

Religion and Reproductive Genetics: Beyond Views of Embryonic Life?

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Advances in new reproductive genetic technologies have spawned a very polarized public and political debate. As with the abortion debate, most formal opposition to these technologies comes from religious organizations that are concerned about embryonic and fetal life. In this article we conduct an analysis of the first nationally representative opinion survey on religion and reproductive genetics. We find, as in the abortion debate, that evangelicals, fundamentalists, and traditionalist Catholics are more opposed than more liberal religious groups. When we compare respondents with the same views on embryonic life, we find that differences remain in the level of approval for genetic technologies, suggesting that there is more to this debate than concern about embryos. We also find that religious conservatives are more distinct from the religious nonattenders in their views of health objectives of reproductive genetic technologies and less distinct in their views of improvement objectives.

For decades social critics have anticipated the impending *Brave New World* that will result from the development of more precise methods of genetic intervention into the human species (Huxley 1932; Ramsey 1970; Rothman 1998). For example, there is now discussion of whether new abilities in genetic intervention are leading us to a “posthuman” future (Fukuyama 2002). One scholar summarizes the breadth of potential social influence by stating that the new technologies are changing the reproductive landscape and challenging basic notions about procreation, parenthood, family, and children (Robertson 1994:3). Others, more critical, state that a new era of eugenics is dawning (Cole-Turner and Waters 1996:xv).

These technologies have been the subject of extended normative debates in bioethics, philosophy, and theology. Social scientists have focused primarily on the experience of the people who use the technologies (Becker 2000; Rapp 1999; Rothman 1986, 1989). Sociologists have also examined the potential social implications of these technologies (Duster 1990), and the nature of debates about the technologies (Evans 2002a). Yet, there have been few studies of the American public’s view of these technologies. As we argue below, religion is a crucial component of the U.S. debate. This is the first generalizable study of how religion influences the public’s attitudes toward reproductive genetic technologies.

Most organized opposition to these technologies comes from religious organizations. While there has long been a political clash over prenatal genetic diagnosis followed by abortion, many religious groups are trying to incorporate the newer reproductive genetic technologies into the abortion debate. Therefore, in this article we focus upon the beliefs and attitudes of the natural constituency for political mobilization for these organizations, the religiously active. Specifically, we examine the role that beliefs about embryonic life plays in shaping attitudes about reproductive genetic technologies, and look for patterns in attitudes about different applications of technologies to ascertain not only the basis of religious objections to reproductive genetic technology, but to derive potential implications for future policy debates.

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OBJECTIVES AND TECHNIQUES IN REPRODUCTIVE GENETIC TECHNOLOGIES

While there have been many years of anticipation, the confluence of advances in reproductive medicine and genetics research has yielded the ability to identify an increasing array of genetic characteristics in embryos and fetuses, thus giving parents unprecedented power to select the genetic characteristics of their offspring. First developed in the 1960s, prenatal genetic diagnosis is the genetic testing of fetal cells collected through amniocentesis or chorionic villus sampling. Prenatal genetic diagnosis is performed during pregnancy and the results are used by parents to make decisions about continuing or terminating a pregnancy or to help prepare for the birth of the child. More recently, it has become possible to perform genetic tests on embryos before pregnancy and use the genetic test results to select those embryos to transfer into a woman's womb (Handyside et al. 1990). This genetic testing of embryos produced through *in vitro* fertilization, called preimplantation genetic diagnosis, is considered to be an alternative to prenatal genetic diagnosis followed by abortion.

Currently, prenatal genetic diagnosis and preimplantation genetic diagnosis are used primarily when parents are at increased risk for having a child with a genetic disorder such as Down syndrome or Tay Sachs. In theory, any of the over 1,000 genetic tests now available and the many more in the pipeline could be used to identify and select particular genetic characteristics in offspring. Observers worry that as genetic tests become available for less serious conditions, even nondisease characteristics such as sex and potential personality, we will enter a "posthuman future" in which eugenics is commonplace if not socially mandatory.

Some applications are pushing toward—or surpassing—the line into traits not considered to be diseases. For example, preimplantation genetic diagnosis has been used to test for gene mutations associated with diseases such as Alzheimer and Huntington disease that do not appear until adulthood (Sermon et al. 2002; Verlinsky et al. 2002), to test for mutations that indicate a heightened but uncertain risk of developing cancer (Rechitsky et al. 2002), to select an embryo that will be an HLA-matched stem cell donor¹ for a sick older sibling (Verlinsky et al. 2004), and to select the sex of an embryo in the absence of x-linked disease (Kuliev and Verlinsky 2004).

Preimplantation genetic diagnosis and prenatal genetic testing involve the selection of genetic characteristics before birth, but the choices are limited to the genetic qualities that the genomes of the two parents could possibly produce. It has been the dream of some scientists that we could engineer children to eliminate disease, or to make them more intelligent, taller, and so on (Kevles 1985; Stock and Campbell 2000). While adding genes to a subset of the cells in the body has been accomplished in so-called somatic gene therapy (Cavazzana-Calvo, Hacein-Bey-Abina, and Fischer 2002; Ehrhardt and Kay 2002; Manno et al. 2003) it is not yet possible to obtain targeted genetic changes in all cells of a human being (Adams 2004; Resnik and Langer 2001). However, the antecedent technologies are in place. Targeted genetic changes in all cells of a human being, which we will call germline genetic modification, has been successful in animal models (Denning and Priddle 2003) and scientists have recently reported success in targeted gene insertion in human embryonic stem cells (Zwaka and Thomson 2003).

