The Science-Faith Debate in Higher Education

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Abstract

A voluntary survey regarding beliefs on evolution, and creation and ethics was developed and administered on-line from June through July 2006 to over 100 students, faculty, and staff at a mid-sized public university in the Midwestern United States. The survey consisted of 33 questions to measure participant agreement with core principles of evolutionary theory, 5 questions designed to place participant views along a creationism-evolution continuum, 21 questions to measure respondent beliefs on ethics, and a concluding question asking for comments. A KR-20 value of 0.896 for the first 33 questions indicated high reliability of the evolution portion of the survey, but the KR-20 of 0.510 for the last 21 questions indicated lower reliability for the ethics portion. The hypothesis tested in this study was that teleological ethical views would correlate positively with evolutionist views. An evolution score and a teleological ethics score were calculated from each participant's responses to the first 33 questions and the last 21 questions, respectively. To generate evolution scores, a response to each of the 33 evolution questions was assigned a "1" if the response indicated agreement with evolution and a "0" if the response indicated agreement with creationism. The evolution score for each participant was the sum of the scores across all 33 questions. Likewise, to generate the teleological ethics scores, a response to each of the 21 ethics questions was assigned a "1" if the response indicated agreement with teleological ethics and a "0" if the response indicated agreement with deontological ethics. The teleological ethics score for each participant was the sum of the scores across the 21 ethics questions. The mean evolution score (n = 123 participants) of 26.10, responses to the 5 creationism-evolution continuum questions, and comments solicited at the end of the survey indicated that participant views were more evolutionist than creationist, but participants held a diversity of views, and seemed unsure of some evidence supporting evolutionary theory, and of the nature of scientific theory itself. The mean teleological score (n = 123participants) of 10.08 indicated that participants were almost equally split between deontological and teleological ethics views. A weak positive correlation between evolutionary views and teleological ethics views (r = 0.258, p < 0.05) supported the hypothesis of this study. At the same time, however, answers to some ethics questions seemed contradictory, reflecting unclear questions, respondent uncertainty with the topic, the inherent difficulty of ethics itself, or a combination of these factors. A question arising from these results is whether ethical values might shift as participants learn more about evolution and the nature of science.

Introduction

Although the arena of the creation-evolution controversy has been primarily in United States high schools, signs of the controversy are starting to appear in colleges and universities in the country. For example, students have formed "Intelligent Design" clubs at several universities (Anderson 2005). Most recently, an evangelical Christian high school has sued the University of California over its refusal to certify for admittance biology courses taught using the Bible as an authority over scientific theory (Associated Press 2006). Although not at the center of the controversy, higher education arguably should be a leader in the creation-evolution debate,

because it is colleges and universities who train teachers, and whose scientists are at the forefront of research in the biosciences.

The scientific community endorses evolutionary theory and advocates its teaching, as reflected in The *National Science Education Standards* (National Research Council 1996) and *Benchmarks for Science Literacy* (American Association for the Advancement of Science 1993). The National Science Education Standards lists five "Unifying Concepts and Processes" that are important to all of science. One of these is "Evolution and Equilibrium," stating, "Evolution is a series of changes, some gradual and some sporadic, that accounts for the present form and function of objects, organisms, and natural and designed systems." Other related statements presented in these standards are, "Species evolve over time," "The great diversity of organisms is the result of more than 3.5 billion years of evolution," and "The millions of different species of plants, animals, and microorganisms that live on earth today are related by common descent from common ancestors (National Research Council 1996)."

These statements are in stark contrast to views of young-earth creationists, who base their beliefs on a literal interpretation of the six-day creation and genealogies presented in the Bible (Dalrymple 2004). While many people in the general public may not be strict evolutionists or young-earth creationists, results of several surveys conducted from 1982 to 2004, in which 44-55% of Americans agreed that God created human beings in their present form, suggest that a substantial percentage hold creationist views (New York Times/CBS 2004, Verhey 2005).

The present study was conducted to determine views on evolution and creationism from a cross section of a mid-sized Midwestern university population, and to relate views on evolution and creationism to views on ethics. Assuming that (1) belief in the existence of absolute moral principles equates to a belief in deontological ethics and (2) belief that moral principles are

relative equates to a belief in teleological ethics, we hypothesized that creationism views would correlate with deontological ethics, and evolutionist views would correlate with teleological ethics.

