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Evolved to be irrational? Evolutionary and cognitive foundations of pseudosciences

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Introduction

People believe the weirdest of things. Forty percent of the US population endorses the claim that Earth and all life on it has been created by God six to ten thousand years ago (Newport, 2010); three in four Americans accept some form of paranormal belief such as astrology or extra-sensory perception (Moore 2005). Europeans are no less gullible: two Britons in five believe that houses can be haunted and one in five thinks that aliens have visited our planet at some point in the past (Lyons 2005). Pseudo-medical treatments such as homeopathy are widely practised and in some countries like Belgium even refunded by health care. Horoscopes can be consulted in numerous popular magazines and newspapers. In sum, there seems to be no end to the irrational propensities of the human mind.

In this chapter, we intend to examine how an evolutionary and cognitive perspective might shed some light on the pervasiveness and popularity of irrational beliefs that make up pseudosciences. As such, this contribution will consist of four parts. First, we will set up the general theoretical framework, explaining what an evolutionary and cognitive approach entails. Second, we will explore how this framework adds to our understanding of why the human mind is so vulnerable to systematic reasoning errors. Third, we will demonstrate how concrete pseudosciences tap into particular cognitive dispositions. And, fourth, we will explain why a number of irrational beliefs take on the form of pseudosciences. To conclude, we will turn to the question we have put in our title and briefly discuss how the evolution of the mind relates to human (ir)rationality.

The evolved mind

The idea that the human mind can be regarded as a product of evolution was already proposed by Charles Darwin. In his seminal work *On the Origin of Species*, in which there is little mention of human evolution, he professed that "psychology will be based on a new foundation, that of the necessary acquirement of each mental power and capacity by gradation" (Darwin 1859, 488). Twelve years later, in the *Descent of Man*, Darwin (1871) argued that humans share particular cognitive faculties with other animals, differing only in degree, which showed that the mind had indeed evolved. But for more than 100 years, despite the enormous potential for explaining human thought and behaviour, Darwin's radically new approach to the human mind was largely ignored, notwithstanding a few unsuccessful and premature attempts to darwinize psychology, such as Freudian psychoanalysis. This situation changed during the second half of the previous century with the development of cognitive ethology, sociobiology and evolutionary psychology.

Evolutionary psychology emerged from several scientific traditions, synthesizing elements from research fields such as cognitive science, cognitive ethology and sociobiology (Tooby & Cosmides 2005), as a consequence of the evidence that had been accumulating in those fields. It challenged the prevailing paradigm in the social sciences, identified by Tooby and Cosmides (1992) and others (e.g., Pinker 2002) as the Standard Social Science Model, which regards the human mind as a blank slate with a small number of general-purpose learning mechanisms that can be inscribed with any content culture provides (Pinker 2002; Tooby & Cosmides 1992).

Instead, this new evidence suggests that the human mind consists of a number of domain-specific, specialized mental inference systems that evolved in response to specific adaptive problems our ancestors had to solve during their evolutionary history. These were mainly problems dealing with survival, mating and sex, kinship and parenting, and group living (Buss 2008). One school of thought in evolutionary psychology (e.g., Pinker 1997) holds that cognitive evolution has not kept pace with cultural developments: the circumstances in which humans live have altered dramatically since the early Holocene (due to, for example, the invention of farming and the Industrial Revolution), but, according to evolutionary psychologists, our evolved mind is still mainly adapted to a hunter-gatherer way of life. Human evolution did not stop in the Pleistocene, as is evident, for example, in mutations in enzymes that allow the digestion of starchy food and dairy products (e.g., Perry et al. 2007), but evolutionary psychologists (e.g., Tooby & Cosmides 1992) contend that the pace of cultural evolution over the last 10,000 years has outstripped that of organic evolution, so that human cognitive adaptations are still to a large extent fitted to a hunter-gatherer lifestyle. There has been some tentative genetic evidence for ongoing cognitive evolution over the past few thousand years (e.g., Evans et al. 2005; Mekel-Bobrov et al. 2005), but these findings have not been without criticism (Currat et al. 2006, Yu et al. 2007). The structure of the human mind constrains and governs human thought and behaviour in systematic ways. For example, people are more wary of spiders than of cars, even though the latter category forms a far bigger risk to one's health than the former in most human lives.

