Stem Cell Research, Regulatory Regimes, and the "Calculus of Consent" in the European Union: A Test of Three Hypotheses

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Abstract

What factors affect the decisions of Europeans either to support or oppose the development of human embryonic stem cell (hESC) research? This study tests the validity of three major hypotheses from the biotechnology literature that have significant implications for the strategies and tactics of regulatory agencies: the "risk assessment discourse," "institutional context," and "information" hypotheses. Ordered logit analysis of the responses of Europeans to a 2005 Eurobarometer survey on biotechnology supports and refines the risk assessment discourse hypothesis: respondents reporting higher levels of religiosity (more so than denomination) were a key determinant of European attitudes, and concern for the moral status of the fetus was even more powerful. It also offers support for the institutional context hypothesis: respondents with greater trust in the European Union and national hESC regulatory systems reported greater support for hESC research. Untangling the information hypothesis, analysis suggests Europeans who value the more cognitively driven print media over the less in-depth and more emotion-inspiring electronic media (TV and radio) as a source for their information offer substantially more support for hESC research. Analysis also indicates that Europeans who are more interested in politics, as well as the more highly educated (both indicators of "chronic" information"), are for the most part more supportive of research, while those who report that they "keep up-to-date" on biotechnology ("domain-specific" information) are strongly supportive of hESC research. Nevertheless, those who are objectively more knowledgeable about the subject actually exhibit less consistency in their support. The implications of these findings are significant for biotechnology regulatory agencies and theory building in Europe and beyond.

> *If human life is viewed as disposable in its early stage, it will be regarded as disposable at a later stage of development also.*
>
> *My main fear is that we will create barriers of regulation and bureaucracy that will prevent the potential that stem cells hold out for very serious diseases being realized.*
>
> —Comments of conference attendees
> (European Commission 2002, 13)

As attested to by the above quotations from attendees of a 2001 Discussion Platform sponsored by the European Union's (EU) Life Sciences High Level Group, passionate disagreements exist among Europeans over the appropriate techniques, purposes, and ethics of human embryonic stem cell (hESC) research. For proponents of therapeutic cloning, hESC holds immense potential to treat some of world's most debilitating neuro- and tissue-degenerative diseases, injuries, and maladies. These include Parkinson's disease, Alzheimer's disease, amyotrophic lateral sclerosis (Lou Gehrig's disease), diabetes, burns, heart disease, rheumatoid arthritis, and multiple sclerosis. Supporters of hESC research also foresee the day when body organs (hearts, livers, and kidneys) can be grown to replace diseased or injured ones, thus alleviating both shortages of organ donors and rejection of transplants. Moreover, they hold out the hope that hESC research might overcome the limitations of existing bone marrow transplant techniques using adult stem cells. These limitations include exposure of patients to toxicity risks and donor shortages. Proponents also frame hESC research issues in terms of the immorality of not taking all steps possible to reduce human suffering.

Opponents in Europe and the United States also frame their opposition in what proponents consider moral and emotional terms. They advocate that research be limited in various ways in order to avoid needless suffering—in this case, for innocent embryos and treatment recipients. They claim that other approaches are available which do not involve the

killing of innocent embryos, and thus progress need not be halted. Opponents also point to profound moral and ethical issues that go beyond embryos to include the risks to humans of experimentation and of gene therapy research trials and applications (Weiss 2007). They also charge that proponents underestimate the challenge of bringing a biological revolution to fruition (International Society for Stem Cell Research 2007), and thus both terminate embryonic life and unethically raise persons' hopes for quick cures that may never arise (Science, Not Speculation 2007).

All this begs the question of how European citizens make their decisions on whether to support hESC research and applications. This is an important question for regulatory agencies in this policy arena and perhaps for biotechnology regulation more broadly. In attempting to assess the calculus of consent of hESC research in Europe, we are especially concerned with testing the relative explanatory power of three major theoretical propositions from the biotechnology literature. The first—the "risk assessment discourse" hypothesis (Kearnes et al. 2006)—posits that the Western cultural predisposition to privilege scientific knowledge at the "top of a hierarchy of ways of knowing" is too narrow a focus for regulators (Mellor 2003, 509). They must appreciate that "new technologies often operate as nodal points around which wider public concerns condense" (e.g., anti-corporatism, fear of risks that persons cannot control, and religious beliefs) (Kearnes et al. 2006, 303). If validated in the hESC research area, this hypothesis means that regulatory agencies need to afford more than "good science" explanations and that they need to direct their messages at different target populations.

The second—or "institutional context" hypothesis—posits that citizens who oppose hESC are not so much risk intolerant but rather fear that regulators do not have the capacity and inclination to protect public safety as research advances. Absent the will or the wherewithal to

offer protection to citizens as research progresses, they lean instead toward protecting economic interests over public safety (Marris et al. 2002). Support for this hypothesis would be indicated if faith in the capacity of regulators to prevent harms to citizens led to greater citizen support for hESC research. This, in turn, would suggest that a focus of corporate, government, scientific, and layperson proponents of hESC research would be to ensure regulatory capacity. It would also suggest that regulatory agencies would afford sufficient transparency and would gear communications strategies toward building faith in their operations.

