

Believers and disbelievers in evolution

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ABSTRACT

BACKGROUND. Citizens of the United States are less likely than are citizens of Europe and several non-European nations to believe that humans evolved from an earlier species. Several theories have been proposed to explain Americans' disbelief in human evolution, but empirical investigation has been sparse.

METHODS. Data on belief in evolution, on scientific knowledge unrelated to evolution, on socioeconomic status, on Christian religiosity, and on political polarity were identified in the General Social Surveys (GSSs) for 1993, 1994, and 2000. These data were then analyzed in bivariate and multivariate tests of theories about evolutionary and anti-evolutionary views.

FINDINGS. Christian religiosity was the strongest correlate of disbelief in evolution. Low educational attainment was another positive, but weaker, correlate, though disbelief in evolution was not related to general measures of scientific knowledge. Political liberalism and political conservatism predicted evolutionary belief even after controlling for religiosity, education, and other potential confounders. Subcultural differences in belief — those between blacks and whites, rural dwellers and urban dwellers, Southerners and non-Southerners, dogmatists and non-dogmatists — became insignificant under appropriate controls.

CONCLUSION. Christian religiosity, especially in a fundamentalist variety, was the primary correlate of disbelief in evolution. Lack of education was an important but lesser factor. Independent of religiosity and education, political conservatism predicted disbelief.

A common but nonetheless disquieting observation is that many Americans do not believe in evolution. In 1993, 1994, and 2000, the General Social Survey (GSS), which samples opinions of United States adults each year, asked “how true” was the following statement: “Human beings evolved from earlier species of animals.” Of 3,673 respondents offering an opinion, a majority, 53 percent, called the statement definitely or probably *not* true. Thirty-six percent of respondents said definitely not true, 17 percent probably not true, 32 percent probably true, and 15 percent definitely true. Results were nearly identical each of the three years.¹

A modern American movement to stop the teaching of evolution in public schools, or at least to give students a roughly equivalent exposure to “creationism” or “intelligent-design theory,” gained momentum

in the 1970s and continues vigorously,^{2, 3, 4} suggesting to some observers a popular turning away from scientific views. However, Gallup polls spanning the years 1982 to 2004 have shown barely any shift in the percentage of Americans believing that “God created human beings pretty much in their present form at one time within the last 10,000 years or so.” Asking whether the Bible is to be taken literally or as an ancient book of fables and moral precepts, Gallup polls have shown little change from 1976 to 2004.⁵ Perhaps the majority of Americans has *never* believed in evolution, acceptance being at a level no lower today than at any other time in recent decades.

Disbelief in evolution is more prevalent in the United States than in some other wealthy nations. A 2001 “Eurobarometer” poll composed of true-false questions

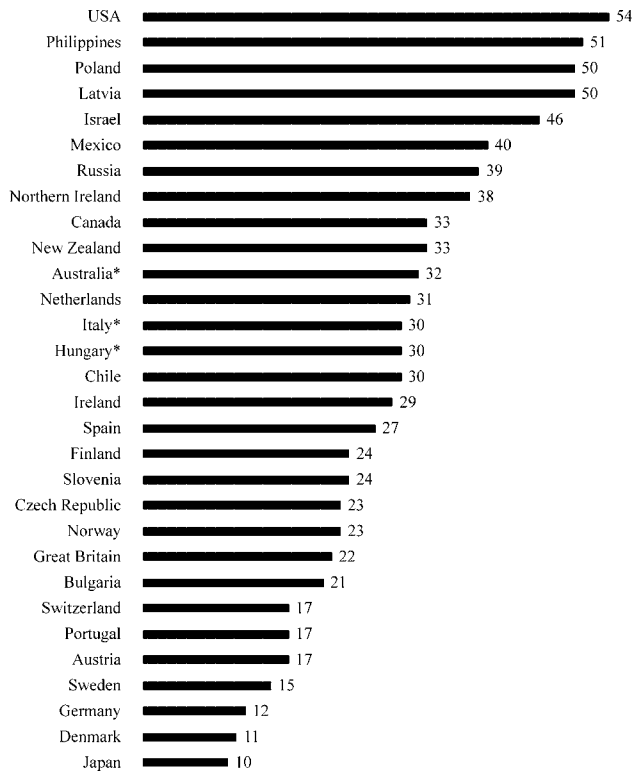


Figure 1. Percentage of national populations not believing that humans evolved from an earlier species, descending order. Data are from the International Social Survey Programme (ISSP) for 2000 except where an evolution question was not asked in that year; for these nations, starred, ISSP 1993 results are shown. (Source: Modules on Environment, I and II, International Social Survey Programme (ISSP) archive, University of Cologne, Germany. <http://www.issp.org/data.htm>.)

