Why does Evolution Matter?

The Importance of Understanding Evolution

Edited by
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P U B L I S H I N G

Chapter One

The Incompatibility Hypothesis: Evolution vs. Supernatural Causation

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Introduction

Supernatural causation (i.e. the belief in a Supreme Being, creator and sustainer of the universe, omnipresent, omnipotent, omniscient) is a cultural pollutant, incompatible with empirical reality. "Belief" disrupts delays and/or stops the correct comprehension and acceptance of evidence. We have postulated that the controversy over evolution-and-science versus creationism is inherent in the incompatibility between scientific rationalism/empiricism and the belief in supernatural causation (Paz-y-Miño-C and Espinosa 2012a, 2013a). This hypothesis (=incompatibility) helps us understand and explain the everlasting and fluctuating antagonism—in cycles, from moderate to intense opposition during human history—in the relationship between science/evolution and religion (Paz-y-Miño-C and Espinosa 2013a). In this chapter, we examine conceptually the incompatibility hypothesis (IH), its predictions and alternatives, and approaches to test it quantitatively.

Conceptual Framework of IH

As a rational explanation of a natural phenomenon, the incompatibility hypothesis (IH) allows us to examine the controversy over evolution-and-science versus creationism. The observable "phenomenon" in society is "the controversy", the conflicts that emerge when facts organized in a rational interpretation of empirical reality (=the science of evolution) challenge "belief-" and the "supernatural-causation-based" answers to questions about the origin of the universe and life, the mutability and

phylogenetic diversification of life, its extinctions and the finite nature of *Nature* (Paz-y-Miño-C and Espinosa 2011a). The 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). It also directly addresses the question: what elicits the controversy evolution-and-science versus creationism? Answer: their intrinsic incompatibility, their opposing approaches to assessing reality, i.e. science via testing hypotheses, falsifying and/or testing predictions, and replication of experiments; creationism, in contrast, via the sole belief in supernatural causality (Paz-y-Miño-C and Espinosa 2013a, 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, for example, religious beliefs, pro-life beliefs and political ideology (Miller et al. 2006), or political and religious conservatism, knowledge about evolution and its relevance, creationist reasoning, evolutionary misconceptions, and exposure to evolution (Hawley et al. 2011). From a research programme perspective, however, IH is a central hypothesis, as a guiding ultimate level of analysis, while the indispensable proximate-level studies are auxiliary in essence (=auxiliary hypotheses; Lakatos 1978).

Predictions of IH

The incompatibility hypothesis makes numerous testable predictions: here we examine three:

Chronological Conflict and Accommodation

IH predicts the emergence of conflict and accommodation, by creationism, when advances in science continue to challenge the belief in supernatural causation. Societal turmoil would not occur if scientific discoveries *proven-beyond-reasonable-doubt*, like evolution, were readily accepted by the public (note that no reputable scientist questions the reality of evolution, although scientific debates about evolution persist as part of the *modus operandi* of science). Examples include Nicolaus Copernicus's heliocentric hypothesis (the sun at the centre of our solar system, 1543), confirmed by Galileo Galilei and Johannes Kepler (iconic contributors to astronomy in the 1600s), which challenged and replaced Claudius Ptolemy's geocentric model (the Earth as the centre of the universe, *ca*160AD—a view worshipped as reality for 1500 years by early

astronomers and theologians); or Charles Darwin's Theory of Evolution by means of natural selection (Darwin 1859, 1871), which debunked the Victorian concept of "species' immutability" of the late 1800s (Montúfar 2013). IH also anticipates that creationist models that emerge and accommodate to modern scientific discoveries by inserting a Creator or Designer into the processes of nature (i.e. theistic evolution, creation science, Intelligent Design) will fail once scrutinized by science, of course not without agitated debate and lawsuits (e.g. Kitzmiller et al. versus Dover School District et al. 2005).

