Perceived Consequences of Evolution: College Students Perceive Negative Personal and Social Impact in Evolutionary Theory

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ABSTRACT: Evolutionary science has consequences for individuals and society, ranging from the way we interpret human behavior to our notions of spirituality and the purpose of our existence. Popular portrayals of evolution depict a paradoxical theory, a source of knowledge and human connections, but also a threat to our humanity and freedom. Using quantitative and qualitative methodology, we examined how college-educated adults ($n = 135$) from diverse ethnic and religious backgrounds perceive the impact of evolutionary theory on individuals and society. We identified a continuum of perspectives, ranging from strong creationist to strong evolutionist. Using the model of "knowledge as an ecology" (Demastes, Good, & Peebles, Science Education, 79, 637–666, 1995; Nardi & O'Day, Information ecologies: Using technology with heart, MIT Press, Cambridge, MA, 1999), we examined the relationships among participants' beliefs, their perceptions regarding the social and personal impact of evolutionary theory, their prior exposure to and knowledge of evolutionary theory, and their opinions regarding the teaching of evolution. Evolutionists and creationists differed in their prior exposure to evolutionary theory, and their opinions about some aspects of teaching, but showed striking similarities regarding perceived impact. All groups viewed the consequences of accepting evolutionary principles in a way that might be considered undesirable: increased selfishness and racism, decreased spirituality, and a decreased sense of purpose and self-determination. From a science education perspective, this one-sided interpretation is troublesome because it runs counter to the available evidence and theories in evolutionary science, and we consider ways of fostering more

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INTRODUCTION

In his history of Darwinian ethics, Farber (1994) describes the reaction to Darwin's ideas in the ninteenth century (p. 22):

> Whether or not ancient populations of armadillos were transformed into the species that currently inhabit the new world was certainly a topic about which zoologists could disagree. But it was in discussing the broader implications of the theory's interpretation—such as the rejection of a teleological view of nature, the attack on natural theology, or the depiction of man as merely an advanced ape—that tempers flared and statements were made which could transform what otherwise would have been a quiet scholarly meeting into a social scandal.

Perhaps things have not changed all that much. In his first book, Dawkins (1976) argued that even apparently selfless behavior was the result of mechanistic genetic self-promotion. In the preface of *Unweaving the Rainbow*, Dawkins (1998, p. ix) writes:

> A foreign publisher of my first book confessed that he could not sleep for three nights after reading it, so troubled was he by what he saw as its cold, bleak message. Others have asked me how I can bear to get up in the mornings. A teacher from a distant country wrote to me reproachfully that a pupil had come to him in tears after reading the same book, because it had persuaded her that life was empty and purposeless. He advised her not to show the book to any of her friends, for fear of contaminating them with the same nihilistic pessimism.

Opponents of evolutionary theory fear that its acceptance leads to consequences they find unacceptable (Gitt, 1995), such as abandoning of the concept of sin, reconciling oneself to a spiritless existence, and losing a sense of purpose:

> Students by and large are told: they are just animals; there is no purpose and meaning in life. For them, pain, death, and suffering are a necessary part of life, essential to furthering the evolution of life on this planet. How, therefore, can there be a loving God? These young people are hurting, but they don't truly understand why this is so. (Ham, 1998).

In contrast, others argue for evolutionary theory as a source of wonder and fulfillment, as did Dawkins (1996) in a televised address:

> If only we could read the language, the DNA of tuna and starfish would have "sea" written into the text. The DNA of moles and earthworms would spell "underground". Of course all the DNA would spell many other things as well. Shark and cheetah DNA would spell "hunt," as well as separate messages about sea and land.
>
> We can't read these messages yet. Maybe we never shall, for their language is indirect, as befits a recipe rather than a reversible blueprint. But it's still true that our DNA is a coded description of the worlds in which our ancestors survived. We are walking archives of the African Pliocene, even of Devonian seas, walking repositories of wisdom out of the old days. You could spend a lifetime reading such messages and die unsated by the wonder of it.

The implications of evolutionary theory has been an issue for scientists, philosophers, and essayists ever since Darwin went public. Today, both proponents and opponents concur

that the cultural and personal implications are considerable. Evolutionary science raises the possibility that personality is mediated by evolutionary forces (Sulloway, 1996), posits an adaptive role for violent behavior (Daly & Wilson, 1988, 1992), explains why we love whom we love (Trost & Alberts, 1998), and sheds light on our ability to think and reason (Cosmides, 1989). It forces us to question our motives when we appear to be acting selflessly and altruistically (Dawkins, 1976), and may hold the key to how we should look at race (Wolpoff & Caspari, 1997).

And it isn't just scientists who are exposed to these issues. We can walk into any major bookstore and find self-help titles that invoke evolutionary theory to explain battles with obesity, disease, and undesirable personality traits (D'Adamo & Whitney, 1997; Hamer & Copeland, 1998). Newspapers inform us that evolutionary theory will explain human violence (Brody, 1998; Wilson, 2000), will help us understand and cure disease (Goode, 2000), and will transform our concepts of race (Shane, 1999). Films like *Mimic* and television shows such as *Prey* portray evolution as creating "more perfect" creatures that live to destroy other species (usually ours).

The science that inspires both fiction and nonfiction, however, does not present one clear set of consequences for individuals and society; working out the social, political, and philosophical implications requires balance and reflection. Consider our human origin. Human beings are one of the most genetically homogeneous species in the world; human beings are more genetically similar to one another than are other hominoids (Gagneux et al., 1998), and most human genetic variation is within populations (Barbujani et al., 1997). We're all really very much the same. Nevertheless, there are racial and ethnic differences that have important health implications; diseases such as sickle cell anemia and Tay-Sachs cluster in people of African and Ashkenazi Jewish descent, respectively. We should neither ignore differences between human groups, nor let them overshadow the underlying commonalities. Altruism presents a similar set of seemingly paradoxical implications. Altruism has an important role in evolutionary theory (Sober & Wilson, 1998), but it leads to the propagation of the altruistic individual's genes (Dawkins, 1976); are altruism and selfishness the same thing? As a final example, suppose we are evolutionarily predisposed to violence or a particular illness; should we feel depressed and fatalistic, or feel heartened by the possibility that understanding can help us combat what we don't want (Nesse & Williams, 1996)? There is no ultimate answer to what evolution means for individuals and society. Does the public appreciate this?

As educators, we need to know. There is a vigorous movement within education that perceives learning as not only mastering a set of concepts, but also as placing these concepts in a framework that makes contact with ideas about ourselves, our society, and our environment (Cobern, 1994; National Academy of Sciences, 1995, 1998). Other researchers have referred to a need to explore the larger framework in which evolutionary knowledge resides (Cobern, 1994), and the "extrascientific" factors (Bizzo, 1994). This is consistent with a growing interest among researchers in characterizing thinking and learning as situated in a larger context created by the dynamics of content, interpersonal interactions, cultural norms, and so on (e.g., Hutchins, 1995; Lave, 1988; Warschauer, 2000). This approach has been labeled by some as the task of uncovering the "ecology" of a system (Demastes, Good, & Peebles, 1995; Nardi & O'Day, 1999; Syverson, 1999). The metaphor is used to highlight that knowledge enters and transforms a system that is dynamic and adaptive, in which different ideas, tools, people, organizations, and other elements develop a relatively stable role and niche as a function of pressures and opportunities. The ability to use, evaluate, and respond to information is influenced by how it fits into a larger knowledge construct (e.g., Chapman & Chapman, 1967; Lord, Ross, & Lepper, 1979; Wisniewski & Medin, 1994).

The purpose of this study was to explore college students' perceptions regarding the social and personal impact of evolutionary theory, as these interact with other elements

in the conceptual ecology. We focused on college students at a public university for both pedagogical and pragmatic reasons. From a pedagogical standpoint, we were interested in people who would have had a fairly traditional secondary and postsecondary educational sequence, and who were still in the educational system and could be reached with any educational prescriptions that might prove necessary. This would indicate a secondary or undergraduate population. Pragmatic constraints caused us to choose to begin our work at the postsecondary level. Secondary teachers reported tremendous pressure to avoid controversy when teaching evolution (Griffith & Brem, 2001), and most of the teachers we worked with either actively avoid these issues or worry deeply about conflicts among parents, teachers, and administrators. Asking them to face community reactions before we had developed a preliminary sketch of what the outcome might be seemed unwise and unreasonable.