Since the technology to detect gene mutations associated with disease is the same technology that would be used to identify genes that would "improve" one's children (e.g., intelligence), there remains the possibility that reproductive genetic technologies could be used to improve one's offspring as well. At present, people *do* use these technologies to avoid giving birth to children with genetic features not considered a disease, such as a particular gender. The reproductive genetic technology applications other than health applications we will call "improvement" applications.

EMBRYOS AND THE POLITICAL DEBATE OVER REPRODUCTIVE GENETIC TECHNOLOGIES

Given how entrenched notions of procreation, parenthood, family, and children are in our culture, it is no surprise that there is a very polarized debate about reproductive genetic technologies

and stark disagreements about whether these technologies should be permitted, if there should be limits placed upon their use, and their potential societal consequences. Since reproductive genetic technologies can result in the death of embryos or fetuses, scholars who have observed the elite debates about reproductive genetic technologies see these debates as almost entirely determined by views of embryonic life. For example, Parens and Knowles (2003), evaluating public policy toward reproductive genetic technologies, state,

the political division that has hampered public policy on [reproductive genetic technologies] is rooted in the vitriolic U.S. debate over abortion. Given the polarizing dynamics of this debate, much of the public policy conversation about embryo research and reproductive policy has consisted of pro-choice and anti-abortion activists shouting past each other. (2003:S10)

Like the abortion debate, most of the organizations that oppose reproductive genetic technologies are religious. For example, the Catholic Church, which is opposed to the destruction of embryos, produces educational materials to argue that reproductive genetic technologies should be integrated as one of the life issues that Catholic activists should oppose.² Similarly, most evangelical denominations and social movement organizations are opposed to abortion on the grounds that the embryo and fetus are human life worthy of protection (Moen 1992), and they are therefore opposed to the reproductive genetic technologies on the same grounds. For example, as the Ethics and Religious Liberty Commission (the social advocacy arm of the Southern Baptist Convention) puts it in its 2004 Sanctity of Human Life Fact Sheet, using preimplantation genetic diagnosis to select an embryo who will be a good tissue donor for a sick sibling is troubling because “human beings who were not the perfect match were simply discarded.”³

Official positions in opposition to both abortion and reproductive genetic technologies are primarily found among conservative religious organizations. Most liberal and mainline Protestant, as well as Jewish, groups are not opposed to abortion, and do not hold embryonic life to be sacred (Evans 1997a; Melton 1989). These groups tend not to advocate for the legality of reproductive genetic technologies, but at the same time, they are not opposed. There is, as one would expect, a general tendency for the members of these groups to follow these positions. That is, evangelicals and traditionalist Catholics are the most conservative on abortion while liberal and mainline Protestants, liberal Catholics, and Jews are the most permissive, with increased attendance in any instance resulting in greater conservatism (Cook, Jelen, and Wilcox 1992; Evans 2002b; Gay, Ellison, and Powers 1996; Hoffmann and Miller 1997:59; Roof and McKinney 1987:211–12; Steensland et al. 2000:306).

One of the basic findings in studies of social movement mobilization is that elites have to match the positions of their organization with unmobilized sentiment pools or public opinion preference clusters or change the opinions of populations to create these clusters (Snow et al. 1986:467). We can therefore go a long way toward understanding the future of the debates about these technologies by examining the attitudes of the unmobilized sentiment pools—the participants in these religious traditions. With this information we can estimate how much effort conservative religious organizations will have to expend to mobilize opposition to these technologies.

The best historical example of an organized religious elite changing the views of the average members of their tradition is the case of evangelical Protestant organizations and the abortion debate. In 1973, at the time of the *Roe* decision, evangelical Protestant organizations were not very concerned with stopping abortion. In fact, the official position of the Southern Baptist Convention was in favor of making abortion more available in certain instances; and the Washington representative of the Southern Baptist Convention assisted in founding the Religious Coalition for Abortion Rights (Evans 1997a:464). The religious conflict over abortion was, throughout the 1970s, between the pro-choice mainline/liberal Protestants and pro-life Catholics. Starting in 1979, elites in what became known as the New Religious Right (Liebman and Wuthnow 1983; Martin 1996; Moen 1992) organized within evangelicalism on issues such as making abortion

illegal. Many resources were spent on convincing evangelicals that abortion was wrong. Opinion data show that evangelicals were the second *most liberal* on abortion of four groups examined in 1974; by the mid 1980s, they had become the most conservative (Evans 2002b:406).

EXISTING RESEARCH AND HYPOTHESES

Research on Attitudes Toward Reproductive Genetic Technologies and Applications

There are many studies of attitudes of particular groups, such as those who have a child with a genetic disorder (Wertz, Janes, and Erbe 1992), adults with a genetic disorder (Henneman et al. 2001), pregnant women (Learman et al. 2003), and geneticists (Wertz and Fletcher 2004). These are obviously of limited usefulness for understanding the attitudes of the general public. There has been very little research on attitudes toward reproductive genetic technologies held by the general U.S. public. There are no studies that closely examine religion.

In the first paper on American attitudes toward prenatal genetic testing, Singer and her colleagues found overwhelmingly favorable attitudes toward prenatal genetic testing, with younger people, those with more education, and those who follow science news more closely being more supportive (Singer 1991:250). A 1999 study that examined attitudes toward prenatal genetic testing found that women and those with more education think prenatal genetic testing will do more good than harm, and nonwhites and those who attend religious services more often think it will do more harm (Singer, Corning, and Antonucci 1999:438). While they did include measures of religious affiliation as covariates, due to the design they only found that Jews are more likely to think genetic testing will do more good than harm, compared to mainline Protestants.