What is of interest here is that the mind has been endowed with cognitive dispositions that were largely adaptive: they offered the ability to produce representations of particular aspects of the world which allowed humans to respond quickly and aptly to specific situations. These predispositions are often pictured as "fast and frugal heuristics" (Gigerenzer et al. 1999) that result in intuitive ways of reasoning that are fast, automatic and largely unconscious. To be sure, we do have the feeling that we have control over our thoughts, that there is an "I" that does the thinking. This reflective way of thinking, which is mostly conscious and functions more slowly in comparison to intuitive reasoning, arises from the human capacity to represent representations. Because this meta-representational capacity does not deal with the outside world directly, it is regarded by some to be domain-general (e.g., Sloman 1996), although according to Sperber (1996), it can be deemed a cognitive specialization that has evolved specifically to deal with representations. Humans do indeed seem to possess two distinct ways of processing information, intuitive and reflective, also called dual-process reasoning (J. S. B. T. Evans 2010). As we will see further on, this has important implications for our understanding of human rationality, and thus, for our present discussion of pseudosciences.

The evolution of cognitive bias

Because the human mind has evolved to deal with adaptive problems in real-life situations, it focuses on specific cues in its environment that are relevant for solving these problems, rather than generating a perfectly accurate picture of the environment. Thus, we can expect human reasoning to exhibit trade-offs between speed and truth-preservation, leading to fast but not always reliable heuristics. This prediction has been borne out by ample studies under the banner of the "heuristics and biases" program, initiated by Tversky and Kahneman in the 1970s (for an overview, see Gilovich et al. 2002). Even in solving abstract reasoning tasks, people rely on their intuitive judgment (unless taught otherwise), which leaves them highly vulnerable to systematic errors. For instance, when evaluating probabilities, people tend to make judgments on the basis of representativeness (Tversky & Kahneman 1974). The effect of these heuristics is exemplified by the classical Linda problem (Tversky & Kahneman 1983). Participants are invited to read the following description: “Linda is 31 years old, single, outspoken, and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice and participated in anti-nuclear demonstrations.” Then, they are asked which of the two following options they think is most probable: a) Linda is a bank teller, or b) Linda is a bank teller and a feminist. Although a conjunction can never be more probable than either of its two constituents, around 85% of participants judge that the second option is more likely than the first, arguably because they consider the text to be more representative of a feminist than of a bank teller. This has been dubbed the “conjunction fallacy.” Fallacies like these have proven to be extremely robust, and not easy to weed out (Tentori, et al. 2004).

Gigerenzer and colleagues (1999) have argued that the appearance of “fallacies” like this does not reflect people’s failure to think rationally, but rather results from researchers appraising people’s reasoning skills by inappropriate standards. To return to the Linda problem, people are supposed to apply a content-free logical rule to arrive at the correct answer. The test, however, contains ambiguous terms like “probable,” that trigger conversational heuristics that look for intended meaning and relevance, causing subjects to understand the word in non-mathematical terms such as “possible” or “conceivable.” When asked for a frequency judgment (“How many?”) instead of a probability judgment, as a result of which the ambiguity dissolves, people do infer the mathematical meaning, and the conjunction fallacy largely disappears (Hertwig & Gigerenzer 1999). According to Gigerenzer (2008), variations on experiments like this confirm that the mind should be regarded as a collection of specialized inference systems that have evolved in such a way that the human brain responds to the environment quickly, frugally and efficiently.[1] Hence, according to dual-process theories of reasoning, a picture emerges of two forms of rationality. On the one hand, there is the slow and reflective mode of rationality that conforms to the norms and rules of logic and probability. On the other hand, we have an “ecological” or

[1] However, this view is not widely shared in the psychology of reasoning. For example, Tentori et al. (2004) contend that Gigerenzer’s frequency approach already provides participants with a part of the solution, prompting them to conceptualize the problem in terms of frequencies.