Our development of the instrument used in this study began with asking undergraduates to write down spontaneous thoughts regarding what evolutionary theory means for people and society. Based on these writings, as well as close study of creationist and evolutionist writings, we developed five areas of possible impact for evolutionary theory:

(1) Sense of purpose in life. Like Ham (1998), or Dawkins's publisher, believing in evolution may rob some people of their sense that there is a "master plan." Likewise, students participating in the written protocols frequently said that the evolutionary aphorism "survival of the fittest" explained why some people and species succeed and others do not; as one said, if evolution is false, "misfits rule."
(2) Perceptions of race and ethnicity. An evolutionary perspective can be used to highlight racial differences, or to see these as minor in light of the strong similarities across all of humankind (Wolpoff & Caspari, 1997).
(3) Sense of spirituality. Is evolution seen as incompatible with the existence of a supreme being, an afterlife, and spiritual rewards? This is perhaps the area of impact most studied by researchers.
(4) Perceptions of selfishness. Evolution may be seen as licensing selfish and ruthless behavior, or as a way to understand and combat undesirable behavior. This is a prominent concern in the writings of creationists, and Griffith and Brem (2001) describe teachers who saw this perspective in their students; one teacher described his students' conception of genes as "street gangs" fighting turf wars.
(5) Sense of self-determination. If evolution creates genetic predispositions, does this lead students to the fatalism of Dawkins's publisher, or does their sense of control increase with understanding, as it does for Dawkins?

It is important to note that we are not making any claim regarding the validity of any particular perception; indeed, we do not believe that the evolutionary evidence supports a single perspective. We can use evolutionary evidence to highlight either similarities or differences in our species. Evolutionary explanations could rob people of a master plan, or could help them to understand why they have particular features (e.g., epicanthic folds), abilities (e.g., heat and cold adaptations), diseases (e.g., sickle cell anemia), and so on. Some people believe that evolution is incompatible with a supreme being, while others might argue that such an elegant system is a sign of a higher power. Evolution does create competition, but also leads to reciprocal altruism and kin selection. In short, the evidence can be spun in many ways, and our goal was to see which spin the participants would choose.

Having identified these areas of potential impact, we then identified aspects of the conceptual ecology to include in our examination, choosing four on the basis of their theoretical importance, and their prominence in the evolution education literature (e.g., Bishop & Anderson, 1990; Dagher & Boujaoude, 1997; Demastes, Good, & Peebles, 1995; Griffith

& Brem, 2001; Lawson & Worsnop, 1992; Schindel, 1999; Sinclair, Pendarvis, & Baldwin, 1997):

(1) Knowledge of evolutionary concepts. Previous studies suggest a negative relationship between religious beliefs and acceptance of evolution among some people, but little or no relationship between beliefs and understanding of evolution (Bishop & Anderson, 1990; Demastes, Settlage, & Good, 1995; Lawson & Worsnop, 1992). Given that all the participants are roughly similar in their exposure to postsecondary education, we expected that they would be roughly similar in their knowledge of evolutionary principles. This information does, however, allow us to correlate individual knowledge with individual results in the other areas.

(2) Beliefs regarding the origin and development of life on Earth. Creationist and evolutionist positions are sometimes portrayed as mutually exclusive and diametrically opposed, particularly in the context of educational policy. Legal battles foster the perception of these two as fundamentally irreconcilable (Ruse, 1988). Lawson and Worsnop (1992) found that religious commitment was negatively correlated with belief in evolution, both before and after instruction, while Sinclair, Pendarvis, and Baldwin (1997) found that strong creationists tended to see the choice between evolution and creation as dichotomous. However, other participants strove to find a balance, though not always successfully. Likewise, Dagher and Boujaoude (1997) noted reconciliatory views among Christian and Muslim college students in Beirut, and Demastes, Good, and Peebles (1995) report intermediate positions among American high-school students. Creationist writers also display a range of positions (Moreland & Reynolds, 1999). Thus we cannot assume that participants will fall into two clear-cut categories.

(3) Prior exposure to pro- and antievolution sources of information. Evidence from social psychology shows that people tend to pursue opportunities to see and hear messages that reflect their own opinion, and they evaluate these messages more favorably (Kunda, 1990; Lord, Ross, & Lepper, 1979). Thus, evolutionists should seek out and value classes, TV shows, Internet sites, and other outlets that feature proevolution messages, while creationists should do the same for antievolution messages. Nevertheless, people do not have absolute control over the messages they encounter, especially in academic settings. Except in schools with strong religious affiliations, even creationists may have a fair degree of exposure to proevolution messages through science instruction.

(4) Positions on teaching evolution and creation. The perceived outcome of accepting the principles evolutionary science could influence students' beliefs regarding whether and how evolution should be taught. To the extent that they see it having positive consequences, they may be more receptive to it being taught, and taught without qualifications or omissions. To the extent that they see it having negative consequences, they may resist the teaching of evolution, or look for ways to balance it with other perspectives and lessons that could mitigate the negative impact.

METHOD

Participant Recruitment

In recruiting participants, two concerns were uppermost: The need to minimize the possibility of scientific or world events affecting participants differentially, and the need to recruit all the participants in the same way, without cues that might lead people with certain beliefs to self-select in or out of the study.

For this reason, data collection took place over a relatively short period of time, 6 weeks in 1999. All recruitment took place on the campus of a major, public university in the Western United States. Prior to participation, no participant knew the subject of the study; they were simply offered $10 to complete some questionnaires. No special interest groups were targeted, and the recruitment booth was set up at a central location on the campus. No participant withdrew from the study. Seventeen participants did not have time to complete the semistructured written section, but no one refused to complete it, and the only factor appears to have been time. We believe that these precautions minimized selection bias and differential demands.

Participants

There were 135 participants, ranging in age from 18 to 38, with a mean age of 21.7 years (SD = 4.1). Equal numbers of men and women participated (51 and 49%, respectively). None had participated in any of the pilot activities that led to the development of these instruments. All were enrolled or had been enrolled in college; a few (4%) were engaged in graduate work. Participant demographics are presented in Figure 1. Given the diversity, we

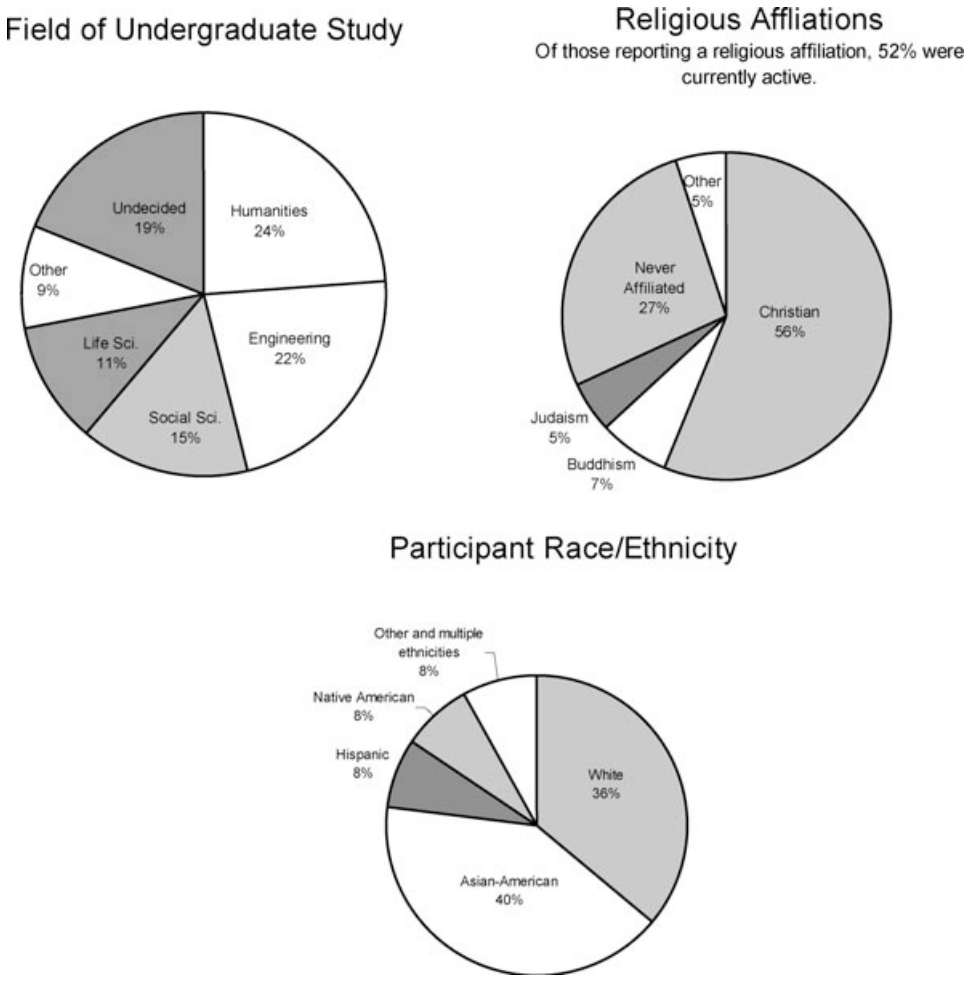


Figure 1. Participant demographics.

did not categorize participants demographically, focusing instead on beliefs and experiences. While this obscures patterns that might be based on religion, race or ethnicity, the patterns that appear across the sample suggest that beliefs and experiences are significant contributors to a person's conceptual ecology.