Methods

The institution- An optional survey was made available on-line to faculty, staff and students of mid-sized public university (enrollment approximately 7,500) in the Midwestern United States. The school is an upper-division university (offering the third and fourth years of the baccalaureate degree and the master's degree); thus, all of the students have transferred from other schools and are distributed roughly equally between the undergraduate and graduate programs. The university contains four colleges (Arts and Sciences, Business, Education, and Health Professions) and a "Board of Governors" program that awards college credit for appropriate life experience. The average student is 34 years of age, and 71% of the students are female. The campus population is very diverse, with 38% of students of minority ethnic groups.

<u>The survey</u>- The survey was developed and administered using SurveyMonkeyTM, and was made available to the university community during June and July 2006. Participants were recruited using the university's e-mail system, through campus-wide posters, and by word-of-mouth. All members of the university community were encouraged to take the survey.

The survey consisted of 59 dichotomous questions (each question asked the respondent to agree or disagree with a statement) that can be grouped into three major sections. The first section of 33 questions measured respondents' conceptions regarding evolution vs. creationism. Questions indicating agreement with evolution were based on statements from *Benchmarks for*

Science Literacy (American Association for the Advancement of Science 1993) and National Science Education Standards (National Research Council 1996). The second section of five questions was designed to place respondent views on a creation-evolution continuum (Nelson 1986, Verhey 2005). The last section of 21 questions was designed to measure whether respondents believed in the existence of absolute moral principles (e.g., deontological ethics), or believed that moral principles are developed by one's society and are thus relative (e.g., teleological ethics). Questions on ethics were primarily adapted from The Ethical Chemist (Kovac 2004) and statements from Evolution in Perspective (Bybee and Gerking 2004). The survey also included an introductory section asking for demographic information, and a concluding section asking for comments.

Analysis of quantitative data- Number of respondents answering at least some of the 59 questions was 143; of these, 123 answered at least 40 questions, and 87 respondents completed all questions. We calculated a KR-20 value for the first 33 questions (i.e., evolution vs. creationism questions) and for the last 21 questions (i.e., ethics questions; Crocker and Algina 1986), using data from 123 respondents.

Responses to the first 33 questions were analyzed in two ways. The first analysis was performed on data from the 123 respondents completing at least 40 of the 59 total questions. For each respondent, a "1" was arbitrarily assigned to each response to a question indicating agreement with evolution, and a "0" was assigned to each response indicating agreement with creationism. An "evolution score" was calculated for each respondent by summing scores for all responses, and a mean evolution score was calculated for all respondents. Differences in mean evolution scores among faculty, staff and students were analyzed using an analysis of variance

(Two respondents did not identify themselves as faculty, staff or students, so the ANOVA was performed on data from 121 respondents.).

The second analysis was performed to characterize responses across all respondents to 16 individually selected questions; all responses for each selected question were analyzed (sample size ranged from 112 to 143 among the 16 questions). The questions selected for the analysis can be described using the following categories: (1) statements on the nature of natural selection and evolution (3 questions), (2) statements on origin of life and supporting evidence (8 questions), (3) statements on common ancestry and supporting evidence (3 questions) and (4) opinions on evolutionary theory (2 questions). For each of the 16 questions, a chi-square test with Bonferroni correction (Holm 1979) was used to test the null hypothesis that number of respondents who agreed with the statement equaled the number of respondents who disagreed with the statement.

For each of the five questions designed to place respondent views on a creation-evolution continuum, again a chi-square test with Bonferroni correction was used to test the null hypothesis that number of respondents who agreed with the statement equaled the number of respondents who disagreed with the statement.

An analysis of the last 21 questions was performed on data from the 123 respondents completing at least 40 of the 59 total questions. For each respondent, a "1" was arbitrarily assigned to each response to a question indicating teleological beliefs, and a "0" was assigned to each response indicating deontological beliefs. A "teleological ethics score" was calculated for each respondent by summing scores for all responses, and evolution scores were correlated with teleological ethics scores.

Analysis of qualitative data- The final question on the survey asked, "Please use the space below to offer us any comments about your beliefs on evolution, creation, and ethics. You may leave this section blank if you wish." The comments were unitized and categorized according to the method of Lincoln and Guba (1985), giving a total of 74 pieces of data.

Results and Discussion

Quantitative data- Of the 123 respondents completing at least 40 survey questions; 47 were faculty, 50 were staff, and 24 were students and 2 were unknown. The mean evolution score calculated from the first 33 questions (26.10 compared to a maximum possible mean of 33; Table 1) suggests that respondent views were more evolutionist than creationist. Mean evolution scores did not differ among faculty, staff and students (ANOVA test, $F_{2,118}$ =1.20, p=.304). The KR-20 score for these questions (0.896; Table 1) indicated high reliability for this portion of the survey.

