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Evolution Controversy: A Phenomenon Prompted by the Incompatibility between Science and Religious Beliefs

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Abstract

The incompatibility between science and the belief in supernatural causation helps us understand why people do not accept evolution. Belief disrupts, distorts, delays, or stops (3Ds + S) the acceptance of scientific evidence. Here we examine the evolution controversy under three predictions of the incompatibility hypothesis. First, chronological-conflict-and-accommodation, which explains the historical re-emergence of antagonism between evolution and religion when advances in science continue to threaten the belief in supernatural causation; in such situations, creationists' rejection of and subsequent partial acceptance of the new scientific discoveries are expected. Second, change in evolution's acceptance as function of educational attainment, which explains the positive association between acceptance of evolution and level of education. And third, change in evolution's acceptance as function of religiosity, which explains the negative association between acceptance of evolution and level of religious beliefs. We rely on an ample assessment of the attitudes toward evolution by highly-educated audiences (i.e. research faculty, educators of prospective teachers, and college students in the United States) to characterize the associations among the understanding of science and evolution, personal religious convictions, and conservative ideology. We emphasize that harmonious coexistence between science and religion is illusory. If co-persisting in society, their relationship will fluctuate from moderate to intense antagonism.

Keywords

Creationism; Evolution Wars; Evolutionary Creation; Incompatibility Hypothesis; Intelligent Design; Theistic Evolution

Introduction

Why do people hesitate to embrace evolution? The incompatibility hypothesis (*IH*) helps us address this question by proposing a testable explanation of the *evolution controversy* (Paz-y-Miño-C and Espinosa 2012a, 2013a, 2014a). Scientific rationalism and empiricism are incompatible with belief in supernatural causation. *Belief* disrupts, distorts, delays, or stops (3Ds + S) the comprehension and acceptance of scientific evidence (Paz-y-Miño-C and

Espinosa 2012a, 2013a, 2014a, b). We consider the 3Ds + S to be cognitive effects of illusory thinking.

The observable phenomenon in society, which we aim at examining academically, is the controversy over acceptance of evolution, the conflicts that emerge when facts organized in a rational interpretation of the empirical reality (i.e. the science of evolution) challenge belief-based answers to questions about the origin of the universe and life (Paz-y-Miño-C and Espinosa 2011a, 2014a, b). *IH* is an ultimate-level hypothesis, rather than a proximate one. *IH* explains the cause of the controversy, its fundamental reason (Paz-y-Miño-C and Espinosa 2012a, 2013a, b, c, 2014a, b). *IH* addresses directly the inquiry: what elicits the controversy evolution-and-science versus creationism? And it offers an educated answer: their intrinsic and opposing approaches to assess reality, i.e. science by means of testing hypotheses, falsifying and/or testing predictions and replication of experiments; creationism, in contrast, via belief in supernatural causality (Pazy-Miño-C and Espinosa 2012a, 2013a, b, c, 2014a, b). We acknowledge and value proximate levels of analysis of the controversy, including the detailed and simultaneous characterization of multiple factors that can influence an individual's acceptance of evolution and scientific evidence, e.g. religious beliefs, pro-life beliefs and political ideology (Miller et al. 2006); or political activity, political and religious conservatism, knowledge about evolution and its relevance, creationist reasoning, evolutionary misconceptions, and exposure to evolution (Hawley et al. 2011); or religious affiliation, frequency of attendance to religious services, college academic level, exposure to evolution in high school, and college major (Rissler et al. 2014). We also value descriptive accounts of the *incompatibilities between science and faith* that result from contrasting *scientific skepticism*, as method to find the truth, versus the sightless trust in religious scripture as *source of the truth* (Coyne 2012; Stenger 2012). We have examined some of these factors in our own studies (Paz-y-Miño-C and Espinosa 2009a, b, 2011b, 2012b, 2013a, b, c, 2014a, b), as we do it in this article; however, we highlight that, from a research program perspective, *IH* is a central hypothesis, as a guiding ultimate level of analysis (Paz-y-Miño-C and Espinosa 2014a, b), while the proximate-level studies, or descriptions of the evolution controversy, are auxiliary in essence (auxiliary hypotheses; Lakatos 1978).

Here we discuss the evolution controversy under three predictions of the incompatibility hypothesis (i.e. chronological conflict-and-accommodation, evolution's acceptance as function of educational attainment, evolution's rejection as function of religiosity; Paz-y-Miño-C and Espinosa 2014a, b) and rely on a recount of the results of our studies on attitudes toward evolution by highly-educated audiences (i.e. research faculty, educators of prospective teachers, and college students in the U.S.; Paz-y-Miño-C and Espinosa 2013b, 2014b) to characterize the associations among understanding of science and evolution, personal religious convictions, and conservative ideology (the latter is the particular emphasis of this article). Because the evolution controversy is a phenomenon prompted by the incompatibility between science and religious beliefs, we alert that harmonious coexistence between science/evolution and religion is illusory (Paz-y-Miño-C and Espinosa 2013b, c, 2014b). Note that in previous publications we have discussed comprehensively recommendations to minimize the disruption, distortion, delay and stop effects of *belief* on

the acceptance of science/evolution in society, particularly in higher-education. However, this is not the purpose of the current article. We advise the reader interested in such recommendations to examine Paz-y-Miño-C and Espinosa (2013b, 2014b).

Predictions of the Incompatibility Hypothesis (IH)

We have conceptualized three major predictions of *IH* (Paz-y-Miño-C and Espinosa 2014a, b); here we summarize them as follows:

Chronological Conflict and Accommodation

IH predicts the emergence of conflict, among creationists, when advances in science threaten the belief in supernatural causation; subsequent accommodation to science progress is expected; thus a cycle conflict-accommodation takes place through human history (Paz-y-Miño-C and Espinosa 2014a). Societal turmoil would not occur, however, if scientific discoveries proven-beyond-reasonable-doubt, like evolution, were readily accepted by the public (note that scientific debates about evolution will persist as part of the modus operandi of science; Paz-y-Miño-C and Espinosa 2013a, 2014a). Our prominent example here is Charles Darwin's Theory of Evolution by means of natural selection (Darwin 1859, 1871), which debunked the Victorian concept of *species' immutability* of the 1800s. Darwin's work caused pervasive public uproar because it challenged the creationist foundation of the immutability principle (God, the Creator of nature), a conflict that has continued over 150 years, cycling from moderate to intense antagonism (Paz-y-Miño-C and Espinosa 2013a, 2014a).

Thus, *IH* anticipates that consecutive creationist models would emerge to confront evolution, however, to later accommodate to the recent scientific discoveries via reinserting a modernized Creator or Designer into the processes of nature (e.g. theistic evolution, creation science, Intelligent Design; Paz-y-Miño-C and Espinosa 2013a, 2014a, b). Such models are destined to fail once scrutinized by science, although not without agitated debate and even lawsuits, as it occurred with the late Intelligent Design (Kitzmiller et al. versus Dover School District et al. 2005).

Part of the chronological-conflict-and-accommodation prediction is also the expectation of differential level of conflict between science/evolution and proximate (here meaning nearby and immediate Creator/Designer, rather than proximate causality as in above) versus distant creationist views (Creator/Designer in the background; Paz-y-Miño-C and Espinosa 2014a). Antagonism shall be intense with proximate creationism in principle and practice, like *Young Earth Creationism* (i.e. the creation of the universe and life by God a few thousand years ago, as in Genesis; Forrest and Gross 2007; Scott 2009; Phy-Olsen 2010). In contrast, antagonism shall be moderate with distant creationism in principle and practice, like with theistic evolution or creation science, where evolution is accepted conditionally, as a Creator-guided process, or with BioLogos/evolutionary creation, which propose to merge Christianity with science by attributing to the biblical God the making of the cosmos and its evolutionary laws (Paz-y-Miño-C and Espinosa 2013a, b, 2014a, b).

IH explains that to minimize faith-versus-fact personal struggles, particularly among disciples of theistic evolution, creation science or BioLogos/evolutionary creation, *individuals* adopt self-comforting positions, such as: evolution and creationism are in harmony, non-overlapping magisteria (*NOMA* = the view that science and religion occupy separate domains; Gould 1999), or declare agnosticism (i.e. doubt about the existence or nonexistence of a deity; Paz-y-Miño-C and Espinosa 2013a, b, 2014a, b).

Hence, the chronological-conflict-and-accommodation prediction helps us rationalize that if during the history of science creationist arguments continue to emerge, to either oppose science or force harmony between science and supernatural causation (e.g. omnipresent background Creator or Designer beyond the frontiers of the known), it follows that the weakness resides in *belief*, not in empiricism. Only one can be true (Paz-y-Miño-C and Espinosa 2014a).

Change in Evolution's Acceptance as Function of Educational Attainment

IH predicts a positive association between acceptance of evolution and level of education (Paz-y-Miño-C and Espinosa 2014a). For example, public acceptance of evolution in the U.S. increases from the high school (21%), to the some college (41%), college graduate (53%), post-graduate (74%)(Brumfield 2005; The Gallup Poll 2009), and university professor levels (94%; Paz-y-Miño-C and Espinosa 2011b, 2012a, b). The underlying assumption of this prediction is that proper, comprehensive formal education leads to an organized exposure to subject content, rational assessment of facts, critical thinking, and adoption of an educated position in respect to evolution (Paz-y-Miño-C and Espinosa 2014a; but see Kahan 2014a, b). In this context, we have documented statistical gradual increase in open acceptance of evolution among biology majors at three distinctive colleges in New England, U.S., from the freshman to the senior academic levels, as follows: public institution (freshman 56.0%, sophomore 69.0%, junior 76.0%, and senior 82.6%; linear regression $R^2 = 0.98$, $P = 0.015$), private institution (freshman 44.0%, sophomore 48.5%, junior 58.5%, and senior 64.9%; linear regression $R^2 = 0.99$, $P = 0.009$), and religious institution (freshman 48.6%, sophomore 53.0%, junior 58.0%, and senior 66.5%; linear regression $R^2 = 0.98$, $P = 0.013$; Paz-y-Miño-C and Espinosa 2009a, b, 2013b).

We have also included as part of this prediction the expectation of detecting higher acceptance of evolution among those exposed to science courses, particularly biology, versus those with no or limited formal education in science (Paz-y-Miño-C and Espinosa 2009a, b, 2013b). For example, on average, 66.1% of biology majors at public, 48.1% at private secular, and 56.1% at religious colleges in New England accept evolution openly; in contrast to 52.1% of non-science majors at public, 26.8% at private secular, and 39.8% at religious institutions (Paz-y-Miño-C and Espinosa 2009a, b, 2013b).