Materials

Because of the wide range of possible positions, our goal was to collect information from a large group of participants, suggesting a quantitative approach, without losing the richness of qualitative data. We therefore employed both Likert-scale measures and semistructured written protocols. Both instruments were developed through a series of pilot studies; all investigations were conducted at the same university. First, we asked students to record their spontaneous thoughts regarding the consequences of accepting evolutionary theory. From these responses, and close study of creationist and evolutionist writings, we developed preliminary instruments. We then asked students to critique the surveys for wording, clarity, biased language, and any other difficulties they might have with the items. We piloted the revised instrument with 85 participants, and then carried out minor revisions to arrive at the instrument we describe here.

(1) Participants began with a concise evaluation of evolutionary knowledge. The task has been used and adapted by a number of researchers (e.g., Bishop & Anderson, 1990; Demastes, Settlage, & Good, 1995; Kaufman et al., 1999). It asks participants to give an evolutionary explanation for an adaptation, and is scored using a rubric covering key aspects of evolution: variation, selection pressure, differential survival, consequences for offspring, and accumulated change. Given prior research showing a dissociation between belief and comprehension, and the likelihood that students from the same campus will have relatively similar academic training, we did not expect to see substantial differences. Rather, it allows us to correlate individual knowledge with individuals' responses in other areas.

(2) Participants completed a Likert-scale questionnaire addressing:

   (a) Their beliefs about the origin and development of life on Earth. As we stated above, rather than initially categorize participants as merely evolutionist or creationist, we wished to leave space for reconciliatory positions. Based upon prior research, the writings of essayists, and pilot studies we arrived at a set of five Likert-scale questions covering a range of beliefs from strong creationism to strong evolutionism (Appendix A, Section I). We also asked participants to choose the one that best captured their views.
   (b) Their prior exposure to pro- and antievolution messages. We asked participants to report their exposure to pro- and antievolution messages from various sources, including family, scientists, clergy, and school. We expected that evolutionists would have encountered more proevolution messages than antievolution messages, and that creationists would encounter more anti evolutionist messages than evolutionists would. Creationists, however, could receive just as many proevolution messages as evolutionists, given that evolution taught in more schools than creationism.
   (c) Perceived impact of evolutionary theory on individuals and society. As described above, we had identified five areas of potential impact: "Is it harder or easier to find purpose in life?," "Is it harder or easier to believe in a supreme being and a spiritual existence?," "Is it harder or easier to justify selfishness?,"

"Is it harder or easier to justify racial and ethnic discrimination?," and "Is it harder or easier to think of people as determining their own fate?"

In each area, six questions addressed specific scenarios and outcomes (examples can be found in Appendix A, Section III). Participants indicated agreement/disagreement on a 7-point (−3 to +3) Likert scale. For half of the questions, *harder* corresponded to a positive score and *easier* corresponded to a negative score; in the other half, this was reversed; reversals were recoded in scoring. Participants could choose "0" to express the opinion that believing in evolution would have no impact at all. We expected participants to exhibit motivated reasoning; such that evolutionists would find more positive impact, while creationists would take a more negative perspective.

(d) Their opinions regarding teaching evolution and creation in schools. We asked students to consider whether and how evolution and creation should be taught, and whether consequences should affect teaching practice. Here, too, we expected to see motivated reasoning; creationists would want to see creationism in the classroom, while evolutionists would want to see evolution taught. We also believed that the possibility of positive consequences would be used by evolutionists to promote their interests, while the possibility of negative consequences would be used by creationists to serve their interests.

(3) Participants answered open-ended written questions in areas (a) and (d). We chose the former because allowing students to expand upon their beliefs provided a form of validation for our quantitative measures of beliefs regarding evolution and creation. We chose the latter because of its interest to educators and educational researchers, and to see whether and how impact concerns influence students' opinions regarding the teaching of evolutionary and creationist theories. As mentioned above, some participants did not have time to complete this section. All quantitative analyses are thus based on 135 individuals, while qualitative analysis is based on 118.

RESULTS

Characterizing Participant Beliefs

We used a two-step process to categorize participants according to their beliefs, applying descriptive labels based upon the Likert scale and "best statement" choice measures. The first step involved only the Likert scale data collected at the beginning of the session; the results are presented in Table 1. For the 17 participants who did not complete the final section because of time limitations, we relied solely upon these data. For the remaining 118, we also incorporated the data from the end of the session, in which they chose the one statement that best characterized their beliefs. We lay out this process and give final category sizes in Figure 2.

Several factors point to the utility of this approach. We were able to characterize almost all participants using a small set of criteria. Furthermore, comparing responses on the Likert and forced choice items provides a measure of temporal consistency; very few participants espoused a creationist view at one point and an evolutionist point at another (Figure 2), and they can be excluded from further analysis. Finally, the categories were formed without reference to the qualitative data or any Likert scale items beyond the five belief statements, ensuring that patterns in other areas cannot be attributed to ad hoc classification.

In particular, we used written responses as a check on our categorization, but did not consult these until we had categorized all participants. In Appendix B, we report examples

TABLE 1
Initial Belief Group Criteria (Possible = Statements Scored Greater than 0)

Descriptor	Statement 1	Statement 2	Statement 3	Statement 4	Statement 5
	No Intelligent Design	Intelligent Initiation of Evolution	Intelligent Intervention in Evolution	Humans Do Not Evolve; All Other Life Does	No Evolution
Creationists (24 participants)					
Strong creationists ($n=6$)	No	No	No	No	Yes
Human-only creationists ($n=11$)	Possible for non-humans	Possible for non-humans	Possible for non-humans	Yes	No
Nonspecific creationists ($n=7$)	No	Possible	Possible	Possible	Yes
Evolutionists (91 participants)					
Nontheistic evolutionists ($n=35$)	Yes	No	No	No	No
Theistic evolutionists ($n=9$)	No	Yes	No	No	No
Interventionist evolutionists ($n=7$)	No	No	Yes	No	No
Nonspecific evolutionists ($n=40$)	Possible	Possible	Possible	No	No
Uncertain (20 participants)					
Inconsistent ($n=7$)	Yes		Possible	Yes	
Neutral ($n=13$)	No	No	No	No	No

to illustrate the categories, to allow the reader to judge construct validity. In these open-ended questions, we explicitly asked participants to describe any problems they encountered in finding their own views among the ones we presented. Thirty-five percent said that one statement matched their position so well that they did not need to qualify their choice in any way; an additional 23% required only minor rewording, most often laying out the specific ways a supreme being might "intervene" (Statement no. 3), or to point out that saying a supreme being did not play a part in evolution (Statement no.1) did not entail denying the existence of a supreme being altogether (this was never part of the statement). Thus, 58% were basically satisfied with just a single statement. An additional 34% were able to cover their beliefs by combining one or more statements. For the remaining respondents (8%), the most common response was that their uncertainties regarding how life developed on Earth were too great to choose a single perspective. These findings suggest that the statement set captured the evolution–creation belief space effectively.