"bounded rationality" that conforms to the adaptive requirements set by the environments in which the human species has evolved (Hilton 2002). From this perspective, the appearance of irrationality does not result from flawed reasoning, but rather from evaluating the latter form of rationality by the standards of the former. However, when intuitive reasoning is applied to complex and abstract cognitive problems, irrational reasoning can still result (Haselton, et al. 2005). The fast and frugal heuristics sometimes lead to error, as they continue to interfere with people's reflective inferences, in the form of well-attested kinds of irrationality (see above).

Keeping the above framework in mind, we argue that the tenacity and popularity of particular pseudosciences, even in the face of strong adverse evidence, can partly be explained by the fact that pseudosciences tap into people's intuitive understanding, thereby exploiting the mental heuristics that have evolved to respond efficiently to particular environmental and social situations. Let us illustrate this point by taking a closer look at one of the most pervasive irrational belief systems of today, creationism.

Pseudoscience and content biases: creationism as a case study

Here, we will use the term "creationism" not in its common sense of Young-Earth creationism, but as a form of belief system that contends that there is evidence that God has purposively intervened in the natural world, creating or designing entities (species, adaptations) that could not have arisen through a naturalistic process. As such, creationism not only denotes Young-Earth creationism, but also includes Old-Earth and Intelligent Design creationism (Matzke 2010; Scott 2009). Note that each of these variants is presented as scientific by its adherents, or at least as scientific as evolutionary theory.

Although the various strands of creationism might differ in their theological specifics, our use of the term "creationism" depends on the idea that they share a minimal core of common assumptions. In the rest of this chapter, we will argue that these core assumptions tie in closely with human intuitions concerning the origins and causal structure of the biological world. More specifically, creationism exploits or piggy-backs on the human mind's essentialism, its preference for teleological explanations and its hyperactive tendency to detect agency. As we will see, each of these intuitions makes sense from an evolutionary perspective.

Psychological essentialism

Essentialism is a hallmark of creationism. It is the view that entities, such as species, possess an immutable essence, which guides their development and behavior. Essentialism can be described as a fast and frugal heuristic that instantly provides our mind with a rich inductive potential, not on the basis of apparent similarities, but on the basis of an unobserved core that is believed to cause members of a given category to share particular behavioral and physical properties. As such, "[essentialism] allows one to exploit the causal structure of the world (of natural kinds, in particular), without necessarily knowing anything about the causes themselves" (Barrett 2001, 7). Historically, essentialism constitutes a major and recurrent theme in Western thought at least since Aristotle (Mayr 1982), a clear indication of its enduring appeal. Today, students' understanding of evolutionary theory is still hindered by essentialist inclinations (Shtulman & Schulz 2008): students with the highest essentialist tendencies have the least understanding of the mechanism of natural selection. Studies on essentialist reasoning in children indicate that this intuition develops early and in the absence of instruction, and that it is stable across cultures. Five-year-olds acknowledge that category membership remains unaffected by superficial changes. They consider a butterfly to belong to the same category as a caterpillar despite the dramatic developmental transformations the organism goes through (Gelman 2003). Also, essentialism is not restricted to Western culture: Yukatek Maya children reason as much about biological categories in terms of essences as children in the United States, a finding that suggests that essentialism is a universal feature of the human mind (Atran 2002). Moreover, young children often reason more in an essentialist fashion than adults, another indicator that this tendency is a stable part of human cognition (Gelman 2004). Although humans are capable of exploiting the causal structure of the world in other ways than through essentialism, it provides a quick and efficient heuristic to do so—for example, if one apple is edible, one can quickly generalize that all are edible; if one tiger is dangerous, one can infer that all are dangerous. Interestingly, humans are not the only species to use essential reasoning in this adaptive way: rhesus monkeys (*Macaca mulatta*) also infer that superficial changes to the exterior of a fruit do not alter its inside properties (Phillips et al. 2010).