In summary, acceptance of evolution increases with increasing level of formal education, and particularly with training in biology. Note that open or private acceptance of creationism — the antithesis to evolution — is usually low among biology majors at secular New England institutions (i.e. 6.4% at public, 4.6% at private); however, it is noticeable among non-science majors at all institutions (10.8% at public, 13.0% at private secular, 9.9% at

religious) and uniquely conspicuous among biology majors at religious colleges (10.9%; Paz-y-Miño-C and Espinosa 2009a, b, 2013b).

Change in Evolution's Acceptance as Function of Religiosity

IH predicts a negative association between acceptance of evolution and level of religiosity (Pazy-Miño-C and Espinosa 2013a, b, 2014a, b). This prediction can be assessed by documenting and plotting acceptance of evolution as function of diverse levels of religiosity, from no-religion (non-believer or atheist position), to moderate, and to deeply religious (this article; see also Pazy-Miño-C and Espinosa 2013a, b, 2014a, b). The assumption is that atheists, non-believers and agnostics will accept evolution more (i.e. 93%, Paz-y-Miño-C and Espinosa 2013a) than moderate or deeply religious individuals, or as function of moderate or fundamentalist religious denominations from Buddhist (81%) to Jehovah's Witness (8%), and everything in between (i.e. Jewish 77%, Catholic 58%, Muslim 45%, Protestant 35%, Mormon 21%; The Pew Forum on Religion and Public Life 2008; Paz-y-Miño-C and Espinosa 2014b). This prediction can also be documented at a broader scale, for example, public acceptance of *human* evolution is high among the least religious countries in the world (i.e. Sweden 68%, Germany 65%, China 64%, Belgium 61%, Japan 60%, France/Great Britain 55%) and low among the most religious (i.e. United States 28%, Russia 26%, Brazil 22%, Turkey 19%, Indonesia 11%, Saudi Arabia 7%; IPSOS 2011; Paz-y-Miño-C and Espinosa 2014a, b). Note that we acknowledge that societal interactions between science/evolution and religiosity, as much as between science broadly defined and ideology, are complex, multi factorial, variable in a spatio-temporal context, and subject to public policy, demographics, law and socio-economic change (Lerner 2000; Moore 2002, 2004; Apple 2008; Miller and Pennock 2008; Berkman and Plutzer 2009, 2011; Ecklund and Park 2009; Gross and Simmons 2009; Padian and Matzke 2009; Matzke 2010; Wexler 2010; Paz-y-Miño-C and Espinosa 2013a, 2014a). However, the point of this prediction is that *belief* disrupts, distorts, delays or stops the correct comprehension and acceptance of the evidence in support of evolution (Paz-y-Miño-C and Espinosa 2014a, b).

Alternative Hypotheses to IH

A logical alternative proposal to the incompatibility hypothesis is *compatibility (CH)* between scientific rationalism/empiricism and the belief in supernatural causation, which could be sustained—only temporarily—when the *individual* adopts the self-comforting positions of: harmony (i.e. compatibility in principle and practice), non-overlapping magisteria *NOMA* (i.e. compatibility in practice), or agnosticism (i.e. compatibility in principle and practice; Paz-y-Miño-C and Espinosa 2013a, b, 2014a, b). But there are problems with these positions: harmony is inherently short lasting, particularly considering that science will continue examining, with facts, all harmony-seeking proposals and, therefore, rejecting them for lacking support (e.g. theistic evolution, creation science, or BioLogos/evolutionary creation, which seek harmony). *NOMA* confines science and belief to separate domains and is compulsory, which challenges the freedoms of science or belief to scrutinize each other (Paz-y-Miño-C and Espinosa 2014a, b); historically, scientific rationalism/empiricism has consistently won the scrutiny battle (i.e. the chronological-conflict-and-accommodation prediction, above). Agnosticism offers a vague escape route

inconsistent with the straightforwardness of science; therefore, it is destined to fade away (Paz-y-Miño-C and Espinosa 2014a).

IH foresees everlasting struggle within the harmony, *NOMA* or agnosticism positions (Paz-y-Miño-C and Espinosa 2014a). Ultimately, *IH* offers a logical explanation—the incompatibility itself—for the causality of the conflict between science/evolution and religion, one that can be tested historically by recounting the chronological victories of science over all creationist challenges, or contemporarily by applying the scientific method to examining the controversy as function of its characterizing variables (as in Miller et al. 2006; Hawley et al. 2011; Paz-y-Miño-C and Espinosa 2013a, b, 2014b; Rissler et al. 2014). *IH* is founded on the premise that because supernatural causation is improbable, the conflict emerges as intrinsic outcome of the debate about its likelihood of occurrence (Paz-y-Miño-C and Espinosa 2013a, 2014a). In contrast, *CH* is founded on the belief that a Creator or Intelligent Designer is possible and, therefore, *harmony* is necessary. We challenge the compatibility principle for lacking scientific support (Paz-y-Miño-C and Espinosa 2013a, 2014a). In consequence, we also challenge the notion that because evolution threatens the *cultural-identity protectors* of religious individuals and their communities, who face the conflict of choosing between science facts and inner beliefs, harmony at the societal level between science/evolution and religion should be pursuit (Kahan 2014a, b). The latter perspective is unattainable scientifically.

A 3D Landscape to Depict Acceptance of Evolution

To explain *IH* to a general audience, we have used a Cartesian landscape where the dependent variable acceptance of evolution is plotted as function of three factors (Figure 1A): personal religious convictions (belief), understanding how evolution works (familiarity with the processes and forces of change in organisms), and understanding the essence of science (method to explore reality; Paz-y-Miño-C and Espinosa 2012a).

The point zero in the Cartesian landscape depicted in Figure 1A, from which coordinates x , y and z originate, corresponds to a low (labeled none) religiosity, evolution, or science awareness condition, or a no awareness corner, which is a low probability of occurrence corner (*LPC*). Away from zero, the tips of the coordinates' arrows correspond to a high or deep religiosity, evolution, or science awareness. The highest acceptance of evolution corner is located in the top right of the landscape, where religiosity is low or none and evolution and science awareness are high or deep. The lowest acceptance of evolution corner is located in the bottom left of the landscape, where religiosity is high or deep and evolution and science awareness are low or none. A potentially highest personal conflict corner resides at the intersection of high or deep religiosity and evolution and science awareness; this potential conflict condition, however, could be resolved by the *individual* adopting comforting positions: evolution and creationism are in harmony, non-overlapping magisteria (*NOMA*), or agnosticism (above). Note that four other corners are labeled *LPC* in Figure 1A due to their low probability of occurrence (e.g. high or deep understanding of science combined with no understanding of evolution and no religiosity, which is unlikely; Paz-y-Miño-C and Espinosa 2012a, 2013a, b, 2014a, b).

To quantitate the levels of religiosity, understanding of science and the evolutionary process and plot them according to the parameters depicted in Figure 1A, we have used three descriptive indexes as characterizers of acceptance of evolution, each ranging from 0 to 3 (least to most religious or knowledgeable about science or evolution): Religiosity Index *RI* (The Pew Global Attitudes Project 2007), Science Index *SI* and Evolution Index *EI* (Paz-y-Miño-C & Espinosa 2011b, 2012a, b, 2013a, b, 2014a, b). These indexes are powerful predictors of religious views worldwide (47 countries, The Pew Global Attitudes Project 2007) and of levels of understanding science and the evolutionary process (e.g. sample of 1,133 U.S. adults with diverse academic backgrounds, from college students to university professors; Paz-y-Miño-C & Espinosa 2011b, 2012a, b, 2013a, b, 2014a, b).

Each index relies on examining responses to simple, informative questions: Religiosity *RI*: +1 if responders believe that *faith in God is necessary for morality*, +1 if *religion is very important in their lives*, and +1 if *they pray daily*. Science *SI*: +1 if responders reject the idea that scientific theories are based on opinions by scientists, +1 if they disagree with the notion that scientific arguments are as valid and respectable as their non-scientific counterparts, and +1 if they reject the statement that crime-scene and accident-scene investigators use a different type of scientific method to investigate a crime or an accident; Evolution *EI*: +1 if responders reject the idea that organisms acquire beneficial traits during their lifetimes and then pass on these traits to their descendants, +1 if they disagree with the notion that during evolution monkeys such as chimpanzees can turn into humans, and +1 if they reject the statement that the origin of the human mind and consciousness cannot be explained by evolution (Paz-y-Miño-C and Espinosa 2011b, 2012a, b, 2013a, b, 2014a, b).

Acceptance of Evolution by Three Distinctive Higher-education Populations

We have used the indexes above to characterize acceptance of evolution by three distinctive higher-education populations: educators of prospective teachers affiliated with 281 colleges and universities in the U.S. (Paz-y-Miño-C and Espinosa 2012b, 2013b, 2014b), New England research faculty affiliated with 35 colleges and universities (Paz-y-Miño-C and Espinosa 2011b, 2013a, b), and New England college students affiliated with one public, one private-secular and two religious institutions (Paz-y-Miño-C and Espinosa 2009a, b, 2013a, b). Both the New England research faculty's and the students' samples are particularly useful as reference higher-education populations, or for statistical comparisons with other populations, because they hold the highest scores of acceptance of evolution among university professors and college students in the U.S. (Paz-y-Miño-C and Espinosa 2009a, b, 2011b, 2013a, b, 2014b).

In Figure 1B, we report rates of acceptance of evolution *openly* and thinking that evolution is *definitely true* among these three populations, as follows: 63% of the college students, 59% of the educators of prospective teachers, and 94% of the research faculty accept evolution openly; 58% of the college students, 51% of the educators of prospective teachers, and 82% of the research faculty think that evolution is definitely true. The science-, evolution-, and religiosity-indexes for each population are also reported in Figure 1B (students *SI* = 1.80, *EI* = 1.60, *RI* = 0.89; educators *SI* = 1.98, *EI* = 1.76, *RI* = 1.31; research faculty *SI* = 2.49, *EI* = 2.49, *RI* = 0.49). Taken together the rates of acceptance of evolution

and the indexes, the following pattern emerges: college students, a population still in training, have low understanding of science and evolution, low acceptance of evolution, and intermediate religiosity; educators of prospective teachers have an intermediate level of understanding science and evolution, low acceptance of evolution, and high religiosity; the research faculty have high level of understanding science and evolution, high acceptance of evolution and low religiosity.

