (1996) addressed this problem by suggesting a three-phase evolution of the mind: a general-intelligence mind capable of learning and decision-making; a mind of specialized intelligences (a simpler version of the Swiss army knife model) that deals with different domains efficiently; and a mind with flow of knowledge and ideas (cognitive fluidity) between domains.

The massive modularity hypothesis provided a major impetus for emerging CSR in the 1990s. Evolved mental systems, it was emphasized, constrain human culture, which can

only take forms that are enabled by the existing mental structures. As a result, even though cultural forms are very diverse, this diversity is neither random nor limitless. For example, languages, despite their great diversity, use a limited variety of sounds and phonetic combinations that our minds, speech organs, and senses can produce and process. As CSR emerged in the 1990s, evolutionary psychology played a particularly important role in the work of Stewart Guthrie (1980, 1993), Pascal Boyer (Boyer 1994, 2001, 2018; Boyer and Liénard, 2006), and Ilkka Pyysiäinen (2003, 2004, 2009), while it also influenced the ritual form theory developed by E. Thomas Lawson and Robert N. McCauley (Lawson and McCauley, 1990; McCauley and Lawson, 2002), and other contributions.

The use of evolutionary psychology in the study of religion can be criticized on several accounts. First, explanations with recourse to evolutionary psychology often give the impression of being just-so stories, ones that make sense but are hard to prove. Second, cognitive mechanisms can be studied with the help of experimental and other methods and one may question whether the evolutionary explanation attached to a given mechanism really adds anything relevant to it. Third, the timeframe that is usually considered when reasoning about human cognitive universals can be problematic. Human migration (or multiple migrations) out of Africa might have taken place in several waves and possibly much earlier than it was assumed previously (Stringer, 2016). As a consequence, various human populations could have spent sufficiently long time in different environments and interbred with other hominids for theorizing about life on the African savannah being of limited value for understanding human cognition.

One might argue, however, that evolutionary psychology (when relying on sufficiently robust evidence, such as insights from primate studies or paleoanthropology) enhances cognitive scientific explanations by showing the deep relationships between empirically observed cognitive mechanisms and the connection between cognitive mechanisms and respective environmental challenges. Instead of dismissing evolutionary psychology as an approach to religion, we can make use of recent developments and more refined theories in the field. For example, the work of Merlin Donald (1991) and Robert Bellah (2011) considered different timescales and addressed more varied effects of evolution on cognition and religion than the studies before them (although their speculative nature has come under criticism [see, e.g., Horst, 2012]). More recently, the fields of cognitive archeology and paleoneurology emerged to combine insights from cognitive neuroscience, evolutionary theory, and archeology in the understanding of human cognitive evolution (e.g., Coolidge *et al.*, 2015; Haidle *et al.*, 2016).

Sexual selection

The study of sexual selection is one of the classical branches of evolutionary science. While sexual selection itself is as complicated and multi-faceted as the rest of evolutionary theory, the basic idea can be summarized as follows: a trait variant that helps the organism to produce more offspring with partners of better quality (see below) will spread as long as its possible negative effects on other aspects of reproductive success (such as preventing the organism from reaching reproductive age or raising the offspring) do not outweigh its advantages.

During the past decade, scholars suggested several ways in which the emergence of religion in *Homo sapiens* could be explained in the framework of sexual selection. Most of the relevant work focused on mate choice, essentially hypothesizing that religious displays make potential mating partners (in most theories, males) more attractive. For example, Jason Slone (2008) proposed that religion evolved, at least in part, to support the assessment of the qualities of potential mates. Pyysiäinen (2009, p. 207-208) suggested that ritual dance can be a good indicator of male fitness and thus function as a male ornament in sexual selection. Rüdiger Vaas and Michael Blume (2009, p. 136-137) identified various elements of religion, in which typically males engage themselves, as potential hard-to-fake signals of fitness, such as tortures of the body, time-consuming rituals, postures that prevent other actions, life-long scriptural studies, meditations, prayers, renouncing consume or nourishment, and high costs of temples, costumes, and art.

