

On the Problem of Teaching Evolution as a Fact (and Not Just a “Theory”)

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Abstract

That living organisms, including our own species, have evolved from antecedent forms is universally regarded among scientists as established fact, and yet the rejection of evolution remains prevalent in the U.S. general population, the principles of which are often dismissed as an “unproven theory”. This paper reviews the primary variables that account for “evolution denialism”, and proposes another, previously unexamined factor, namely the confusion between the common language and scientific/probabilistic definitions of the meaning of fact.

Key words: evolution, denial, education, theory, fact, creationism

1. Introduction

Critics of evolutionary science, such as advocates of *intelligent design*, routinely dismiss evolution as “just a theory”, meaning that the evidence supporting evolution is tentative, approximate, and most importantly, not “proven fact” (Behe, 1996; Gregory, 2008; Moran, 1993). Evolutionary scientists, on the other hand, accept as a matter of founding principle that evolution from antecedent forms is indeed an established scientific fact, and that only the specific details of the supporting mechanisms of evolution are theoretical (e.g., Gould, 1981, Gregory, 2008).

Resistance to the fact of evolution appears to be deeply rooted in the American psyche; one study of international attitudes toward evolution documented that Americans are less likely to believe in evolution than the citizens of other industrialized nations; this study showed acceptance rates in the U.S. to be lower than the 32 developed nations in the survey, including the entirety of western Europe and Japan (Miller, Scott, & Okamoto, 2006). A more recent Gallup poll (Newport, 2012) reported that 46% of Americans hold strong creationist views on human origins, and only 15% believe that human evolution occurred fully without God's guidance.

The resistance to evolution in the U.S. population has a strong basis in religious fundamentalist and evangelical belief; recent studies show that religiosity accounts for the majority of the variance (Miller, Scott, & Okamoto, 2006; Newport, 2012; Pew Research Center, 2013). In the Pew study for example, 64% of White Protestant evangelicals endorsed the belief that humans have existed in their present form since the beginning of time, compared to only 20% of religiously unaffiliated respondents (Pew Research Center, 2013). Similarly, the Gallup poll showed that 67% of the most religious respondents (weekly church goers) believed that God created humans in their present form within the last 10,000 years; another 25% endorsed the belief that humans have evolved, but that God guided the process. Only 3% of this group endorsed the belief that evolution has occurred entirely through natural processes (Newport, 2012).

Acceptance of evolution divides along political affiliation as well, with lowest acceptance among self-identified Republicans. In fact, the Pew study found that belief in evolution among Republicans has been declining in recent years, and that the gap between Republicans and Democrats on this issue has been widening. They report that in 2009 a slim majority of Republicans (54%) and nearly two thirds of Democrats (64%) agreed that humans had evolved over time, a relatively modest difference of 10%. By 2013, however, Republicans endorsing evolution had become a minority within their ranks. Specifically, only 43% of Republicans said that human evolution had occurred, compared to 67% of Democrats—a full 24 percentage point gap.

Research in cognitive psychology has shed light on another variable that applies to what may be called “evolution denialism”. Researchers at Occidental College hypothesized that counter-intuitive (but correct) scientific concepts are, in effect, in competition with previously held intuitive (but incorrect) ones (Shtulman & Valcarcel, 2012). They tested this by presenting hundreds of scientific statements to a sample of college undergraduates who had taken multiple science and math courses, asking them to judge the veracity of each statement as quickly as possible. Some of these statements were scientifically true, while others were not—and most importantly to the intention of the study—some of the scientifically true statements were consistent with intuition (e.g., “The moon revolves around the earth”), while others were true but counter-intuitive (e.g., “The earth revolves around the sun”). It took the students significantly longer to verify the true but counter-intuitive statements. The authors interpret this finding as support for the notion that scientifically naïve beliefs continue to operate unconsciously (even in educated individuals, such as those in this study), and rather than being over-written by subsequently acquired scientifically correct concepts, they must be actively suppressed.

Inasmuch as evolution represents a relatively sophisticated and even counter-intuitive set of scientific concepts, the lingering power of intuitive but scientifically naïve beliefs may operate as a cognitive bias against the acceptance of evolution.

Compounding the problem is the fact that evolution is not systematically taught in U.S. high school biology classes. A national survey of high school biology teachers conducted by Berkman and Plutzer (2011) found that 13% of biology teachers not only do not teach evolution as accepted scientific fact, but explicitly teach creationism instead; only 28% of the respondents claimed to teach evolution in a manner consistent with the recommendations of the National Research Council, which include providing students with substantive information concerning the evidence for evolution and explaining the ways in which it constitutes a unifying theme in all of biology. The remaining 59% remain ambivalent about teaching evolution; at least for some, in the interest of avoiding a controversial or adversarial atmosphere in the classroom.