As depicted in Figure 2, these three populations differ statistically from one another in each of the index analyses. We did expect the research faculty to be more knowledgeable about science and evolution than the educators, and the educators to be more knowledgeable about these topics than the students, which was corroborated by the statistical differences in *SI* and *EI* among populations (Figure 2A, B). However, detecting higher religiosity among the educators, in respect to the other two groups, was indeed disturbing (Figure 2C), particularly considering that the educators of prospective teachers are responsible for mentoring the teachers-to-be in the American school system (Paz-y-Miño-C and Espinosa 2014b). Their hesitation to embrace evolution resides in a deficient understanding of science/evolution and high religiosity (below).

Associations between Science, Evolution, and Religiosity Indexes

The levels of understanding science and evolution in each of the three populations decreases significantly with increasing religiosity (negative association of variables; science Figure 3A-C; evolution Figure 3D-F); in contrast, the levels of understanding evolution increases significantly with increasing understanding of science (positive association of variables; Figure 3G-I). The *SI*, *EI* and *RI* reported in Figure 3 are in accordance with our proposal that level of religiosity influences an individual's acceptance of evolution: the $3Ds + S$, above (Paz-y-Miño-C and Espinosa 2014a, b).

Various studies have detected inverse correlation between religiosity/belief and acceptance of evolution (Miller et al. 2006; Nadelson and Sinatra 2009; The Gallup Poll 2008, 2009, 2010, 2014). It is important to point out that the religiosity indexes of our samples of research faculty ($RI = 0.49$), educators ($RI = 1.31$) and students ($RI = 0.89$) are below the U.S. national score $RI = 1.40$, $n = 2,026$ (The Pew Global Attitudes Project 2007), respectively, but that only the research faculty of New England have a level of religiosity comparable to that of the general public in Western Europe, the lowest worldwide (The Pew Global Attitudes Project 2007; Paz-y-Miño-C and Espinosa 2011b, 2013b, 2014b). Our sample of educators of prospective teachers in the entire U.S. is more religious than the Canadian general public ($RI = 0.72$; The Pew Global Attitudes Project 2007), whose overall acceptance of evolution, 61% (Angus Reid Strategies 2010), is comparable to the 59% open acceptance by our elite educators (Figure 1). Note that public acceptance of *human* evolution in the U.S. has fluctuated around 47-40% since the 1980s, one of the lowest ratings among industrialized nations (Miller et al. 2006; The Gallup Poll 2014).

Understanding of Science and Evolution among the Non-religious vs the Deeply Religious

To examine in more detail the relationship between no-religiosity and science-and-evolution literacy, we plotted *SI* and *EI* values exclusively for our subsamples of non-religious

research faculty, educators, and students, and compared these indexes among groups (Figure 4). The non-religious researchers had statistically higher *SI* and *EI* than the non-religious educators and students; understanding of science (*SI*) by non-religious educators and non-religious students was statistically similar (Figure 4A), however, non-religious educators showed statistically higher understanding of evolution (*EI*) than non-religious students (Figure 4B). The important message inferable from Figure 4 is that non-religious individuals, in the three groups, scored the highest *SI* and *EI* of all responders, which can be visualized by comparing *SI* and *EI* scores reported in Figure 4 versus Figure 2, as follows: non-religious research faculty $SI = 2.59$, $EI = 2.53$, versus all research faculty $SI = 2.49$, $EI = 2.49$; non-religious educators $SI = 2.15$, $EI = 2.19$, versus all educators $SI = 1.98$, $EI = 1.76$; and non-religious students $SI = 1.97$, $EI = 1.67$, versus all students $SI = 1.80$, $EI = 1.60$.

We interpret these differences among the non-religious responders as an effect of their differential awareness about science and evolution (educational attainment), i.e. the New England researchers as broadly trained scholars in the sciences versus the educators as specialists in pedagogy; and the students as a population still in training. For a discussion on potential differential academic preparation between research faculty and educators of prospective teachers in the U.S. see Paz-y-Miño-C and Espinosa (2012b).

To contrast the responses of the non-religious subjects with those of the most religious, we plotted *SI* and *EI* values exclusively for our subsamples of deeply-religious research faculty, educators, and students, and compared these indexes among groups (Figure 5). The most religious researchers, educators, and students had statistically indistinguishable *SI* (Figure 5A). The *EI* values, however, were significantly different among groups (Figure 5B); note that despite the small representation of highly religious researchers (3.2%), in respect to the educators (18.5%) and students (12.3%), the researchers scored significantly higher in *EI* than the educators and students; the last two groups were statistically indistinguishable from one another. Again, the important message inferable from Figure 5 is that deeply-religious individuals, in the three groups, scored the lowest *SI* and *EI* of all responders, which can be visualized by comparing *SI* and *EI* scores reported in Figure 5 versus Figure 2, as follows: deeply-religious research faculty $SI = 2.00$, $EI = 2.00$, versus all research faculty $SI = 2.49$, $EI = 2.49$; deeply-religious educators $SI = 1.58$, $EI = 1.10$, versus all educators $SI = 1.98$, $EI = 1.76$; and deeply-religious students $SI = 1.31$, $EI = 1.35$, versus all students $SI = 1.80$, $EI = 1.60$.

These findings were in accordance with the third prediction of *IH* (above): the three populations showed differential understanding of science/evolution and differential acceptance of evolution as function of level of religiosity; both consistent with the *3Ds + S* effects of belief on comprehension and acceptance of scientific evidence (Paz-y-Miño-C and Espinosa 2012a, 2013a, 2014a, b). At the national level, a comparable phenomenon has been reported: public acceptance of evolution in the U.S. is higher (71%) among those who rarely or never attend religious services; in contrast to those who do it nearly weekly or monthly (52%), and those who do it weekly (24%; The Gallup Poll 2007).

Influence of Political Ideology on Acceptance of Evolution

We have adopted two strategies to explore the influence of political ideology on acceptance of evolution, which we report here for our sample of educators of prospective teachers in the entire U.S ($n = 209$; for rationale on representativeness of the sample see Paz-y-Miño-C and Espinosa 2014b). First, we asked participants in our surveys to self-identify their political ideology; subsequently, we compared these answers to their acceptance of evolution or creationism, and to their opinions about the likelihood of evolution. Second, we extracted information on our responders' views about statements concerning *human life*, which other studies (Miller et al. 2006) had demonstrated to be associated with liberal/progressive or conservative principles, and we matched these responses with acceptance of evolution and views about evolution's likelihood.

On average, 61.72% of the educators in the entire U.S. identified themselves as liberal or progressive, 26.32% as moderate, 9.09% as conservative, and 2.87% as other (Figure 6). When we segregated the data by region, according to the U.S. Census Bureau designations (i.e. Northeast, Midwest, South and West), the groups differed statistically from one another ($Chi-square = 27.091$, $df = 12$, $P = 0.007$). More than half of the educators in each region of the U.S. considered themselves to be liberal/progressive and at least one in every five educators was moderate. Self-identification as conservative was noticeable (above the survey's margin of error $\pm 4.6\%$) in the South (13.04%) and West (13.46%) of the country (Figure 6), which became relevant when examining their views about evolution (below).

On average, 52.63% of the liberal/progressive, 17.70% of the moderate, and 3.35% of the conservative educators in the entire U.S. accepted evolution openly or privately (Figure 7A). Only 2.87% of the liberal/progressive, but up to 5.26% of the moderate and 5.74% of the conservative educators in the entire U.S. accepted creationism openly or privately (Figure 7C). Although we found no statistical differences as per U.S. region in the educators' acceptance of evolution or creationism openly/privately, creationist views were noticeable (above margin of error $\pm 4.6\%$) among moderates in the South (5.8%) and West (7.69%), and conservatives in the South (10.14%) and West (7.69%) of the U.S. (Figure 7C).

These views were consistent with the educators' opinions about the likelihood of evolution. On average, 59.81% of the liberal/progressive, 20.57% of the moderate, and 4.31% of the conservative educators in the entire U.S. thought that evolution is definitely or probably true (Figure 8A). When we segregated the responses by region, the groups did not differ statistically from one another ($Chi-square = 14.354$, $df = 8$, $P = 0.072$; Figure 8A). However, educators who thought that evolution is definitely or probably false were noticeable (above margin of error $\pm 4.6\%$) only among moderates in the West (5.77%), and conservatives in the South (8.70%) and West (5.77%) of the U.S. ($Chi-square = 19.790$, $df = 8$, $P = 0.011$; Figure 8C).

To corroborate these findings with an alternative approach to identifying political ideology by means of asking true/false questions regarding *human life*, which other researchers have demonstrated to reveal ideological positions (Miller et al. 2006), we did the following: (1) we segregated by U.S. region the true/false answers to liberal/progressive statements like '*life begins at birth*' or '*the human embryo has no moral condition*;' or a moderate-neutral

statement like ‘all stages of human life should be equally protected by law;’ or a conservative statement like ‘*life begins at conception.*’ (2) We matched the agreement with these statements with the responders’ open/private acceptance of evolution/creationism, and with their views about the likelihood of evolution. On average, 43.54% of the educators in the entire U.S. agreed with the statement ‘life begins at birth,’ 19.14% agreed ‘the human embryo has no moral condition,’ 84.13% agreed with ‘all stages of human life should be equally protected by law,’ and 29.19% agreed with ‘life begins at conception’ (Figure 9). When we segregated the responses by region, the groups did not differ statistically from one another (*Chi-square* = 10.574, *df* = 12, *P* = 0.565; Figure 9).

On average, 37.8% of the educators in the entire U.S. who agreed with the statement ‘life begins at birth,’ 17.70% of those who agreed with ‘the human embryo has no moral condition,’ 4.31% of those who agreed with ‘all stages of human life should be equally protected by law,’ and 16.27% of those who agreed with ‘life begins at conception,’ accepted evolution openly or privately (Figure 10A). We found no statistical differences as per U.S. region when comparing open/private acceptance of evolution among groups (*Chi-square* = 5.796, *df* = 12, *P* = 0.926; Figure 10A). However, open or private acceptance of creationism was noticeable (above margin of error \pm 4.6%) among educators who agreed with the conservative statement ‘life begins at conception’ in the Midwest (8.57%), South (13.04%), and West (15.38%) of the U.S. (*Chi-square* = 32.275, *df* = 12, *P* = 0.001; Figure 10C).

These views were consistent with the educators’ opinions about the likelihood of evolution. On average, 42.58% of the educators in the entire U.S. who agreed with the statement ‘life begins at birth,’ 18.66% of those who agreed with ‘the human embryo has no moral condition,’ 5.74% of those who agreed with ‘all stages of human life should be equally protected by law,’ and 19.62% of those who agreed with ‘life begins at conception,’ thought that evolution is definitely or probably true (Figure 11A). We found no statistical differences as per U.S. region when comparing views about the likelihood of evolution among groups (*Chi-square* = 7.216, *df* = 12, *P* = 0.843; Figure 11A). Educators who thought that evolution is definitely or probably false were noticeable (above margin of error \pm 4.6%) only among educators who agreed with the conservative statement ‘life begins at conception’ in the South (11.59%), and West (11.54%) of the U.S. (Figure 11C).