Other suggestions about the role of sexual selection in the origins of religion dealt with long-term bonding and joint parenting. Some ethnographic and experimental data suggests that religious beliefs and behavior support long-term, monogamous relationships at least in some contemporary societies (Bulbulia *et al.*, 2015; McCullough and Willoughby, 2009; Watts *et al.*, 2015a; Weeden, 2015; Weeden *et al.*, 2008).

More recently, work on religion and sexual selection developed in yet another direction, looking into the connection between religion and mate guarding. For example, Sela *et al.* (2015) made a case for the use of religion as a tool of aggression in sexual selection. They noted that both intrasexual aggression between men and various forms of intersexual aggression by men toward women provide males with a reproductive advantage. Pazhoohi *et al.* (2017) suggested that religious veiling is a mate-guarding strategy and showed that the practice becomes more frequent in harsher environments. Finally, Czachesz (2018a) proposed that proto-religious traits emerged in *Homo erectus* in the context of mate-guarding, more specifically, as an adaptation in males guarding a group of female mating partners.

Given that sexual selection can produce very strong effects, it is almost beyond dispute that it influenced the development of religion in one way or another. It is surprising that the discussion about religion and sexual selection has remained rather marginal in CSR so far. Recent studies explored various aspects of the problem and opened up the discussion in several directions simultaneously. It is quite reasonable to suppose that religion and sexual selection interacted in different ways during

human evolutionary history. Learning from recent developments in cognitive paleoanthropology (see above) and paying attention to specific problems at different stages of human and hominid cognitive evolution could lead to improved theorizing in this exciting area (see Czachesz, 2018a).

Gene-culture co-evolution

Gene-culture co-evolution offers a new way of looking at the connection between evolution and culture, beyond the important but limited insight that the evolved mind constrains cultural forms. Cultural practices, if they exist persistently over a sufficiently long period of time, will constitute evolutionary pressures, just as other environmental factors do. Well-documented genetic adaptations to culture include the shape of the human larynx (assumedly an adaptation to language) and the ability to digest milk in adults (at least in many populations) (Jablonka and Lamb, 2005, p. 286-317). On a general level, human language (and material culture) has shaped the mind as much as humans shaped their environments. According to the theory of *cognitive ratcheting*, proposed by Michael Tomasello (Tomasello, 1999; Tomasello *et al.*, 1993), small changes in the mind led to small changes in the artifacts made by early humans, which, in turn, initiated further changes in the mind. It is possible, however, that the notable cases of genetic adaption to cultural pressures (such as language and dairy farming) constitute exceptions rather than the rule: it has been argued (Gibbons, 2010) that the spread of beneficial mutations usually takes longer than the relatively short history of dairy farming would have allowed for. In special circumstances, however, genetic mutations can spread faster than normally. Artificial selection and self-domestication provide such examples in animals and plants.

The theory of gene-culture co-evolution can be taken into consideration in different ways in the study of religion. First, it is beyond dispute that religion has been with *Homo sapiens* and its ancestors for sufficiently long time so that religious beliefs and behaviors could shape human biological traits. It is reasonable to hypothesize that some form of religion, such as ritual displays, and some form of belief in ancestors and spirits preceded the appearance of language and symbolic thought in evolutionary history. For example, if certain expressions of religion (such as artistic and ritual displays) increased reproductive fitness (as we think better linguistic expression did), the necessary cognitive and sensory-motor skills would have been selected for. Let us note that in this hypothetical scenario we are considering religion as a continuous environmental condition. The suggested process is different from the assumed selection of religious traits that are thought to enhance cooperation and group solidarity, for example. Admittedly, such arguments remain difficult to prove, which takes us back to our discussion of the potential of evolutionary psychology above.

Second, one can study the effect of religion on particular historical populations, in the same way as we can study lactose tolerance or sickle-cell anemia. For example, Gabriel Levy (2012) considered the effects of literacy, endogamy, social isolation, and other factors on biological traits in Jewish history. More generally, one can argue that religion plays a significant role in shaping and maintaining social boundaries, dietary habits, marital structures, and other cultural patterns, and can be expected to cause relatively rapid evolutionary change especially in the genomes of isolated populations.