Evans (2000a, 2001) found that young children until the age of ten have a preference for creationist accounts for the origin of species, and this is often accompanied with essentialist thinking. Creationists believe that God (or a "designer") has created the biological world, which is divided into distinct, non-overlapping categories or kinds, the members of which share an unobserved essence that makes them belong to that particular category and which resists evolutionary change. For instance, in *Evolution? The fossils say NO!,* Young-Earth creationist Duane Gish (1978, 43) firmly asserts that "the human kind always remains human, and the dog kind never ceases to be a dog kind. The transformations proposed by the theory of evolution never take place." Intelligent Design adherents are no different in this regard. Although some claim that they have no issue with common descent, they too state that natural selection is limited to micro-evolution, which has always been conceded by creationists as limited change within "kind". Towards naturalistic macro-evolution ("the molecule-to-man theory", in the words of Gish), however, Intelligent Design proponents are as skeptical as any other creationist. As one of the leading figures within the Intelligent Design movement, biochemist Michael Behe (1996, 15), puts it: "[T]he canyons separating everyday life forms have their counterparts in the canyons that separate biological systems on a microscopic scale. [...] Unbridgeable chasms occur even at the tiniest level."

Teleology

Intuitively, humans not only view the world in terms of essences, but they also assume that things in the world happen or exist for a purpose. This teleological tendency reveals itself from a young age. Four and five year olds are more inclined to ascribe functions to biological wholes and natural objects than adults do. They assume that lions are "to go in the zoo" and that clouds are "for raining" (Kelemen 1999a). When asked "why rocks are so pointy," seven to ten year olds prefer a teleological explanation ("so that animals wouldn't sit on them and smash them") over a purely physical explanation ("They were pointy because bits of stuff piled up on top of one another for a long time", see Kelemen 1999b). The teleological tendency wanes with age, which is probably due to the effects of science education. Scientifically untrained Romani adults were shown to be more prone to ascribe teleological explanations to non-biological natural entities than their educated peers (Casler & Kelemen 2008). However, evidence suggests that education merely suppresses the teleological tendency, which continues to act as a mental default setting throughout the entire lifespan. Adults are more likely to endorse teleological explanations ("the sun makes light so that plants can photosynthesize") when questioned under time pressure (Kelemen & Rosset 2009). Also, Alzheimer patients tend to revert to teleological thinking as a result of their condition

(Lombrozo, et al. 2007), indicating that the exposure to causal explanations only affects people's reflective, but not their intuitive beliefs.

Understanding biological properties in teleo-functional terms, particularly in combination with our capacity to categorize, provides a rich and valuable source of information for making inferences about the environment. As such, the teleological stance can also be identified as a fast and frugal heuristic that may have added to our adaptive rationality. Some philosophers even argue that teleological reasoning forms an indispensable conceptual tool for acquiring a solid scientific understanding of the biological world (Ruse 2003). Nonetheless, teleological intuitions have also been shown to highly constrain students' understanding of evolutionary theory. Students tend to mistake natural selection for a goal-directed mechanism. Or, they assume that evolution as a whole moves towards an end, which is commonly identified with the human species (see Bardapurkar 2008 for a review). Like essentialism, the teleological stance becomes an easy target for exploitation by irrational belief systems when it operates on unfamiliar terrain.

In creationist literature, the idea that things in this world exist because of a particular purpose is a strong and recurrent theme. In *Scientific Creationism*, under the subtitle Purpose in creation, Henry M. Morris (1974a, 33-34) contends that "the creation model does include, quite explicitly, the concept of purpose", and that "the creationist seeks to ascertain purposes." Rhetorically, he asks his readers:

> Do both fish and men have eyes because man evolved from fish or because both fish and man needed to see, in order to fulfil their intended creative purpose? Can stars and galaxies be arranged in a logical hierarchy of order from one type to another because they represent different stages in an age-long evolutionary process, or because they were each specially created to serve distinct purposes, such purposes requiring different degrees of size and complexity?

The same notion of purposefulness also resonates throughout the entire Intelligent Design literature. In fact, the basic claim of the movement is that complex biological systems can be compared with artefacts, implying that they too have been made to serve a particular purpose. Often, people's teleological intuitions are brought in as a justification for the design inference. As William Dembski (1999, 48), another important Intelligent Design proponent, puts it:

> Intelligent Design formalizes and makes precise something we do all the time. All of us are all the time engaged in a form of rational activity which, without being tendentious, can be described as 'inferring design.' Inferring design is a perfectly common and well-accepted human activity.