In summary, as we expected, conservative ideology, assessed by both self-identification of responders’ liberal/progressive or conservative views, or by their agreement with liberal/progressive or conservative statements about human life, was linked to low acceptance of evolution and to low agreement with the likelihood of evolution. These findings matched national trends of public acceptance of evolution in the U.S. as function of political ideology, e.g. conservative, religious and pro-life republicans accept evolution less than progressive liberals and independents (30% versus 60%, respectively, *n* = 1,007; The Gallup Poll 2007). In fact, religious beliefs, pro-life beliefs, and political ideology account for most of the variance against evolution’s acceptance (total nine independent variables), which differ distinctly between the U.S. (R^2 = 0.46 total effects) and Europe (R^2 = 0.18 total effects; Miller et al. 2006; Miller and Penock 2008; see The Pew Forum on Religion &

Public Life 2008 for detailed statistics on the relationship between religious affiliations and pro-life beliefs, political ideology and evolution).

Conclusions

Based on current scientific evidence, 100% of all people should accept evolution (Paz-y-Miño-C and Espinosa 2012a). We have formulated the incompatibility hypothesis (*IH*) precisely to explain the controversy over acceptance of evolution in society and the everlasting conflict evolution-and-science versus religiosity (Paz-y-Miño-C and Espinosa 2013a, b, 2014a, b). Belief in supernatural causation disrupts, distorts, delays or stops (*3Ds + S*) the comprehension and acceptance of scientific evidence (Paz-y-Miño-C and Espinosa 2013a, b, 2014a, b). These *3Ds + S* emerge when facts organized in a rational interpretation of the empirical reality threaten belief-based answers to questions about the origin of the universe and life (Paz-y-Miño-C and Espinosa 2011a, 2014a). The *3Ds + S* are cognitive effects of illusory thinking. Each effect, however, deserves to be further studied experimentally, at the psychological and neurological levels, specifically in the context of the conflict between the innate human capacity to discover the factual reality, and the propensity of the brain to believe in the supernatural (e.g. Shermer 2011).

As a rational explanation of an occurring phenomenon in nature (society), *IH* proposes testable predictions that can be examined academically when studying the evolution controversy, i.e. chronological conflict-and-accommodation, evolution's acceptance as function of educational attainment, and evolution's rejection as function of religiosity (Paz-y-Miño-C and Espinosa 2014a, b). *IH* is an ultimate-level of analysis hypothesis; it explains the cause of the controversy, its fundamental reason, i.e. the opposing approaches to assessing reality by science (= scientific rationalism and empiricism) and belief (= faith in supernatural causation; Paz-y-Miño-C and Espinosa 2012a, 2013a, b, 2014a, b).

IH anticipates the cyclic emergence of creationist models (e.g. Intelligent Design) that challenge evolution and its always ongoing new discoveries, or that aim at coercing harmony between evolution and belief (e.g. theistic evolution, creation science, BioLogos/evolutionary creation, above). All these proposals and their proximate or distant endorsements by creationism in principle or in practice (above) are destined to fail once scrutinized by science (Paz-y-Miño-C and Espinosa 2014a). *IH* predicts intense antagonism between evolution and proximate creationism in principle and practice, like Young Earth Creationism (above), and moderate conflict with distant creationism in principle and practice (the conditional acceptance of evolution if guided by a background Creator/Designer). In the long term, these positions (= creationism in principle/practice or proximate/distant) will continue to be irreconcilable with science and, therefore, be destined to everlasting conflict (Paz-y-Miño-C and Espinosa 2013a, b, 2014a, b).

IH explains that adoption of self-comforting positions, by individuals, to seek compatibility (*CH*) between evolution and belief (i.e. harmony, *NOMA* or agnosticism, above) are unsustainable and destined to lack scientific support (Paz-y-Miño-C and Espinosa 2014a, b). Harmony is self-deceiving rather than self-correcting like science; *NOMA* is compulsory rather than free to challenge itself and all postulates like science; and agnosticism is

accommodating rather than aiming at straightforwardness like science (above, Paz-y-Miño-C and Espinosa 2014a).

To characterize the chronological-conflict-and-accommodation prediction of *IH*, we referred to a single, iconic example: the formulation of Darwin's theory of evolution by means of natural selection (Darwin 1859, 1871), which challenged the 1800s view of species immutability and its creationist foundations. However, any historical case of replacement of a supernatural-causation-based explanation of a phenomenon, with a scientific fact, suffices to support this prediction (e.g. from geocentric to heliocentric views of our solar system; or from spontaneous generation of life, or even miasma theory of disease, to germ theory; or from flat to rounded shape of the Earth; Montúfar 2013; Paz-y-Miño-C and Espinosa 2013c).

We have documented significant change in evolution's acceptance as function of educational attainment in the U.S. (second prediction of *IH*) from high school (21%), to some college (41%), college graduate (53%), post-graduate (74%), and university professor levels (94%; above). As well as a short-term significant and gradual increase in acceptance of evolution among college biology majors at three distinctive New England institutions, i.e. public, private secular and religious: from freshman (49.53%) to sophomore (56.83%), junior (64.16%), and senior levels (71.33%; mean values estimated from data above). And we have documented higher acceptance of evolution among college students exposed to science courses, particularly biology (56.76%), versus those with no or limited formal education in science (39.56%; mean values estimated from data above).

In accordance with the third prediction of *IH*, we have also documented a significant negative association between understanding of science/evolution and level of religiosity for three distinctive higher-education populations: research faculty in New England, educators of prospective teachers in the entire U.S. and New England college students (Figure 3). The non-religious members of these populations ($RI = 0$) held the highest levels of understanding science (*SI* researchers 2.59, educators 2.15, students 1.97) and evolution (*EI* researchers 2.53, educators 2.19, students 1.67; Figure 4); in contrast, the most religious ($RI = 3.0$) held the lowest levels of understanding science (*SI* researchers 2.0, educators 1.58, students 1.32) and evolution (*EI* researchers 2.0, educators 1.10, students 1.35; Figure 5).

Finally, we have explored the influence of political ideology on acceptance of evolution: The majority (73.68%, additive value extracted from Figure 7A) of educators of prospective teachers in the entire U.S., who considered themselves either liberal/progressive, moderate or conservative, accepted evolution openly or privately. Likewise, the majority of these educators (84.69%, additive value extracted from Figure 8A) thought that evolution is definitely or probably true. In contrast, 13.87% (additive value extracted from Figure 7C) of these educators accepted creationism openly or privately, and 8.61% (additive value extracted from Figure 8C) thought that evolution is definitely or probably false. Acceptance of creationism openly or privately, as per U.S. region, occurred in the South (18.84%, additive value extracted from Figure 7C) and West (17.30%, additive value extracted from Figure 7C) of the U.S., and it was most prominent among conservatives. Views that evolution is definitely or probably false, as per U.S. region, occurred in the South (13.05%,

additive value extracted from Figure 8C) and West (13.46%, additive value extracted from Figure 8C) of the U.S., and were most prominent among conservatives.

The majority (76.08%, additive value extracted from Figure 10A) of educators of prospective teachers in the entire U.S., who agreed with liberal/progressive or conservative statements about human life (above), accepted evolution openly or privately. Likewise, the majority of these educators (86.60%, additive value extracted from Figure 11A) thought that evolution is definitely or probably true. In contrast, 14.81% (additive value extracted from Figure 10C) of these educators accepted creationism openly or privately, and 8.62% (additive value extracted from Figure 11C) thought that evolution is definitely or probably false. Acceptance of creationism openly or privately, as per U.S. region, occurred in the Midwest (8.57%, additive value extracted from Figure 10C), South (18.84%, additive value extracted from Figure 10C) and West (17.30%, additive value extracted from Figure 10C) of the U.S., and it was most prominent among those who agreed with the statement 'life begins at conception.' Views that evolution is definitely or probably false, as per U.S. region, occurred in the South (13.04%, additive value extracted from Figure 11C) and West (13.46%, additive value extracted from Figure 11C) of the U.S., and were most prominent among those who agreed with the statement 'life begins at conception.'

Outlook: The Future of Evolution's Acceptance

Although acceptance of evolution can always be improved by strengthening education of the public and outreach campaigns (Paz-y-Miño-C and Espinosa 2013b, 2014b), the intrinsic incompatibility of *belief* and science makes it illusory to expect peaceful coexistence of religion and evolution in advanced societies (Paz-y-Miño-C and Espinosa 2013b). The evolution controversy is destined to persist for as long as belief in the supernatural continues to disrupt, distort, delay or stop the acceptance of scientific evidence. Current efforts by reputable organizations like the American Association for the Advancement of Science (i.e. AAAS: Dialog on Science, Ethics, and Religion 2014), or the National Center for Science Education (i.e. NCSE: Science and Religion 2014), or smaller-scale initiatives led by influential theist scientists, such as BioLogos/evolutionary creation (above), to seek harmony between science and religion are destined to short lasting accomplishments. We acknowledge and value programs aiming at educating religious/creationist audiences about the significance of science for cultural, social and technological development (e.g. Smithsonian Institution: Human Origins Initiative Broader Social Impacts 2010; or the National Academy of Sciences and The Institute of Medicine: Compatibility of Science and Religion, the Intersection of Science and Religion 2008, 2014a, b); however, such initiatives will be most effective when the scientific truth is communicated with no stoppers of thought or restrains on logic, and without compromising the integrity of science by seeking harmony where there is fundamental incompatibility (Paz-y-Miño-C 2013). Scientific discoveries have opened humanity's intellectual horizons and the next frontiers of proper concern, investment, and effort should be the long-term survival of our civilization in always changing environments, planet, and the cosmos.