Analysis of 16 selected questions from this portion of the survey also reflected views more evolutionist than creationist, but suggested that some respondents were unsure both of evidence supporting evolutionary theory, and of the nature of scientific theory itself (Table 2). Most respondents agreed with general statements on the nature of natural selection and evolution, and with statements on common ancestry of species and supporting evidence. Respondents collectively seemed less sure, however, of evidence supporting the geological age of the earth, and when and how life originated. Regarding opinions on evolutionary theory itself, most respondents agreed with the following statement:

Biological and geological evolution is a scientific theory that is supported by a large body of factual evidence and has withstood repeated tests. Like any

scientific theory, it may be disproven, but it currently is the best scientific framework for unifying and explaining patterns and processes in the living world.

At the same time, however, respondents were almost equally split between agreeing and disagreeing with this statement:

Because biological and geological evolution is only a theory, it should be viewed with skepticism and may be replaced any day by another better explanation of how species originated.

Responses to the five statements designed to place respondent views on a creation-evolution continuum also indicated evolutionist views of respondents. The statements, each describing an attitude toward evolution and creationism, were ranked in order from highly nonrationalist attitudes (e.g., Christian Literalist) to rationalist attitudes (e.g., Atheistic Evolutionist; Nelson 1986, Verhey 2005, Table 3). The statement describing the Nontheistic Evolutionist attitude drew most agreement from respondents (85% agreeing), and the statement describing the Christian Literalist attitude drew least agreement (17% agreeing). Statements describing Progressive Creationist/Intelligent Design, Theistic Evolutionist and Atheistic evolutionist attitudes had 30%, 24% and 33% agreement, respectively (Table 3). Because some respondents agreed with more than one statement, the sum of percent agreement across all five statements is greater than 100%. This irregularity probably occurred because the survey did not allow respondents to return to prior questions to change their response.

The mean teleological ethics score calculated from the last 21 questions (10.08 compared to a maximum possible mean of 21; Table 1) suggests that the respondents were almost equally split between deontological and teleological ethics views. The KR-20 score for these questions (0.510; Table 1) indicated relatively low reliability for this portion of the survey. Reliability

could probably be improved by rejecting questions with low discrimination. In addition, participants' comments may be helpful in rewording some of the questions for greater clarity.

A small but statistically significant correlation was demonstrated between teleological ethics scores and evolution scores (r = 0.258, p < .05), with 6.6% of the variance in the ethics scores shared with the variance in evolution scores. Although the correlation was relatively weak, the hypothesis that belief in evolution would correlate with adherence to teleological ethics was supported for this population of respondents.

According to responses to some ethics questions, most participants agreed that humans should abide by some form of absolute moral principles that are independent of the society in which they live. For example, the greatest agreement with any statement on ethics (97%) was obtained for the statement, "Some behavior is ethical despite the fact that it makes many people unhappy," and the next greatest agreement (96%) was obtained for the statement, "Ethical theories should advocate concern for justice." Eighty-five percent of participants agreed with the statement, "There are times in which ethical behavior must contradict the values of society."

At the same time, many participants apparently believe that societal norms are a legitimate source of some ethical values. For example, 91.1% of participants agreed with the statement, "A person's ethical actions should cause an increase in universal good," 83.6% of respondents agreed with the statement, "Ethical codes of conduct are dependent upon the society that produces them," and only 31.9% of participants agreed with the statement, "Any system of ethics should be universally valid." In addition, lack of consensus was apparent among other responses. For example, 44% agreed with the statement, "It should be possible to write universal ethical codes of conduct," but 50% agreed with the statement, "The virtue of any behavior is determined by the value of its consequences."

These apparent contradictions in responses suggest that many participants either have not thought closely about how their own ethical values are obtained or that the participants wanted to support intermediate positions not readily evaluated using dichotomous responses. Either scenario also could explain the relatively low KR-20 value for this section of the survey.

Despite the apparent contradictions in some of the responses, most participants agreed that adoption of a personal set of ethical values was a matter of more than casual concern. Only 19.5% of participants agreed with the statement, "An increase in personal worth or happiness is an indicator of morality," and only 26.4% of those surveyed agreed with the statement, "A person's ethical values should be developed from personal sentiment."

Qualitative data- The final question on the survey asked, "Please use the space below to offer us any comments about your beliefs on evolution, creation, and ethics. You may leave this section blank if you wish." Seven major categories emerged from this analysis of responses to this question: (1) Compliments about the survey, (2) Comments about frustrations with the survey, (3) Comments on ethics, (4) Pro-creationism comments, (5) Pro-evolution comments, (6) Intermediate position comments and (7) Statements about ontology (Table 4).