The third—or "information" hypothesis—suggests that the extent, sources, and types of citizens' information on hESC research will affect their support for hESC research. Proponents of hESC argue that citizens who know more about the science of hESC are more likely to support it, as are citizens who get most of their information from print media (newspapers and magazines) rather than from the electronic media (radio, television, and Internet). The print media have more in-depth coverage of issues such as hESC research than do TV and radio, and their culture tends to afford opposing views on issues. At the same time, radio and television also tend to tap into and provoke more emotional and less thoughtful responses (especially with the use of pictures and music) than the print media (Durant 1995; Pearce 1995; Rosen and Taylor 1992). Likewise, the Internet is plagued by information of uneven quality and the selective attention of web users to outlets sharing their views. The same also occurs, of course, with television and print media because of the segmented nature of their markets. Listeners tend increasingly to turn to electronic media sources that reinforce their own positions on issues rather than afford them balanced perspectives. If true, this hypothesis has significant implications for the amount, type, and targets of information that regulatory agencies must cope, address in their

regulatory efforts, and use strategically to build citizen confidence in their commitment to regulation. .

We test these hypotheses in the hESC policy arena by applying ordered logit analysis to responses by European citizens to a 2005 Eurobarometer survey. While Eurobarometer surveys are frequently conducted, the 2005 survey is the most recent Eurobarometer survey that uses questions suitable for operationalizing variables associated with all three hypotheses we are testing. To place the analysis in the social, political, and regulatory context of survey respondents, the study begins by reviewing the history of European hESC regulatory regimes prior to the 2005 survey. Offered next is a tested model for assessing the "calculus of consent" for hESC research in the EU. The paper concludes by considering the implications for future practice and research of the regulation of hESC biotechnology in Europe and elsewhere.

Stem Cell Research, the Science-Morality Nexus, and the EU Regulatory Maze

Between 1981 and 1998, the only type of stem cell research available to scientists involved mice and animal embryos. This changed in 1998 when separate teams of researchers at the University of Wisconsin and The Johns Hopkins University isolated hESCs. From a purely scientific perspective, the appeal of hESC is rooted in the unique pluripotentiality of embryonic stem cells. As opposed to adult stem cells that are already differentiated and headed to becoming fully specialized to fulfill a particular function (e.g., livers or kidneys), embryonic stem cells (those 8 weeks old and younger) still have the potential to produce any cell type found in the body. As such, they hold the promise of advancing therapeutic cloning: regenerating tissues and organs that are deteriorating, malfunctioning, or already failed. They also offer the possibility that persons may one day create and store their own cultured cells to regenerate or replace failed or failing organs and tissues, thus enhancing both quality and duration of life.

Not unlike in the United States, however, critics in Europe have charged that proponents underestimate the challenge of bringing to fruition their promises of a biological revolution. In the process, they attack proponents for overselling (or at least not disabusing citizens of their impression) the idea that breakthroughs are right around the corner. Even proponents concede that "stem cell research of all kinds has the potential to improve millions of lives, but no one can know exactly how, when or for what ailment" (Science, Not Speculation 2007). Specifically, critics point to outstanding obstacles related to differentiating stem cells from adult cells, finding the right conditions for cell differentiation, and avoiding uncontrollable cells that may grow into tumors. Also challenging is ensuring that stem cells are integrated into a recipient's natural cell processes (e.g., cardiac or brain cells may not beat in rhythm with a recipient's natural heart rate or be integrated appropriately into brain cell circuitry) (International Society for Stem Cell Research 2007). Opponents also counter that other promising alternatives exist or will exist in the future—including adult stem cell research, placental cord blood and cells, and future breakthroughs. Thus, a rush to research that does not respect human life as they define it is avoidable.

Further framing these European debates was that respect for human life and freedom of research inquiry have disparate national constitutional bases. Prior to 2000, for example, the Austrian Constitutional Court decided that the European principle of respect for life did not apply to embryos, while Germany treated the embryo as a human being. Nor was there always policy consistency within nations between positions on abortion and hESC research. France, for example, had liberal policies when it came to abortion and in vitro fertilization (IVF) but forbade embryo research. Yet, in Germany, a consistency grounded in its unique history drove positions on embryo research: "religion and a profound commitment to respect for natural processes,

combine[d] with the need to reject the Hitler regime's degradation of human life [to] contribute to a strict prohibition of embryo research" (Science, Not Speculation 2007).

Not everything about hESC research, however, was left to individual nations. In the 1990s, two key pan-European initiatives affected debates over embryo research in that era (and continue today). In 1992, for example, the European Group on Ethics in Science and New Technologies (known as the EGE) was created to advise the European Commission, the EU Parliament, and the EU Council of Ministers on ethical dimensions of scientific applications. The EGE did not call for a ban on EU funding during that era (nor has it since), and argued that harmonization of hESC research was not possible because of differences in views over its morality. Likewise, a 1998 regulation on the Legal Protection of Biotechnological Inventions prohibited the patenting of embryos as incompatible with European principles against the commercialization of the human body. In addition, the Council of Europe's Convention on Human Rights and Biomedicine precluded the creation of embryos for research purposes (in the late 1990s, the technique was limited largely to reproductive technology). Then, in September 2000, after the 1998 American breakthrough in hESC research, the EU expressed its opposition to therapeutic and reproductive cloning. In that action, the EU claimed that both techniques "irreversibly cross[ed] a boundary in research norms" that was contrary to accepted EU policy (European Parliament 2000).

With both the Convention on Human Rights and Biomedicine and the EGE eschewing efforts at harmonization, however, highly disparate hESC regulatory regimes sprung up in EU countries. By October 2003, three EU nations—Italy, Luxembourg, and Portugal—lacked specific legislation dealing with hESC research. Of those EU countries that had hESC research regulatory regimes, the United Kingdom (UK) and Belgium were the most promotional of the

technique, controversially allowing researchers to create human embryos for stem cell harvesting. At the other end of the spectrum, four EU countries—Austria, France, Ireland, and Spain—had bans on the procurement of stem cells from human embryos. Taking more mixed approaches, Germany prohibited stem cell harvesting from human embryos but joined Belgium in allowing the import of embryonic stem cell lines from other nations. Meanwhile, the use of supernumerary embryos (those left over from IVF) was allowed by Belgium, Denmark, Finland, Greece, the Netherlands, Sweden, and the UK.