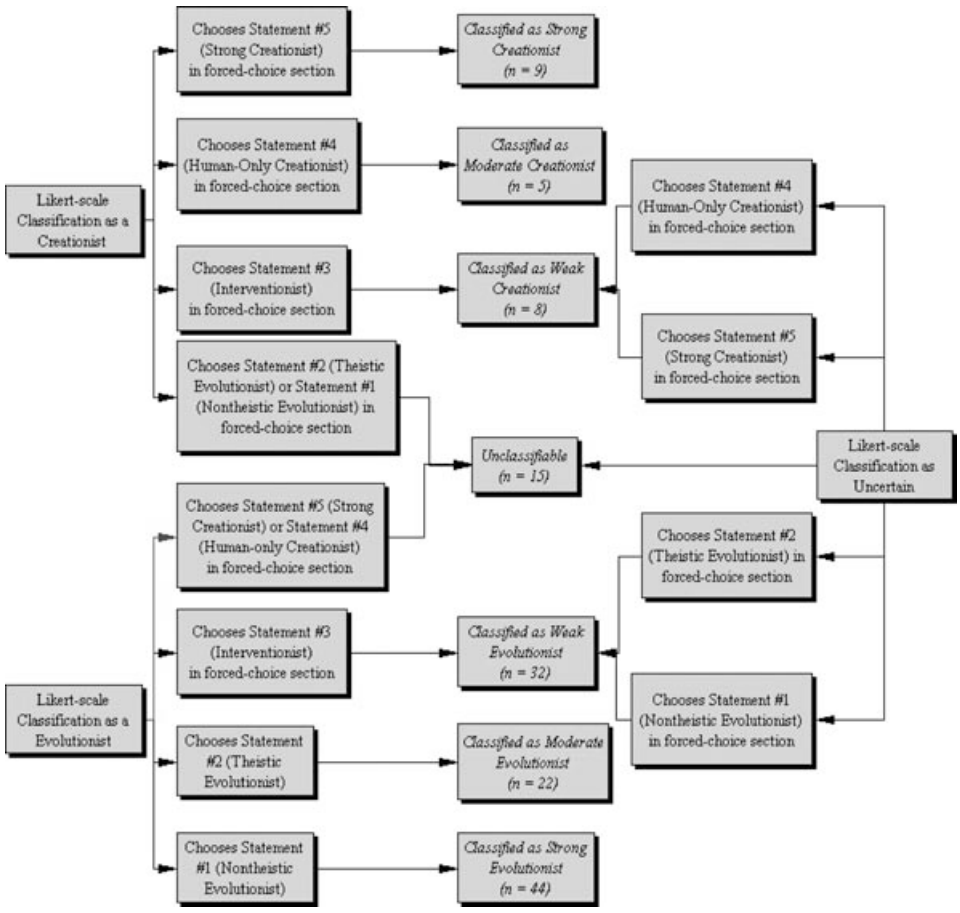


Figure 2. Flow chart depicting the procedure for locating participants within belief groups. Likert scale classifications are explained in Table 1.

The sample of creationists is smaller than that of evolutionists. This raises the question as to whether it would be advisable to collect additional data to increase the sample of creationists. However, unless we target particular groups or move to a different population, it is unlikely that the proportions will change. Targeting different populations raises the problem that the samples are not comparable. We decided that a sample of 22 was large enough to give us an initial picture of college-educated creationists, but, certainly, greater exploration is needed.

Qualitative Analysis of Participant Beliefs

Readers familiar with prior research regarding evolutionist and creationist positions (e.g., Dagher & BouJaoude, 1997; Demastes, Settlage, & Good, 1995; Sinclair, Pendarvis, & Baldwin, 1997) will note similarities between the reconciliatory themes voiced here and those of participants in past studies, including giving a supreme being the role of setting evolution in motion, allowing the evolution of nonhuman animals while reserving creation for humans, and describing a "spiritual force" that parallels or interacts with evolution. Thus, across studies, we are moving beyond recording the mere existence of intermediate positions to describing the nature of these positions.

Reconciliatory themes are most often found in the moderate and weak groups. For reconciliatory creationists, intelligent design remains the driving force. Some reserve creation for humans:

> I believe in God and the theory that he created mankind. At the same time i (sic) accept ideas of evolution and adaptation. It is somewhat contradictory to say that while plants & animals evolved humans did not. But i do not believe that the role of evolution to humans in the [one unreadable word] position that we evolved from primates.

Others cast evolution as a creator's tool (P27, Weak Creationist):

> . . . [A]ll forms of life were created by a supreme being, but that they have changed in small ways over time due to environmental conditions. /It also says that the supreme being who created the Earth and its inhabitants has control still over what happens on Earth. /I would say that I totally agree with the statement. I may interpret it differently than someone else, though. I believe that God has the ability to intervene whenever He wants/needs to, but I also believe that He wants us to live our own lives to make our own choices.

Reconciliatory evolutionists commonly refer to a supreme being as initiating the evolutionary process, as this participant did: "God created the initial particle in a void of nothingness and that particle underwent predictable chemical processes to create galaxies, stars, planets, and life. 'God' no longer needs to intervene in evolutionary process. . . . " Other evolutionists see "God" as a scientific entity: "the being could just be like a math or physics equation so we shouldn't think of it as being human or compassionate toward our needs."

Are There Differences Between Belief Groups Regarding Knowledge of Evolution?

We first examine whether these groups differ in their knowledge of five evolutionary concepts: variation, selection pressure, differential survival, consequences for offspring, and accumulated change. This portion of the instrument was scored on a 5-point scale, 1 point for each of the five rubric areas. Two raters scored all items independently, and resolved disagreements through discussion. Interrater reliability exceeded 85%. Consistent with past research and our initial predictions, we failed to find a relationship between belief and knowledge (Figure 3; for all graphs, error bars represent 95% confidence levels). We will, however, return to these scores to relate individuals' knowledge levels to their responses on later measures.

Do Belief Groups Differ in Exposure to Pro- and Antievolution Messages?

As shown in Figure 4; exposure to both pro- and antievolution messages was relatively low regardless of beliefs; in most cases, exposure did not exceed "several times a year" (a score of 3 in Figure 4). Consistent with our expectations, evolutionists reported more exposure to proevolution than antievolution messages. They also had greater exposure to proevolution messages than most creationists. Most creationists reported roughly equal exposure to pro- and antievolution positions, perhaps reflecting exposure to academic treatments of evolution, as we discussed in the introduction.

Weak creationists are the exception. As their semistructured responses above indicate, these individuals give evolution an important role while wanting to maintain the primacy of a supreme being. Weak creationists are similar to evolutionists in their exposure to

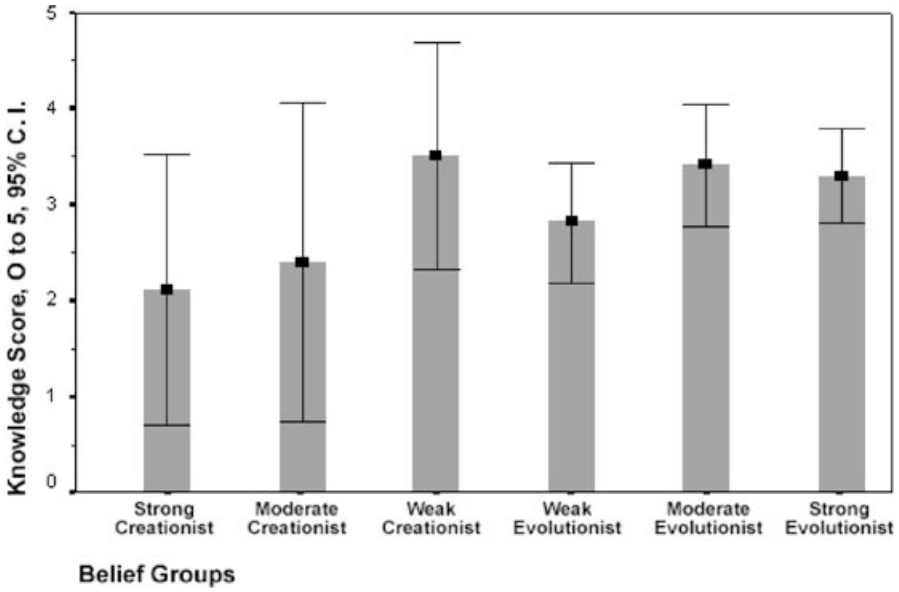
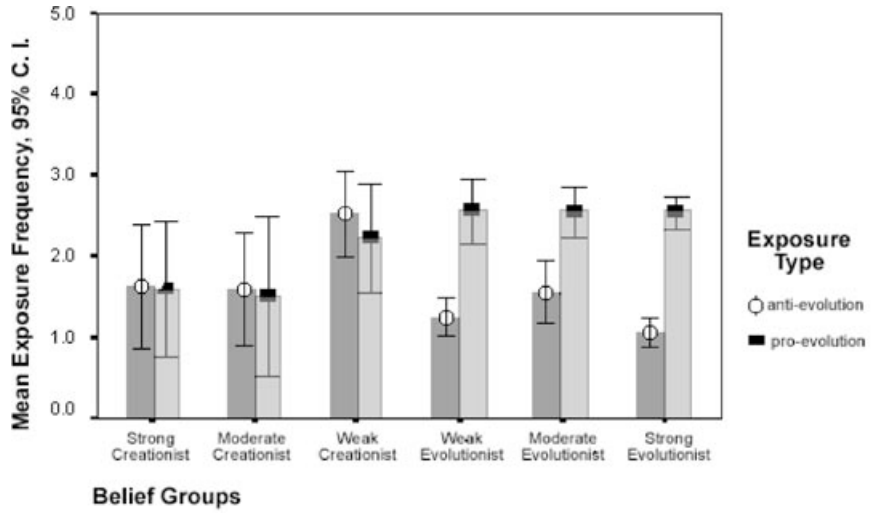


Figure 3. Exhibition of knowledge of evolutionary principles, by belief category. Higher scores indicate better performance on the knowledge measure.

proevolution messages while having greater exposure to antievolution messages than any other group. This may explain their ambivalence.