A 2000 study that focuses upon attitudes toward prenatal genetic testing also found that church attendance is a significant negative predictor of preferences for testing and that self-identification as Catholic is similarly related to negative attitudes toward testing (Singer, Antonucci, and Van Hoewyk 2004:41).⁴ Singer's research did not focus on religion, and what we can learn about the views of religious groups can only be determined by looking at her covariates. That said, the sum of this research on attitudes toward reproductive genetic technologies—for our purposes—is simply that attending the services of any religious tradition is associated with greater opposition to reproductive genetic technologies. The more important question of *why* different religious groups would be opposed to reproductive genetic technologies has been totally unexamined.

Hypotheses

Given the religious elites' efforts at incorporating reproductive genetic technologies into the broader debate about abortion, this suggests a preliminary hypothesis that the average person's attitudes toward reproductive genetic technologies are determined by whether they are in a religious tradition that exposes them to anti-abortion teachings.⁵ If this hypothesis is correct, we should observe the following relationships between religious groups:

H1: Compared to nonparticipants in religion, evangelicals, traditionalist Catholics, and fundamentalists will be most opposed to reproductive genetic technologies, while mainline Protestants and moderate Catholics will be somewhat less opposed, with liberal Protestants and liberal Catholics the least opposed.

This still leaves open the question of whether opposition to reproductive genetic technologies by the religiously active is due to concerns about embryonic life. If beliefs about embryonic life are determinative of attitudes toward reproductive genetic technologies, then:

H2: Controlling for the respondent's view of embryonic life, there will be no differences between any religious group and the nonreligious in their attitudes toward reproductive genetic technologies.

If attitudes toward reproductive genetic technologies are not driven by beliefs about embryonic life—if H2 is not supported—then there are a plethora of alternative explanations. An explanation often tested in survey research on religion and moral issues is that it is not religious belief or practice itself that leads to opposition to a practice like reproductive genetic technologies, but rather opposition is actually based in the beliefs of a social group that happens to be overrepresented among the religious groups that are opposed to the practice. For example, in the voluminous literature on religion and attitudes toward abortion, scholars often test whether it is actually a respondent's educational level, age, gender, and so on that leads to his or her attitude about an issue (Cook, Jelen, and Wilcox 1992; Evans 1997b; Gay, Ellison, and Powers 1996; Steensland et al. 2000). Therefore, if this were to be true of the debate over reproductive genetic technologies:

H3: Attitudes toward reproductive genetic technologies are determined by the demographic characteristics of the respondents, not their religious identity or their beliefs about embryonic life

We can imagine many other explanations for opposition to reproductive genetic technologies. Only one can readily be tested using the existing survey data, but it is an important one. The null hypothesis is that members of religious groups will see the technologies through the lens of healing the suffering of disease. Most Christian traditions view one of the tasks of believers to be to improve the world that God has given them (Cole-Turner 1993). One of these improvements is to alleviate suffering, such as the suffering caused by disease. In the Christian narrative, one could argue that the primary act of Jesus' brief ministry was the healing of disease of people he encountered. This theological impulse has been manifested in the tradition of religious hospitals, the provision of health care to the poor, and the continued focus in parts of conservative Protestantism on the divine healing of disease. There is no general opposition to medical research or medicine among Christians, but rather a celebration of how humans use God-given gifts to help each other.

This is also roughly how the reproductive genetic technology debate is framed outside of religious circles: that reproductive genetic technologies are an important method of alleviating suffering, but that there is no good reason to use them for improvement. In particular, the medical community has been at great pains to demonstrate that they are only interested in healing the suffering of disease. Specifically, if the religious are viewing these technologies through the lens of relieving the suffering of disease, like the general public has been primed to do, then when compared to the nonreligious the degree of difference with the nonreligious will be of the same size for both the healing and improvement objectives.

The alternative hypothesis is that religious and secular norms about relieving suffering are not the same. That is, members of some religious groups may have a tendency to believe that the suffering of disease has an important function. As many theologians have noted, at least within some Christian traditions, suffering is not meaningless and therefore does not always need to be eradicated. Evangelical theologian Stanley Hauerwas even goes so far to say that "the most decisive challenge which medicine raises for Christian convictions and morality involves the attempt to make suffering pointless and thus subject to elimination" (1986:24). If this view is held by the religious respondents, then they would not accept the dominant narrative promoted by the proponents of the technologies, that they are needed to relieve the suffering of disease. But, since "improvement" objectives do not involve the relief of suffering, we would expect these groups to be similar in view to the nonreligious. Therefore, if the religious have a different view of suffering we would expect to find:

H4: Groups opposed to reproductive genetic technologies in general will be more opposed to health objectives than to improvement objectives, compared to the nonreligious.

To be clear, this hypothesis states that the greatest differences in view between the religious and nonreligious will be on the health objectives. While we are interested in this difference, it is

important to note that if we look noncomparatively, all of the groups analyzed in this article are more opposed to improvement objectives than to health objectives.

METHODS

Participants

Our study was conducted using an Internet-based survey that is nationally representative of the American public aged 18 years or older. Knowledge Networks, a survey research firm, has developed a panel of respondents who are given a free Internet access for their homes, which they use for both personal use and to answer occasional surveys. The sample is representative because the panelists are selected through a standard random-digit dial procedure, and are given the computer equipment and online access. The method has been studied extensively, and has been demonstrated to be as representative as random-digit dialing.⁶ Papers using Knowledge Networks surveys have been published in *JAMA*, *Health Services Research*, the *Journal of Personality and Social Psychology*, and other prestigious locations. This survey, fielded in March 2004, had a 73 percent response rate, resulting in 4,834 completed interviews. Similar to most surveys, this one is weighted to reflect the demographic distribution of the U.S. population aged 18 years and older. To assuage concerns that religious affiliation might not be accurately represented in the study, we compared the percentage claiming each religious tradition in the Knowledge Networks study with identically worded religious affiliation questions in a random-digit dial study.⁷ We found that the percentages were within 2.1 percent of each other for each religious group.