Naturally, being creationists, Morris and Dembski depict the alleged purposes in nature as resulting from the intentional actions of a supernatural agent. As such, creationism does not only hijack people's teleological intuitions, but also taps into the strong inclination of the human mind to detect other agents and understand their behaviour as motivated by intentions and desires. This makes creationism all the more cognitively appealing.

Detecting agents and the intentional stance

The human mind is highly prone to detecting agency and it often does so even in the absence of agents. Just think of the times you thought there was someone near when it turned out only to be some piece of garment hung out to dry on a clothes horse or a bush blown in the wind, or of the times you mistook a bag blown by the wind for a bird or a small animal. The opposite scenario, however, in which one mistakes an agent for a inanimate object, rarely occurs, even though it is in principle possible, e.g., mistaking a person for a mannequin, or a bird for a lump of earth and some leaves. At least two good evolutionary reasons have been proposed as to why the mind is more likely to produce false positives than false negatives when it comes to detecting agency. First, we can expect that agency detection is hyperactive, based on game-theoretical considerations involving predator-prey interactions, in particular the costs of false positives and negatives and the potential payoffs (Godfrey-Smith 1991). For complex organisms that live in variable conditions and that rely on signals in the environment that are not always transparent to make decisions, it is far less costly to assume that there is an agent when there is none than the other way around (Guthrie 1993)—this is the case not only for animals that need to avoid predators, but also for predators looking for potential prey, in which case the potential benefit outstrips the costs of a false positive. Because of the asymmetry between costs, natural selection favors organisms with an agency detection device that occasionally generates false positives rather than false negatives. Second, agency detection is not only related to predator-prey interactions, but is also highly relevant for the detection of the attention of conspecifics. Being watched may have consequences for one's reputation. Any reputational damage might entail a decrease in cooperation opportunities, thus limiting access to vital resources which, in turn, affects reproductive success. This provides a plausible scenario for why the human mind is hypersensitive to cues of being watched by other agents. For example, a picture of two eyes suffices to induce people to put more money in a donation box (Bateson, et al. 2006), or leave significantly less litter in a canteen (Ernest-Jones, et al. 2011); stylized eyespots on a computer screen or an eye-like painting significantly increase generosity in a Dictator Game (Haley & Fessler 2005; Oda et al. 2011).

Evolutionary psychologists argue that the human mind has an evolved capacity to interpret the behavior of other agents as motivated by internal states, such as intentions and beliefs. Adopting the "intentional stance" (Dennett 1987) allows one to predict the behavior of complex organisms. To account for the origin of this capacity, two scenarios have been proposed—they are related to the scenarios set out above explaining human hypersensitivity to the presence of other agents. One is that the intentional stance has evolved in order to deal with complex social interactions. This Machiavellian intelligence hypothesis traces the evolution of human mind reading in the complex social interactions that most primates engage in. Given the large group sizes in humans compared to other primates, humans require more sophisticated mindreading skills to successfully interact with group members (see e.g., Byrne 1996; Humphrey 1976). The other suggests that this stance has evolved in relation to predator-prey interactions: the ability to remain undetected by predators, or to find prey requires that one is able to accurately predict what other agents will do (Barrett 2005; Boyer & Barrett 2005). For the purpose of this chapter, we need not decide between these hypotheses, which are also not mutually exclusive. The human mind does not only have the capacity to interpret the behavior of agents in term of their intentions, it also forms expectations as to what agents are capable of, in particular in relation to inanimate objects. Ten-month-old babies assume that only agents create order out of chaos (Newman et al. 2010), and 10- to 12-month-olds expect an object's movement only to be caused by a human hand, not by an inanimate object (Saxe et al. 2005). These inferences add to the rich explanatory power that comes with human intuitive psychology, or theory of mind.