Finally, there is a weak correlation between knowledge of evolutionary concepts and message exposure. Controlling for belief, higher scores on the knowledge measure were associated with greater exposure to both pro- ($r = 0.27$, $p < 0.01$) and antievolution ($r = 0.20$, $p < 0.05$) messages. It will be interesting to see whether any causal relationship



Note: 0 = "Never," 1 = "Less than once a year," 2 = "Once a year," 3 = "Several times a year," 4 = "Once a month," and 5= "Once a week or more."

Figure 4. Exposure to positions supporting or conflicting with evolution, by belief group. Higher scores represent greater frequency of exposure.

can be identified in future studies. For example, does exposure to antievolution messages help people learn evolutionary concepts, or perhaps knowing about evolution causes people to seek out and remember antievolution messages.

Do Belief Groups Differ Regarding the Perceived Impact of Evolutionary Theory?

As described above, we addressed five areas of potential impact:

(a) Is it harder or easier to find purpose in life?
(b) Is it harder or easier to believe in a supreme being and a spiritual existence?
(c) Is it harder or easier to justify selfishness?
(d) Is it harder or easier to justify racial and ethnic discrimination?
(e) Is it harder or easier to think of people as determining their own fate?

First we consider those cases in which participants chose "0"; that is, how many saw *no* consequences of evolutionary theory? In all areas, evolutionists were more likely to assert that believing in evolutionary theory would have no social or personal impact (Table 2). Looking at those cases in which participants did perceive a social or personal impact, two things are particularly striking: the perceptions are overwhelmingly negative, and the perceptions are very similar across belief groups. We examined whether there were any significant differences between subgroups. The only significant difference was in the area of "race," for which weak creationists were more likely than strong evolutionists to see impact in terms of greater racism (omnibus $F(5, 111) = 2.67$, $p < 0.05$; Tukey HSD, mean difference 1.70, $p < 0.05$). Given the number of comparisons (six subgroups in five areas

TABLE 2
The Perceived Impact of Evolutionary Theory

	Perceived Impact		
		Of those seeing an impact . . .	
Area of Impact	No Impact (%)	Reduces (%)	Increases (%)
Sense of purpose			
Creationists	18	78	22
Evolutionists	31	75	25
Racism			
Creationists	15	28	72
Evolutionists	21	41	59
Self-determination			
Creationists	13	77	23
Evolutionists	21	74	26
Selfishness			
Creationists	26	17	83
Evolutionists	39	17	83
Spiritual beliefs			
Creationists	16	83	17
Evolutionists	20	83	17

In all cases, evolutionists were more likely than creationists to assert that there would be no impact. Those seeing an impact consistently see that impact as negative; all differences are significant at $p = 0.05$.

of impact), one significant difference at an α of 0.05 is expected by chance. Given the similarity, we collapsed across subgroups in Table 2. In each area, there is a significant direction to the perceived impact: an increase in selfishness and racial discrimination, and a decrease in sense of purpose, feelings of self-determination, and spiritual beliefs.

These findings were contrary to our expectations. We were not surprised that creationists would find undesirable outcomes for evolutionary theory, but we expected those who accepted evolutionary theory to see the acceptance of evolutionary theory as having positive consequences. Perhaps they believe these *are* positive outcomes, but only evolutionists expressing atheist beliefs would see a loss of spirituality as a positive outcome, and it is difficult to create a scenario by which evolutionists would see racism, selfishness, and a loss of purpose and self-determination as desirable.

An additional surprising finding is that, controlling for belief, partial correlations suggest that knowing more about evolution strengthens this perception of negative consequences. Both pro- and antievolution exposure were associated with the perception of greater selfishness (antievolution, $r = 0.27$, $p < 0.05$; proevolution, $r = 0.24$, $p < 0.05$) and less spirituality ($r = -0.31$, $p < 0.05$; $r = -0.16$, $p = 0.08$); exposure to negative messages was also associated with the perception of greater racism ($r = 0.21$, $p < 0.05$). Greater knowledge of evolutionary principles correlated with the perception of less purpose ($r = -0.25$, $p < 0.01$), greater racism ($r = 0.19$, $p < 0.05$), less self-determination ($r = -0.20$, $p < 0.05$), greater selfishness ($r = 0.19$, $p < 0.05$), and less spirituality ($r = -0.23$, $p < 0.05$). While we would hope that knowing more about evolution would lead to a richer understanding of complicated issues, these the results suggest that the more a person knows about evolution, the more negative they become.

Do Belief Groups Differ Regarding the Teaching of Evolutionary Theory?

Given that both evolutionists and creationists see the impact of evolutionary theory in negative terms, how they feel about teaching it? Initial analyses showed no significant differences between subgroups. We collapse across them in the reporting of Likert scale data, but retain the subgroups in the qualitative analysis of open-ended responses.

Figure 5 shows that participants generally reject any plan that marginalizes their beliefs. Evolutionists reject teaching creation without evolution; creationists reject teaching evolution without creation. Beyond this, however, participants showed little consensus. We turn to qualitative analysis to explore their ambivalence.

Regardless of belief, participants stress the idea that students should have the opportunity to formulate their own beliefs, and silencing either side is censorship. Less than 25% of participants advocated teaching creation alone ($n = 2$, both Strong Creationist) or evolution alone ($n = 27$; 4 Weak Evolutionist, 5 Moderate Evolutionist, 16 Strong Evolutionist). Those who did saw schools as gatekeepers, protecting students from inaccurate information:

> I do not believe that evolution is a correct theory and therefore should not be taught as fact. I know for myself that God created all life, and this is the knowledge that should be taught./ I believe in "creationism" and not evolution and feel only creationism should be taught./ In some ways, I feel that creationism should be taught in the church but in a society that is ideal (to me) it should be part of regular curriculum. (P14, Strong Creationist)

> Only scientific theory should be taught in schools not religious ideas./ School is not the place to learn about religious creation myths as facts. If one chooses, for whatever reason, a religion then they can believe whatever they want but they [one unreadable word] not impose their religion on others/ Different creation myths should be explored but not to replace evolution but to broach minds about dif. cultures. (P28, Weak Evolutionist)

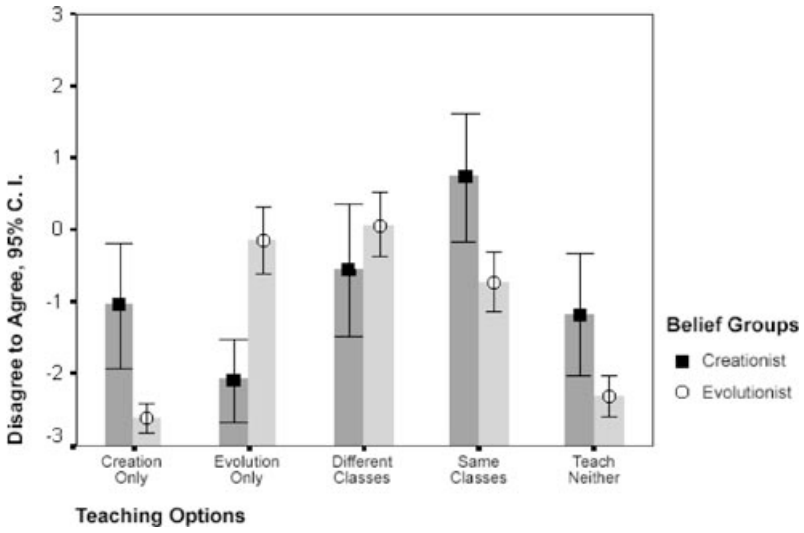


Figure 5. Alternatives for teaching creationism and evolution. Both creationist and evolutionists tend to reject options that would present only their opponents' position, but there is considerable variance.