Dependent Variables

Early in the survey the respondents were introduced to the technologies, and given a short written explanation of each.⁸ The respondents were then asked for their level of approval of each of five distinct applications for prenatal genetic testing. Respondents were asked whether they would strongly approve, approve, disapprove, or strongly disapprove of the use of prenatal genetic testing to find out whether a baby: (a) will develop a fatal childhood genetic disease; (b) will have a tendency to develop a disease like cancer when he or she is an adult; (c) will have desirable characteristics such as high intelligence or strength; (d) is a certain sex; (e) will be a good match to donate his or her blood or tissue to a brother or sister who is sick and needs a transplant. The survey then asked questions with the same set of five applications for preimplantation genetic diagnosis and then the same five applications for human genetic modification.

For the purpose of analysis, we created three additive indices (Table 1). The first is an index of all 15 of these variables. It has a Cronbach alpha of 0.94. The second is an index of the six questions that ask about improvement applications (sex selection, intelligence; alpha = 0.91). The third is an index of the nine health objectives questions (tissue match, adult onset disease, fatal child disease; alpha = 0.93). Higher values of the indices indicate greater opposition.

Independent Variables

We divided the respondents into eight mutually exclusive religious identities. Respondents who claimed a Protestant or "other" Christian religious identity when asked about their religious preference were subsequently asked: "When it comes to your religion, would you say you are a fundamentalist, evangelical, mainline or liberal Protestant, or do none of these describe you?" For those respondents who claimed "none of these describe me," or "other," they were subsequently asked: "If you had to pick one of these, would you say you are a fundamentalist, evangelical, mainline or liberal Protestant, or do none of these describe you?" People with a Catholic religious preference were asked a similar series of questions with their choices being traditionalist,

TABLE 1
DESCRIPTIVE STATISTICS, RELIGION, AND REPRODUCTIVE
GENETICS SURVEY

Variable	<i>N</i>	Mean	<i>SD</i>	Min	Max
<i>Dependent Variable Indices</i>					
Reproductive Genetic Tech Index	4,202	38.34	9.57	15	60
“Improvement” Objectives Index	4,369	17.26	4.10	6	24
“Health” Objectives Index	4,298	21.08	6.43	9	36
<i>Religious Attender Groups</i>					
Fundamentalists	4,778	0.045	0.206	0	1
Evangelicals	4,778	0.098	0.297	0	1
Mainline Protestants	4,778	0.044	0.205	0	1
Liberal Protestants	4,778	0.072	0.259	0	1
Traditionalist Catholics	4,778	0.029	0.167	0	1
Moderate Catholics	4,778	0.039	0.192	0	1
Liberal Catholics	4,778	0.024	0.152	0	1
Other Attenders	4,778	0.114	0.318	0	1
<i>Demographics</i>					
Age	4,834	45.31	15.83	18	99
High School Education	4,834	0.303	0.460	0	1
Some College Education	4,834	0.322	0.467	0	1
College Education or More	4,834	0.271	0.444	0	1
Female	4,834	0.534	0.499	0	1
White	4,834	0.649	0.477	0	1
Has Biological Child	4,834	0.633	0.482	0	1
Has Adopted or Stepchild	4,834	0.072	0.258	0	1
Lives in South	4,834	0.359	0.480	0	1
<i>Other Indices</i>					
Knowledge of Technology Index	4,771	5.22	0.978	4	8
Embryonic Life Index	4,606	0.855	0.807	0	2

moderate, or liberal Catholic. Dichotomous variables were created for respondents in each of these Protestant and Catholic categories who also claimed to attend religious services once or twice a month or more. The eighth religious affiliation variable is for people who attend religious services once or twice a month or more, but who do not consider themselves to fit any of these traditions or are members of minority religions. There are not enough Jewish respondents or members of other religious traditions to conduct valid analyses, so respondents who did not fit the primary categories above are also put in the heterogeneous other attender category. Forty-six percent of the entire sample attended religious services this frequently. The reference group for the analyses of religion is therefore respondents who attend religious services a few times a year or less. Those who refused to answer the attendance question were coded as missing.

We created these attendance thresholds for each religious affiliation variable because ultimately we are interested in past and future mobilization by religious elites through tradition-specific communications channels such as worship services. We are then, for example, interested in fundamentalists who attend services rather than people with a fundamentalist identity who have not attended services in decades because the attenders are those who will have received messages about embryos and reproduction from elites in the past, and can be expected to potentially receive such messages in the future.

There is of course a long-running debate about how to identify members of different religious traditions from surveys (Leege and Kellstedt 1993; Smith 1990, 1998; Steensland et al. 2000). One critique of the self-identification method is that respondents do not know the meaning of the terms used in surveys, such as evangelical. Christian Smith's interviews with churchgoing Protestants led him to the conclusion that while his respondents could not explain the subtleties of the distinctions between traditions, most ordinary Protestants possess definite basic associations about the different Protestant traditions (Smith 1998:233). A more recent analysis concludes that this approach has "substantial predictive validity" (Alwin et al. 2006).

Age is coded as a continuous variable (range = 18–96). Education is coded as three dummies: those with a college degree or more, those with some college, those with just a high school degree; those with less than a high school education are the reference group. Female, white race, and residence in the South are coded in a self-explanatory fashion. Since Singer found that people without children were the most favorable toward prenatal genetic testing (Singer 1991:243), we created two dummy variables: whether the respondent had biological children, and whether the respondent had adopted or stepchildren; people with no children were the reference group.