Meanwhile, at the EU level, debates over funding grants for hESC research have been no less charged, divisive, and acerbic. In the context of the EU's Sixth Framework Programme (FP6), for example, the EU Commission proposed a regulatory regime predicated on the source of embryos (whether they were donated, supernumerary, aborted, or cloned) and the date of their creation. Under the proposal, EU grants for hESC research were limited to projects involving stem cell lines derived "from human embryos created as a result of medically-assisted in vitro fertilization designed to induce pregnancy and were no longer to be used for that purpose (supernumerary embryos) and created before 27 June 2002, the date of approval of the overarching Framework Programme 6." Taking the side of research scientists, however, the European Parliament dropped the time criterion and expanded sources to include embryos by spontaneous or therapeutic abortion. This proved unacceptable, however, to the European Council of Ministers, meaning that a moratorium on hESC research expired without any clear guidelines. Thus, by default, hESC funding by the EU for therapeutic cloning was not allowed, grants were permitted for research using supernumerary embryos, and funding involving research on donated and aborted embryos was left in legal limbo.

The impassioned debate over hESC research continued until a now-expanded EU, incorporating Eastern European nations, agreed in July 2006 not to issue a broad ban on stem cell research. This disappointed hESC research proponents who worried (among other things) that pan-European cooperation on research would be difficult without harmonization of national laws, thus stymieing progress that advocates hoped would afford Europe a competitive advantage over the United States. The UK and Sweden, for example, remained the most aggressive promoters of hESC research. While forbidding reproductive cloning, both allowed the use of supernumerary embryos, the destruction of embryos to find new stem lines, and the creation of embryos through somatic cell nuclear transfer. By 2005, Sweden formalized ethical guidelines for hESC research and legalized therapeutic cloning. At the most restrictive extreme, Germany banned the importation and derivation of stem cell lines (thus limiting researchers to those identified before January 2002), while the Italians banned either creating or destroying embryos (but did not enact specific regulations regarding hESC research).

Data and Methodology

To test the three major hypotheses of interest with their implications for regulatory agencies in the hESC policy domain—the risk assessment discourse, institutional context, and information hypotheses—we developed and tested empirically a theoretically grounded model of citizen support for hESC. The data are from the 2005 Eurobarometer Survey (63.4) (Papacostas 2007) collected in November-December of that year. Respondents were drawn from multistage probability samples from: Belgium, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Slovakia, Slovenia, and Spain.[1]

Four dependent variables were selected that attempt to measure respondents' attitudes

toward stem cell research. In the first, respondents were asked:

Overall, which of the following best captures your views about research using embryonic stem cells?

Possible responses were: 4 = approval, as long as the usual levels of government regulation are in place; 3 = approval of stem cell research if it is more tightly regulated; 2 = don't know; 1 = disapproval except under special circumstances; 0 = disapproval under any circumstances.

Perhaps the most controversial aspect of the debate on stem cell research concerns the fact that the cells are most frequently gathered from embryos. In this process, the embryos are destroyed. Utilizing the same coding and response set for the more general question, a second dependent variable was tested with an alternative scenario.

…Suppose scientists were able to get all the stem cells they need for research from umbilical cords and no longer had to get them from embryos. Which of the following would best capture your view?

Two other dependent variables were assessed, also utilizing a 0-4 coding that represents, in order, 4 = totally agree; 3 = tend to agree; 2 = don't know; 1 = tend to disagree; 0 = totally disagree.

Stem cell research will help with cures and treatments for serious diseases.

We have a duty to allow research that might lead to important new treatments, even when it involves stem cells from human embryos.[2]

Because these dependent variables consist of ordered categories, ordinary least squares (OLS) regression analysis is inappropriate. Instead, we utilize ordered logit analysis, which corrects the problems of inefficient and biased estimates. With OLS regression, where the dependent variable is continuous, coefficients are generally unbiased and consistent. But with a discrete dependent

variable, OLS produces estimates that are lacking because relationships are not linear.

The Ordered Logit Model

It is useful to consider the independent variables in our model as they relate to the three hypotheses under investigation.

The Risk Assessment Discourse Hypothesis

We also believe that yet another nonscientific value—religion—will play an important part in determining attitudes toward stem cell research, thus also displacing science at the top of the discursive model of risk assessment. The Roman Catholic Church is opposed, institutionally, to stem cell research, since it is the Catholic belief that human life begins at conception. As on a number of biologically related issues such as contraception and abortion, the beliefs of the larger lay community of Catholics (both practicing and non-practicing) do not always mirror the precepts of the Holy See. Nevertheless, we created a variable indicating 1 = Catholic, 0 = non-Catholic. A similar binary variable was created for the Eastern Orthodox Church (1 = Eastern Orthodox, 0 = non-Eastern Orthodox), as members of this religion also tend to be "pro-life." Instead of denomination, it is also possible that religiosity may be a more important predictor. The greater the religiosity (measured in terms of religious service attendance), the less likely a respondent will support stem cell research. We also added a variable questioning whether the respondent believes the embryo is a human life at the point of conception. In essence, this variable would also capture the influx of Islamic immigrants into EU countries. We hypothesize that the greater the degree of religious observance, and the more strongly an individual agrees that the embryo is a human being, the greater the opposition to stem cell research.[3]