But the majority of participants felt that both perspectives should be presented. Teaching evolution and creation side by side was advocated in every subgroup ($n = 33$; 4 Strong Creationist, 2 Moderate Creationist, 3 Weak Creationist, 8 Weak Evolutionist, 7 Moderate Evolutionist, 9 Strong Evolutionist):

> There would be a class where both sides of creationism and evolution are taught without any bias towards any. It would be up to the student to choose which one he/she believes is the truth./ I believe that everyone needs to make choices like this to define what kind of person they are. You can't just force one idea without showing an alternative solution. It is up to the student to decide for himself what he puts his/her faith in, science or religion. (P15, Strong Creationist)

> No one has the ultimate truth on Earth. Thus, it is critical to presents (sic) not only both sides of the coin, but also the entire rim around it./ There, we can find a spectrum of information that will guide us towards making a decision based on the facts presented to us. (P30, Weak Creationist)

> I would say that both of these need to be taught, because it is not 100% certain that evolution is the only way by which we could of evolved. Therefore both should be taught and it should be down to those who are learning to make their decision as to the most viable option./ My own opinion is that evolution is the best and most accurate explaination (sic) as to our existance (sic). However it is not for me or anybody else to say either is 100% correct, since we dont (sic) know for sure. Therefore it is down to that person to choose. (P73, Strong Evolutionist)

However, advocating and teaching them side by side does not guarantee equal time or coverage in the eyes of evolutionists:

> Creationism & evolution should both be presented in biology classes as possibilities for life development./ Both are theories, neither has all the answers./ More emphasis should be placed on evolution as scientific theory, but creationism should be mentioned in context of "some believe that, as an alternative to straight-out evolution, life was created by a supreme being . . . " (P37, Weak Evolutionist)

> It seems like it would be a very fascist way to go about things if teachers don't let students in on multiple opinions regarding a subject. Both ideas should be presented as fully as possible and the student's job is to decide his or her own belief./ I think that both sides of an argument should always be addressed in a classroom setting./ The problem is, how does one define creationism? From what standpoint does one regard it? Its (sic) hard to teach something that has no set definition and is not accompanied with any facts. Most creationism arguments, unfortunately, are founded solely upon someone's opinion. (P19, Moderate Evolutionist)

Others argue for presenting them different classes ($n = 43$; 2 Moderate Creationist, 3 Weak Creationist, 13 Weak Evolutionist, 10 Moderate Evolutionist, 15 Strong Evolutionist). Some creationists explicitly stated that creationism should be taught as a science, but not all.

> This statement means that I believe that both Creationism and Evolution should be taught in school. They do not, however need to be taught in the same classroom . . . This is not to say that Creationism should not be taught in the same type of class. They should both be taught in scientifically based classes. (P27, Weak Creationist)

> You should teach both creationism and evolution in school because you can't present a biased view. (should present alternative views). However, you could teach evolution in a science class + maybe discuss creationism in an english class. (P61, Moderate Creationist)

No evolutionist explicitly argues for creationism as a science course. Some pointed to differences in the type of knowledge each represents. Evolution was associated with greater amounts of "physical evidence," and with "science," rather than "history," "religion," or "myth":

> Creationism should be taught, actually "presented" in school so that kids can choose if they like it or not. It could be presented in Religion class, if available, which is not mandatory. Evolution should be taught, no: "presented" in the same way, but in science class. Science class should also not be taught as the "be-all end-all" of classes. (P24, Weak Evolutionist)

> Creationism and evolution should both be brought up as intellectual positions—though neither should be privileged more than other as the absolute truth. However, the relevant data for each argument should be taught, and as more physical data in support of evolution exists, the course on evolution, I imagine, would be lengthier and in greater depth. Neither of the views should be imposed upon the student./ Teachers, if asked by their students, should be free to discuss their personal view. (P22, Moderate Evolutionist)

Given this ambivalence, if teaching evolution has social or personal consequences, will participants take these into consideration? We asked participants to imagine teaching evolution as having certain consequences (specifically, promoting or combating racism), and then to consider whether they would advocate teaching evolution under these circumstances. (Recall that the majority believed that evolutionist beliefs make people vulnerable to racist views.)

Positive scores indicate that the outcome is a reason *to teach* evolution; negative scores indicate that the outcome is a reason *not to teach* evolution. Participants could assert that outcome is irrelevant by circling "0." Evolutionists saw positive outcomes as a reason for teaching evolution, but moved toward zero when faced with negative outcomes, asserting that outcome should be irrelevant (Figure 6). Weak creationists show the same pattern as evolutionists. Moderate and strong creationists hovered around zero; neither positive nor

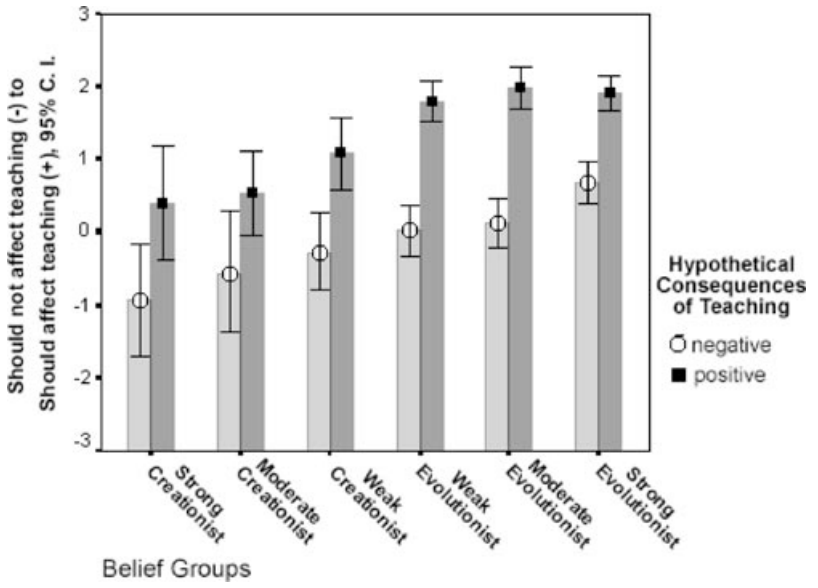


Figure 6. Should the consequences of teaching evolution affect our decision to teach it? Positive scores indicate participants' belief that outcomes should be taken into consideration; negative scores indicate a belief that they should not.

negative outcomes significantly influenced their opinion. We found no correlations with exposure to or knowledge of evolution.

Again, the qualitative data reveals conflict. Few participants, creationist or evolutionist, initially claimed that they wanted to exclude evolution from the curriculum because of the outcome. However, as they elaborated their view, it became clear that they came to this position for very different reasons. Some strong and moderate creationists thought outcome should not be a factor because evolution should not be taught under *any* circumstances.

> So because evolution makes it easier for some students to believe humans are all related doesn't mean that evolution is a good theory. It may still confuse many God believing young students./ All men come from Adam + Eve—so we are all related. If the bible and it's truths are propagated it would also be easier for everyone so we should not base our stand of teaching evolution in school on this fact. (P3, Moderate Creationist)

> I argue that evolution should not be taught because it tells the students what scientist (sic) think is true. What if students had their own beliefs?/ see, I believe that there was once a life-form that made (us) the life-forms today. Now, when you teach about evolution and present a different perspective, it is confusing and messes the whole picture up./ Evolution may and probably will be taught, but I won't teach or talk about it. (P51, Strong Creationists)

Weak and moderate evolutionist participants initially dismissed consequences, but then found ways to slip them in. For example, a positive outcome could be treated as a "bonus," while negative outcomes require "antidotes":

> People need to just be told conclusive truths—after that, it's up to them to shape their actions according to their own personal, moral or philosophical beliefs. (But it would be a bonus if teaching evolution helped people to accept one another easier!) (P100, Strong Evolutionist)

> I think then evolution is being taught wrong [if it promotes racism]. Evolution isn't about the "best qualities."/ Evolution is a process + we are for the most part historical accidents

> that came to be by chance. I think there needs to be a focus on environment. (P26, Weak Evolutionist)

> Teaching evolution is purely scientific. Anything else deals with the person's personality. Now we go to a moral issue. Teaching evolution should not be blocked because of moral objections./ Maybe along with evolution you need to reinforce the notion that people should all be treated equally regardless of what evolution says about people. (P12, Moderate Evolutionist)

PUTTING IT ALL TOGETHER: CONCLUDING PORTRAITS OF EVOLUTIONISTS AND CREATIONISTS

While some evolutionists in our study subscribe to the orthodox scientific view of evolution, many reserve a place for a supreme being; neither do creationist participants consistently advocate strict positions. The forms of reconciliation seen are similar to those seen in other studies, with participants reserving spheres of influence for both evolution and divine intervention; unsurprisingly, the greater share goes to evolution in the evolutionist scheme of things, and to the divine in the creationists' accounts. Across both creationists and evolutionists, exposure to evolutionary theory is fairly low, but while the frequency of proevolution messages tends to outweigh the frequency of antievolution messages for evolutionists, creationists show roughly similar levels of exposure to both sorts. While some holding extreme positions on both sides feel the need to silence their opposition in schools, many creationists and evolutionists are uncomfortable with the idea of teaching only one theory or the other, and value exposure to a variety of positions (Schindel, 1999).