reported that only 17 percent of Europeans denied that humans “evolved from older animal species.”⁶ Disbelief was most prevalent in Greece, where 35 percent denied that humans evolved from earlier species, and least prevalent in Britain, France, Italy, Spain, Ireland, and Denmark, where disbelief was reported by only 13 to 15 percent.

Nations that participated in the International Social Survey Programme (ISSP) in 1993 and 2000 asked the GSS’s evolution question at least once. In each nation that asked the question both years, responses were similar over time. Figure 1 shows, in descending order, the percentage of each nation’s population *not* believing that humans evolved from an earlier species.⁷ Results shown

are for 2000 except where unavailable; in these cases, indicated with stars, 1993 data have been substituted.

Several popular theories address Americans’ disbelief in evolution. The simplest presumes *ignorance* among nonbelievers — that they do not understand the evidence for evolution, either because of a general lack of education or because they specifically lack “scientific literacy.” Another explanation focuses on *religion*, noting that fundamentalists who espouse the Genesis story of creation reject contradictory scientific claims.^{8, 9} A third explanation associates creationist belief with conservative *political views*. A fourth explanation cites disbelief in evolution in certain regional (Southern), or lifestyle (rural), or minority (black) *subcultures*.^{10, 11, 12, 13, 14, 15, 16} A fifth explanation presumes that disbelievers have *closed minds* and are resistant to scientific evidence.¹⁷

Methods

As noted above, the GSS in 1993, 1994, and 2000 asked representative samples of United States adults (combined $n = 3,673$) how true was the statement, “Human beings evolved from earlier species of animals.” Closed-ended responses were definitely true, probably true, probably not true, and definitely not true. In 1993 and 1994, the GSS included four other “test” questions about established scientific knowledge, using the same format. Respondents were asked if it was true or not that all radioactivity was made by humans (not true); that antibiotics killed bacteria, not viruses (true); that astrology had some scientific truth (not true); and that all man-made chemicals can cause cancer if eaten in sufficient quantity (not true). For purposes of the present analysis, the choices “definitely” and “possibly” have usually been combined.

The GSS contains standard background variables. Respondents’ years of education (denoted EDUC) range from 0 to 20 where usually “12” means a high-school graduate and “16” a college graduate. The GSS variable XNORCSIZ was dichotomized to distinguish urban areas (codes 1–5; 70 percent of the population) from rural areas (codes 6–10). A respondent’s political view was measured on a 7-point self-report scale from liberalism to conservatism; here this scale has been collapsed into three categories: liberal or extremely liberal (14%); slightly liberal, moderate, and slightly conservative (69%); and conservative or extremely conservative (17%).

Believers and disbelievers in evolution

Table 1. Percent correct answers to five questions on science topics, by education.

Years of education	0–11	12	13–20
Number of respondents	> 432	> 774	> 1,346
	Percent correct answers		
Radioactivity	44	55	74
Antibiotics	77	75	78
Astrology	33	39	57
Evolution	38	40	55
Chemicals	37	49	52

The GSS categorized religious denominations as fundamentalist, moderate, or liberal. The Roman Catholic Church was coded as a moderate affiliation, having accepted a Darwinian position in December 1996 when Pope John Paul II, in a written message to the Pontifical Academy of Sciences, proclaimed evolution “more than just a hypothesis” and compatible with Christian faith.

Other independent variables are most conveniently described as they arise.

Findings

Ignorance

Fifty-five percent of respondents with some college education believed that humans evolved from other species, while only 39 percent of respondents with a high-school education or less believed this. Table 1 shows that better educated respondents were generally more often correct on science test questions, with the antibiotics question an exception. However, pair-wise Pearson correlations among the test questions were low, ranging from $r = 0.01$ to $r = 0.26$, indicating that respondents who answered any one question correctly were not especially likely to answer the others correctly. Responses to the evolution question were poorly correlated with correct responses to other test items ($r < 0.15$).