Testing the "chronological-conflict-and-accommodation" prediction requires historical documentation of the scientific discoveries and/or creationists' challenges to science as they have been systematically discredited by research, e.g. the flat-earth hypothesis versus oblate-sphere-at-the-poles versus oblate-sphere-at-the-equator planet, or geocentrism versus heliocentrism, or species immutability versus modern genetics and natural selection (above, see also Stenger 2012). A more recent chronology, which is limited to only two decades and involves the late Intelligent Design (ID) movement, is comparably vast: the fallacy of ID, a doctrine born in the 1980s, proposes that a designer is responsible, ultimately, for the assemblage of complexity in biological systems; according to ID, evolution cannot explain holistically the origin of the natural world, nor the emergence of intricate molecular pathways essential to life, nor the immense phylogenetic differentiation of biological diversity, and instead ID proposes an *intelligent agent* as the ultimate cause of nature (Pennock 2001; Young and Edis 2004; Forrest and Gross 2007a, b; Petto and Godfrey 2007; Phy-Olsen 2010; Paz-y-Miño-C and Espinosa 2013a, b). In conceptually mistaken, type-I-error-based arguments to discredit evolution, ID has attributed randomness to molecular change, deleterious nature to single-gene mutations, insufficient geological time or population size for molecular improvements to occur, and invoked "design intervention" to account for complexity in molecular structures and biological processes (Paz-y-Miño-C et al. 2011; Paz-y-Miño-C and Espinosa 2013a, b). In 2005, ID was exposed in court (Dover, Pennsylvania, Kitzmiller et al. versus Dover School District et al. 2005; Padian and Matzke 2009; Wexler 2010) for violating the rules of science by "invoking and permitting supernatural causation" in matters of evolution, and for "failing to gain acceptance in the scientific community". After 2005, ID continued to be debunked on additional grounds in which ID ventured to introduce an Intelligent Designer, e.g. string theory and cosmology in physics (Susskind 2006), geology and the fossil record in

paleontology (Schneiderman and Allmon 2009), or common descent versus common design in phylogenetics of unicellular organisms (Paz-y-Miño-C and Espinosa 2010).

IH also predicts differential levels 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). Antagonism shall be intense with proximate creationism in principle and practice, like "Young Earth Creationism" (=the creation of the universe and life by God a few thousand years ago, as in *Genesis*). In contrast, antagonism shall be moderate with distant creationism in principle and practice, as with theistic evolution or creation science, where evolution is accepted conditionally, as a Creator-guided process, or with BioLogos which proposes merging Christianity with science (Paz-y-Miño-C and Espinosa 2013a, b).

IH explains that to minimize personal conflict, particularly among disciples of theistic evolution, creation science or BioLogos, an individual can 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; as in Gould 1999), or declare agnosticism (=doubt about the existence or nonexistence of a deity) (Paz-y-Miño-C and Espinosa 2013a, b). Because disciples of all forms of creationism vary, as in a natural population, from moderate to extreme, IH predicts everlasting conflict, from moderate to intense, between scientific rationalism/empiricism and the belief in supernatural causation (Paz-y-Miño-C and Espinosa 2013a).

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.

Change in Evolution's Acceptance as Function of Educational Attainment

IH predicts a positive association between acceptance of evolution and level of educational attainment. This prediction can be tested by documenting and plotting acceptance of evolution as function of overall

education. For example, public acceptance of evolution in the United Sates increases from the high school (20/21%), to the some college (32/41%), college graduate (52/53%), post-graduate (65/74%) (Brumfield 2005; The Gallup Poll 2009), and university professor levels (94%; Paz-y-Miño-C and Espinosa 2012a, b). Likewise, it can be documented as function of world technological prosperity, which correlates with excellence in education, for example, public acceptance of evolution is above 50% in Sweden (68%), Germany (65%), China (64%), Japan (60%), Belgium (61%), Great Britain and France (55%), and Spain (53%); around or below 50% in Australia (51%), Canada (45%), South Korea (41%), Italy (40%), India (39%) and Argentina (37%); and alarmingly low in Mexico (34%), U.S. (28%), Russia (26%), Brazil (22%), Turkey (19%), Indonesia (11%) and Saudi Arabia (7%) (IPSOS 2011). Note that the U.S. and Russia (highly religious culturally) are exceptions. 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.

Change in Evolution's Acceptance as Function of Religiosity

IH predicts a negative association between acceptance of evolution and level of religiosity. 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. The assumption is that atheists, non-believers and agnostics will accept evolution more than the moderate or deeply religious (Paz-y-Miño-C and Espinosa 2013a). We have documented such patterns by polling two distinct groups: first, self-identified atheists, non-believers and agnostics affiliated with the Atheist Alliance of America (AAA-US, N=133; Paz-y-Miño-C and Espinosa 2012c); and second, researchers, educators and students at 35 colleges and universities in New England, the U.S., plus European scientists from 25 countries (grand total N=1,392; Paz-y-Miño-C and Espinosa 2012a, b, 2013b). In a scale-religiosity index RI ranging from 0 to 3, least to most religious position, 93% of the atheists, non-believers and agnostics (whose RI=0 and educational attainment varied broadly) indicated to "accept evolution openly regardless of others' opinions", which was comparable to the 94% of the highly-educated New England researchers (RI=0.49) and 92% of the European scientists (RI=0.46), and significantly higher than the 72% of the New England educators (RI=1.31) and 63% of the students (RI=0.89) (Paz-y-Miño-C and Espinosa 2012a, b, c, 2013a, b). When RI was 0,