Thus, while they may differ on the relative importance of biological mechanism and divine will, there is some common ground among evolutionists and creationists. The most striking group are the weak creationists, who give the divine the upper hand in explaining the origins and development of life on earth, but whose exposure to evolution is most similar to that of evolutionists. They show greater conflict than any other group, and more studies focusing on these individuals may prove valuable.

Across all groups, however, the most surprising commonality is their perceptions regarding the impact of evolutionary theory on the social and personal aspects of life. While substantial numbers assert that accepting evolutionary theory would have no impact on other aspects of life, those who do see some impact tend to put a negative "spin" on evolutionary theory, seeing it as decreasing spirituality, increasing selfishness and racism, and interfering with one's sense of purpose and self-determination.

It is often the case that, as individuals learn more about a subject, their perspectives become richer, more complex, and more balanced. In this case, however, even when controlling for belief, greater exposure to information about evolution, whether pro- or antievolution, is associated with greater negativity regarding the consequences of believing in evolution. Likewise, greater knowledge of the principles and mechanisms of evolution are associated with greater negativity. Even if you accept evolutionary theory, learning more is associated with a bleaker view.

PEDAGOGICAL IMPLICATIONS

Although we cannot yet explain the origin of this negative perspective, we do have some leads, as suggested in the introduction. Clearly, the implications of evolutionary science for religious and spiritual beliefs has been with us since the theory was first introduced. Furthermore, a review of the popular literature shows that stories about evolutionary theory that have a sensational element may get greater play than the science pages. The sensational

aspects are usually violence or disease. Stories about male dolphins kidnapping and raping females are picked up by the wire services, as are stories about stepparents being more likely to physically harm stepchildren than biological children (having no genetic investment in the stepchildren). Reports about genetic markers for diseases highlight the way that our genes may bring us to a particular end. In some cases, these stories relate drastic attempts to beat genetic determinism, such as women who choose radical bilateral mastectomy over the possibility of breast cancer, or choosing to abort a fetus that shows genetic anomalies. Likewise, the evolution of fiction is often ruthless, violent, and superhuman, as portrayed in films such as *Mimic* and *Evolution*, and television shows such as *X-Files* and *Prey*.

Some of these scenarios, fictional and nonfictional, are viable and realistic, but none of these possibilities are inescapable or certain. What makes these issues both difficult and important is that there are few clear-cut answers. Evolutionary theory has been used to promote and to combat racism. It can be cast as promoting self-determination by taking control from a supreme being and putting it in our hands, or as stealing control from us and putting it in our past. Evolution may obviate the need for a supreme being, or be seen as so elegant as to have something of the divine about it. What is important is not that people find evolution utterly comforting or discomforting, but that the complexities are recognized and dealt with. Our participants do not seem to appreciate this balancing act, rather seeing the messages as strongly negative.

It is possible that this is merely an artifact. Perhaps our instrument is simply insensitive to the differences between evolutionists and creationists. However, we do see differences between belief groups. They differ in respect of message exposure, and they reject the marginalization of their beliefs in the classroom. Where there is ambivalence, the qualitative data supports this interpretation of ambivalence. Thus, if the instrument is failing, it is only in the area of impact. Moreover, the questions about impact explicitly address both positive and negative outcomes. It is not simply that the negative view was the only one presented and sounded likely in the absence of any alternative; participants not only resonated to a negative spin, but also rejected a more positive interpretation.

Additional support for these results is provided by preliminary findings reported in Griffith and Brem (2001). In interviews and focus groups, we asked inservice Biology teachers how the personal and social impact of evolution affected their teaching. Their responses were strikingly similar to those of the undergraduates. Like some students, they saw no connection between evolutionary principles and these issues; however, those who did see a connection saw it as having considerable potential for negative outcome.

Returning to constructs we introduced at the beginning of this paper, we need to understand why the conceptual ecology of college students (and possibly high school teachers) is generating an almost unilaterally negative perspective of evolution. Our concern is that if the complexity of evolutionary theory and its consequences is not appreciated by students, it may impair their ability to make informed, independent decisions, and resist dogmatic pressure from all sides. What options does this leave a Biology teacher?

In Griffith and Brem (2001), we describe three options that inservice teachers use; there may certainly be more. "Scientist" teachers simply draw a line between teaching evolutionary principles, and the application of those principles to social and personal issues. Principles are in-bounds, applications are out. "Selective" teachers choose to present only those aspects of evolution that they feel would not create conflict in their classroom or their community; human evolution is generally excluded, and the structure of the class becomes highly constrained, so that discussion cannot break out. The third group, "Conflicted" teachers, who sometimes harbor their own doubts about teaching evolution, actively attempt to forestall conflict by talking to students one-on-one, or by spending a day convincing the students that they won't try to change their beliefs. Working from an ecological perspective,

we can see each of these as a way of adapting to multiple constraints, including content and academic requirements, administrative goals of balancing academic performance with community harmony, parental and student concerns, personal beliefs and goals, and legal considerations.

The notion of an ecology of thought and society, navigated through experience and adapting the experiences of others, is wholly consistent with a philosophy of democratic education (Dewey, 1916/1994).

What is the best solution? In a healthy ecological system, the input and output of each organism is balanced by the needs and production of other organisms. It is, effectively, an organic solution to a set of simultaneous equations, or a multivariate regression model. Every ecosystem is different; substituting one organism for another changes the opportunities and competition presented to every other organism. Likewise, a slight change in academic standards, administrative goals, community demographics, or science education shapes constrains the development of the others.

Finding a solution requires adaptation and environmental responsiveness. Items from popular culture sources might be used to engage in discussions about the determinants and biological validity of racial and ethnic classifications, the degree of determinism that can be associated with a particular gene, or the role of altruism in evolution. Arriving at a single class perspective is unlikely, and even undesirable, both because the science is too rich and complex to support just one account, and because personal commitments and beliefs have a valid role in issues of social and personal import. Open-ended discussions about why multiple perspectives may be supported, and how social and political agenda may shape science should be encouraged. Still, community and administrative support will also be needed, standardized testing requirements will need to be accommodated. These discussions will be inherently part of a larger landscape, and each successful ecosystem may be somewhat different than the next. Because of this, we are currently focusing on ways to collect teachers' experiences, positive or negative, in order to compile a database that would allow other teachers to search for situations similar to their own, and then adapt prior solutions to their circumstances.

Communication of, reflection upon and respect for multiple perspectives has been long thought of as our best hope for truly effective and equitable education. Understanding the influence of science on individuals and society seems our best chance for using science in their service.

APPENDIX A: SAMPLE ITEMS

I. Belief statements were presented on a scale ranging from −3 (*Strongly Disagree*) to +3 (*Strongly Agree*):

   1. All forms of life evolved from earlier forms, and no supreme being or beings has ever played any role in the evolution of life on Earth.
   2. All forms of life evolved from earlier forms, but evolution was first set in motion by a supreme being or beings and then left running without any additional intervention by the supreme being or beings.
   3. All forms of life evolved from earlier forms, but a supreme being or beings intervenes from time to time to shape or override the evolutionary process.
   4. Some forms of life evolved from earlier forms, but human beings were created in more or less their present form by a supreme being or beings.
   5. All forms of life were first brought into being in more or less their present form by a supreme being or beings.