Religion

As a measure of religious fundamentalism, respondents were asked to select which of three statements most closely described their perception of the Bible. Thirty-four percent said the Bible was the actual word of God and was to be taken literally, word for word; 50 percent said the Bible was the inspired word of God, but not everything in it should be taken literally; 16 percent said the Bible was an ancient book of fables, legends, history, and moral precepts recorded by men. Figure 2 shows the percentage of correct responses for each test

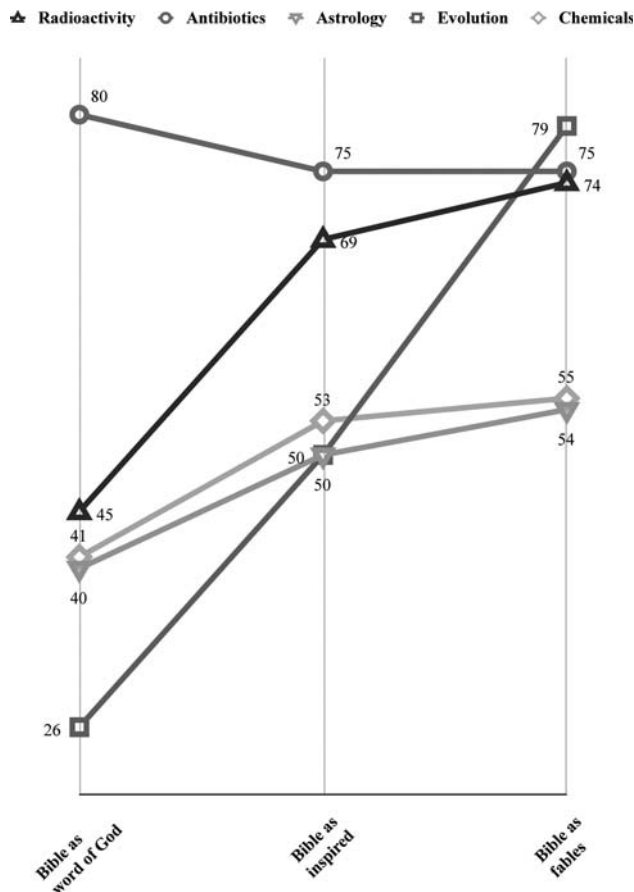


Figure 2. Percentage of correct responses for each test question as a function of perceptions of the Bible.

question as a function of perceptions of the Bible. Excepting the item on radioactivity, correct answers were less frequent among the more fundamentalist respondents. Those who saw the Bible as the literal word of God were less likely to believe in evolution than those who regarded the Bible as fable and moral teaching.

Other indicators of religiosity — categorized in the GSS as affiliation with a fundamentalist, moderate, or liberal denomination — gave similar results. Only 27 percent of respondents in fundamentalist denominations regarded evolution as true, compared with 53 percent in moderate denominations and 63 percent in religiously liberal denominations. Combining all denominations, only 30 percent of respondents who attended religious services at least weekly believed in

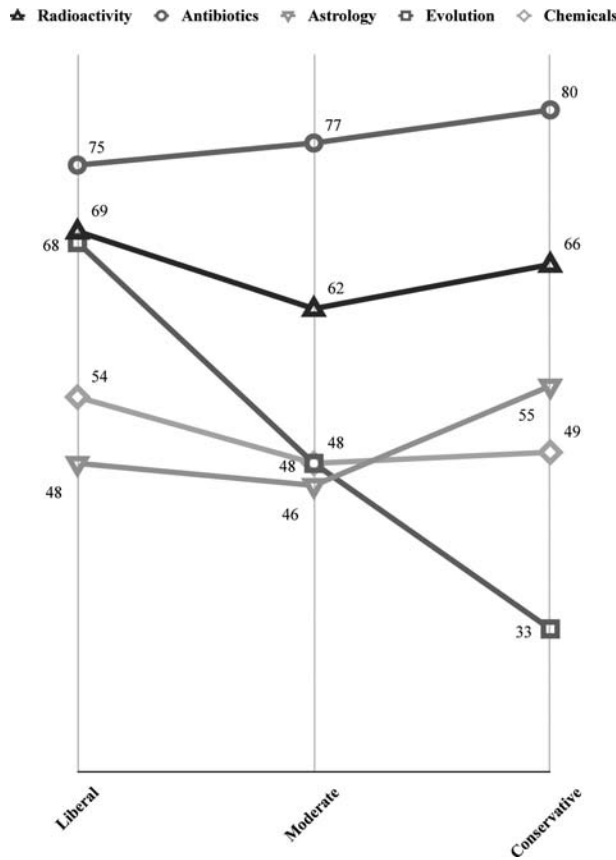


Figure 3. Percentage of correct responses to each test question as a function of self-reported political view.

evolution, compared to 60 percent of those who attended two or fewer services per year.