Cultural evolution and group selection

The theory of cultural evolution applies the principles of evolutionary theory to the study of transmission processes and long-term developments in culture. It is obvious that humans pass on not only genes but also cultural items (such as ideas, stories, and artifacts) to their offspring. According to Richard Dawkins (2006 [1976]), culture is passed on in the form of *memes*, which are units of culture that can be inherited independently of each other. Examples of memes are "tunes, ideas, catch-phrases, clothes fashions, ways of making pots or of building arches" (Dawkins, 2006, p. 192). If culture is inherited in gene-like units, it is reasonable to ask whether natural selection and other evolutionary dynamics apply to it.

The concept of the meme has been criticized on different accounts (Kundt, 2015). First, it is not straightforward to isolate memes from other memes: for example, is Buddhism a meme? Second, what is the building material of a meme? Third, the mechanisms of copying memes are not well known: specifically, it seems that they are copied with less fidelity than genes. Addressing the latter problem, Dan Sperber (1996, 2000) argued that pieces of culture are not copied with high enough fidelity so that something like natural selection could act on them; the stability of cultural traits is due to psychological biases rather than to the faithfulness of copying. According to Sperber, among the range of possible forms a cultural bit can take there are optimal forms dictated by psychological factors, which he calls *attractor positions*. For example, people will copy the idea of a ghost with low fidelity (missing or distorting details and adding new ones), but the idea will remain relatively stable across generations because the idea of a ghost is constrained by innate psychological structures (cf. Boyer, 2001; Pyysiäinen, 2009). It has been suggested (Czachesz, 2017a, p. 42-48; McElreath and Henrich, 2007) that although Sperberian attraction influences culture, it does not exclude the existence of other processes of transmission, such as natural selection. In other words, psychological biases provide constraints that limit the range of possible forms of culture that can survive in the long run; however, there are still possibilities for variation and selection within those limits. For example, although concepts of ghosts are fundamentally shaped by evolved, cross-culturally consistent psychological mechanisms, particular representations of ghosts, tales about ghosts, or prac-

tices related to ghosts and spirits can take different forms so that cultural evolutionary processes can shape them.

Another contested aspect of cultural selection is the assumed intentionality of cultural innovations, which is contrasted with the randomness of genetic variation, on which natural (biological) selection acts. As Alex Mesoudi (2011, p. 33-34) pointed out, however, cultural innovation is much less intentional than innovators tend to claim. In fact, cultural innovations usually result from long chains of trials and errors, often in many generations of thinkers and tinkerers. Yet another contradiction with the neo-Darwinian theory is the passing on of acquired cultural traits. A corresponding inheritance of acquired biological traits is strictly rejected by the Modern Synthesis. This is related to the problem of oblique transmission: while we cannot inherit genes from our peers, we can learn new ideas from them. Discussing the challenges to cultural evolutionary theory, Mesoudi (2011, p. 46-47) suggested that cultural evolution might not be neo-Darwinian, but still Darwin's original concept of evolution can be helpful in studying it.

It is quite possible that we can identify evolutionary processes in various mediums (for example, computer modeling offers many opportunities), using the broad definition of (Darwinian) evolution, *and* discover other rules that apply only to one or another type of evolution. Further, as we will see in a moment, some of the basic tenets of the Modern Synthesis are being called into question and new insights about biological evolution might shed new light on cultural evolution.

While cultural evolution can be examined in the context of individual differences in reproductive success, its applications to religion have taken selection on the level of groups as a starting point. The concept of group selection (Nowak and Highfield, 2011, p. 81-94; Wilson and Wilson, 2007, 2008) states that some genes contribute traits that are neutral or even disadvantageous for the reproductive success of the individual but are transmitted because they benefit the group. Group selection presupposes the formation of closed social groups: if a group can reproduce much more successfully than other groups due to pro-social behavior within the group, the spread of the genes of non-cooperating group-members can be neutralized. The use of group selection in cultural evolutionary theory allows for a number of other mechanisms (cf. Richerson and Boyd, 2005, p. 197-211). For example, cultural memes can be learned from other groups, a group can physically annihilate another group, or group members can migrate to other groups (to the point of complete assimilation). The definition of groups and group membership poses challenges for most group-selectionist accounts. People are members of several social groups at the same time and the boundaries of social groups are usually fuzzy. In the context of cultural evolution, one could define a group as the collection of all individuals who carry a certain meme. This of course implies that the members of such a group will not necessarily know each other or interact with each other, which might be a problem for some (but not all) applications of group selection.