The deficit model of attitudes toward scientific innovation, a theory often advocated by scientists, claims that the public is opposed to technologies because they lack knowledge of the technologies (Bak 2001; Priest 2001). To address this possibility, respondents were asked at the beginning of the survey if they had heard about the technology in question. For each question the respondent could state yes or no, and the responses to the three technologies under examination were summed into an index ($\alpha = 0.54$) (range = 3–6). Higher numbers indicate more knowledge.

The respondent's view of embryonic life is measured by an index composed of two variables, which have a correlation of 0.82. The index was constructed as follows. Respondents were asked to "rank the moral worth" of "a human embryo in a petri dish" on a scale of 1 to 5. The five points on the scale were labeled "no moral worth," "low moral worth," "moderate moral worth," "high moral worth," and "maximum moral worth." This variable was standardized. The second variable gave respondents choices concerning which statement best describes your thoughts on the beginnings of life. Those who selected life begins when a sperm fertilizes an egg were given a 1 for this variable, and others a 0.⁹ This variable was also standardized and added to the first variable to create an embryonic life index. Descriptive statistics for the variables in the analyses can be found in Table 1. Since the dependent variables are ordinal categories, we estimated ordered logistic regression models (Long 1997).

RESULTS

Public Attitudes Toward Technologies and Goals

Before breaking down the response by religious group, Table 2 shows the responses toward different reproductive genetic technologies and applications for the entire sample. Table 2 shows strong disapproval for improvement objectives, but more public support for goals that could be considered health-related. For example, 71.5 percent disapprove or strongly disapprove of using prenatal genetic testing to improve the chances of having a more intelligent baby, however, 67.6 percent approve or strongly approve of using preimplantation genetic diagnosis to avoid the birth of a child with a fatal disease.

The most striking finding in Table 2 is that there is not more opposition to improvement applications or more support of health-related applications. For example, 27.9 percent approve or strongly approve of using preimplantation genetic diagnosis to ensure a baby "will have desirable characteristics such as high intelligence or strength." Examination of elite discourse would suggest a more universal condemnation of this application. Similarly, genetic testing for a fatal genetic disease is used by potential parents to avoid having children with fatal genetic diseases, yet despite

TABLE 2
FREQUENCIES OF RESPONSE, BELIEFS ABOUT REPRODUCTIVE GENETIC TECHNOLOGIES

	PGT Intelligence	PGD Intelligence	HGE Intelligence	PGT Sex	PGD Sex	HGE Sex	PGT Tissue Match	PGD Tissue Match
Strongly Approve	237 (5.1%)	237 (5.2%)	209 (4.3%)	388 (8.4%)	310 (6.8%)	226 (5.0%)	862 (18.6%)	726 (16.0%)
Approve	1,076 (23.3%)	1,027 (22.7%)	677 (14.8%)	1,988 (42.9%)	1,502 (33.1%)	905 (19.8%)	2,443 (52.8%)	2,246 (49.5%)
Disapprove	2,331 (50.4%)	2,209 (48.8%)	2,170 (47.5%)	1,552 (33.5%)	1,832 (40.3%)	2,056 (45.0%)	896 (19.4%)	997 (22.0%)
Strongly Disapprove	977 (21.1%)	1,057 (23.3%)	1,509 (33.0%)	707 (15.3%)	898 (19.8%)	1,382 (30.2%)	423 (9.1%)	570 (12.6%)

	HGE Tissue Match	PGT Adult Disease	PGD Adult Disease	HGE Adult Disease	PGT Fatal Child Dis.	PGD Fatal Child Dis.	HGE Fatal Child Dis.
Strongly Approve	587 (12.8%)	670 (14.5%)	625 (13.8%)	598 (13.1%)	1043 (22.6%)	899 (19.8%)	772 (16.9%)
Approve	1,799 (39.3%)	2,091 (45.3%)	1,995 (44.0%)	1,739 (38.2%)	2,337 (50.6%)	2,172 (47.8%)	1,842 (40.4%)
Disapprove	1,267 (27.7%)	1,392 (30.2%)	1,364 (30.1%)	1,368 (28.3%)	887 (19.2%)	998 (22.0%)	1,149 (25.2%)
Strongly Disapprove	925 (20.2%)	460 (10.0%)	534 (12.0%)	851 (18.7%)	353 (7.6%)	473 (10.4%)	799 (17.5%)

Note: PGT = Prenatal Genetic Testing; PGD = Prenatal Genetic Diagnosis; HGE = Human Genetic Engineering.

its widespread integration into medical practice, 26.8 percent disapprove or strongly disapprove of this application. One might expect more universal and enthusiastic support.

Attitudes of Participants in Religious Groups: The Conservative to Liberal Spectrum

Table 3 shows a series of ordered logistic regressions with the indices as the dependent variables. The independent variables are dummy variables representing the religious groups under analysis, with those who do not attend religious services regularly being the reference group. That is, the coefficients show the magnitude of the difference in attitudes between the religious group and all respondents who do not regularly participate in religious activities.

To interpret ordinal logistic regression models, we use cumulative odds ratios, which indicate the odds of a response or set of responses (e.g., 15 and 16 on the dependent variable) compared to the combined odds of the higher possible outcomes (e.g., 17 and higher).¹⁰ Similarly, the exact same odds ratio indicates the odds of the difference between selecting a 15 through 17 versus an 18 or higher.

As an example of the interpretation of the coefficients in Table 3, the first coefficient in the first column of coefficients shows that a fundamentalist's odds of being coded with a 15 on the overall index (most approving on all technologies), compared to a 16 or higher, is 0.35 times that of the reference group.¹¹ To conserve space, we will not regularly calculate odds ratios or interpret the regression coefficients. For the same reason we do not report the cutpoints for the models. The full results of this analysis are available from the authors.