Political views

Figure 3 shows the percentage of correct responses to each test question as a function of self-reported political view. On the evolution question, but on none other, liberals were markedly more often correct than were conservatives.

Subcultures

Correct answers for respondents from the South and from elsewhere are compared in Table 2, as are answers from urban and rural areas and from among whites and blacks. Southerners did worse on four of five items, though most differences were so slight as to be inconsequential. The evolution question showed the greatest regional difference, with correct answers from

Table 2. Percent correct answers to five questions on science topics, by region, residence, and race.

	Region		Residence		Race	
	Non-south	South	Urban	Rural	White	Black
	Number of respondents					
	2,362	1,311	2,619	1,054	3,043	458
Radioactivity	66	58	66	57	66	44
Antibiotics	77	77	76	77	77	75
Astrology	49	46	50	41	50	35
Evolution	52	40	51	40	49	40
Chemicals	50	47	49	48	51	37

Boldface indicates a difference > 10 percent.

40 percent of Southerners but 52 percent of non-Southerners. Rural respondents did slightly worse overall than did urban, and the evolution question again showed the greatest difference. Racial differences on the evolution question were small.

Closed minds

The GSS asks respondents if they would be willing to allow people deviating in certain ways from social norms to speak in their communities, teach in their colleges, or author books on loan in their public libraries. As they ask about deviations that may be seen as offending Christian values or violating Christian doctrine, these questions might fail accurately to measure dogmatism among fundamentalists. To avoid conflating closed-mindedness with acceptance of Biblical injunctions, I have selected as my dogmatism variable a single item, DOGMAT: “Suppose . . . [someone] wrote a book advocating doing away with elections and letting the military run the country. Somebody in your community suggests that the book be removed from the public library. Would you favor removing it, or not?” Thirty-seven percent of respondents would have removed the book; these respondents I considered dogmatic. Compared to non-dogmatists, they were less likely, by 35 percent to 55 percent, to believe that humans evolved, and they were also more likely, by 63 percent to 49 percent, to find some truth in astrology.

Multivariate analysis

The explanatory variables used in this analysis are not completely independent of one another. Blacks, for example, are slightly over-represented among religious fundamentalists. Table 3 presents a correlation matrix of all explanatory variables, allowing us to explore their inter-relationships.

Table 3. Pearson correlations among explanatory variables.

	AGE	RACE	REGION	URBAN	BIBLE	FUND	ATTEND	POLVIEW	DOGMAT
EDUC	-0.26	-0.13	0.11	-0.16	-0.29	-0.22	0.01	-0.04	-0.31
AGE		-0.05	-0.01	0.06	0.09	0.00	0.14	0.12	0.21
RACE			-0.14	-0.12	0.15	0.24	0.08	-0.09	0.09
REGION				-0.14	-0.16	-0.22	-0.09	-0.06	-0.12
URBAN					0.13	0.10	0.07	0.06	0.11
BIBLE						0.38	0.33	0.17	0.26
FUND							0.28	0.12	0.18
ATTEND								0.17	0.15
POLVIEW									0.09

Boldface indicates $r > 0.25$.

Here years of education (EDUC) range from 0 to 20. RACE is coded white (0), black (1). REGION is coded South (0), Non-South (1). The respondent's perception of the BIBLE is coded, from low to high, as fable, inspired, or God's word. FUND is the GSS categorization of religious denominations, coded, from low to high, as liberal, moderate, or fundamentalist. ATTEND is a 9-point ordinal measure of the respondent's frequency of attending religious services, ranging from never to several times a week. POLVIEW is retained as a 7-point scale for this analysis, with a higher score more conservative. DOGMAT is coded high for respondents who would remove a militarist's book from the public library (dogmatic), and low for those who would not.