We also expect that perceptions of "globalization" of the economy may affect attitudes toward stem cell research. While many oppose stem cell research on moral grounds, others may

view it as an economic opportunity for themselves or their nation afforded by biotechnology. Also, multinational firms will inevitably be involved in the production of hESC technologies. Thus, as noted, some in Europe (including many scientists) worry that biotechnology and, hence, the development of new treatments that might emerge will be produced in other parts of the world or other European nations. And, politically, they worry that should, for example, a cure for Parkinson's disease be found, it will be impossible to stop the importation of these breakthroughs into a nation that bars hESC research. Under these circumstances, the market and price for these breakthroughs will be set by other nations or non-Europeans, with none of the financial benefits or scientific acclaim accruing to nations with prohibitions against hESC research. Conversely, some Europeans may simply have anti-corporate attitudes and fear that hESC research will inordinately benefit the bottom line for corporations. Respondents were asked to choose what is most important: "having strong European companies to compete in global markets" or "reducing inequalities among people in Europe." We hypothesize that the greater the sentiment for ensuring that EU companies are competitive globally, the more likely individuals will support stem cell research.

Also consonant with the risk assessment discursive hypothesis, we included ideology in the ordered model. The political science literature suggests that individuals often utilize ideology or party preference as cues when they confront a difficult issue and have no clear-cut opinion on a subject (Huckfeldt et al. 1999; Zaller 1992). This raises the possibility of "information" shortcuts (Lupia 1992, 1994) or "heuristics" where individuals do not have to possess complete information to reach a preference. We believe that those who identify with the "Right" side of the political spectrum will be less likely than those on the "Left" to approve stem cell research. The primary reason behind this hypothesis is that conservatives are more put off by the

destruction of embryonic stem cells than liberals, who believe that the potential gains in health outweigh protecting embryos.[4]

The Institutional Context Hypothesis

Also consistent with the institutional context hypothesis, we posit that trust in regulatory authorities is an important factor in determining respondents' assessments of hESC. During the 1990s and beyond, Europeans have faced a number of health crises in which their beliefs in the efficacy of government actions have been tested. These include tainted meat, contaminated blood, and doubts about the quality of foods, especially genetically modified organisms. Both national governments and the EU in Brussels have been frequently criticized for the inadequate protection of health. Moreover, as noted, there exists a growing body of literature suggesting that low levels of trust in government in European regulatory structures and processes, rather than irrationality or Luddite attitudes, explain European concerns with biotechnological advances (Ferretti 2007; Marris et al. 2002; Wynne 2001). These scholars see "institutional trust" (i.e., trust in government) as either trumping or nesting "calculative trust" (i.e., cost-benefit calculations regarding risk) within it. Consequently, we also posit that those who have more faith in their own national government and the EU to do a "good job in making regulations about biotechnology" will be more supportive of stem cell research than others who do not.

Also related to institutional trust, stem cell research inevitably involves the opinion of experts, despite opposition that seeks to thwart the practice based solely on moral or ethical grounds regarding embryo use. But addressing health problems using hESC requires significant, difficult, and uncertain advances in technical and scientific knowledge. Many lay and secularly oriented citizens will trust their own instincts on stem cells or have an aversion to the scientific enterprise on methodological, scriptural, or moral grounds. Indeed, what some refer to as a

populist movement against science is prevalent today (Brown 1993; Collins 2006). Thus, although many lay citizens will trust their own instincts on stem cells, we hypothesize that those who believe "decisions about the new technology should be based mainly on the advice of experts" will be more apt to support stem cell research than respondents who believe that such decisions "should be based mainly on the general public's view."

The Information Hypothesis

We additionally test hypotheses related to respondent information and culled from the literature on public opinion. A great deal of public opinion literature also exists regarding how information types affect citizens' policy and electoral preferences (Alvarez and Brehm 1995, 1997, 1998; Bartels 1986, 1996; Lupia 1992, 1994; Wolpert and Gimpel 1997). But uncertainties remain about the relative effects of chronic (general) and domain-specific (policy-specific) information on policy and electoral choice generally, and on biotechnology more specifically. As developed by Alvarez and Brehm (2002), chronic information is of a general nature. An individual's level of education is frequently used as a surrogate to determine the amount of information an individual receives concerning a policy issue. In addition, the educated are more likely to consult the media, discuss complex issues with citizens of similar backgrounds, and formulate a firm opinion on a subject. Similarly, the educated are more apt to be able to take advantage of the health or commercial benefits that hESC can provide. Accordingly, we expect that the educated are more likely to be supportive of stem cell research.

A second chronic information variable is the extent to which a respondent is "interested" in politics. In general, we believe that those who report that they are interested in politics will be more likely to understand political and policy issues, spend more time pondering their implications for society, and be less conflicted about them than others who say they are not as

current on issues generally. Consequently, we posit that those who take more of an interest in politics are more likely to be positive in their views toward hESC research.

A second category of information is domain specific, as categorized by Alvarez and Brehm (2002). Domain-specific information is related directly to the policy in question. We have four measures of domain-specific information. The first is self-reported and measures whether an individual is "up-to-date on biotechnology." Based upon reasoning analogous to the "interest in politics variable," we believe those who state that they are current on biotechnology issues are more likely than others to be supportive. Because of the self-reported nature of this question, we characterize it as "soft" information. Also employed is an objective, true/false knowledge measure concerning stem cells. Specifically, EU citizens were asked to assess the truth/falsity of the following statement:

Embryonic stem cells have the potential to develop into normal human beings.