II. Questions regarding exposure to sources supporting and conflicting with evolution were presented on this scale:

Never	Less Than Once a Year	Once a Year	Several Times a Year	Once a Month	Once a Week or More

1. I discuss evolution with clergy who tend to *accept* evolution.
2. I discuss evolution with clergy who tend to *reject* evolution.
3. I discuss evolution with family members who tend to *accept* evolution.
4. I discuss evolution with family members who tend to *reject* evolution.

III. Impact questions were presented on a scale ranging from −3 (*much harder*) to +3 (*much easier*):

Purpose

1. If everyone accepted the theory of evolution as true beyond any doubt, do you think that people would find it harder or easier to know how they should live their lives?
2. If everyone accepted the theory of evolution as true beyond any doubt, do you think that people would find it harder or easier to lose their focus on what is important in life?

Spirituality

3. If everyone accepted the theory of evolution as true beyond any doubt, do you think that people would find it harder or easier to believe that there is an afterlife?
4. If everyone accepted the theory of evolution as true beyond any doubt, do you think that people would find it harder or easier to believe that there is a supreme being or beings?

Racism

5. If everyone accepted the theory of evolution as true beyond any doubt, do you think that people would find it harder or easier to consider some races and ethnic groups "less advanced" than others?
6. If everyone accepted the theory of evolution as true beyond any doubt, do you think that people would find it harder or easier to believe that all races of human beings are related to one another?

Self-determination

7. If everyone accepted the theory of evolution as true beyond any doubt, do you think that people would find it harder or easier to believe that great athletes, artists and thinkers were born with talents that the rest of us don't have?
8. If everyone accepted the theory of evolution as true beyond any doubt, do you think that people would find it harder or easier to believe that with hard work one can overcome most physical and intellectual obstacles?

Selfishness

9. If everyone accepted the theory of evolution as true beyond any doubt, do you think that people would find it harder or easier to rationalize becoming obsessed with getting ahead?

10. If everyone accepted the theory of evolution as true beyond any doubt, do you think that people would find it harder or easier to believe that human beings are always looking out for their own best interests?

IV. Statements on teaching were presented on a scale ranging from −3 (*Strongly Disagree*) to +3 (*Strongly Agree*)

1. Creationism and evolution should always be taught side by side in the same class in schools.
2. Only creationism should be taught in schools, not evolution.
3. Only evolution should be taught in schools, not creationism.
4. Creationism and evolution should both be taught in school, but need not be taught in the same class.
5. Neither creationism nor evolution should be taught in school.

V. Questions on hypothetical outcomes were presented on a scale ranging from −3 (*Definitely should not be taught*) to +3 (*Definitely should be taught*):

1. If it were shown conclusively that teaching evolution in schools makes it *easier* for students to believe that all races of human beings are related to one another, then evolution . . .
2. If it were shown conclusively that teaching evolution in schools makes it *harder* for students to believe that there are only superficial differences between the human races, then evolution . . .

VI. Sample procedure from semistructured written questions:

[The same format was used for all questions. Participants were asked to choose one statement. They were told "None of these statements may capture your opinion perfectly, but we would like you to mark the one that most closely matches your opinion. We will give you a chance to explain how this view is similar to and different from your own."]

——— Creationism and evolution should always be taught side by side in the same class in schools.
——— Only creationism should be taught in schools, not evolution.
——— Only evolution should be taught in schools, not creationism.
——— Creationism and evolution should both be taught in school, but need not be taught in the same class.
——— Neither creationism nor evolution should be taught in school.

Imagine that a friend asked you what the statement you chose means to you. How would you paraphrase this statement for them? Please give as much detail as you think would be necessary to fully explain the statement to your friend.

If you were explaining to your friend how the statement you chose matches with your own opinion, what would you say? Please give as much detail as you think would be necessary to fully explain how your opinion is similar to the statement you chose.

If you were explaining to your friend how the statement you chose differs from your own opinion, what would you say? Please give as much detail as you think would be necessary to fully explain how your opinion is different from the statement you chose.

APPENDIX B: EXCERPTS FROM PARTICIPANTS' WRITTEN RESPONSES

Group	Description of Beliefs
Strong Creationist	I believe that God formed us according to his plan for the world. He gave us a gentle make-up that has mostly stayed the same. That is, it stayed within the bounds of the genes that were found in Adam and Eve. Of course some mutations have entered the gene pool, but as one can see, they are degenerative—they result in deformity and disease, not improvement (because the design is so complicated that a random mutation would have to be bad by purely statistical reasoning.)
	I (sic) means that I believe in God, the supreme being, made man and animals, and everything on this Earth in 7 days.
Moderate Creationist	I think that everyone but humans were evolved from earlier forms. Most can be traced back the prehistoric times. Not exactly but have some type of characteristics. As far as humans I think that they advanced mentally maybe even physically but their form and features have not changed because all humans have the same characteristics. Unlike animals some fly, some crawl, some [one unreadable word] they can all mix and change. Human only change there (sic) colors.
	I believe in God, and human beings were created with a purpose to express God in His life + nature, but not in the Godhead and to be one with Him and Him one with us so this expression is enlarged. Thus, humans have not changed. Yet there is conclusive evidence supporting the evolution of certain species so some many have changed over time.
Weakly Creationist	A supreme being (God, beings from another dimension, etc) set off the beginning of life by putting DNA in inantimate (sic) objects. From there, life evolved to the present. However, they/He looks over us and takes care of our souls, but our physical earth is a result of evolution./ I believe in evolution & a supreme being, but I think the watches mostly. He may have intervened here & there, like giving humans souls, but beyond that, evolution & life is what they teach in Bio 1A & 1B. I believe that there exists a supreme being. And that it created all the forms of life that exists, but not necessarily in their present form. Through time, as nature sees fit and necessary, the forms of life evolves into different forms in order to survive. But the supreme being does intervene whenever it's necessary to shape the evolutionary process. In addition, human beings were created in their present form, more or less. So, I believe that the supreme being created human beings along with all the form (sic) of life, and then the evolutionary process took place.
Weakly Evolutionist	I believe there is are supreme beings, but they can't control everything all the time. The evidence and arguments for evolution are convincing, but some aspects are so incredible, like maybe a beneficial mutation of one gene, that the odds of it happening are miniscule. I think at those times something (one) tweaks the process a little. I also think the beings started it all./

Continued

(Continued)

Group	Description of Beliefs
	The process of evolution does take place, but sometimes something happens that is influenced by an outer source./ I would add in the idea that the whole thing was first set in motion by a supreme being.
	Evolution is the supreme beings master plan. All existence must abide by evolutionary lava in order to survive. God's design will allow life to adapt to whatever situation./ I believe in evolution and that all life has the same origin. I also believe that God created life and in divine intervention./ I don't think that God overrides the evolutionary process, rather I think he uses it to advance life.
Moderate Evolutionist	There is a supreme being, who probably is not like human beings at all and is not (in any significant way) like what religion teaches us, who "set up" evolution and has allowed it to progress without much intervention. I'm not sure if there would be a significant reason why there should be intervention so, there probably isn't any interventions by that being. And, the being could just be like a math or physics equation so we shouldn't think of it as being human or compassionate toward our needs./ The supreme being may or may not have intervention. I lean toward it not having intervention because I have no reason to believe that the supreme being is compassionate to me or is malevolent to me.
	All living things that we see today, plants included, evolved from single-celled organisms. These organisms began to live as a serendipitous interaction of energy and chemicals on primordial earth, formed in the big bang. The rub is, what was there before the big bang? That's why I think there must have been some divine intervention.
Strong Evolutionist	There is no God or Jesus: we are what we are b/c we evolved to do so. Genetic differences evolved to make us humans from what we originally were, microbacteria.
	We evolved from amoebas, and we're not a product of God [no further detail needed].
	There is no proof of God: if there is a God, he would have shown himself by now, or at least in actions. However, there is proof of evolution: look at Darwin's finches + the fossil record. Clearly, then, we evolved from microbacteria. I think the main point is that humans are not "ideal" or "perfect," or "designed." We have limitations & inherent faults that can be understood in an evolutionary context. There is no drive to [one unreadable word] and this would only make "evolution" replace "God" in our thought. There is no "selector."/ The statement [#1] is similar in that there is no role of any conscious entity in deciding on some mountain top how humans will be . . . The words evolved -> seems to [one unreadable word] that things are getting "better," which I don't believe is true. Things have always been "better" for the environment in which life had to exist.

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