This intuitive psychology is easily triggered. Adults have been shown to overattribute intentions to purely natural events. Sentences like "she broke the vase" are by default interpreted as describing an intentional act, not something that happened by accident (Rosset 2008). However, it is unclear whether folk psychological intuitions are also invoked by and connected with the teleological intuitions discussed above. In the case of artefacts, there is an obvious link between the purpose of the artefact and the intention for making it, which results in the “design stance” (Dennett 1987). For instance, both children and adults privilege creator’s intent over later afforded usage when deciding which function to attribute to an artefact (Chaigneau, et al. 2008; Kelemen 1999a. But concerning the natural world, the connection between the teleological and intentional stance is far less apparent. Both Evans (2000b) and Kelemen and DiYanni (2005) have established a link between these two stances in 7- to 10-year-old children from the USA and the UK respectively, independently of their being raised in a religious cultural environment. Based on these findings Kelemen (2004) coined the term “intuitive theists,” meaning that these children intuitively project an agent who is responsible for creating the world. However, the Dutch children that were probed by Samarapungavan and Wiers (1997) for their beliefs concerning the origins of species did not express such a creationist inclination. Furthermore, in the aforementioned studies with Alzheimer patients (Lombrozo et al. 2007) and adults under time pressure (Kelemen & Rosset 2009), the teleological and intentional stance were not clearly correlated. Alzheimer patients, despite their increased endorsement of teleological explanations, were not more likely to invoke God as an explanation compared to healthy control subjects. People who were more likely to endorse teleological explanations under time pressure were not more likely to believe in God. In sum, intuitive teleology cannot be equated with intuitive theism (De Cruz & De Smedt 2010). It seems that people’s creationist intuitions are not as deeply ingrained as their teleological intuitions.

Even though theism is not intuitive in the sense of being an innate, untutored intuition, it is nevertheless easy to grasp and natural for minds like ours, that are hypersensitive to the actions of agents, that readily infer intentionality, and that consider only agents to be capable of creating movement and order. The suggestion that the world is the result of a creative act by a hidden supernatural agent is something that makes intuitive sense. Indeed, creationists insist that the intentions of such an agent can be read off from both the order and the beauty in the universe and the functional complex systems found in nature. For instance, Morris (1974a, 33) writes:

> The Creator was purposive, not capricious or indifferent, as He planned and then created the universe, with its particles and molecules, its laws and principles, its stars and galaxies, its plants and animals, and finally its human inhabitants.

And, also:

> The creationist explanation will be in terms of primeval planning by a personal Creator and His implementation of that plan by special creation of all the basic entities of the cosmos, each with such structures and such behavior as to accomplish most effectively the purpose for which it was created.

Hence, creationists compare the bacterial flagellum with an outboard rotary motor (Behe 1996), and conceptualize DNA as some kind of code, programmed by an intelligent designer (Davis et al. 1993; H. M. Morris 1974b). In biology school books, artefact metaphors are commonly used as explanatory tools to make sense of complex biological systems, which points to their strong intuitive appeal. However, because of this appeal, they can become an alluring piece of rhetorical equipment in the hands of creationists, who intend these metaphors to be taken quite literally (Pigliucci & Boudry 2011).

Discussion

Although we have limited our discussion of mental predispositions exploited by creationism to the essentialist, teleological and intentional biases, there may be other biases at play as well. For instance, the intuitions that humans are fundamentally different from other animals (De Cruz & De Smedt 2007), and that mind and body belong to two separate ontological domains (Bloom 2004; Slingerland & Chudek 2011) are other good candidates to explain widespread pseudoscientific thinking. Also, we have only demonstrated how creationism piggybacks on those inference systems, but we hold that the same reasoning goes for other pseudosciences as well. Essentialism, for instance, may contribute to explaining the persistence of homeopathy (Hood 2008)—even if a substance is diluted to the point that it is no longer chemically detectable, our intuitive essentialism can lead to the mistaken intuition that the essence of the product is still there. Note, however, that we do not intend to debunk the beliefs that make up pseudosciences simply by demonstrating that the latter tap into people’s evolved intuitions. Doing so in a straightforward way would be committing the genetic fallacy. One could try to set up a debunking argument by claiming that our evolved inference systems are systematically off-track or unreliable, but this does not seem to be the case. After all, these cognitive predispositions at least produce ecologically rational solutions to recurrent problems the human mind has evolved to solve. Furthermore, scientific beliefs too rely on intuitive assumptions. For example, scientists share with young children (e.g. Saxe et al. 2005) the intuition that any contingent state of affairs has one or more causes to account for it. The search for (often non-obvious) causes is part of our intuitive understanding of the world that is continuous between scientific and everyday reasoning (De Cruz & De Smedt in press). Hence, if dependence on evolved biases would count as a debunking argument, scientific beliefs would also be susceptible to debunking arguments, a conclusion we obviously do not want to draw. Rather, a cognitive and evolutionary approach to pseudosciences helps to explain why people steadfastly adhere to such belief systems, even in the face of strong defeating evidence.