understanding of evolution—as function of an evolution literacy index EI, also ranging from 0 to 3, least to most knowledgeable about evolution—was high(er) in all groups (EI=2.59 among 70% of the New England researchers, EI=2.56 among 72% of the European scientists, EI=2.41 in 100% of the atheists, EI=2.16 among 36% of the New England educators, and EI=1.67 among 54% of the students; grand total N=778), however when RI was 3, understanding of evolution EI was low(est) (EI=2.0 among 3% of the New England researchers, EI=1.33 among 6% of the European scientists, EI=1.35 among 13% of the students, and EI=1.25 among 19% of the New England educators; grand total N=157) (Paz-y-Miño-C and Espinosa 2012a, b, c, 2013a, b).

The prediction can also be documented on a broader scale: acceptance of evolution is high among the least religious countries in the world and low among the most religious. For example, creationist views combined with the notion that "humans cannot possibly be apes" are low in Germany and Great Britain (12%), China, Spain and Japan (11%), Sweden (10%), France (9%) and Belgium (8%); higher in Russia (34%), India (33%), Mexico (32%), Argentina (26%), South Korea (24%), Canada (22%), Italy (21%) and Australia (15%); and even higher in Saudi Arabia (75%), Turkey (60%), Indonesia (57%), Brazil (47%), and the U.S. (40%) (IPSOS 2011). Note that scores for acceptance of evolution in these countries were given in the previous section.

We acknowledge, of course, 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; Padian and Matzke 2009; Matzke 2010; Wexler 2010; Paz-y-Miño-C and Espinosa 2011a, b Gross et al. 2012). However, the point of this prediction is that "belief" disrupts, delays and/or stops the correct comprehension and acceptance of the evidence in support of evolution.

Alternatives to IH

The obvious alternative proposal to the incompatibility hypothesis is "compatibility" (CH) between scientific rationalism/empiricism and the belief in supernatural causation, which can be supported—at least temporarily—when the individual adopts the self-comforting positions of:

harmony (=compatibility in principle and practice), non-overlapping magisteria NOMA (=compatibility in practice), or agnosticism (=compatibility in principle and practice). However, harmony is short lasting considering that the essence of science is to examine with facts all harmony-seeking proposals and reject them when lacking support (e.g. theistic evolution, creation science, or BioLogos, 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; historically, scientific rationalism/empiricism has consistently won the scrutiny battle (above). Agnosticism offers an uncompromising escape route inconsistent with the straightforwardness of science; therefore, it is destined to fade away. Although not strict a alternative hypothesis to IH, harmony, NOMA and agnosticism have been discussed under such premise (Paz-y-Miño-C and Espinosa 2013a).

IH foresees everlasting struggle within the harmony, NOMA or agnosticism positions. 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 (see multiple-variable analyses below). IH is founded on the premise that because supernatural causation is improbable, the conflict emerges as an intrinsic outcome of the debate about its likelihood of occurrence. 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.