Moderate clustering was seen among the three measures of religiosity: BIBLE, FUND, and ATTEND; their pair-wise correlations ranged in magnitude from $r = 0.28$ to 0.38 . Education was inversely related to belief in the Bible as God's word and to dogmatism. Blacks and Southerners were slightly more fundamentalist than whites and non-Southerners. No correlation in the table exceeded 0.38 , so subsequent analysis was not plagued by multicollinearity. We therefore move to a multivariate analysis, aiming to pinpoint the most essential explainers of belief or disbelief in evolution.

The four-valued test question on evolution (high score = disbelief) was regressed on three models to compare the importance of different explanations. Results for each model are reported in Table 4 as standardized regression coefficients (betas), which compensate for the differing ranges among the explanatory variables. Significance levels are indicated by boldface, but with so large a sample ($n > 2,000$), magnitude of the betas is a far more important criterion of importance.

Model 1 is a test of the ignorance and subculture theories. It corroborates prior bivariate results with the exception that RACE is now rendered irrelevant as an

explanatory variable. Low education remains a potent predictor of disbelief in evolution. To a lesser extent, living in the South and in a rural area likewise predict disbelief.

Model 2 adds to the first model the three measures of religiosity. Doing so considerably enhances explanatory power, raising the explained variance (R^2) from 8 percent in Model 1 to 25 percent. With religiosity controlled, the differences between Southerners and non-Southerners and between rural- and city-dwellers are reduced to nearly zero, leaving no support for the subculture theory. The explanatory power of education is somewhat reduced. In Model 2, each of the three religiosity variables has a larger beta than does education, emphasizing the contribution of religion to disbelief in evolution. Indeed, the three religiosity variables overlap — they inter-correlate — and each one, in the presence of the others, retains a relatively strong beta.

Model 3 adds political view (POLVIEW, conservative = high) and dogmatism to the second model. Despite these additional controls, education, age, and religiosity retain their explanatory effects. However, dogmatism no longer has any relationship to disbelief

Table 4. Standardized coefficients (betas) for belief in evolution, for three models.

	Model 1	Model 2	Model 3
EDUCATION	-0.19	-0.13	-0.11
AGE	0.11	0.09	0.08
RACE	0.04	-0.02	-0.05
REGION	-0.09	-0.02	-0.05
URBAN	0.07	0.02	0.01
BIBLE		0.25	0.30
FUND		0.16	0.14
ATTEND		0.15	0.09
POLVIEW			0.10
DOGMATISM			0.00
R^2	0.08	0.25	0.26

Boldfaced betas indicate $p < .01$ (t-test).

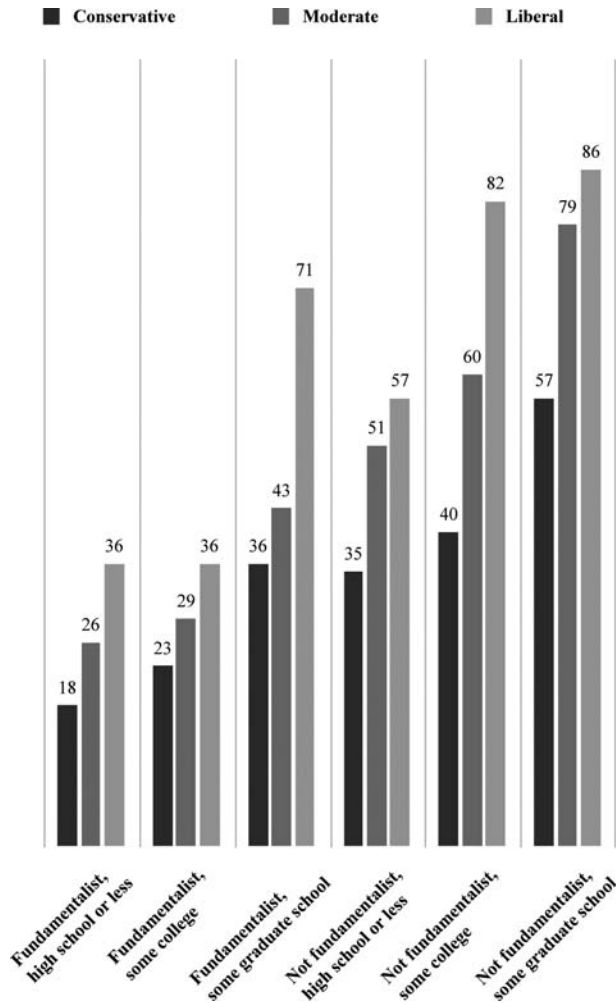


Figure 4. Percentage of respondents believing that humans evolved from an earlier species, plotted against political view and grouped by pairings of dichotomized religious denomination and educational attainment.

in evolution, while political conservatism holds its place as one of the stronger predictors.