Cultural group selection has been invoked to explain religion, either as an evolved or exapted trait (that is, an evolved trait that gained a new function). Perhaps the most famous statement has been David S. Wilson's *Darwin's Cathedral* (2003), which focused on Calvinist Christianity as a test case. As Wilson (2003, p. 54) acknowledged, his approach is indebted to Durkheim's functionalism, as indeed are most other approaches to religion as an adaptation to solve the problem of social cooperation (Bulbulia and Sosis, 2011; Johnson, 2015; Norenzayan, 2013; Teehan, 2010; Turner *et al.*, 2018). It has to be noted that much of the work inspired by Durkheim seems to proceed from the *a priori* assertion that religion answers some problem of social cooperation. While it is obvious that religion can have a major impact on society, pursuing grandiose hypotheses might not be the most useful strategy from the perspective of advancing cultural evolutionary theory. Contemporary and historical case studies, such as Richard Sosis' work on Israelite kibbutzim and utopian communities (Sosis, 2000; Sosis and Bressler, 2003), phylogenetic modeling of cultural traditions (Watts *et al.*, 2015b), or ongoing work on early Christian texts and communities (Czachesz, 2017b; Luomanen, 2017) might be helpful in mapping out the mechanisms and limitations of cultural (group) selection when applied to historical data.

Beyond the Modern Synthesis

While the critics of meme theory have a point in questioning the value of the meme concept to describe units of inheritance, it appears that the nature of genes as units of inheritance has become problematic, too. In this part of the article, I will present some of the major challenges to the Modern Synthesis, as well as some suggested changes to evolutionary theory.

The concept of the gene goes back to Georg Mendel and Wilhelm Johannsen (the latter introduced the word), who thought about it as something causing an inheritable phenotypic trait. After the discovery of DNA, genes were identified with discrete sequences of nucleotides that encode functional units of proteins. Soon it turned out that a single nucleotide can belong to more than one gene and different parts of the same gene can be used to create different proteins (Falk, 2010, p. 259-267). Further, humans have considerably fewer genes (on the order of 30,000) than geneticists expected (on the order of 100,000) even two decades ago. An individual gene seldom codes for one specific trait. Various new developments in evolutionary science have helped us to understand these surprising outcomes.

First, *epigenetics* determines how genetic material is activated or deactivated in different contexts and situations (Moore, 2015, p. 14). As a result, the same genetic information can yield divergent phenotypic traits. Moreover, epigenetic changes in the organism can be passed on to subsequent generations, a phenomenon called epigenetic inheritance (Moore, 2015, p. 145-166). Epigenetic inheritance can deter-

mine, among others, food preferences and the utilization of nutrients in several generations (Bateson *et al.*, 2004; Mennella *et al.*, 2001; Moore, 2015, p. 125-126; Quarta *et al.*, 2016). Epigenetic inheritance summarizes the experience of multiple generations and raises interesting questions about the biological foundations of religious food traditions and other cultural traits (Czachesz, 2018b).

Further, genes are organized into networks to produce phenotypic traits. So-called gene regulatory networks include DNA, RNA, and proteins, which interact in complex ways to decide what genetic information is transcribed in a given context (Davidson and Peter, 2015). Requiring fewer components to code for more traits is not the only benefit of this arrangement. As it turns out, genetic regulatory networks have a modular structure (Zhang and Zhang, 2013). It is assumed that the modular structure of the networks makes it less likely that random mutations result in harmful changes and helps to preserve successful evolutionary designs (Wilkins, 2007).