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REFERENCES

- Angus Reid Strategies. [April 27, 2015] Britons and Canadians Side with Evolution, Not Americans. 2010. http://angusreid.org/britons_and_canadians_side_with_evolution_not_americans/
- American Association for the Advancement of Science. [April 27, 2015] Dialog on Science, Ethics, and Religion. 2014. www.aaas.org/DoSER
- Apple, Michael W. Evolution versus Creationism in Education. *Educational Policy*. 2008; 22:327–35.
- Berkman, Michael, B.; Plutzer, Eric. Scientific Expertise and the Culture War: Public Opinion and the Teaching of Evolution in the American States. *Perspective on Politics*. 2009; 7:485–99.
- Berkman, Michael, B.; Plutzer, Eric. *Evolution, Creationism, and the Battle to Control America's Classrooms*. Cambridge University Press; New York: 2010.
- Brumfiel, Geoff. Who Has Designs on Your Students' Minds? *Nature*. 2005; 434:1062–5. [PubMed: 15858545]
- Coalition of Scientific Societies. Evolution and Its Discontents: A Role for Scientists in Science Education. *The FASEB Journal*. 2008; 22:1–4. [PubMed: 18166582]
- Coyne, Jerry A. Science, Religion, and Society: The Problem of Evolution in America. *Evolution*. 2012; 66:2654–63. [PubMed: 22834762]
- Darwin, Charles. *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life*. John Murray; London: 1859.
- Darwin, Charles. *The Descent of Man, and Selection in Relation to Sex*. John Murray; London: 1871.
- Ecklund, Elaine H.; Park, Jerry Z. Conflict between Religion and Science among Academic Scientists? *Journal for the Scientific Study of Religion*. 2009; 48:276–92.
- Forrest, Barbara C.; Gross, Paul R. *Creationism's Trojan Horse: The Wedge of Intelligent Design*. Oxford University Press; New York: 2007.
- Gould, Stephen J. *Rocks of Ages*. Ballantine Books; New York: 1999.
- Gross, Neil; Simmons, Solon. The Religiosity of American College and University Professors. *Sociology of Religion*. 2009; 70:101–29.
- Hawley, Patricia H.; Short, Stephen D.; McCune, Luke A.; Osman, Mark R.; Little, Todd D. What's the Matter with Kansas?: The Development and Confirmation of the Evolutionary Attitudes and Literacy Survey (EALS). *Evolution: Education and Outreach*. 2011; 4:117–32.
- IPSOS. [April 27, 2015] Supreme Being, the Afterlife, and Evolution. 2011. <http://www.ipsos-na.com/news-polls/pressrelease.aspx?id=5217>
- Kahan, Dan M. [April 27, 2015] Climate-Science Communication and the Measurement Problem.. *Advances Political Psychology*. 2014a. <http://ssrn.com/abstract=2459057>
- Kahan, Dan M. [April 27, 2015] Ordinary Science Intelligence': A Science Comprehension Measure for Use in the Study of Risk Perception and Science Communication.. *The Cultural Cognition Project Working Paper No. 112, Yale Law & Economics Research Paper No. 504*. 2014b. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2466715
- Kitzmiller, Tammy, et al. [April 27, 2015] versus Dover Area School District et al. 2005. http://ncse.com/files/pub/legal/kitzmiller/highlights/2005-12-20_Kitzmiller_decision.pdf
- Lakatos, Imre. *The Methodology of Scientific Research Programmes, Philosophical Papers Volume 1*. Cambridge University Press; Cambridge: 1978.
- Lerner, Lawrence S. *Good Science, Bad Science: Teaching Evolution in the States*. The Thomas B. Fordham Foundation; Washington DC: 2000.
- Matzke, Nicholas J. The Evolution of Creationist Movements. *Evolution: Education and Outreach*. 2010; 3:145–62.

- Miller, John D.; ennock, Robert T P. *Secularism and Science in the 21st Century*, edited by Ariela Keysar, and Barry A. Kosmin, 9-32. Institute for the Study of Secularism in Society and Culture; Harford: 2008. *Science Education and Religion in America in the 21st Century: Holding the Center..*
- Miller, John D.; Scott, Eugenie C.; Okamoto, Shinji. *Public Acceptance of Evolution*. *Science*. 2006; 313:765–6. [PubMed: 16902112]
- Montúfar, Carlos. *Evolution From the Galapagos, Social and Ecological Interactions in the Galapagos 2*, edited by Gabriel Trueba, and Carlos Montúfar. Springer Science Business Media; New York: 2013. *From Copernicus to Darwin (1473-1882).*; p. 11-14.
- Moore, Randy. *Teaching Evolution: Do State Standards Matter?* *BioScience*. 2002; 52:378–81.
- Moore, Randy. *How Well Do Biology Teachers Understand the Legal Issues Associated with the Teaching of Evolution?* *BioScience*. 2004; 54:860–5.
- Nadelson, Louis S.; Sinatra, Gale M. *Educational Professionals' Knowledge and Acceptance of Evolution*. *Evolutionary Psychology*. 2009; 7:490–516.
- National Academy of Sciences, and The Institute of Medicine. *Science, Evolution, and Creationism*. The National Academies Press; Washington DC: 2008.
- National Academy of Science. [April 27, 2015] *Compatibility of Science and Religion*. 2014a. <http://www.nas.edu/evolution/Compatibility.html>
- National Academy of Sciences. [April 27, 2015] *The Intersection of Science and Religion*. 2014b. <http://www.nas.edu/evolution/ScienceAndReligion.html>
- National Center for Science Education. [April 27, 2015] *Science and Religion*. 2014. <http://ncse.com/religion>
- Padian, Kevin; Matzke, Nicholas. *Darwin, Dover, 'Intelligent Design' and Textbooks*. *Biochemistry Journal*. 2009; 417:29–42.
- Paz-y-Miño-C, Guillermo. *Evolution Stands Faith Up: Reflections on Evolution's Wars*. Nova Science Publishers; New York: 2013.
- Paz-y-Miño-C, Guillermo; Espinosa, Avelina. *Assessment of Biology Majors versus Non-majors Views on Evolution, Creationism and Intelligent Design*. *Evolution: Education and Outreach*. 2009a; 2:75–83.
- Paz-y-Miño-C, Guillermo; Espinosa, Avelina. *Acceptance of Evolution Increases with Student Academic Level: A Comparison between a Secular and a Religious College*. *Evolution: Education and Outreach*. 2009b; 2:655–75.
- Paz-y-Miño-C, Guillermo; Espinosa, Avelina. *On the Theory of Evolution versus the Concept of Evolution: Three Observations*. *Evolution: Education and Outreach*. 2011a; 2:308–12.
- Paz-y-Miño-C, Guillermo; Espinosa, Avelina. *New England Faculty and College Students Differ in Their Views About Evolution, Creationism, Intelligent Design, and Religiosity*. *Evolution: Education and Outreach*. 2011b; 2:323–42.
- Paz-y-Miño-C, Guillermo; Espinosa, Avelina. *Introduction: Why People Do Not Accept Evolution?* *Journal of Eukaryotic Microbiology*. 2012a; 59:101–4. [PubMed: 22273365]
- Paz-y-Miño-C, Guillermo; Espinosa, Avelina. *Educators of Prospective Teachers Hesitate to Embrace Evolution Due to Deficient Understanding of Science/evolution and High Religiosity*. *Evolution: Education and Outreach*. 2012b; 5:139–162.
- Paz-y-Miño-C, Guillermo; Espinosa, Avelina. *The Everlasting Conflict Evolution-and-science versus Religiosity..* In: Simpson, Gloria; Payne, Spencer, editors. *Religion and Ethics*. NOVA Publishers; New York, NY: 2013a. p. 73-97.
- Paz-y-Miño-C, Guillermo; Espinosa, Avelina. *Attitudes toward Evolution at New England Colleges and Universities, United States*. *New England Science Public: Series Evolution*. 2013b; 1:1–32.
- Paz-y-Miño-C, Guillermo; Espinosa, Avelina. *Galapagos III World Evolution Summit: Why Evolution Matters*. *Evolution: Education and Outreach*. 2013c; 6:28.
- Paz-y-Miño-C, Guillermo; Espinosa, Avelina. *The Incompatibility Hypothesis: Evolution versus Supernatural Causation..* In: Trueba, Gabriel, editor. *Why Does Evolution Matter? The Importance of Understanding Evolution*. Cambridge Scholars Publishing; Newcastle UK: 2014a. p. 3-16.

- Paz-y-Miño-C, Guillermo; Espinosa, Avelina. Acceptance of Evolution by America's Educators of Prospective Teachers. *New England Science Public: Series Evolution*. 2014b; 2:1–92.
- Phy-Olsen, Allene S. *Evolution, Creationism, and Intelligent Design: Historical Guides to Controversial Issues in America*. Greenwood; Santa Barbara: 2010.
- Rissler, Leslie J.; Duncan, Sarah I.; Caruso, Nicholas M. The Relative Importance of Religion and Education on University Students' Views of Evolution in the Deep South and State Science Standards Across the United States. *Evolution: Education and Outreach*. 2014; 7:24.
- Scott, Eugenie C. *Evolution vs. Creationism: An Introduction*. Greenwood Press; Westport: 2009.
- Shermer, Michael. *The Believing Brain*. New York. Times Books Henry Holt and Company. 2011
- Smithsonian Institution. [April 27, 2015] A Primer on Science, Religion, Evolution and Creationism. 2010. <http://humanorigins.si.edu/about/bsic/science-religion-evolution-creationism-primer>
- Stenger, Victor J. *God and the Folly of Faith: The incompatibility of Science and Religion*. Prometheus Books; Amherst: 2012.
- The Gallup Poll. [April 27, 2015] Majority of Republicans Doubt Theory of Evolution. 2007. <http://www.gallup.com/poll/27847/Majority-Republicans-Doubt-Theory-Evolution.aspx>
- The Gallup Poll. [April 27, 2015] Evolution, Creationism, Intelligent Design. 2008. <http://www.gallup.com/poll/21814/Evolution-Creationism-Intelligent-Design.aspx>
- The Gallup Poll. [April 27, 2015] On Darwin's Birthday, Only 4 in 10 Believe in Evolution. 2009. <http://www.gallup.com/poll/114544/xDarwin-Birthday-Believe-Evolution.aspx>
- The Gallup Poll. [April 27, 2015] Four in 10 Americans Believe in Strict Creationism. 2010. <http://www.gallup.com/poll/145286/Four-Americans-Believe-Strict-Creationism.aspx>
- The Gallup Poll. [April 27, 2015] In U.S., 42% Believe Creationist View of Human Origins. 2014. <http://www.gallup.com/poll/170822/believe-creationist-view-human-origins.aspx>
- The Pew Forum On Religion & Public Life. [April 27, 2015] US Religious Landscape Survey – Religious Beliefs and Practices: Diverse and Politically Relevant. 2008. <http://religions.pewforum.org/pdf/report-religious-landscape-study-full.pdf>
- The Pew Global Attitudes Project. *World Publics Welcome Global Trade But not Immigration*. Washington D. C.: 2007. <http://pewglobal.org/files/pdf/258.pdf> [April 27, 2015]
- Wexler, Jay D. From the Classroom to the Courtroom: Intelligent Design and the Constitution. *Evolution: Education and Outreach*. 2010; 3:215–24.