While this is not the objective of hESC research, the statement is true and was answered correctly by 51 percent of respondents (coded "1") (Gaskell et al. 2006, 59). Those who stated that the sentence was false or who admitted they did not know were coded "0." Because this measure is objective, we characterize it as "hard" information.

Finally, we test two variables regarding the sources of information. These operationalize the well-established argument that respondents who value and obtain their information from the electronic media are less likely to support biotechnological innovations than those who rely on the print media. As noted, the less in-depth, analytical, and more emotive electronic media afford less information about the complexity of risk/benefit tradeoffs and thus preclude the more cerebral evaluation that biotechnology proponents say is required to gain support. To be sure, and as noted in the introduction to this paper, both proponents and opponents of hESC appeal to

emotions (e.g., killing infants or ending grandparents' dementia). Our point is that the print media is more likely than the electronic media to convey the more complete picture of the pros and cons for respondents to weigh.

First, we assess the effects of newspaper and magazine reporting on attitudes regarding biotechnology research generally. There was no specific question dealing with stem cell research. However, perceptions about the value that respondents give to various information sources on biotechnology are a good proxy measure for hESC. We then determine the effect of TV reporting. Those who believe that the media are "doing a good job for society" in reporting about biotechnology were coded "1" with a "0" code for all others. We hypothesize that positive opinions about the reporting of magazines and newspapers will be predictive of more support than a favorable view about TV reporting. This is because newspaper and magazine articles on biotechnology issues in general, and on hESC research in particular, are likely to be more informative than the shorter, and probably more emotion-inducing, reporting that occurs on television.

Control Variables

Attitudes toward stem cell research are not developed in a vacuum. They are socially embedded. Thus, citizens should be influenced by government policies and cultures in the nations of residence.[5] For example, citizens in the UK and Sweden may be more likely to be supportive of stem cell research than those in other European nations simply because their governments have had a much less restrictive policy (Hauskeller 2004). In addition, the British and Swedish governments and their biotechnology industries have invested much more heavily in hESC than others. Thus, the UK and Sweden serve as points of comparison to all other nations.[6] If significant positive coefficients are estimated, residents of these nations are more

favorably disposed to hESC than citizens of other European polities, with all exogenous variables controlled. In contrast, significant negative coefficients would indicate less support. We hypothesize that citizens of the UK and Sweden will be more positive in their evaluations of stem cell research than those in other UK nations.

Demographic variables also afford another level of social embededness and thus may influence the choice a respondent makes on stem cells. For example, past research (Durant and Legge 2005) has demonstrated that elderly citizens are more resistant than younger citizens to technological innovations. Also, women tend to be more hesitant than men. Some women may see hESC research as a feminist issue involving a diminution of women's control over their bodies and reproductive functions. Other women may view hESC research as affording positive or negative health or financial benefits and evaluate its merits accordingly.

Findings

The frequency distributions reported in table 1 regarding support for stem cell research indicate that Europeans are divided. Those listing the highest categories of general approval are at approximately 53 percent; when stem cell research is restricted to the umbilical cord, the approval percentage rises approximately 7 points. Utilizing stem cells to defeat serious diseases demonstrates the highest level of agreement, while views are sharply divided on the possibility that stem cells might lead to new treatments, even if it involves the human embryo. Results of the ordered logit analysis also are presented in table 1. A coefficient exceeding unity for the ordered logit estimates indicates support for stem cell research, while a parameter of less than 1 demonstrates opposition. The z scores test the probability that the odds ratios are significantly different than zero.

- TABLE ONE ABOUT HERE -

Control Variables

When we evaluate the impact of residing in either Sweden or the UK, nation-specific effects are evident and consistent with our expectations. The Swedes and British support stem cell research more favorably than other Europeans. We believe the stronger backing by the British and Swedes to be partially attributable to the more permissive policies of their governments on stem cell research, as well as to the greater technological development supporting such policies. In contrast to our expectations, however, there are inconsistencies between men and women concerning hESC research. These statistically significant differences concern new treatments, with women being less supportive. But women are more supportive of stems cells and health. The elderly demonstrate some inclination to oppose the new technology, as hypothesized. But their attitudes are inconsistent also. While the elderly are more inclined to oppose stem cells in general circumstances or in obtaining the material from umbilical cords, and to oppose it even for health reasons, they are like younger persons on the new treatments variable, where the coefficient is insignificant.

The Risk Assessment Discourse Hypothesis

Religious factors, as expected, play an important role in determining choice regarding stem cell policy. But denominations are not as strong as we anticipated. The Eastern Orthodox are opposed to stem cell research except for new treatments. Catholics are opposed in the cases of umbilical cords and health but demonstrate support for new treatments. But *religiosity* plays a significant role in explaining opposition. As hypothesized, those who are more involved religiously oppose stem cell research significantly in all equations. So it is the religious, regardless of faith, who play a strong role in opposing the new science.

Related to religious and moral beliefs is the question as to when an embryo becomes a

human being. If an individual believes that the embryo becomes human immediately after fertilization, he/she would have obvious problems with stem cell research as it would be virtually the same as experimenting with a live human. The evidence presented in table 1 indicates that the question as to when human life begins *is* very strongly related to position on stem cell research, reaching statistical significance easily across all four equations. Those who believe that life begins at conception are much more likely to oppose hESC research. Because Muslims—along with Catholics and the Orthodox—tend to oppose abortion, the strength of this variable is suggestive but requires additional analysis to assess its validity.