The index including all 15 variables shows that across all five applications of the three reproductive genetic technologies, evangelicals are the most opposed, followed by fundamentalists,

TABLE 3
ORDERED LOGISTIC REGRESSION COEFFICIENTS, RELIGION
AND REPRODUCTIVE GENETICS SURVEY

Independent Variables	Dependent Variable Indices		
	Overall	Improvement	Health
Fundamentalist	1.04*** (0.158)	0.631*** (0.155)	1.09*** (0.162)
Evangelical	1.38*** (0.124)	0.928*** (0.117)	1.44*** (0.123)
Mainline Protestant	0.456*** (0.137)	0.319* (0.140)	0.428** (0.137)
Liberal Protestant	-0.067 (0.137)	-0.048 (0.139)	-0.083 (0.143)
Traditional Catholic	0.759*** (0.235)	0.410* (0.206)	0.893*** (0.212)
Moderate Catholic	0.594*** (0.152)	0.594*** (0.156)	0.519*** (0.153)
Liberal Catholic	0.424 (0.262)	0.389 (0.265)	0.318 (0.238)
Other Attender	0.627*** (0.133)	0.325* (0.130)	0.686*** (0.127)
Wald Chi-Squared	171.12	85.09	189.60
N	4,172	4,338	4,266

Note: Standard errors in parentheses. Cutpoints not shown. * = $p < 0.05$, ** = $p < 0.01$, *** = $p < 0.001$.

traditionalist Catholics, moderate Catholics, and mainline Protestants. Liberal Catholics and liberal Protestants are not different from the reference group. In this rank order of degree of opposition, not all of the religious groups are statistically distinct in their response. The following groups are distinct in their ranking of opposition using a chi-squared test (0.05 level of significance): fundamentalists versus mainline Protestants, liberal Protestants, Catholic moderates, and Catholic liberals; evangelicals versus every group but fundamentalists; mainline Protestants versus liberal Protestants; liberal Protestants versus traditionalist Catholics and moderate Catholics. However, as a generalization, the rank order of opposition stated at the beginning of this paragraph holds. The rank orders for the health¹² and improvement¹³ indices are broadly similar.

H1 is therefore supported in that evangelicals, traditionalist Catholics, and fundamentalists are the most opposed, mainline Protestants and moderate Catholics are less opposed, and liberal Protestants and liberal Catholics are the least opposed. That is, the degree of opposition to reproductive genetic technologies by religious groups in the United States is consistent with the pattern found in the abortion debate.

The Impact of Beliefs about Embryonic Life

In the following analyses, we add the beliefs about embryonic life index to each of the models in Table 3 to see if the differences between the groups of different religious attenders and the nonattending public remain (labeled Model A in Table 4).

The first column of coefficients in Table 4 predict attitudes toward all of the technologies and applications, and here we see that the life variable is a significant predictor. The addition of this variable to the model does lessen the impact of the religious identity dummy variables, particularly those representing the conservative religious traditions. Yet, each remains statistically significant, suggesting that beliefs about embryonic life do not wholly explain attitudes toward reproductive genetic technologies. Hypothesis 2 is not supported.

The Impact of Demographics

It is possible that the relationship between religious identity and attitudes toward reproductive genetic technologies is not the result of the view of embryonic life, but a demographic characteristic that is merely associated with religious identity. Or, alternatively, attitudes toward reproductive genetic technologies could be structured by the respondents' knowledge or lack of knowledge of the technology. To test this hypothesis, we added the knowledge index and the demographic variables to each of the A models to create the B models. While many of these demographic variables have strong effects, none significantly reduce the impact of religion on the dependent variables. Clearly, there is much more to religious opposition to reproductive genetic technologies than the view of embryonic life, knowledge of the technology, or demographics. Therefore, Hypothesis 3 is not supported.

Do Different Religious Groups Have Different Views of Suffering?

Hypothesis 4 predicts that the groups opposed to the technologies, which we have already identified as the religious conservatives, will have a greater difference with the nonreligious for the health objectives than the improvement objectives. The test of this hypothesis is whether the coefficients in the health model for each religious group are larger than the same coefficients in the improvement model. Traditionally, this comparison would be hampered by the fact that the dependent variables have different ranges. However, methodological innovation in social statistics has led to a new procedure, seemingly unrelated estimators, which allows this comparison to occur (Stata Corporation 2003:126–47). Comparing the latter two “B” columns in Table 4, we see that the effect of being a fundamentalist, evangelical, or traditionalist Catholic is much larger