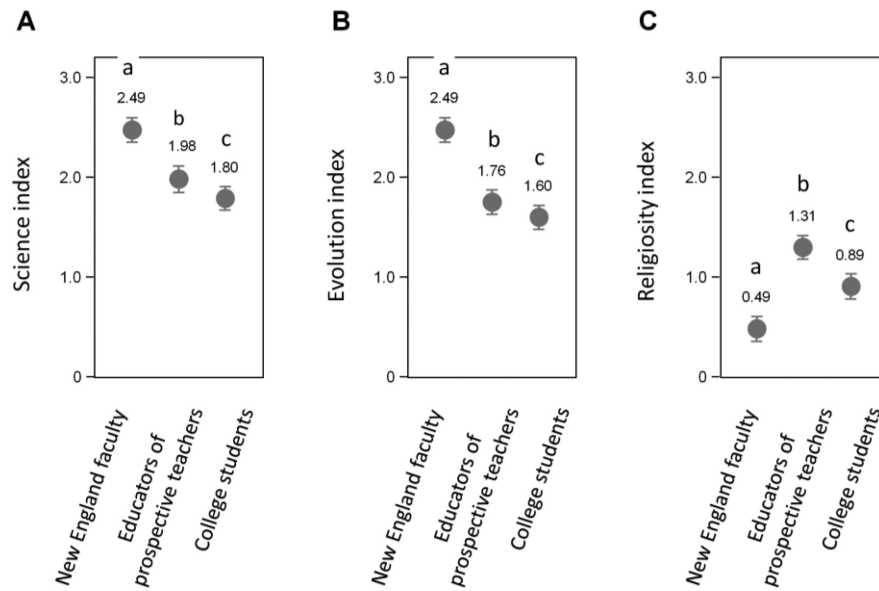


Figure 2.

Understanding of science, understanding of evolution, and personal religious conviction of three distinctive higher-education populations: New England research faculty ($n = 222$), educators of prospective teachers in the entire U.S. ($n = 411$), and New England college students ($n = 576$). (A) Understanding-of-science index, Kruskal-Wallis one-way ANOVA on ranks, $H = 95.024$, $df = 2$, $P = 0.001$; (B) understanding-of-evolution index, Kruskal-Wallis one-way ANOVA on ranks, $H = 174.958$, $df = 2$, $P = 0.001$; (C) religiosity index, Kruskal-Wallis one-way ANOVA on ranks, $H = 84.987$, $df = 2$, $P = 0.001$. Lowercase letters indicate Dunn-test two-tail pair-wise comparisons within groups $P = 0.05$. Error bars are standard errors. The total number of responders per population can vary because participants in the surveys were allowed to skip questions or end the survey voluntarily at any time. Source: Modified from Paz-y-Miño-C and Espinosa 2013b, 2014b.

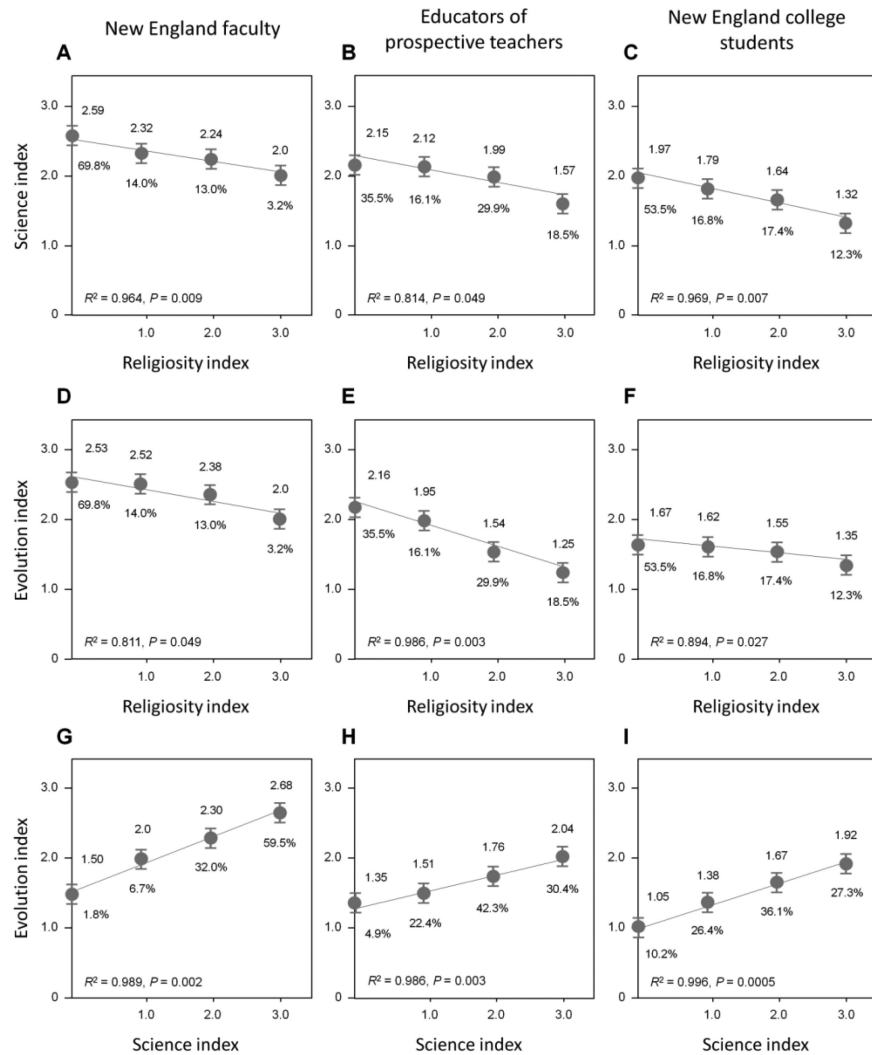


Figure 3. Association between understanding-of-science, understanding-of-evolution, and religiosity indexes of three distinctive higher-education populations: New England research faculty, educators of prospective teachers in the entire U.S., and New England college students. Understanding-of-science versus religiosity indexes: (A) New England research faculty $R^2 = 0.964$, $P = 0.009$; (B) educators of prospective teachers in the entire U.S. $R^2 = 0.814$, $P = 0.049$; (C) New England college students $R^2 = 0.969$, $P = 0.007$. Understanding-of-evolution versus religiosity indexes: (D) New England research faculty $R^2 = 0.811$, $P = 0.049$; (E) educators of prospective teachers in the entire U.S. $R^2 = 0.986$, $P = 0.003$; (F) New England college students $R^2 = 0.894$, $P = 0.027$. Understanding-of-evolution versus understanding-of-science indexes: (G) New England research faculty $R^2 = 0.989$, $P = 0.002$; (H) educators of prospective teachers in the entire U.S. $R^2 = 0.986$, $P = 0.003$; (I) New England college students $R^2 = 0.996$, $P = 0.0005$. New England research faculty $n = 222$, educators of prospective teachers $n = 411$, New England college students $n = 576$. All linear regressions are one tailed. The total number of responders per population can vary because participants in the surveys were allowed to skip questions or end the survey voluntarily at any time.

Source: Modified from: Paz-y-Miño-C and Espinosa 2013b, 2014b.

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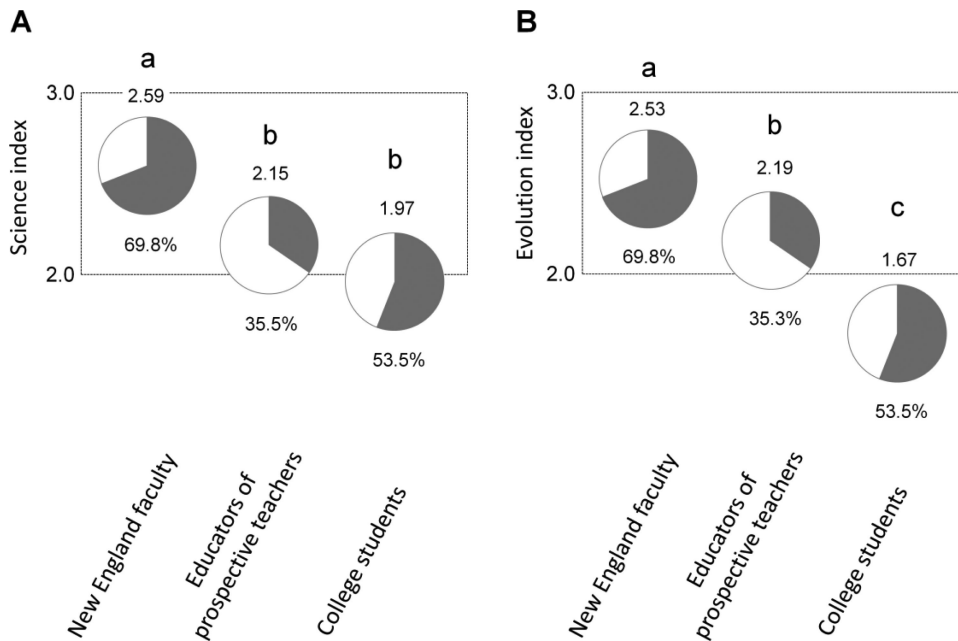


Figure 4.

Understanding of science and evolution as percentile of the non-religious members of three distinct populations: New England research faculty, educators of prospective teachers in the U.S., and New England college students. Gray areas in circles correspond to the percentage of the non-religious in respect to the total number of individuals surveyed within groups. The center of each circle is aligned with the level of understanding science (Science index) or the level of understanding evolution (Evolution index), values on the vertical axis, as in Fig. 2. (A) Science index: Kruskal-Wallis one-way ANOVA on ranks, $H = 57.256$, $df = 2$, $P = 0.001$. (B) Evolution index: Kruskal-Wallis one-way ANOVA on ranks, $H = 114.006$, $df = 2$, $P = 0.001$. Lowercase letters indicate Dunn-test two-tail pair-wise comparisons within groups $P < 0.05$. New England research faculty $n = 155$, educators of prospective teachers $n = 146$, New England college students $n = 308$. The total number of responders per group can vary because participants in the surveys were allowed to skip questions or end survey voluntarily at any time.

Source: Modified from Paz-y-Miño-C and Espinosa 2014b.