Relatedly, the data are also supportive of our hypothesis regarding expertise. Respect for experts has to do with respect for science and the good it can do for humanity (Collins 2006). Several scholars, and especially those writing about value-laden issues such as hESC, however, say people today are less likely to value expertise of any kind (Jasanoff 2007). The data presented in table 1 demonstrate that if individuals put their faith in "experts," they are more likely to support hESC research than others who hold the preferences of the public in greater esteem. Presumably, the impact of experts has to do with respect for science, the good it can do for humanity, and the inability of some respondents to comprehend the nuances of the issue.

We also find that those who hold that the competition of European firms in a global economy is more important than fostering equality among the people of Europe are generally supportive in all equations. Although weaker than in the case of expertise, the greater the preference for fostering global competition, the more probable the individual is to support stem cell research. As alluded to earlier, it appears accurate to expect that some Europeans fear both the economic and political downsides for their nation should hESC breakthroughs occur.

Finally, with regard to ideology, the lack of impact of this explanatory variable in three of

the four equations is an important finding. As noted earlier, ideology (and party identification) has been hypothesized by political scientists as a heuristic for taking positions whenever citizens lack information. In the case of stem cell research, "Right" respondents are more likely to oppose science and "Left" respondents are more apt to support it except for new treatments. In retrospect, the newness of the stem cell issue and the lack of a consensus in European political parties in 2005 may account for the limited effectiveness of ideology as a consistent predictor or citizen aid in arriving at a policy preference.

The Institutional Context Hypothesis

The belief in the efficacy of governments to "do a good job" with biotechnology also helps give citizens the confidence to support stem cell research. All coefficients that measure citizen attitudes toward national or EU governments' performance toward biotechnology are significant and in the hypothesized positive direction. They indicate, however, that slightly more confidence is nested in the EU than in national governments to address the stem cell problem. With such a complex scientific issue, Europeans may simply have more faith in the EU than in the capacities of their individual governments to balance risk and benefits appropriately. Europeans also may be seeking solid consensus across governments than merely seeking a strictly national solution. Overall, there is considerable evidence that citizens must have confidence in the ability of government to handle biotechnical issues in order to support stem cell research. As such, we also again find evidence supporting the institutional context hypothesis that opposition to biotechnological innovations more generally is nested within perceptions of government regulatory effectiveness and, hence, is not the product of irrational fears of biotechnology that can be "fixed" by simply improving consumer knowledge of science (e.g., Wynne 2001).

The Information Hypothesis

According to the information hypothesis, it is the information source that respondents value and that thus informs their judgments about hESC research and applications. As noted, the literature consistently finds the print media more apt than the electronic media to afford extensive analyses of issues and to stimulate a more comprehensive understanding of the risk/benefit calculus involved in new biotechnologies such as hESC applications. Turning first to operationalization of the information hypotheses, in general, the two chronic information variables (i.e., those presumably more exposed and paying more attention to current events) perform reasonably well in helping to account for support among sample members. For six of the eight coefficients for these variables, the educated and citizens who indicate they are current with politics support stem cell research.

Turning next to domain-specific information, "keeping up-to-date with biotechnology" may be thought of as "soft" information in that the variable is self-reported. Judging by the z scores, this variable, the belief that the embryo is human, and the belief in "experts" are the strongest predictors of stem cell support/opposition. These findings suggest that those who *believe* they are knowledgeable with regard to biotechnology have an easier time establishing a viewpoint on stem cells than do others, at least with regard to these three dependent variables.

But the danger of accepting these findings at face value is that they are self-reported. Put differently, those who self-report that they keep up-to-date with biotechnology may find it easy to express support because they *believe* they possess the correct scientific information when they really may not. Supporting this argument, there is a slightly negative but an effectively zero correlation between keeping up-to-date on biotechnology and objective information.[7] More troubling is that if one examines the objective (or "hard") measure of biotechnological

information, the role of information is not consistent, especially in direction. In the case of umbilical cords and health, the more informed oppose stem cells, while for new treatments they tend to be supportive. These findings suggest an important disconnect between *types* of domain-specific information. Stem cell support may be an easy choice for those who simply state that they keep up-to-date on biotechnology. Perhaps those with more specific objective knowledge are more likely to reason through the different stem cell applications and come to less consistent but informed decisions.

Although not perfectly in line with our hypothesis, the media variables also offer insight about how respondents process information regarding hESCs. In general, believing that the press (newspapers and magazines) do a "good job" with regard to biotechnology issues is associated with increased support for stem cells in three of the four equations. In contrast, faith in television reporting—and, hence, the more likely source of their information regarding hESCs—has no effect on any of the dependent variables. The results may be a reflection of the shallower reporting due to the limited amount of time available for news coverage on television.

Conclusions

The findings offer several implications for practice, theory, and future research. Methodologically, our findings establishing that public opinion varies widely across these nations mean that cross-national variation in support must be considered in future research designs. While these fluctuations cannot be summarized neatly, the methodology employed confirms that cross-national variation must be estimated and controlled in any multinational model of public opinion regarding stem cells and, possibly, other new biotechnologies.