How to Test IH and Its Auxiliary Hypotheses

To examine IH theoretically and test it quantitatively, we have conceptualized a Cartesian landscape where the dependent variable acceptance of evolution is plotted as a function of three factors (Fig. 1): 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).
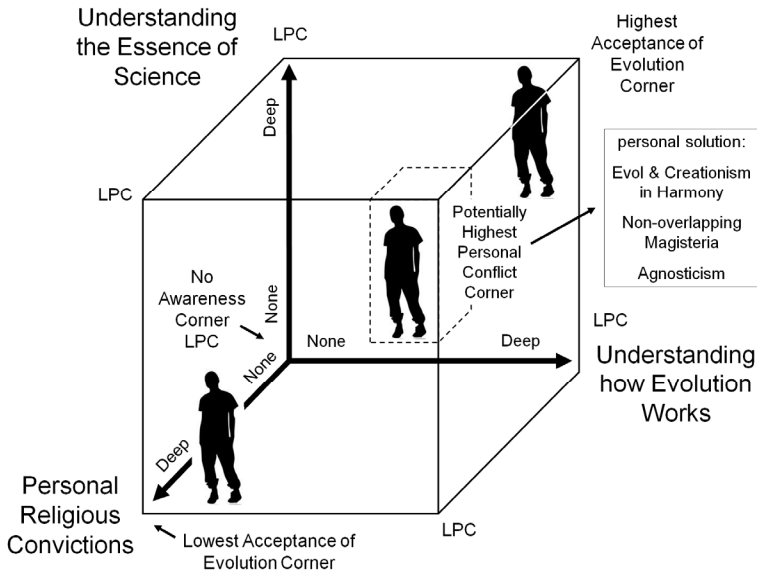
Fig. 1 Conceptual three-dimensional landscape where the acceptance of evolution is depicted as a function of religiosity, science awareness and evolution literacy (adapted from Paz-y-Miño-C and Espinosa 2012a, with permission).

The point zero in the Cartesian landscape depicted in Fig. 1, from which coordinates *x*, *y* and *z* originate, corresponds to a low (labelled *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 arrows of the coordinates 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, can be resolved by the individual's adopting comforting positions: evolution and creationism are in harmony, non-overlapping magisteria NOMA, or agnosticism (above). Note that four other corners are labelled LPC in Fig. 1 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).

To quantitate the levels of religiosity, understanding of science and the evolutionary process, and plot them according to the parameters depicted in Fig. 1, 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). 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, 2012b, 2013a, b).

Each index relies on examining responses to simple, informative questions: (i) 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*; (ii) 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*; and (iii) 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*.

Our studies on patterns of acceptance of evolution and attitudes towards science in New England (i.e. university professors, educators and college students), or among European scientists and members of the AAA (above) have given us robust results, consistent with the conceptualization depicted in Fig. 1: understanding of science and acceptance of evolution has always decreased with increasing religiosity. Acceptance of evolution has increased with higher levels of understanding science. The non-religious responders have reached the highest levels of understanding of science and evolution (=no conflict with science/evolution), in contrast to the deeply

religious who have scored lowest in science- and evolution-literacy indexes (=highest conflict with science/evolution) (Paz-y-Miño-C and Espinosa 2012a, b; 2013a, b). Those exposed to science courses, particularly biology, were more inclined to accept evolution than those deficient in science (Paz-y-Miño-C and Espinosa 2009a). In all groups, acceptance of evolution increased conspicuously with academic level (Paz-y-Miño-C and Espinosa 2009a, b, 2011b, 2012b, and 2013b).

In significant studies, Miller et al. (2006) and Hawley et al. (2011) have used structural equation models to explore the interconnectivity of multiple characterizers of acceptance of evolution. These approaches are critical for the comprehensive understanding, at the proximate level (=proximate hypotheses), of the dynamic and multi-factor nature of the controversy. For example, Miller et al. (2006) have determined that public opposition to evolution in the U.S. resides in specific variables: religious beliefs, pro-life beliefs, and political ideology account for most of the variance against evolutionary views (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). Although in the U.S. and Europe religiosity is the main factor associated negatively with acceptance of evolution, the North American and European populations differ distinctively in the magnitude and/or set of variables influencing the phenomenon. Hawley et al. (2011) have gone further into the multiple variable analysis of attitudes towards evolution and identified six "higher-order" factors (political activity, political and religious conservatism, knowledge about evolution and its relevance, creationist reasoning, evolutionary misconceptions, and exposure to evolution) which interact with sixteen other "lower order" constructs (e.g. political, religious, moral and social commitments and/or objections; knowledge about science, evolution and technology; and exposure to evolution and/or its misconceptions; among others), thus illustrating the multidimensional complexity of the controversy.

The auxiliary hypotheses, as examined by Miller et al. (2006) and Hawley et al. (2011), are susceptible to rapid change, for example, the relationship among religious beliefs, pro-life beliefs or political ideology will vary in the short-term depending on societal circumstances; the same applies to Hawley et al.'s higher- and lower-order factors. The IH, however, as central hypothesis, is less prone to abrupt transformations (it predicts everlasting conflict between science/evolution and religion), unless "belief" vanishes and, therefore, the conflict ceases. Importantly, the auxiliary proposals are essential to study and characterize IH.

Acknowledgments

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