The first category, "Compliments about the survey," indicates that the survey was very popular with a segment of the university community. Comments such as, "Loved taking the survey," and, "I would love to learn your results and interpretations so I can better understand. Will you share them with the university community?" were not uncommon (Table 4). Several participants took the opportunity to say that the questions addressed were very important.

The second category, "Comments about frustrations with the survey," consisted mostly of concerns that participants were forced to either agree or disagree with statements that they

perceived as requiring some type of explanation. An excellent example is, "Some of the questions seemed to suppose binary responses were appropriate when they seemed to me not to be," and another is, "I have not answered a number of the questions because a number of them pose, what are in my opinion, false dichotomies. I've tried not to be too picky about this and have grudgingly answered some but others simply cannot, in my humble opinion be boiled down the choice you provide." Although most of the comments focused on frustrations regarding the section on ethics, some participants also stated that they either did not know or had forgotten material on evolution (Table 4).

Several participants offered remarks in the third category, "Comments on ethics;" these comments were very diverse (Table 4). Some participants held very strong views in the fourth category, "Pro-creationism comments," although these were in the minority. A greater number of participants held strong opinions in the fifth category, "Pro-evolution comments." Statements that may have been intended to mollify creationists, such as, "None of us were here during creation so, we don't know. Science can help us find these answers," were mixed with more inflammatory statements such as, "Science rules, religion does not!" Some participants expressed particular concerns about teaching creationism as an alternative to evolution in public school science classes (Table 4).

Some extremely thoughtful responses were given in the sixth category, "Intermediate position." An example is, "There has been and always will be a huge line between science and religion. I will recognize both as valid theories but when it comes down to it, there has to be some supreme being who created science." The last category, "Statements about ontology," contains some remarks about the differences between ontology and belief (Table 4).

As a whole, the comments reflected a diversity of opinion among the university community that mirrors that evidenced by the quantitative data. The qualitative data suggest that although a majority of the participants agree with many aspects of evolution, they wish to reconcile this belief with some type of supernatural explanations for creation. An appreciable minority is uncomfortable with evolution and adheres to creationist beliefs instead. Strict creationists were generally quite insistent that their position was correct and that the evidence for evolution was either flawed or generally lacking; however, the strict evolutionists tended to be more strident in their comments. An intermediate position between strict creationism and strict adherence to atheistic evolution was advocated by many.

Conclusion

Results from both quantitative and qualitative data indicated that although respondents held a diversity of views from strict creationist to atheistic evolutionist, most respondents tended toward relatively moderate evolutionist views. Some respondents seemed generally unsure about the nature of science, and more specifically unsure about supporting evidence for evolutionary theory. Evolutionist views correlated weakly with teleological ethics views, but responses to ethics questions sometimes were contradictory, making the results unclear. The nature of the ethics results in this study may reflect unclear questions, respondent uncertainty with the topic, the inherent difficulty of ethics itself, or a combination of these factors. A question arising from this study is whether ethical values will shift as participants learn more about evolution and the nature of science.

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Table 1. Evolution and teleological ethics scores and KR-20 values

	Questions		
	Evolution vs.	Ethics	
	Creationism		
Score (mean \pm S.E.)	26.10 <u>+</u> 0.50	10.16 <u>+</u> 0.25	
KR-20 <u>+</u> S.E.	0.896 <u>+</u> 0.568	0.510 <u>+</u> 1.41	

Table 2. Analysis of responses to selected statements on evolution vs. creationism

Table 2. Analysis of responses to selected statements on evolution vs. creationism				
	Proportion of			
	respondents			
	agreeing with			
Statement	statement	n		
	50000			
A. Nature of natural selection and evolution				
"The forms of plant, animal, and other species on earth commonly change gradually over many generations."	0.97* ^a	142		
"Within a species, those individuals that possess characteristics that enable them to survive and develop better in their environment have the most offspring and pass on their characteristics to these offspring."	0.94*	142		
"Genetic mutations and recombination of genes during reproduction eventually result in changes in forms of species over generations."	0.95*	143		
B. Origin of life and supporting evidence				
"The great diversity of plants, animals, and microorganisms is the result of slow changes occurring over the course of approximately 3.5 billion years."	0.84*	139		
"There are a great many different plant and animal species on the earth today, all of which were probably created at approximately the same time."	0.15*	140		
"Slow changes in plants and animals due to environmental pressure and genetic mutation and recombination are reflected in the fossil record."	0.88*	128		
"Current methods of dating geologic formations include using the known decay rates of radioactive isotopes present in rocks to measure the time since the rock was formed."	0.98*	119		
"The use of the decay rates of radioactive isotopes to determine the ages of rocks is questionable because we have no evidence that these rates do not change with time."	0.21*	112		
"One common model accepted by many scientists claims that the earth in its present form was created approximately 10,000 years ago."	0.27*	135		
"The fossil record of the earth indicates that a great flood probably covered nearly all of the earth's surface several thousand years ago."	0.55	124		