Turning to findings related to the institutional context hypothesis, our analysis indicates that positive perceptions of government performance on biotechnology (both by the EU and, to a

lesser extent, national governments) are extremely important factors in encouraging citizens to support hESC research. This lends additional empirical support to findings in prior research on European attitudes toward research, production, and consumption of genetically modified foods (Durant and Legge 2005, 2006; Gaskell et al. 2006). Relatedly, an important finding for future research is that the results are somewhat dependent on the political unit in which the EU citizen resides. In particular, the strong governmental financial support and biotechnological infrastructure of Sweden and the UK may join with confidence in regulatory institutions to foster strong backing of stem cell research in these nations. Substantively, that difference across governmental units may reflect more confidence in the regulatory capability of the EU in this policy arena because of variations in regulatory capability, financial support, and biotechnological infrastructure. This, in turn, would suggest that ensuring regulatory capacity should be a focus of corporate, government, scientific, and layperson proponents of hESC research. It also would suggest that regulatory agencies should afford sufficient transparency and gear communications strategies toward building faith in their operations. Moreover, future research needs to focus on assessing the link between regulatory capacity, capacity building, transparency, and citizen support of hESC research and other biotechnological initiatives in European and non-European settings.

In terms of the risk assessment discourse hypothesis, our findings significantly qualify claims that building calculative trust alone (i.e., showing how the benefits of biotechnological innovations outweigh the risks through education) will enhance citizen support. Religiosity—defined as church attendance—plays a major role in opposing hESC research. So, too, does an individual's belief that an embryo becomes a human life at the moment of conception; this is a more consistent predictor than Catholicism, orthodoxy, or religiosity. To be sure, the analysis

offers some support to proponents of the rational-scientific approach to discourse (i.e., if citizens understand the science better, that alone will enhance support for hESC). However, one might understand the science, see inordinate risk, but temper one's aversion to that risk by having trust in regulators for protection against that risk. These findings sorely challenge the idea of privileging scientific knowledge over more social, cultural, or religious values when citizens assess the risk of biotechnological research and innovations. The lessons for both proponents and regulatory agencies is that both must focus on more than affording "good science" explanations and direct their message to different target populations. And when combined with our findings regarding the explanatory power of the institutional thesis, our study suggests a nesting effect that deserves exploration in future research on hESC and in a range of biotechnological and national regulatory environments: even when levels of calculative trust are present, citizens need to be confident that governmental capacity exists to perform competently in the area of biotechnology regulation.

Our findings in regard to the information hypothesis also offer guidance for practice and future research. That Europeans valuing print over electronic media—and, hence, relying on it more for their information on biotechnology—tend overwhelmingly to support hESC research (with the exception of the general support question) has significant implications for the amount, type, and targets of information regulatory agencies. Again, targeting and meeting the needs of consumers of information through better messaging strategies to consumers of these disparate information sources seems useful. Likewise, our finding that those with objective information can lean either way in support or opposition to hESC research suggests that simply affording additional information on hESC science to citizens by proponents of this biotechnology guarantees neither support nor opposition.

Future research related to the information hypothesis might also assess why the discrepancy between "soft" and "hard" sources of domain-specific information occurs. We offer two possibilities that warrant caution and further exploration by researchers. One lies in the findings of prior research showing that citizens exhibit tendencies to reduce cognitive dissonance by paying selective attention to information. This tendency also is abetted by the fragmentation of mass media markets and by the targeted marketing of campaigners. Thus, we think support for hESC research by respondents self-reporting their understanding of biotechnology issues (soft domain-specific information) could be a function of these reinforcing phenomena. A second possibility for these disparities may lie in self-reporting as a methodology when assessing attitude formation. Subjects may believe that having ownership of information is a socially desirable behavior in and of itself. Consequently, they indicate that they have an understanding of a complex area when they really do not. There also may be some corresponding tendency to please the interviewer when talking about more abstract (i.e., less personal) issues such as hESC research. Whatever the case regarding generic and domain-specific information (soft or hard), scholars studying information types and their linkage to attitude formation need to consider both of these possibilities in their future research. What is more, this type of research will become increasingly important as science continues to offer complex policy choices that have scientific, regulatory, and moral implications in Europe and elsewhere.

Notes

[1] The data utilized in this study were made available by the Inter-University Consortium for Political and Social Research (see Papacostas 2007). Neither the collectors of the original data nor the Consortium bear any responsibility for the analyses or interpretation.

[2] The differences in the wording of responses limit the degree to which we can directly compare the equations to each other. The first two equations are comparable to each other but not to equations three and four.

[3] There is a relationship between being Catholic, the degree of religiosity, and the belief as to whether an embryo becomes a human being at the point of fertilization. In general, Catholics are more religious and also more likely to believe that an embryo becomes human at the point of conception. But the relationships do not present a multicollinearity problem. We attempted to interact several of these terms but were unable to find a significant relationship. Thus, we believe we are estimating the model in its most correct form when utilizing these variables. These relationships generally hold for the Orthodox as well.

[4] A rival hypothesis is that those on the extreme Right and Left may oppose hESC research because of the involvement of multinational corporations. The extreme Right may see it as yet another assault on nationalism, while the extreme Left may see hESC research as one more effort at global dominance by multi- and transnational corporations. We tested for this possibility, but the expected results did not materialize. An interaction term between Catholicism and religiosity is not significant on the new treatment variable; however, it is the less religious Catholics who are most supportive.

[5]Please see the appendix for these questions and for the coding of the exogenous variables.

[6] The coding for UK and Sweden versus all others is the "cleanest" coding available and reflects

policies in effect as of the end of 2005. There are other multiple classifications, but many nations overlap into several of these typologies. In addition to the merging of Northern Ireland with the rest of the UK, the former German Democratic Republic territories are merged with the Western Länder to reflect current political boundaries.

[7] Preliminary evidence suggests that those who say they are familiar also say they keep up-to-date on biotechnology (r = . 34). But the familiar are weaker with regard to objective information (r = .08). The latter finding suggests that familiarity, like soft information, may be an indicator of acquiescence bias.