Context biases, or why pseudoscience?

Irrational (reflective) belief systems tend to mimic real sciences, sometimes down to the smallest detail. Biblical creationism has developed into scientific creationism or Intelligent Design, osteopathy and the like are presented as alternative treatments on a par with modern medicine, and contemporary vitalistic theories use scientific terms like “energy” to leave a scientific impression. Obviously, these pseudosciences piggyback on the authority science has been endowed with in modern society. The question remains as to why it is so important for pseudosciences to seek that authority and, also, why they often succeed in attaining it. Again, an evolutionary and cognitive perspective can shed some light on these issues.

Humans are social rather than individual learners: they gain significantly more information through communication with conspecifics than by direct experience with the environment. Although the benefits of social learning, the extent of which is unique to humans, are huge (one has access to much more information at a much lower cost), such a capacity would not have evolved if humans did not have ways to protect themselves from being misinformed. Therefore, Mercier and Sperber (2011) have argued that humans are critical social learners, who exhibit epistemic vigilance with regard to socially transmitted information: they critically evaluate both the content and the source of the information received. As to the latter, both cues that signal competence and benevolence are important, although these are less easy to trace when one is confronted with information that is transmitted via cultural communication. As a result, the epistemic vigilance provided by the heuristics that track such cues might break down (Sperber et al. 2010). To deal with the resulting uncertainty and to restore protection against false beliefs, a predisposition might have evolved to trust epistemic authorities, that is individuals (or, by extension, institutions) other people defer to as being competent and benevolent sources of information (Henrich & Gil-White 2001). Hence, people may put their epistemic trust in authorities, simply for the reason that the latter are commonly acknowledged as such. Why has science come to enjoy this epistemic authority? Undoubtedly, the tremendous instrumental efficacy of science, in the form of, for instance, medicine and communication technology, has been an important factor in its widespread public acceptance. However, it is important to point out that this trust is not universal and that in some communities people defer to religious authorities as a source of reliable information (Kitcher 2008). Religion is historically and socially well-embedded in these communities, where it enjoys public support and is also endorsed in education (denominational education, Sunday school). If people indeed place their epistemic trust in science, why is this trust not universal, and why are some pseudosciences like creationism widely endorsed? One reason is that creationists successfully present themselves as scientifically legitimate. Many of their proponents have a PhD, and publish books and papers in scientific fields. Given that their claims enjoy the extra advantage of being in line with our evolved cognitive predispositions, such as essentialism, teleology and the intentional stance—whereas real science often runs counter to these intuitions—they can successfully win converts among the general public.

Conclusions

Let us return to the question in the title. Are we evolved to be irrational? Given the ubiquity of pseudosciences, this seems a fair question to ask. However, from an evolutionary perspective, we should at least expect some rationality in ecologically relevant domains. The representations an evolved mind generates should at least allow an organism to respond aptly, and thus rationally, to environmental situations. The human mind is stacked with fast and frugal heuristics, the operations of which result in an adaptive, ecological rationality. However, when these heuristics operate outside their proper domain in solving abstract and complex cognitive problems that require a reflective mode of thinking, their output becomes subjugated to the normative rationality of logic and probability theory. Hence, when their impact on reflective thinking remains unchecked, we are likely to endorse irrational beliefs. The tendency to endorse pseudosciences increases when they are given an air of scientific respectability, which allows them to take advantage of the epistemic authority that scientific theories enjoy. Therefore, to answer our title question, although we could not have evolved to be irrational, sometimes people are irrational because we have evolved.

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