2. Common Language vs. Scientific/Probabilistic Meanings of Fact

The previous section provided a brief overview of commonly cited reasons for the denial of evolution as scientific fact. To that list may be added a very basic, but previously unexamined reason: a simple confusion about what exactly is meant by the word *fact*.

In everyday usage, a fact is something that is obvious or easily ascertained by observation, measurement or consensual agreement, often supported by historical documentation. The sun rises in the east, water freezes at 32 degrees Fahrenheit, Abraham Lincoln was the 16th President of the United States—these are statements that people tend to recognize as “factual”. For those who doubt evolution, descent from antecedent forms is certainly not an obvious or easily ascertainable fact—especially in the case of human evolution. Demonstrations of changes in fruit fly morphology over multiple generations, comparisons among fossil forms, or even patterns of DNA similarities across species are seen as irrelevant—particularly to the sensitive question of whether human beings descended from non-human ancestors. As one online commentator put it: “Unless Charles Darwin was available and had a front row seat to observe the creation of the universe and man, he cannot be counted on as the only source of ... expertise in this area” (Tacey, 2005).

It may be easy for the scientifically minded to ridicule the attitude displayed in the quote above—but the commentator could also be seen as a kind of insistent empiricist—she wants to see the *proof* that evolution is a “fact”, and of course she is expecting that the fact of evolution should conform to the common language definition of that word.

The problem is that there is no direct, obvious or immediate “proof” of the fact of evolution—that is, proof of the kind that applies to the common language meaning of fact. When scientists speak of evolution as fact, they are employing the scientific/probabilistic meaning of the term, not the common language meaning. The distinction between common language and scientific/probabilistic definitions of fact was delineated in an oft-cited essay by Stephen J. Gould (Gould, 1981): In science, Gould explained, a fact means something “confirmed to such a degree that it would be perverse to withhold provisional assent.”; that is, a scientific fact is not of the variety familiar to laypersons, but rather an inference supported by such high probability that refusing to accept it constitutes a perversity of reason. Gould goes on to explain that these “inferential” facts are part and parcel of all modern sciences, specifically mentioning geology and cosmology, to which we could certainly add climatology, particle physics, and (given its dependence of inferential statistics), experimental psychology as well.

The distinction, then, between the common language and scientific/probabilistic meanings of the word fact is critical to the understanding of evolution as fact—and yet, this distinction is rarely ever highlighted or acknowledged—let alone formally introduced in curricula. The layperson, then, is left with the common language meaning by default. Consequently, this lack of formal education regarding the scientific meaning of fact fundamentally undermines the ability of educators to convey the status of evolution as an established scientific fact. After all, how can a layperson be expected to understand something as a *fact* when that very definition of that word has taken on a specialized and unfamiliar scientific meaning?

3. Conclusion

This article has reviewed several factors that have been found to account for what may be referred to as “evolution denialism”—the failure to accept evolution as scientific fact. These include religious fundamentalism/evangelism, political affiliation, and a certain form of cognitive bias. In addition to those, this article highlights a previously unrecognized or overlooked factor: the difference between the common language and scientific/probabilistic definitions of what is meant by a *fact*. In common or everyday language, a fact is something that is obvious or easily ascertainable, such as that apples grow on trees, and that the White House is in Washington, D.C. A scientific fact, on the other hand is a more abstract construct, one that relies upon an appreciation of probability. In this sense, a fact is an event, condition or process that has been determined to be so highly probable that denial is tantamount to a logical perversity. It is in this special meaning of the term that evolution is an established scientific fact. The lack of a general appreciation for this distinction provides support for the popular notion that evolution is “just a theory”, and not a fact.

Recent research has focused on variables supporting another kind of denialism, namely the phenomena of climate change denial. Such studies have documented that the tendencies toward evolution and climate change denial share certain characteristics—notably the aforementioned variables of religious fundamentalism/evangelicism and political conservatism (Arbuckle & Konisky, 2015; Båtstrand, 2015; McCright & Dunlap, 2011). Another similarity may be noted: the scientific evidence for climate change relies largely on the same kind of inferential, probabilistic fact as does that of evolution; thus the confusion concerning the two separate meanings of the word fact—the common language and the scientific/probabilistic—may be significant to this issue of climate change denial as well.

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