Meanwhile, the field of evolutionary developmental biology (evo-devo) emerged, with the purpose of studying the role of development in evolutionary change (Hall, 2012). It has been understood that the physical design of the organism takes over a variety of tasks from the genome and the epigenome. For example, many features of the limbs develop as a result of biological and environmental constraints, both ensuring their functionality and making genetic coding for the respective features unnecessary. As was the case with gene regulatory networks, the study of developmental templates led to insights about their role beyond the obvious benefit of reducing the size of the genetic code. It has been argued (Uller *et al.*, 2018) that evolution acts on a system comprising both the organism (with its physical properties) and the genome (including regulatory networks and epigenetics).

These and other insights resulted in calls for a new evolutionary science beyond the Modern Synthesis (Huneman and Walsh, 2017). For example, Uller *et al.* (2018) considered the phenotype as a regulatory system, which allows for "facilitated variation" (a position between random variation and directed variation) in evolutionary change. Stewart Newman (2017) argued for a "nonidealist evolutionary synthesis," which takes into consideration the ways physics and biological materials influence the evolution of form. Finally, Denis Noble (2015) called for a reconsideration of the distinction between replicator and organism.

What is the significance of these new developments for the study of religion? (1) First, it has to be noted that biologists are divided over the implications of the new insights about evolution for the Modern Synthesis (Laland *et al.*, 2014). However, it is not the fate of the neo-Darwinian consensus that matters most for scholars of religion. The various new (and not so new) insights about how evolution works can be considered independently of their consequences for the future of evolutionary science. (2) Second, the above-mentioned developments in evolutionary theory shed new light on how genes and culture interact (Rosa and Müller, 2018).

Meanwhile, growing attention to development, the organism, and the environment characterized the recent history of cognitive science. These trends have also influenced CSR: for example, the theories of embodied cognition (Geertz, 2010) and niche construction (Bulbulia, 2008) have been used to explain religion. (3) Third, new insights in systems biology can be used to rethink the concept of cultural evolution. For example, the changing view of the nature of biological replicators offers fresh perspectives on the nature of cultural replicators. At this place, let us consider the theoretical model developed by Richard Watson and Eörs Szathmáry (2016).

In their article entitled "How Can Evolution Learn?," Watson and Szathmáry suggest that evolution is a learning process that takes place in networks. Specifically, they draw on the concept of neural networks in artificial intelligence research. Neural networks in computer modeling are loosely based on how neurons work in the brain and have been used in artificial intelligence for some decades. They have been going through a renaissance in recent years, also referred to as *deep learning*. Without delving into the details of deep learning, we can note that neural networks learn by adjusting their connection weights (based on their learning algorithms) to produce increasingly better outputs in response to inputs. We have seen that both gene regulatory networks and the phenotype as a regulatory system lend themselves to network theoretical modeling. Variation in these systems, due to both random and directional mutations, can be understood as adjustments of their network structures. Natural selection, Watson and Szathmáry argue, serves as a feedback mechanism and drives the learning process. (They also extend the model to ecological networks, which we cannot discuss at this point.) The model of neural networks and the related body of learning theory provide conceptual frameworks for understanding learning processes in various domains and raise the possibility of rethinking cultural evolution in terms of network science. In recent years, network theory started to gain traction in the study of religion, with emerging applications to social, environmental, and textual data (e.g., Ambasciano, 2016; Chalupa, 2015; Czachesz, 2013, 2016; Elwert and Sellmer, 2013; Lane, 2015). Moving beyond data representation and descriptive statistics in the study of cultural networks, the evolutionary paradigm championed by Watson and Szathmáry presents itself as a new opportunity to think about cultural evolution as a learning process on these network structures.

Conclusions

In this article, I surveyed the uses of evolutionary theory in the cognitive science of religion. While CSR relied heavily on evolutionary psychology in the beginning, it has received influences from various branches of evolutionary science during the last decade. The second part of the discussion focused especially on the use of evolutionary theory to understand culture and the controversies surrounding the theory

of cultural evolution and its use in the study of religion. In the final part of the article, I suggested that considering current advances in evolutionary science can be especially helpful in developing an improved concept of cultural evolution.

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