POLVIEW remains nearly as potent as education in predicting evolutionary belief. The correlation between the evolution test question and POLVIEW is $r = 0.25$, which is equivalent to beta when POLVIEW is the sole independent variable in a regression model. In Model 3, POLVIEW’s beta is reduced to 0.10, indicating that part of its bivariate association with evolution is explained by covariance with religiosity.

The persistent covariation of political and evolutionary beliefs, despite statistical controls, is illustrated

in Figure 4. Here the percentage of respondents believing that humans evolved from an earlier species is plotted simultaneously against political view (conservative, moderate, liberal), respondent’s religious denomination (dichotomized into fundamentalist or not fundamentalist), and educational attainment (high school or less, some college, some graduate school). Whether respondents belonged to fundamentalist denominations or not, and whatever their education level, belief in evolution rose along with political liberalism.

Discussion

Religious belief is the primary correlate — and may be the chief determinant — of Americans’ attitudes toward the life-sciences claim that humans evolved from earlier species. Fundamentalist religion especially, but also just the frequency of attending religious services, account for this effect. Three measurements of religiosity, taken together, explain far more variation in evolutionary belief than do education and age. Each measure of religiosity, while controlling the others, predicts evolutionary belief nearly as well or better than education does.

More highly educated respondents were more likely to answer correctly each of five GSS science questions, including a question concerning evolution. However, this performance cannot confidently be attributed to improved scientific literacy alone because a correct answer to any one test question barely predicted correct answers to others. One way to account for these seeming inconsistencies is to assume that test answers were given more or less randomly, and that higher education somewhat improved the odds of a correct guess. More plausible, though, is the influence of a factor other than scientific literacy *per se*.

Closed-mindedness, or *dogmatism*, is usually conceptualized as an unwillingness to consider beliefs other than one’s own, rejection or rationalization of ostensibly inconsistent evidence, discomfort with ambiguity, and intolerance of deviance. Open-minded, or non-dogmatic, people, in contrast, are willing to entertain novel ideas, especially in light of new evidence, and are tolerant of views other than their own and of people unlike themselves. Psychologist Milton Rokeach’s classic treatment of the topic has inspired a stream of research as well as continuing criticism. The tendency of researchers to find high levels of dogmatism among political conservatives, and among Biblical fundamentalists,^{18, 19}

invites a rejoinder from creationists that it is the evolutionists who are dogmatic for rejecting “intelligent design” as an alternative theory. We need not enter this quagmire because it turns out that, after appropriate controls, dogmatism, as measured here, is unrelated to respondents’ views about evolution.

Popular theories attributing Americans’ anti-evolutionary stance to “strong religion and weak education” gain credibility through the analysis reported here. However, subcultural theories, at least those focused on the Southern states, on rural life, or on black communities, are not supported. While disbelief in evolution is indeed higher in Southerners than non-Southerners, in rural people compared to urbanites, and to a slight extent in blacks compared to whites, these differences disappear after controlling on education or religiosity or both.

Many commentators attribute anti-evolutionary positions to conservative political ideology, pointing to various attempts over the years by ideologues to keep evolution out of public-school textbooks or more recently to guarantee respectful attention for modern creationist theories, such as “intelligent design.” Often, at least implicitly, these commentators presume that motivations are rooted in the fundamentalist religiosity or Southern mentality of politically conservative activists. Consistent with this presumption, the correlation between political conservatism and disbelief in evolution is diminished by controlling on religiosity in Model 3. However, to this author’s surprise, the relationship is not *wholly* explained in this way or by additionally controlling on education, race, age, and region. After holding these potential confounders constant, political orientation remains nearly as powerful as education in predicting evolutionary belief. Even among respondents who have attended graduate school and who do not belong to a fundamentalist religious denomination, political liberals are more likely than political conservatives to believe that humans evolved from earlier species. Why this should be the case remains a puzzle.

Allan Mazur, a sociologist and an engineer, has been a professor in the Maxwell School of Syracuse University since 1971. He is the author or coauthor of seven books and over 150 articles, most focused on the sociology of science, technology and environment, and biosociology. His most recent book, published in 2005 by Rowman & Littlefield, is *Biosociology of Dominance and Deference*.

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