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Appendix
Coding of Independent Variables per Hypotheses

I. The Risk Assessment Discourse Hypothesis

Catholic: Explained in text.

Eastern Orthodox: Explained in text.

Religiosity: Apart from weddings and funerals, how often do you attend religious services? 1 = never, 2 = less often, 3 = about once a year, 4 = only on special holy days, 5 = every 2 or 3 months, 6 = about once a month, 7 = once a week, 8 = more than once a week.

An Embryo is a Human Being: Immediately after fertilization, the embryo can already be considered a human being: 1 = totally disagree, 2 = tend to disagree, 3 = don't know, 4 = tend to agree, 5 = totally agree.

Global Markets vs. Equality: Which of the following do you think is the most important? 1 = reducing inequalities among people in Europe, 2 = don't know, 3 = having strong European companies to compete in global markets.

Ideology: A 10-point scale where 10 = the most "Right" value and 1 = the most "Left" value.
fairly familiar, 5 = very familiar.

II. The Institutional Context Hypothesis

National Government/EU Performance: For each of the following people and groups (national governments/EU), do you think they are doing a good job for society or not doing a good job for society ("in making regulations about biotechnology")? 1 = not doing a good job for society, 2 = don't know, 3 = doing a good job for society.

Experts vs. General Public: Which of the following views is closest to your own? Decisions on the new technology should be based: 1 = mainly on the general public's view, 2 = don't know, 3 = mainly on the advice of experts.

III. Information Hypothesis

Chronic Information

Education: 1 = highest level of education, 0 = all others.

Up-to-Date on Politics: I keep up-to-date on what is going on in politics: 1 = never, 2 = rarely, 3 = don't know, 4 = sometimes, 5 = often.

Domain-Specific Information

Up-to-Date on Science and Technology: I keep up-to-date on what is going on in science and technology (same coding as for politics).

Information (objective): Explained in text.

Newspaper/Magazine Reporting/TV Reporting on Biotechnology: For each of the following people and groups (newspaper/magazine reporting/TV reporting on biotechnology), do you think they are doing a good job for society or not doing a good job for society (same coding as for National Government/EU Performance above)?

IV. Control Variables

Gender: 0 = Male, 1 = Female.

Age: Actual age of the respondent.

Nation: Explained in text.

Table 1 Ordered Logit Estimates: Approval of Stem Cell Research (Odds Ratios)

	General Support	Umbilical Cords	Health	New Treatments
I. Percentage Approving				
	53.1%	60.4%	74.2%	50.5%
II. Control Variables				
Sweden	1.39**	1.43**	1.76**	1.53**
	(3.91)	(4.17)	(6.27)	(4.88)
UK	1.60**	1.55**	1.21**	1.62**
	(6.06)	(5.64)	(2.44)	(6.47)
Gender	1.01	1.08**	1.11**	.889**
	(.24)	(2.30)	(2.83)	(-3.40)
Age	.996**	.993**	.996**	1.01
	(-3.45)	(-6.06)	(-3.28)	(1.84)
III. Risk Assessment Discourse Hypothesis				
Embryo is Human	.790**	.880**	.965**	.745**
	(-18.03)	(-9.84)	(-2.59)	(-21.84)
Catholic	1.04	.890**	.931*	1.17*
	(.99)	(-2.85)	(-1.70)	(4.88)
Orthodox	.797***	.654**	.823**	1.07
	(-3.24)	(-6.09)	(-2.75)	(1.02)
Religiosity	.945***	.960**	.933**	.936**
	(-8.09)	(-4.82)	(-7.92)	(-7.88)
Global Markets vs. Equality	1.13**	1.07**	1.05**	1.11**
	(6.32)	(3.41)	(2.30)	(5.61)
Ideology	.981**	.971**	.982*	.994
	(-2.12)	(-3.24)	(-1.85)	(-.63)

Table 1 Ordered Logit Estimates: Approval of Stem Cell Research (Odds Ratios) (continued)

	General Support	Umbilical Cords	Health	New Treatments
IV. Institutional Context Hypothesis				
Nat'l Govt. Performance	1.15** (5.48)	1.16** (5.59)	1.08** (3.21)**	1.10** (3.81)
EU Performance	1.21** (6.88)	1.20** (6.54)	1.26** (8.21)	1.24** (7.90)
Experts vs. General Public	1.33** (13.76)	1.36** (14.48)	1.40** (15.54)	1.25** (10.75)
V. Information Hypothesis				
Chronic Information				
Politics	1.07** (5.44)	1.09** (6.46)	1.14** (10.03)	1.01 (.65)
Education	1.04** (1.98)	1.02 (.94)	1.10** (4.48)	1.04* (1.76)
Domain-Specific Information				
Biotechnology (Self-reported)	1.20** (13.60)	1.22** (15.03)	1.33** (20.46)	1.18** (12.38)
Information (Objective)	1.01 (.26)	.921* (-1.85)	.884** (-2.70)	1.08** (1.75)
Newspaper/ Magazine	1.07** (2.34)	1.10** (3.37)	1.12** (3.94)	1.02 (.74)

Table 1 Ordered Logit Estimates: Approval of Stem Cell Research (Odds Ratios) (continued)

	General Support	Umbilical Cords	Health	New Treatments
Reporting on Biotechnology				
TV Reporting on Biotech-nology	.965 (-1.23)	.972 (-1.00)	1.00 (.09)	1.03 (.92)
N = 12,255				
Likelihood Ratio Chi Square	1746.5**	1618.2**	2114.8**	1505.2**

z scores are in parentheses; p≤ .10, ** p≥ .05.