TABLE 4
ORDERED LOGISTIC REGRESSION COEFFICIENTS. RELIGION
AND REPRODUCTIVE GENETICS SURVEY

Independent Variables	Dependent Variable Indices					
	Overall A	Overall B	Improvement A	Improvement B	Health A	Health B
Embryonic Life Index	0.178*** (0.025)	0.178*** (0.026)	0.142*** (0.023)	0.138*** (0.024)	0.173*** (0.026)	0.175*** (0.026)
Fundamentalist	0.781*** (0.163)	0.740*** (0.176)	0.430** (0.154)	0.411* (0.163)	0.850*** (0.166)	0.800*** (0.178)
Evangelical	1.15*** (0.132)	1.18*** (0.137)	0.745*** (0.124)	0.738*** (0.128)	1.22*** (0.132)	1.26*** (0.136)
Mainline Protestant	0.387** (0.139)	0.399** (0.137)	0.261 (0.141)	0.277* (0.139)	0.361* (0.141)	0.398** (0.143)
Liberal Protestant	-0.113 (0.137)	-0.026 (0.140)	-0.067 (0.138)	-0.034 (0.144)	-0.156 (0.145)	-0.063 (.146)
Traditional Catholic	0.528* (0.236)	0.499* (0.234)	0.221 (0.217)	0.244 (0.220)	0.675** (0.211)	0.616** (0.209)
Moderate Catholic	0.421** (0.151)	0.393* (0.157)	0.440** (0.154)	0.412** (0.158)	0.366* (0.154)	0.351* (0.160)
Liberal Catholic	0.318 (0.264)	0.282 (0.258)	0.295 (0.260)	0.159 (0.256)	0.217 (0.239)	0.257 (0.236)
Other Attender	0.497** (0.134)	0.526*** (0.134)	0.231 (0.132)	0.250 (0.131)	0.554*** (0.128)	0.585*** (0.127)
Knowledge Index	-	-0.211*** (0.038)	-	-0.114** (0.038)	-	-0.238*** (0.037)
Age	-	-0.003 (0.002)	-	-0.007** (0.002)	-	-0.001 (0.002)
High School Educ.	-	0.215 (0.131)	-	0.347** (0.126)	-	0.113 (0.127)
Some College Educ.	-	0.217 (0.129)	-	0.405** (0.127)	-	0.070 (0.127)
College Educ.	-	0.327* (0.135)	-	0.570*** (0.133)	-	0.085 (0.132)
Female	-	0.203** (0.073)	-	0.455*** (0.073)	-	-0.004 (0.071)
White	-	0.255** (0.083)	-	0.380*** (0.081)	-	0.128 (0.080)
Has Biological Child	-	0.166 (0.085)	-	0.274** (0.083)	-	0.051 (0.084)
Has Adopted/ Step child	-	0.095 (0.149)	-	0.112 (0.140)	-	0.059 (0.146)
South	-	-0.213** (0.077)	-	-0.261*** (0.076)	-	-0.148* (0.075)
Wald Chi-Squared	227.87	278.05	116.24	220.70	244.89	285.41
N	4,107	4,078	4,265	4,236	4,198	4,168

Note: Standard errors in parentheses. Cutpoints not shown. * = $p < 0.05$, ** = $p < 0.01$, *** = $p < 0.001$.

for the “health” index than the “improvement” index. At the 0.05 level of significance, an adjusted Wald test shows that the coefficients for fundamentalists, evangelicals, and traditionalist Catholics are different across the two models, but the coefficients for the other religious groups are the same (not shown). H4 is supported for the religiously conservative groups that are also those most opposed to the technologies.

DISCUSSION

Examination of data from the first U.S. public opinion survey of religion and reproductive genetic technologies finds that religious opposition is structured in a similar manner as the abortion debate, with evangelicals, fundamentalists, and traditionalist Catholics being the most opposed compared to those who do not participate in religious activities; and liberal Protestants and liberal Catholics the least different in view to those who do not participate in religious activity. Attendance in any religious tradition (except liberal Protestantism and liberal Catholicism) makes one more disapproving of reproductive genetic technologies.

The temptation is to say that the rank order of opposition is the same as in the abortion debate because both abortion and reproductive genetic technologies involve the destruction of embryos or fetuses. However, this study shows that beliefs about embryonic life (as well as demographics and knowledge of the technology) do not account for the differences between these groups of religious attenders and the nonattending public. This means, for example, that irrespective of whether an evangelical is highly concerned or unconcerned with embryonic life, they are more likely to oppose these technologies than nonreligious participants.

Given that opposition to reproductive genetic technologies does not seem to be determined by view of embryonic life or demographics, we tested one additional hypothesis: that a differential importance given to healing disease leads to an overall opposition to these technologies. Here we found that religious conservatives, who are also those least supportive of the technologies in general, are the most different from the nonattending respondents on the “health” objectives. This suggests that for religious conservatives, a disconnect with the secular arguments occurs in the area of the meaning of suffering and the relief of disease.

While we could test the embryonic life and suffering theses, there of course remain many other explanations for why the actively religious in conservative religious traditions are different from the nonreligious. The religious could feel that reproductive genetics are not within the legitimate power of humans, but rather should be “left to God.” Given concerns at least within the Christian traditions under examination in this article about universal treatment of all persons, it is possible that the religious are more opposed because they think that reproductive technologies will form new forms of inequality. We hope future research will examine these possibilities.

Of course, these are cross-sectional data, so there is some ambiguity of the causal direction of the various effects. While it seems unlikely that views of reproductive genetics would determine one’s religious affiliation, it is more possible that one’s views of reproductive genetics would determine one’s views of embryonic life. That would be the inverse of the causal story we are assuming in this article.

However, in this case, views of embryonic life seem prior to views of reproductive genetic technologies because very few people had thought much about the latter until they were educated on the subject by the interview. Embryos, on the other hand, have been the subject of public debate for decades now, and the focus of discussion in many religious communities. Therefore, in this instance, it seems reasonable that the causal direction is from views of the embryo to views of reproductive technologies.

Implications for Public Debates

The implication of these findings for the public debate is that the policy positions of the religious elites who are mobilizing against these technologies are generally in tune with the

attitudes of their natural constituency. However, the motivating reasons for the conclusions about the technologies may be off. If their message is solely focused upon embryonic life, this is not the only factor that influences religious conservatives' views. These leaders would be advised to consider what else about these issues motivates their followers. Our research suggests one possibility: differential views of the importance of healing diseases.

Also, the fact that this debate is not only about embryonic life suggests that the debate may not be as polarized as the abortion debate. In their study of polarization in attitudes on social issues, DiMaggio and his colleagues found that the only issue where polarization had occurred was over abortion (DiMaggio, Evans, and Bryson 1996). People's attitudes have crystallized as some organized groups have spent many resources teaching the public one of two polarized perspectives on the issue. If people's views on embryonic life have become fixed and uncompromising, then debates that are about embryonic life will likely be stalemated. However, since the debates about reproductive genetic technologies are clearly about some other feature or features of the technology, perhaps the debate will be more open and fluid.