"Although isolated instances of dramatic changes in the earth (such as volcanic activity and earthquakes) can be observed, the physical form of the earth and the position of the continents is probably very similar today as when the earth was first created."	0.10*	120
C. Common ancestry and supporting evidence		
"The millions of different species of plants, animals, and microorganisms that live on earth today are very probably related by descent from common ancestors."	0.83*	127
"Although there is a great diversity among plants, animals, and microorganisms, there are many common biochemical and molecular processes in diverse species that can be explained on the basis of common ancestry."	0.94*	126
"There is very little similarity between most of the biochemical and molecular processes that occur in insects and those that occur in mammals."	0.11*	123
D. Opinions on evolutionary theory		
"Biological and geological evolution is a scientific theory that is supported by a large body of factual evidence and has withstood repeated tests. Like any scientific theory, it may be disproven, but it currently is the best scientific framework for unifying and explaining	0.004	110
patterns and processes in the living world."	0.92*	118
"Because biological and geological evolution is only a theory, it should be viewed with skepticism and may be replaced any day by another better explanation of how species originated."	0.43	119

^aAsterisk indicates number of respondents agreeing with the statement is different from number disagreeing with the statement (chi-square test, $\alpha = 0.0025$).

Table 3. Analysis of responses to statements expressing an evolution-creationism continuum

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statement	n
0.17* ^a	119
0.30*	115
0.24*	114
0.85*	114
0.33*	114
	0.30* 0.24* 0.85*

^aAsterisk indicates number of respondents agreeing with the statement is different from number disagreeing with the statement (Chi-square test, $\alpha = 0.0025$).

Table 4. Summary of respondents' comments

Compliments about the survey

General Comments

Example: "Loved taking this survey."

Specific Requests

Example: "I would love to learn your results and interpretations so I can better understand. Will you share them with the university community?"

Comments about frustrations with the survey

Dichotomies

Example, "Some of the questions seemed to suppose binary responses were appropriate when they seemed to me not to be."

Lack of knowledge

Example: "Also, it's been a long time since I studied evolution. The fact based questions were guesses on my part in some instances, because I had to assume the facts were correct, since I wasn't absolutely sure of the actual facts."

Wanted to take an intermediate position

Example: "Many times I wished to say 'usually' or 'often', but was not allowed."

Comments on ethics

Ethics and religion

Example: "Ethics/Morals/Faith are very difficult to separate."

Ethics and evolution

Example: "It seems to me that either ethics could be an evolutionary product that may assist our survival. Evolution may have produced a consciousness that created subsequent creations. If so, a creator is a natural being. And, if the creator came first, then evolution is a created system."

Other ethical issues

Example: "Ethics appears to be a human dilemma that is challenged by humans' multiple perceptions of how one should answer the question 'Why?""

Pro-creationism comments

Challenges to the science behind evolution

Example: "Evolution is only a theory there is little to no supporting evidence. There is far more evidence of creation. If more people would realize that knowing God is know truth."

Statements regarding the power of God

Example: "God is too big for us to understand all of his ways."

Pro-evolution comments

Statements about evidence

Example: "None of us were here during creation so, we don't know. Science can help us find these answers."

Simple anti-creationist

Example: "I feel very strongly that religious mythologies should not be taught in the

science classroom nor should they be presented as scientifically based if they are not." Statements about the nature of science

Example: "At the same time, I believe that science is the best instrument available to humanity to explore the mechanisms of the universe and that the 'creationist' theories presently being advanced are the product of the inappropriate and nonsensical application of ancient religious dogmas in a realm of science where they have no validity."

Intermediate position comments

Statements advocating belief in a supreme being.

Example: "There has been and always will be a huge line between science and religion. I will recognize both as valid theories but when it comes down to it, there has to be some supreme being who created science."

Statements not requiring belief in God.

Example: "I believe there is a ordering principle, a creative force that drives and motivates the creative process of evolution and sets the laws of nature in motion in opposition to the principle of entropy."

Statements about ontology

Knowledge vs. belief

Example: "Knowledge can be and should be separated from belief."

Nature of Biblical teaching

Example: "The Bible is a combination of forms of literature meant to guide our lives. It is to give guidance morally and spiritually. However, one must remember that the authors were of a different time, language, and culture."

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