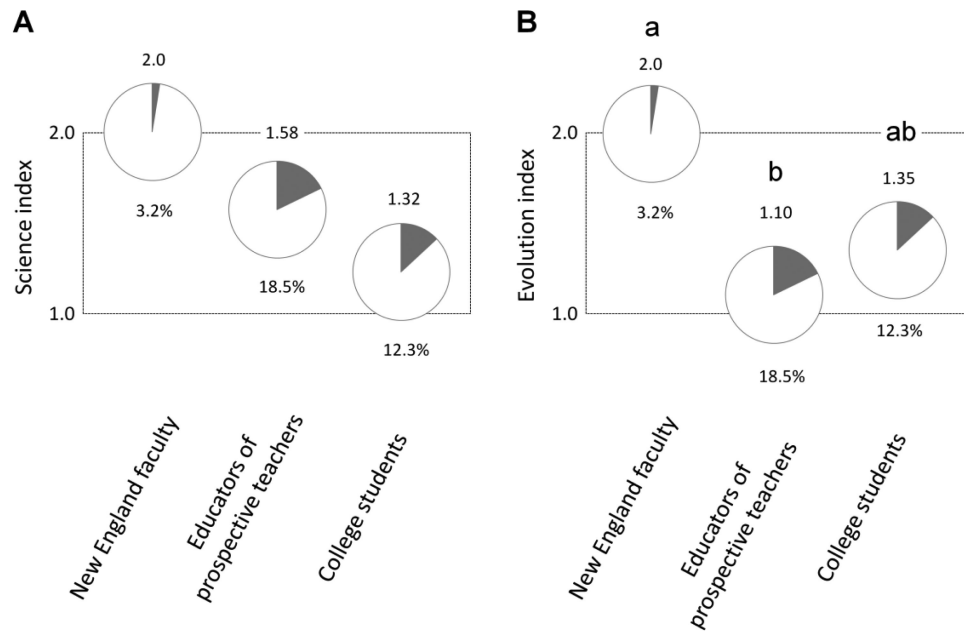


Figure 5. Understanding of science and evolution as percentile of the deeply religious members of three distinct populations: New England research faculty, educators of prospective teachers in the U.S., and New England college students. Gray areas in circles correspond to the percentage of the most religious in respect to the total number of individuals surveyed within groups. The center of each circle is aligned with the level of understanding science (Science index) or the level of understanding evolution (Evolution index), values on the vertical axis, as in Fig. 2. (A) Science index: Kruskal-Wallis one-way ANOVA on ranks, $H = 4.644$, $df = 2$, $P = 0.098$. (B) Evolution index: Kruskal-Wallis one-way ANOVA on ranks, $H = 10.223$, $df = 2$, $P = 0.006$. Lowercase letters indicate Dunn-test two-tail pair-wise comparisons within groups $P < 0.05$. New England research faculty $n = 7$, educators of prospective teachers in the U.S. $n = 76$, New England college students $n = 71$. The total number of responders per group can vary because participants were allowed to skip questions or end survey voluntarily at any time. Source: Modified from Paz-y-Miño-C and Espinosa 2014b.

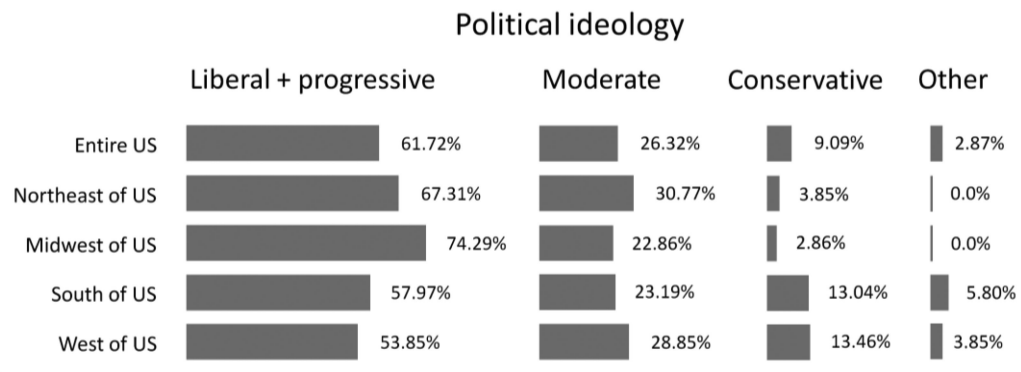


Figure 6. Self-identified political ideology of the educators of prospective teachers who responded to questions about accepting evolution or if evolution is a reality, U.S. Comparisons among groups: *Chi-square* = 27.091, *df* = 12, *P* = 0.007; liberal + progressive *n* = 129, moderate *n* = 55, conservative *n* = 19, other *n* = 6; entire U.S. *n* = 209, North East of U.S. *n* = 53, Midwest of U.S. *n* = 35, South of U.S. *n* = 69, West of U.S. *n* = 52. The total number of responders per group can vary because participants were allowed to skip questions or end survey voluntarily at any time.

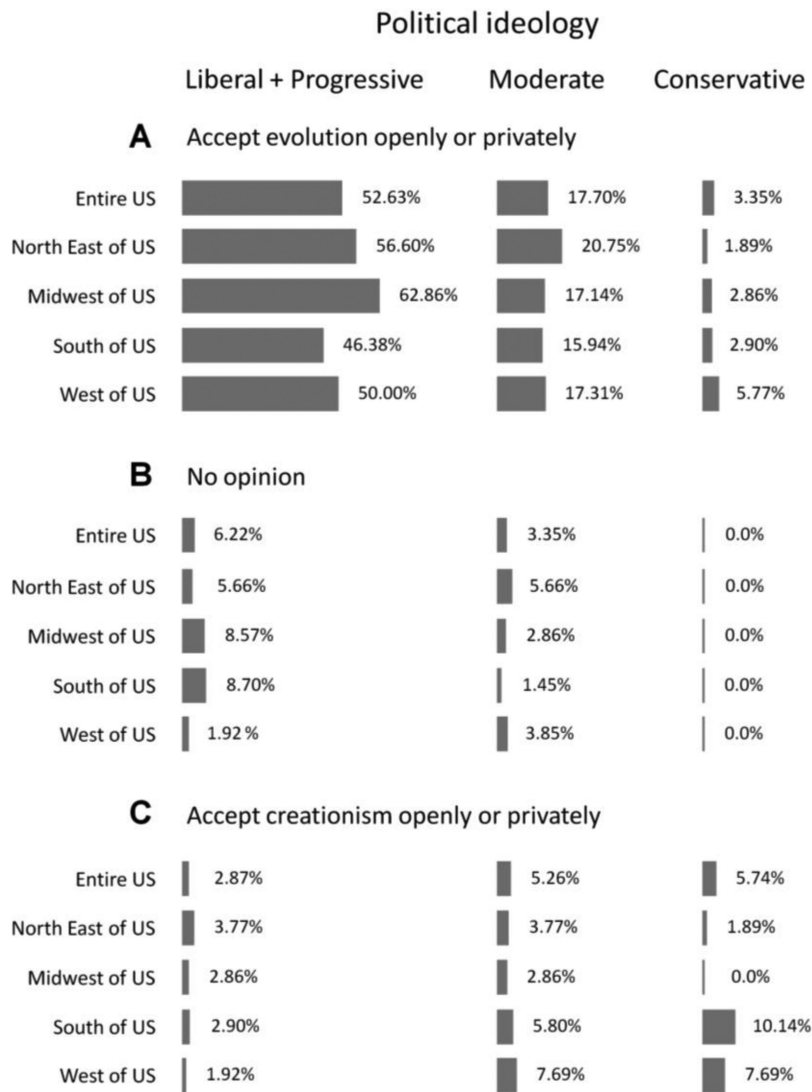


Figure 7. Acceptance of evolution or creationism by educators of prospective teachers who self-defined their political ideology, U.S. Comparisons among groups: (A) accept evolution openly or privately: *Chi-square* = 4.051, *df* = 8, *P* = 0.852; (B) no opinion: *Chi-square* = 7.144, *df* = 4, *P* = 0.128; (C) accept creationism openly or privately: *Chi-square* = 9.844, *df* = 8, *P* = 0.276. Liberal + progressive *n* = 129, moderate *n* = 55, conservative *n* = 19, other *n* = 6 (details not shown); entire U.S. *n* = 209, North East of U.S. *n* = 53, Midwest of U.S. *n* = 35, South of U.S. *n* = 69, West of U.S. *n* = 52. The total number of responders per group can vary because participants were allowed to skip questions or end survey voluntarily at any time.

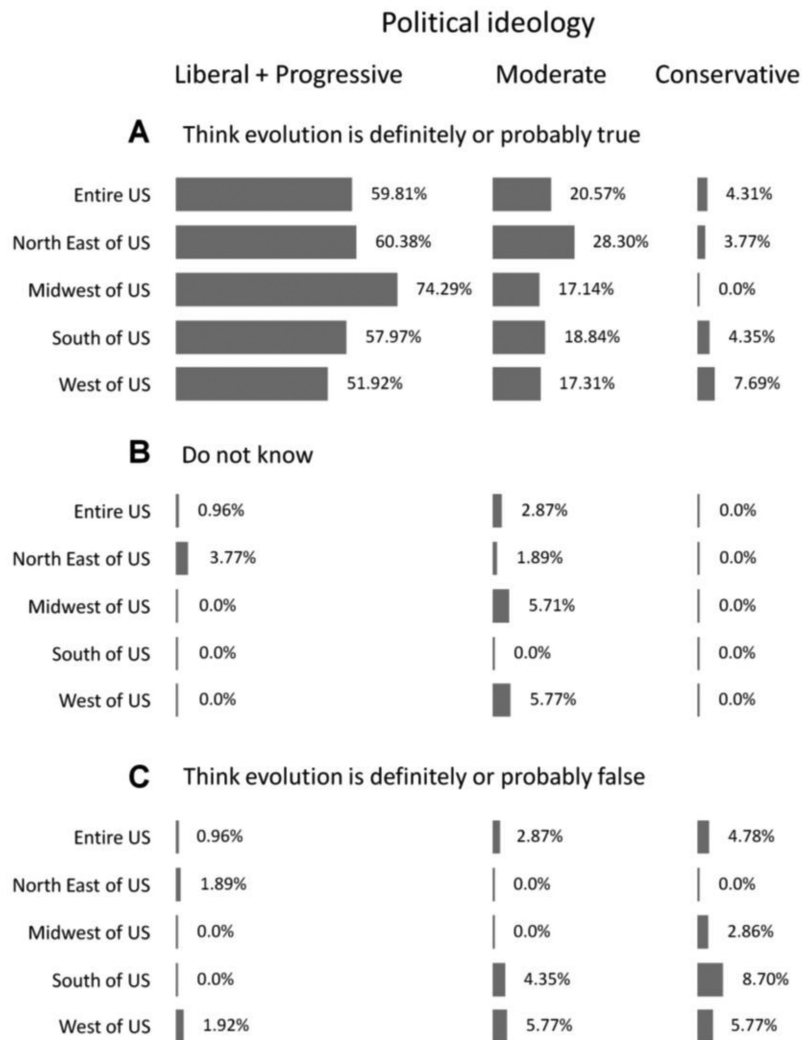


Figure 8. Views about evolution by educators of prospective teachers who self-defined their political ideology, U.S. Comparisons among groups: (A) evolution is definitely or probably true: *Chi-square* = 14.354, *df* = 8, *P* = 0.072; (B) do not know: *Chi-square* = 10.137, *df* = 3, *P* = 0.017; (C) evolution is definitely or probably false: *Chi-square* = 19.790, *df* = 8, *P* = 0.011. Liberal + progressive *n* = 129, moderate *n* = 55, conservative *n* = 19, other *n* = 6 (details not shown); entire U.S. *n* = 209, North East of U.S. *n* = 53, Midwest of U.S. *n* = 35, South of U.S. *n* = 69, West of U.S. *n* = 52. The total number of responders per group can vary because participants were allowed to skip questions or end survey voluntarily at any time.