Supporters of these technologies should be aware that while the religious elites seem to be in line with their members in the orientation toward the technology itself, they are not in tune with the reasons for the opposition. It may well be that the actual reasons for opposition, once identified, may ultimately be negotiable for the advocates of reproductive genetic technologies (unlike the seemingly nonnegotiable abortion debate). However, advocates should be aware that they will likely face opposition on the health objectives from religious conservatives, even though these are considered the least problematic within the medical community.

If social critics are correct, we are embarking on a long political conflict over what some have called the new eugenics. The earliest debates are seemingly between the religiously oriented and everyone else. These data support that view. However, the views of the average religious member are clearly complex. Most notably, this debate is not necessarily only about embryonic life. Future scholars should identify those factors to ensure a debate that may not be harmonious, but may be better from knowing what is actually at stake for the various groups.

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NOTES

1. PGD can be used to test and select embryos such that the resulting child will be an immunological match to an older sibling sick with a disease that can be treated with tissue donation. Usually, blood from the baby's umbilical cord is used to treat the sick sibling. This blood contains stem cells and collecting it does not harm the donor baby.
2. For example, see the materials of the U.S. Conference of Catholic Bishops, available at <http://www.nccbuscc.org:8765/>.
3. Available at <http://www.sbc.net/redirect.asp?url=http://www.forfaithandfamily.com/>.
4. A 1998 paper summarizes opinion change over time in attitudes toward genetic testing, genetic modification, and gene therapy using commercial polls, without attempts to determine the variables that predict certain responses. They find little change in awareness or attitudes (Singer, Corning, and Lamias 1998:635). Bane and her colleagues later engaged in a very similar study, with similar results (Bane et al. 2003).
5. As a generalization, we can say that evangelicals and fundamentalists are exposed to anti-abortion discourse. Catholicism is a more complicated matter. While Catholicism is officially unified into one organization, it is actually a confederation of diverse subgroups. While the church hierarchy definitely sends the anti-abortion messages out to the universal church, people self-select into parts of the church where these communications will or will not be emphasized. For example, if you were a liberal Catholic, you would attend a liberal parish, perhaps run by Jesuits. If you are a traditionalist Catholic, you would attend a congregation that focuses much more tightly on fidelity to Rome. Therefore, while Catholicism is one "denomination," we separate respondents by their further self-identity as traditionalists, moderates, and liberals.

6. Knowledge Networks has created a series of papers for reviewers that discuss method, representativeness, and the construction of weights. See <http://www.knowledgenetworks.com/ganp/reviewer-info.html>). For a list of all of the technical papers, see <http://www.knowledgenetworks.com/info/press/papers/KNBibliography080403.pdf>. While this method does not have as long a history as standard random-digit dial, the conclusion so far seems to be that the Knowledge Networks method is equally good as the alternatives.
7. The Religion and Politics Survey, available at www.thearda.com. The survey was conducted between January 6 and March 31, 2000. The Knowledge Networks survey had 2.1 percent more fundamentalists, 2.1 percent more evangelicals, 0.3 percent more mainline Protestants, 1.1 percent more liberal Protestants, 1.4 percent fewer traditional Catholics, 2.1 percent fewer moderate Catholics, 0.3 percent more liberal Catholics. Of course, there is no way of telling which survey is a true measure of religious preference in the United States.
8. (1) Prenatal genetic testing: genetic testing that is done during pregnancy to find out if the fetus has or is likely to develop certain inherited diseases or characteristics. Test results may be used to help parents prepare for the birth of that child or make a decision about terminating the pregnancy. (2) Preimplantation genetic diagnosis: genetic testing that is done on embryos produced through *in vitro* fertilization before they are transferred to a woman's womb. Based on the test results, parents can select which embryos to transfer into the woman's womb. For example, they may want to select only embryos with no genetic diseases, those of a specific sex, or those that have other characteristics. Leftover embryos may be discarded, frozen, and stored for future use, donated to other couples, or used for research. (3) Genetic modification: a technique to change the DNA or genes of a person in order to produce particular inherited characteristics.
9. The other choices were: life begins before a sperm fertilizes an egg, life begins when an embryo implants in the uterus or womb, life develops as a continual process from fertilization to birth, life begins when a mother feels the fetus move, life begins when a fetus could survive outside the mother's womb, life begins at birth. While the response "life begins before a sperm fertilizes an egg" references a time for life to begin "before" the response we are focusing on of "life begins when a sperm fertilizes an egg," we do not include this in the dummy variable. This is because those who hold the embryo to be sacred do not consider the former response to be "life." In fact, we interpret the former response as more liberal than the latter, indicating a belief in a great circle of life. If we look, for example, at the mean response of people who pick this category on the overall RGT index, we see that they are indeed more liberal than those who pick the response "when a sperm fertilizes an egg."
10. Each coefficient can be translated into an odds ratio by calculating the exponent of the negative value of the coefficient (Long 1997:139). That is: Odds Ratio = e^{-B} .
11. $0.35 = e^{-1.04}$.
12. The following differences in the magnitude of coefficients are significant at the 0.05 level via a chi-square test: fundamentalists versus mainline Protestants, liberal Protestants, Catholic moderates, and Catholic liberals; evangelicals versus every group but fundamentalists; mainline Protestants versus liberal Protestants; liberal Protestants versus traditionalist Catholics and moderate Catholics.
13. The following differences in the magnitude of coefficients are significant at the 0.05 level via a chi-square test: fundamentalists versus liberal Protestants; evangelicals versus traditionalist Catholics, mainline Protestants and liberal Protestants; mainline Protestants versus liberal Protestants; liberal Protestants versus moderate Catholics.

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