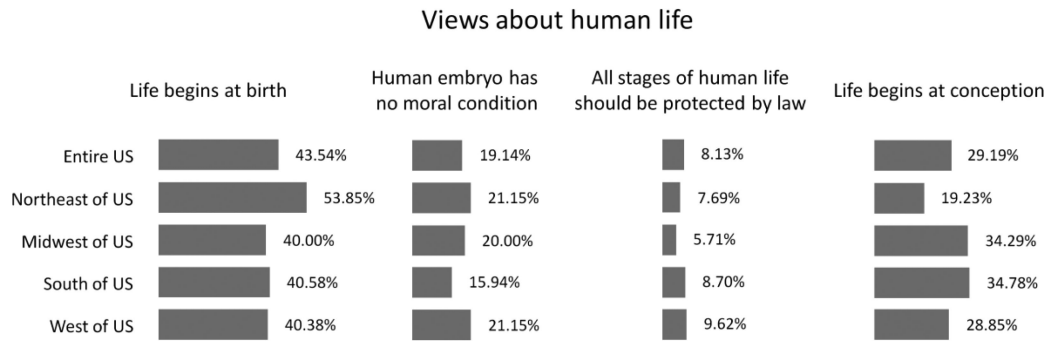


Figure 9.

Views about human life by the educators of prospective teachers who responded to questions about accepting evolution or if evolution is a reality, U.S. Comparisons among groups: *Chi-square* = 10.574, *df* = 12, *P* = 0.565; life begins at birth *n* = 91, the human embryo has no moral condition *n* = 40, all stages of human life should be equally protected by law *n* = 17, life begins at conception *n* = 61; entire U.S. *n* = 209, North East of U.S. *n* = 53, Midwest of U.S. *n* = 35, South of U.S. *n* = 69, West of U.S. *n* = 52. The total number of responders per group can vary because participants were allowed to skip questions or end survey voluntarily at any time.

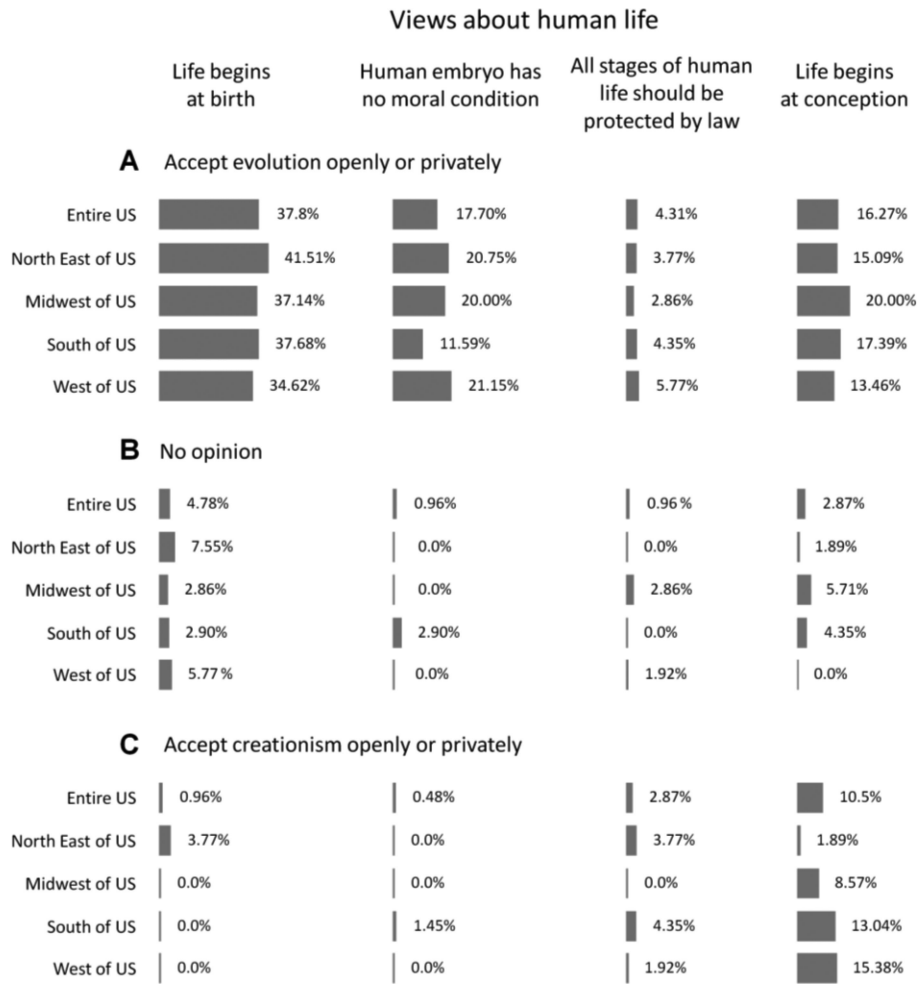


Figure 10. Acceptance of evolution and creationism by educators of prospective teachers who held diverse views about human life, U.S. (A) accept evolution openly or privately: *Chi-square* = 5.796, *df* = 12, *P* = 0.926; (B) no opinion: *Chi-square* = 23.517, *df* = 12, *P* = 0.023; (C) accept creationism openly or privately: *Chi-square* = 32.275, *df* = 12, *P* = 0.001. Life begins at birth *n* = 91, the human embryo has no moral condition *n* = 40, all stages of human life should be equally protected by law *n* = 17, life begins at conception *n* = 61. Entire U.S. *n* = 209, North East of U.S. *n* = 53, Midwest of U.S. *n* = 35, South of U.S. *n* = 69, West of U.S. *n* = 52. The total number of responders per group can vary because participants were allowed to skip questions or end survey voluntarily at any time.

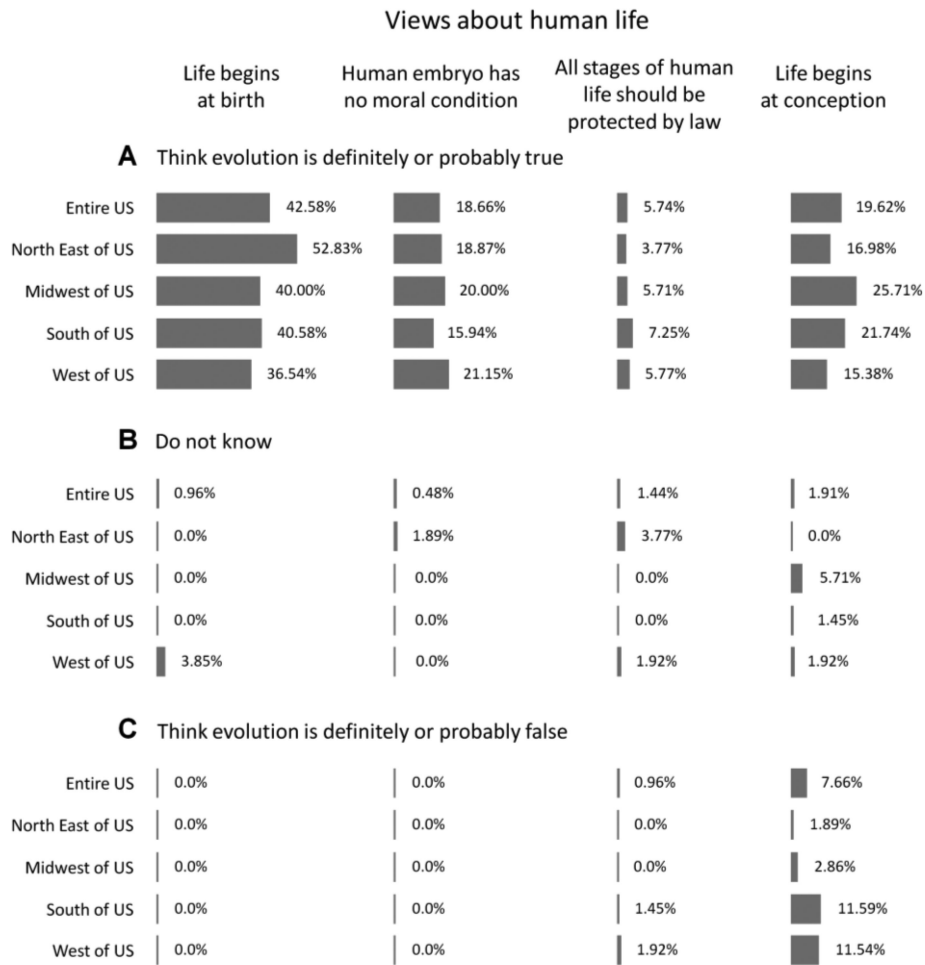


Figure 11.

The ‘likelihood of evolution’ as seen by educators of prospective teachers who held diverse views about human life, U.S. Comparisons among groups: (A) evolution is definitely or probably true: *Chi-square* = 7.216, *df* = 12, *P* = 0.843; (B) do not know: *Chi-square* = 26.717, *df* = 12, *P* = 0.008; (C) evolution is definitely or probably false: *Chi-square* = 0.832, *df* = 4, *P* = 0.934. Life begins at birth *n* = 91, the human embryo has no moral condition *n* = 40, all stages of human life should be equally protected by law *n* = 17, life begins at conception *n* = 61. Entire U.S. *n* = 209, North East of U.S. *n* = 53, Midwest of U.S. *n* = 35, South of U.S. *n* = 69, West of U.S. *n* = 52. The total number of responders per group can vary because participants were allowed to skip questions or end survey voluntarily at any time.